IMPACT OF AGRICULTURAL PRODUCTION ON RURAL WELFARE IN NIGERIA

OLAWALE EMMANUEL OLAYIDE

MATRIC NO: 87211

DEPARTMENT OF AGRICULTURAL ECONOMICS

FACULTY OF AGRICULTURE AND FORESTRY

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OLAWALE EMMANUEL OLAYIDE

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ABSTRACT

Increase in agricultural production is essential for agricultural development since it enhances profitability and income which leads to welfare improvements. In Nigeria agricultural production and rural welfare have worsened over the years. Adequate information on the link between agricultural production and rural welfare in Nigeria is expected to better inform policy makers on implementation. Agricultural production and its impact on rural welfare in Nigeria were, therefore, investigated.

Secondary data covering the military period (1970-1979 and 1984–1999) and democratic (1980–1983 and 1999-2007) periods were used for the study. The pre-Millennium Development Goals - MDGs (1970– 1999) and MDGs (2000–2007) periods also fall within the study period (1970 – 2007). The government regimes (military and democratic) as well as the pre-MDGs and MDGs periods captured the various policies implemented. Data were obtained from the National Bureau of Statistics (NBS), Central Bank of Nigeria and the Food and Agriculture Organization. Data were extracted on agricultural inputs and production, Agricultural Gross Domestic Product (AGDP), foreign private investments in agriculture, agricultural budgets as well as infrastructural and industrial development indices. These were analysed against extant policy regime at the periods of data collection. Rural welfare was proxied by real AGDP per capita. Data were analysed using descriptive statistics, stochastic frontier function and generalized method of moments at $p = 0.05$.

Irrigated area as a percentage of arable land was highest in the MDGs period (0.90±0.03) and lowest during the pre-MDGs period (0.74±0.04). Use of tractors per ha of arable land was highest during the MDGs (9.74±0.64) and lowest at pre-MDGs era (5.78±3.08). Rate of fertilizer use was highest (15.51±3.47) during the democratic period and lowest during military rule (13.34±3.46) kg ha^{-1}. Aggregate index of agricultural production peaked during the MDGs period (165.58 ± 14.85). Production indices for crop, livestock, and forestry were highest during the MDGs period (176.58±22.53, 225.91±36.54, and 129.42±11.89) but that of fishery peaked during the democratic period (158.62±29.79). The AGDP as a percentage of national GDP was highest during the MDGs period (41.76%) and lowest during the pre-MDGs period (38.72%). Agricultural budget as a percentage of total national budgets was highest during the military period (3.67±2.77) and lowest during the democratic period (3.21±2.87). Improvement on road was highest during the military era (63.00±26.51) while industrial development peaked during the democratic period (53.83±11.47). Percentage of foreign private investments in agriculture peaked during the pre-MDGs (1.77±1.03). A unit change in area under irrigation led to increase in agricultural productivity by 2.11%. Agricultural productivity index was highest during the MDGs period (0.87±0.09) and lowest during pre-MDGs era (0.84±0.11). Real AGDP per capita was also highest during the MDGs era (₦2872.19±491.75) and ebbed during military era (₦1950.75±398.76). Agricultural productivity and agricultural budgets significantly improved rural welfare by 0.28% and 0.29%. Also, industrial development and road infrastructure indices significantly improved rural welfare by 0.01% and 0.11%. The policies implemented during democratic period significantly improved rural welfare by 0.65%.

Increase in agricultural production led to significant improvement in rural welfare in Nigeria. Increment in land area under irrigation would therefore, be recommended to sustain the agricultural production.

Keywords: Agricultural production, Rural welfare, Millennium development goals.

Word Count: 480

DEDICATION

To my wife, Princess Pamela Bose Olayide

and

Children, AanuOluwapo Favour Olayide and IreOluwa Wisdom Olayide

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To the Amighty God, the Father, the Immortal, Invincible, the Only wise God be all the glory. He indeed, is the Alpha and Omega. I return all the praise and glory to God.

CERTIFICATION

I certify that this work was carried out by Mr. Olawale Emmanuel OLAYIDE in the Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria

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Supervisor

Professor A. E. Ikpi

Ph.D Agricultural Economics (Purdue, USA)

Professor of Agribusiness, Marketing and Policy

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CHAPTER ONE
INTRODUCTION

1.0 Introduction

This section introduces the study. It gives the study background, enumerates Nigeria's agricultural and rural development policy, the problem statement, justistifies the study, presents the objectives of the study and highlights the limitations of the study.

1.1 Background to the Study

Agricultural production is essential for generating broad-based growth necessary for development. Agricultural production is also fundamental to the sustenance of life and is the bedrock of rural economic development, especially in the provision of adequate and nutritious food so vital for human development and industries. Agriculture accounts for 88 percent of the non-oil foreign exchange earnings and employs about 60 to 70 percent of the active labour force in the country, and it is an important contributor to the Gross Domestic Product (GDP), (FGN, 2001a; Akinyosoye, 2005). Also, according to the World Development Report 2008, the Nigerian economy is agriculture-based since agriculture constitutes more than 32 percent of GDP growth on average and that most of its people are in the rural area.

Similarly, increase in agricultural production promotes agricultural rural incomes which in turn enhance rural welfare (agricultural income per capita) in developing economies (World Bank, 2008). According to Datta and Meerman (1980), the distribution of income derives from the fundamental interest in the distribution of human welfare. Additionally, agriculture is also a major source of growth and development of most developing economies (Mogues *et al*., 2008; World Bank, 2008).

Past studies (Aigbokhan, 2000; World Bank, 2008) have suggested that increasing agricultural production could lead to improvement in agricultural incomes and hence, improvement in rural welfare. However, studies (Manyong *et al*., 2005; NBS, 2007) revealed that there is low level of agricultural production in Nigeria. Government policies at improving the level of agricultural production are also not well focused or distorted (Idachaba, 2006; Olomola *et al*., 2008; Ayanwale, 2011). The neglect of agricultural and rural development in Nigeria has led to a pitiably poor level of total annual food and fibre production in Nigeria (World Bank, 1990, Ikpi 1995); such that whereas Nigeria's population has been expanding steadily at an average annual rate of about 3 percent, total food production in the country has been rising by no more than 1.5 percent per annum on the average for the same period. The situation puts the nation in a *"Malthusian Paradox".* That is, growth rate of human population increasing more than that food production. This situation has implications for food self-sufficiency in Nigeria. The food self-sufficiency ratio of the country dropped from 98 percent in the early 1960s to less than 60 percent in the early 1980s and less than 54 percent by 1986. This means that the average Nigerian as at 1986 had over 45 percent less home-grown food (Ikpi, 1995). The food self-sufficiency in Nigeria is currently at 80 percent (Shii, 2008). Despite that, recent data show that food imports has gradually become an important component of total imports (CBN, 2005; Lucas, 2007). Also, food insecurity and food prices (inflation) have risen drastically in recent times resulting in general increases in the prices of goods and services with its attendant welfare implications. These situations reflect the low level of agricultural production and poor rural welfare in Nigeria.

In Nigeria, various regimes (military and democratic) have made efforts to effect positive changes in agricultural production levels (see appendix 8 for synthesis of major agricultural policies, projects and programmes aimed at boosting agricultural production in Nigeria). These efforts are with the view to improving agricultural incomes and rural welfare. Yet there exists yield gap in most of the staple and industrial crops (Idachaba, 2000). Nigeria crashed from being the leading producer and exporter of groundnuts with the famous pyramids of the 1950s and 1960s to become a net importer of vegetable oil. The sudden reversal of fortunes has been attributed to agricultural underdevelopment and low performance in agriculture (Idachaba, 2006). Further, Ikpi (1995) and Idachaba (2000) have shown that undesirable/unworkable agricultural policies were at the centre of decline in agricultural production in Nigeria which consequently contributed to the vicious cycle of low levels of income and rural welfare in Nigeria. This, therefore, underscores the need for assessing the impact of agricultural production on rural welfare (proxied by per capita real agricultural GDP) in Nigeria with a view to gaining insights and empirical evidences to support the promotion of agricultural and rural development transformation in Nigeria.

1.1.1 Nigeria's agricultural and rural development policy

It is on record that Nigeria did not have an explicit statement of National Agricultural Policy for most of its history as a nation (Manyong, 2005). At independence in 1960, national planning and policies were formulated to achieve national objectives of economic growth and development (Akinyosoye, 2005). The first Agricultural policy document was in 1988. The publication of that document in 1988 was a welcome relief beyond the "Agriculture Chapter" of the first four National Development Plans (1962-1968, 1970-1974, 1975-1980 and 1981-1985). Nigeria has recently reviewed the 1988 Agricultural Policy document and has come up with the new Agricultural Policy document (FGN, 2001a).

Between 1960 and 1987, Nigeria used unarticulated administrative and political pronouncements to guide the operation of its agricultural activities. It was not until 1988 that it finally dawned on the federal government that there was the need to have a formal and well-articulated policy framework for a systematic and guided development of the agricultural sector in the country (Ikpi, 1995). Based on input from a broad spectrum of agricultural administrators, researchers, and academicians, the Agricultural Policy document was produced by the Federal Ministry of Agriculture, Water Resources and Rural Development in 1988 and was decreed by the federal government to be operational for at least fifteen years. Following a similar approach, the new Agricultural Policy document was formulated in 2001 (FGN, 2001a).

The amalgamated policy document (FGN, 2001a) covers issues on i) agricultural resources (land, labour, capital, seeds, fertilizer, etc.), ii) crops, livestock, fisheries, and agro-forestry production, iii) pest control iv) mechanization, v) water resources and irrigation, vi) rural infrastructure, vii) agricultural extension and technology transfer, viii) research and development, ix) insurance, xii) agricultural cooperatives, xiii) training and manpower, and xiv) agricultural statistics and information management.

Furthermore, Nigeria's agricultural policy framework has gone through a number of evolutionary processes and fundamental changes that reflect, in a historical perspective, the changing character of agricultural development concepts and the roles which different sectors of the economy were expected to play in tackling economic development problems. According to Olayemi (1995), three distinct agricultural phases can be identified in Nigeria. The first phase spanned the entire colonial period and the first post-independence decade from 1960 to about 1969; the second covered the period from about 1970 to about 1984; and the third phase started from about 1985; while Manyong et.al. (2005) built on the continuum of the periods and maintained that the fourth phase of agricultural policy in Nigeria was what could be characterized as the post-structural adjustment period starting from about 1994.

It should be noted, however, that some fundamental changes have occurred since 1954, when the adoption of the Federal Constitution created the federal government and three regional governments in the North, West and East. The post-independence republic Constitution retained the main features of the 1954 Federal Constitution. The 1979 Federal Constitution also retained essentially the same features with a total of nineteen states and Abuja as the federal capital territory. In both the 1954 and the 1963 Constitutions, agriculture appeared on the 'residual' list of functions that were also claimed as a state responsibility, rather than on the legislative lists of either 'exclusive' or 'concurrent' federal responsibilities (Idachaba, 2006).

From the foregoing, it is clear that agricultural and rural development policy documents are not in want in Nigeria as various government regimes and different policy scenarios have revealed (Idachaba, 2000, and 2006; Akinyosoye, 2005; FGN 2001a and 2001b). Both the exclusive (ministry-based) and concurrent (national-based) agricultural policy targets are not known to go by implemention targets. This has resulted in inherent deviations in implementation and inconsistencies (Garba, 1999 and Adebayo *et al*., 2009;

Ayanwale, 2011). Perhaps, agricultural and rural development policies' lack of follow-through is the bane of Nigeria's agriculture and rural development (ECA, 2010).

1.2 Problems Statement

Agricultural production is known to have led to rural economic transformation in some developing countries (World Bank, 2008). However, the case of Nigeria has not been well documented as there is limited literature on the impact of agricultural production on rural welfare in Nigeria. Despite the dominant role of the petroleum sector as a major foreign exchange earner, agriculture remains the mainstay of the economy. The Nigerian economy is agriculture-based (World Bank, 2008). Agriculture is both an economic actvitity and a source of livelihood of the rural sector in Nigeria. Apart from being the largest non-oil export earner, the largest employer of labour, and the key contributor to wealth creation, the agricultural sector is the base from which a large percentage of the population derives its income (CBN/NISER, 1992; NBS, 2007; Falusi, 2007). The agricultural sector is also the most important source of economic growth in Nigeria (Diao *et al*., 2009). However, over the years, the rate of growth in agricultural production has been unstable due to underdevelopment (Diao *et al*., 2009).

The elements of agricultural and rural underdevelopment include the standard of the Nigerian agriculture which remains primitive, subsistent and unproductive, and therefore, unable to produce sufficient food in the quantity, quality and variety for the increasing population of taste-discriminating consumers in spite of the country's enviable biodiversity and agricultural resource endowment (Ikpi, 1995). Also, where there has been some improvements in agricultural technologies, gains in production achieved from such improved agricultural technologies have not been fully exploited by farmers in developing countries, including Nigeria (Pingali and Heisey, 1999; Kalirajan and Shand, 2001; Alene and Manyong, 2006). Production growth in the agricultural sector is considered essential if the agricultural sector is to grow and develop at a sufficiently rapid rate to meet the demands for food and raw materials because of steady population growth (Coelli and Rao, 2003). Agricultural production is known to enhance profitability and income which leads to welfare improvements (Fulginiti and Perrin, 1998; World Bank, 2008). But the impact of agricultural production in enhancing rural welfare improvements has not been fully researched for Nigeria. Hence, the knowledge gap is being filled by this study.

The factors that influence agricultural production have not been revealed in literature. Manyong *et al*. (2005) identified 13 constraints to agricultural development in Nigeria; which include: labour, land tenure, environment, institutions, microeconomic policy, macroeconomic policy, health, socio-culture, politics, finance, economics, infrastructure, and technology. There is also a wide gap between potential and actual results in agricultural production in Nigeria has been attributed to lack of progressive pursuit of the nation's agricultural plan and policies (Idachaba, 2000). This study empirically established the factors that influence agricultural production and went on further to establish the impact of agricultural production on rural welfare in Nigeria.

Yet, we know that the Nigerian agricultural and rural development policy recognizes agriculture as the engine of economic growth (FGN, 2001a&b), but the agricultural and rural sector remains underdeveloped. The policy emphasizes, public spending for rural development, technology generation and transfer; infrastructural development including rural roads, power, communication, and water; and human capital investment (FGN, 2001b). Yet, public spending for agricultural and rural development have been low as evident by budgetary allocation to agriculture with no relationship to the sector's contribution to national GDP. Accelerated and profound technical change in production has also been identified as a missing link in agricultural and rural development in Nigeria. Also, the rural sector policy strategies report (FGN, 2001b) identified the deficiency of human capital in terms of education and health in rural areas.

The problem of rural infrastructure decay is a clog in the wheel of agricultural development in Nigeria. There has been neglect and inconsistency on rural infrastructural development in Nigeria. Also, the linkage among rural infrastructure, agricultural production and rural welfare has not been fully explored for Nigeria (Hazell *et al*., 1983; Mellor 1999). Rather, past policies and programmes like the establishment of the

Directorate of Food, Roads and Rural Infrastructures (DFRRI) in 1986 which was responsible for the provision of rural infrastructures were started and later jettisioned (Idachaba, 2000).

The problem of rural economic growth that is not leading to welfare improvements for the rural popolations has also been of concern in literature (Oyekale, 2006; Omonona, 2010). Agricultural GDP has been on the increase in recent years reaching as high as 40 percent of the total national GDP (CBN, 2007). Also, agricultural production index has been on stable but growing steadily (Nkonya *et al*., 2012). Yet agricultural performance in terms of agricultural production is said to be mixed (Manyong *et al*., 2005) and rural poverty is on the increase (NBS, 2007). Besides, empirical studies (Oyekale *et al*., 2006; World Bank, 2008; Daio *et al*., 2010) seem to suggest that agricultural production and enterprises hold the key to exiting low agricultural incomes trap in Nigeria. But there are limited empirical studies on the impact of agricultural production on rural welfare in Nigeria. Therefore, this study is a response to the knowledge gap observed in literature.

1.3 Justification for the Study

The current sub-optimal position of Nigeria as manifested in declining agricultural production, low level of rural welfare, food self-insufficiency, a mono-product without economic diversification have generated immense interest on the need for some comprehensive, objective, empirical assessment and evaluation of the impact of agricultural production on rural welfare in Nigeria.

According to Akinyosoye (2005), an important indicator of the failure of performance/underdevelopment of agriculture in Nigeria is in its inability to increase farm production technology in order to escape from the trap of agricultural under-development when compared with the performances in many developed and developing countries. A comparative picture of the agricultural situation in Nigeria with what prevails in some selected developing and developed countries are presented in Table 1. The table shows that Nigeria is greatly endowed with agricultural resources and if seriously harnessed would engender the much desired food self-sufficiency, food security and enhance sustainable agricultural and rural development. Nigeria has the highest percentage of agricultural land but lowest percentage irrigated land, mechanization and agricultural contribution to export. All these need to be reversed through appropriate interventions. Interestingly, Nigeria also has the largest percent of labour force engaged in agriculture; this has implications for rural employment, wealth creation and production.

Table 1: Comparison of key parameters of agricultural endowments and performance in selected countries

Parameter	USA	Denmark	Argentina	Brazil	Thailand	Malaysia	Indonesia	Nigeria
% Arable land	18	52.6	10.1	6.93	27.6	5.46	11	33
Agricultural land (% of land area)	45.3	61.0	47.0	31.2	36.2	24.0	26.4	79.7
Agricultural raw material contribution to exports (% of merchandise export)	2.3	2.5	1.4	3.9	4.5	2.5	5.0	0.01
% of labour force engaged in agriculture	0.6	2.9	7	20	42.6	13	42.1	59.4
Irrigated land (% of cropland)	12.5	19.7	5.4	4.4	28.1	4.8	12.4	0.84
Agricultural machineries (tractors/100 hectatres of arable land)	269.4	542.8	107.4	136.6	155.7	240.6	41.1	9.8

Sources: FAOSTAT, 2005; Akinyosoye (2005) and Diao *et al*. (2010).

Moreover, the recent World Bank's (2008), World Development Report 2008 - the first in 25 years that was devoted to agriculture - revealed that in countries where agricultural production have increased (e.g., South Asia), agricultural incomes and poverty (welfare indicator) had equally reduced. However, the same cannot be said for sub-Saharan Africa, and indeed Nigeria as agricultural production and cereal yields are comparably low (despite the availability of farm technology) and poverty levels remain increasingly high especially in the rural areas (NBS, 2007). Also, the expansive agricultural land (80% of arable land) confers huge potential for increased agricultural production in Nigeria. Therefore, there is need to assess agricultural production and its impact on rural welfare in Nigeria with a view to moving the country from the present sub-optimal position of low production and low levels of rural welfare improvements.

It is important to note that investments are needed in rural feeder roads, electricity, water, agricultural infrastructure, health care, and education, in order to ensure sustainable agricultural and rural development. Despite the fact that policy development organizations like International Food Policy Research Institute (IFPRI) and the African Union (AU) had recommended 10 percent investment of national budgets in agriculture, the level of agricultural investment in Nigeria is currently less than 5 percent (IFPRI, 2008). This low level of investments in agriculture is not commensurate with the fact that the agricultural sector accounts for more than 40 percent of the GDP, and that the agricultural sector is important for economic growth and poverty reduction and wealth creation.

Despite the significant contribution of agriculture to the overall GDP, the rural sector of Nigeria still grapples with increasing level of income poverty as indicated by growing incidence of poverty in Nigeria. Figure 1 reveals that the rural sector is more poverty striken that the urban sector. In all the years, rural poverty incidence exceeded national averages. Therefore, effort to reduce rural poverty in Nigeria will contribute significantly to poverty reduction at the national level. The situation in the rural sector is sub-optimal (Akinyosoye, 2005), and succinctly justifies the present study on the the need to assess the impact of agricultural production on rural welfare in Nigeria.

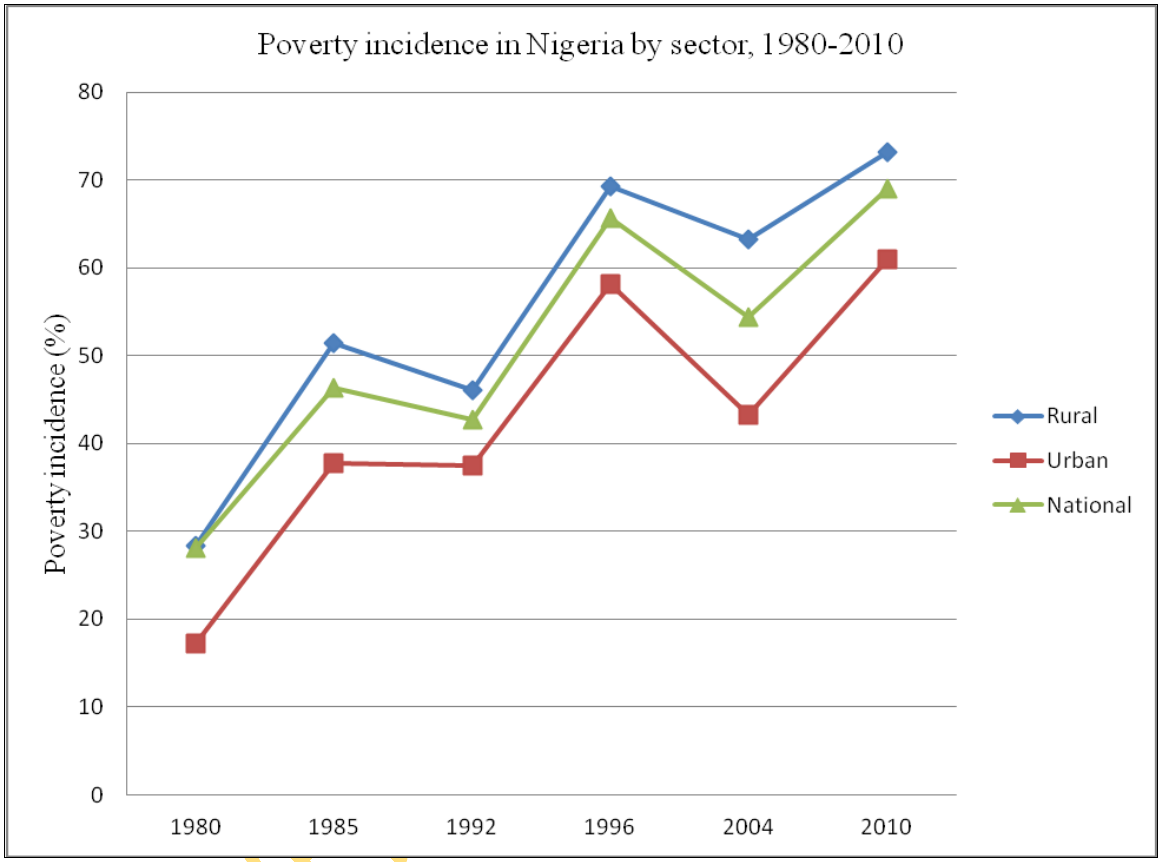

Figure 1: Poverty incidence in Nigeria by sector, 1980-2010. Author's illustration. Original data sourced from NBS, 2007 and 2012.

Given the sub-optimal position of agriculture and rural sector in Nigeria, on the one hand, and the potentials of agriculture for economic growth and welfare improvements, on the other hand, this study offers comprehensive evaluation (using the sustainable livelihood framework) of the impact of agricultural production on rural welfare in Nigeria; since, it is known that strategies that lead to higher levels of agricultural production are needed for economic environment to increase agricultural profitability for sustainable rural livelihoods (Nkamleu *et al*., 2007), which have implications for rural welfare in Nigeria.

This study is further justified in terms of methodology: measurement of variables and method of analysis. Most agricultural performance and impact assessment studies in Nigeria are not known to have given explicit consideration to the impact of agricultural production on rural welfare. Therefore, this study provides adequate information on the link between agricultural production and rural welfare in Nigeria by employing robust theoretical and conceptual methodologies coupled with econometric analyses.

The study is in tandem with government's agricultural and rural development policies, strategies and programmes like the National Economic Empowerment and Development Strategy (NEEDS) and the Vision 20: 2020. These policies are designed to support the country's development goals spelt out under the Millennium Development Goals (MDGs). The study delivered on many grounds: it is a feedback on government's agricultural policies, investments in agriculture, agricultural production and rural welfare improvements. It filled the knowledge gap on the nation's progress towards the achievements of the MDGs, New Partnership for Africa's Development (NEPAD, National Economic Empowerment Development Strategy (NEEDS I & II), and "Vision 20:2020" agenda; all of which emphasize increased agricultural production, wealth creation, import substitution, agricultural exports, food self-sufficiency, poverty reduction, land reforms, healthcare, functional education, improved rural infrastructural as well as sustainable agricultural and rural development (FGN, 2001a&b; IMF, 2007; and Marcellus, 2009).

Empirical evidence of the impact of agricultural production on rural welfare can inform policy makers in the agricultural sector towards the attainment of the United Nation's Millennium Development Goals. Finally, the performance of Nigeria's agriculture has to a large extent been attributed to low incentives and incomes (Walkenhorst, 2007). Hence, getting agricultural production incentives right is of utmost importance not only boosting production but also for fostering economic growth and rural development. Whereas there have been studies on agricultural production in Nigeria, studies on the extent to which agricultural production impacts on rural welfare in Nigeria is limited in the literature.

Overall, this study assessed the impact of agricultural production on rural welfare in the context of sustainable agricultural and rural development, to the extent that it proffered answers to the following research questions:

(i) what is the performance of agriculture in Nigeria from 1970 to 2007?

(ii) what is the level of agricultural production technical efficiency in Nigeria?

(v) what impact does agricultural production have on rural welfare in Nigeria?

1.4 Objectives of the Study

The general objective of this study is to assess the impact of agricultural production on rural welfare in Nigeria. The specific objectives are to:

(1) assess the performance of agriculture in Nigeria from 1970 to 2007;

(2) estimate agricultural production technical efficiency in Nigeria; and

(3) assess the impact of agricultural production on rural welfare in Nigeria.

1.5 Limitations of the Study

All the stated objectives of the study were successfully achieved. However, more comprehensive analyses on the performance of agriculture and impact of agricultural production on rural welfare at the regional/zonal, state and local government levels in Nigeria would ensure policy implementation at those levels of analyses, were there longitudinal data on selected variables for the period of the study.

CHAPTER TWO

THEORY AND LITERATURE REVIEW

2.0 Introduction

This section deals with the theoretical underpinnings of the study and literature review. The theoretical underpinings are further buttressed by the presentation of the conceptual framework. Review of empirical studies on key aspects of the study concludes the section.

2.1 Theoretical Underpinnings and Framework

The basic theory of agricultural and rural development impact analysis is based on optimality and sub-optimality in development positions (Akinyosoye, 2005), and development that meets future challenges through sustainable development (DFID, 2001). Agricultural and rural development impact analysis, therefore, is the analysis of what has changed (in time and space) in terms of agricultural production and rural welfare. Rural welfare in this context refers to agricultural income per capita over time (Okoruwa and Oni, 2002; Akinyosoye, 2005; Oyekale, 2008; Giovanni *et al*., 2009).

Figure 2 represents an idealistic theoretical construct and restrictive assumption, which uses a two-product-two-consumer model of an economy to conceptually visualize an optimal development position vis-à-vis a sub-optimal position in a society. The theory assumes an economy producing two items, food and non-food using all variable resources and that only two households live in the community spending their incomes on food and non-food. If all resources are used for food production, zero non-food will be produced and vice versa. In view of this, a Production Transformation Curve "P" shows the relationship between food production and non-food production. The figure shows that with available resources, when food is produced, less non-food will be produced and vice versa (Akinyosoye, 2005).

On the other hand, a consumer preference curve (C) which shows the relationship between food consumption and non-food consumption is obtainable and superimposed on

“P” to meet at their tangency point (A). Point A indicates the point where all the desired levels of consumption of the two commodities agree with the “best” production levels. Therefore, all producers and consumers are happy and for the society this is the “bliss” point, which typifies *Eldorado*. At point B, the food and non-food production are less than those produced at A, which means none of the items is sufficient to meet the expectations of the society. This is the sub-optimal position. Food is not sufficient to meet people’s consumption needs and non-food is below the required level needed, as production of these two commodities is constrained by various factors. The sub-optimal position is very sticky typifying poor rural welfare. It is the desire to escape this sticky and low equilibrium trap that attracts the attention of governments to agricultural and rural development policy (Akinyosoye, 2005).

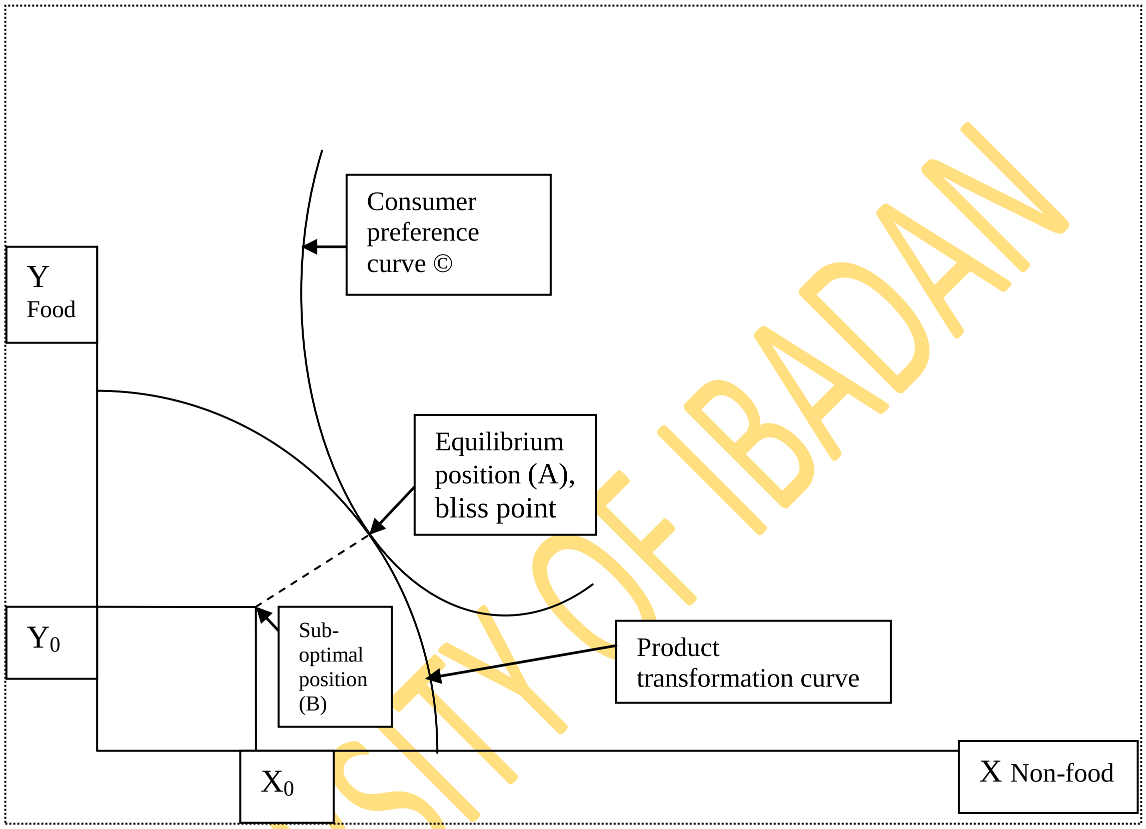

Figure 2: Sub-optimal and equilibrium position in a two-product-two-consumer economy

2.2 Conceptual Framework

The study was built on the theoretical concept of the Sustainable Livelihoods Framework (SLF). The SLF (Figure 3) uses a range of quantitative and qualitative information and applies quantitative and qualitative analyses to assess the impact of agricultural performance on rural welfare.

The *assets* on which people/nation build their livelihoods are of particular interest. Rather than looking only at land, agricultural production or other classic wealth indicators alone, the SLF suggests consideration of a portfolio of five different types of assets (DFID, 2001). These assets or capitals and their compositions as adapted) are:

• *Natural capital:* water resources (rainfall) and forests;

• *Physical capital:* transportation (e.g., roads), building/housing, energy/electricity, technology, communications and capacity utilization;

• *Financial capital:* credit, investments, inflows, trade, and monetary or macroeconomic policies;

• *Human capital:* education, health, gender and labour power; and

• *Social capital:* access to opportunities or liberalization, informal safety nets, cooperations/partnerships (the MDGs), and governance.

The adapted framework explicitly accounts for the theoretical/empirical continuum of livelihoods assets (inputs) leading to agricultural production (output); and the impact of agricultural production on rural welfare (outcome). Furthermore, the adapted framework recognizes the role of agricultural policies, institutions and processes in shaping and influencing livelihoods and development outcomes (that is, income per capita). This sound theoretical concept provided a guide in conceptualizing and analyzing impact of agricultural production on rural welfare in Nigeria; and follows the study by Kristjanson *et al*. (2005).

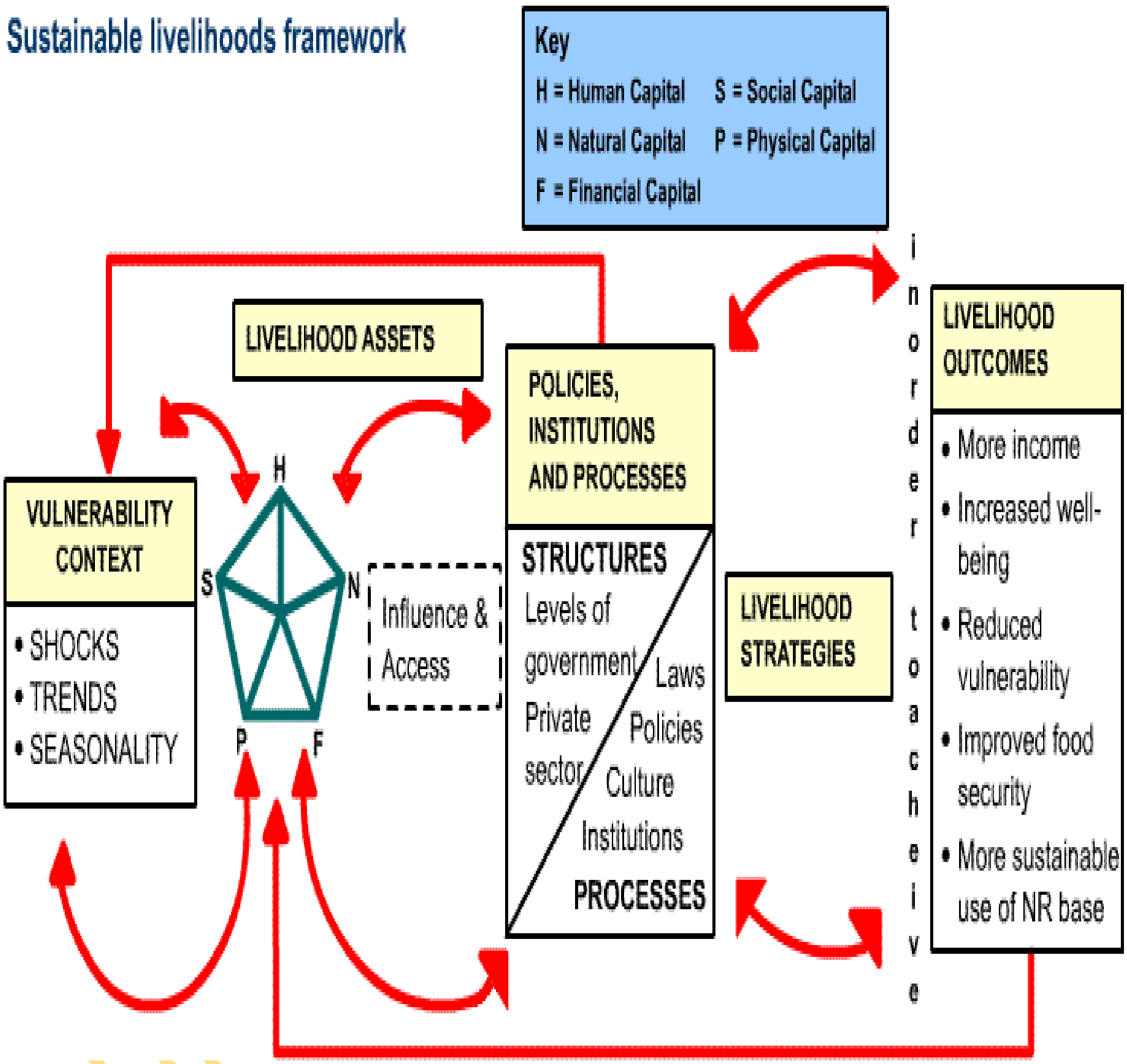

Figure 3: The adapted sustainable livelihood framework

Source: DFID, 2001.

2.3 Literature Review

2.3.1 Agricultural perfomance and agricultural production

The overwhelming importance of agriculture in the Nigerian economy and the huge potential that agricultural production holds in changing the structure of the rural economy to enable the sector fulfill its major role in the overall development of the economy has drawn its attention to researchers. Hence, agricultural performance had often been assessed in various ways, including investment on agriculture, government programmes and policies, desirability and workability of agricultural policies, expenditures of government, improvement in rural livelihoods, and levels of commercialization in agriculture (Wells, 1974; Akinyosoye, 2005; Idachaba, 2000; Manyong *et al*., 2006; Beintema and Ayoola, 2004; Alene *et al*., 2007; Mogues *et al*., 2008).

Others have examined the agricultural input and factor policies (Ruben *et al*., 1997; Nagy and Edun, 2002; Okoruwa and Oni, 2002; Oskam and Meester, 2006) as well as effects of the exchange rate, on agriculture and agricultural commodities (Dorosh and Valdes, 1990; Yusuf and Falusi, 1999; Okunmadewa and Olayemi, 1999) and found the variables to be significant in promoting agricultural production and rural welfare.

Olomola *et al*. (2008) identified some channels through which agricultural performance influences industrial growth. First, they said, growth in agriculture generates demand for industrial output such as fertilizer and other chemicals. Second, agriculture supplies the inputs needed by agro-based industries. Therefore, the link between agriculture and industry will be weekened if the industrial output (e.g., fertilizer), required for agriculture is wholly imported and agricultural output for industries is exported rather than processed domestically. Third, agriculture is capable of influencing the output of the industrial sector via demand. Due to large population size of the rural areas in developing countries like Nigeria, their consumption aspect can be substantial. Fourth, a rise in agricultural production will lead to government saving and higher public investment. The saving can come from the huge amount which otherwise would have been used for food and raw materials importation which can now be invested (Titilola, 1998).

Nagy and Edun (2002) assessed Nigerian government fertilizer policy from 1990 to 2001, and suggested alternative market-friendly policies. Issues such as the cost to the treasury and transparency of policies and programmes were also examined by the study. The study outlined the main policy options that the Nigerian government could take in the light of economic efficiency, equity and food security and budget aspects. However, this current study went beyond the fertilizer subsidy programme, which is just one of the agricultural programmes (equally identified by this study), to assess agricultural performance in Nigeria from 1970 to 2007 to include other agricultural inputs and production activities by including fertilizer use, agricultural land, agricultural machinery, crops, fisheries, livestock, and forestry.

Manyong et. al. (2005) observed that policy instability, inconsistent policies, narrow base of policy formulation and poor implementation of policies were among the major constraints limiting the effectiveness of past agricultural policy efforts, agricultural performance in Nigeria.

Garba (1999) analyzed the implementation of agricultural policies in Nigeria, 1970-1993 using the descriptive methodology of estimates of implementation deviation and reported significant over- and undershooting of policy targets and agricultural performance in terms of agricultural inputs, outputs and investment policies. The study, however, could not establish the effect or impact of government regimes on agricultural production and/or rural welfare in Nigeria. This study therefore, differs from that of past studies, including Garba's, in that it used longer times series data to analyze the performance of agriculture and established impact of agricultural production on rural welfare in Nigeria.

Murgai *et al*. (2001) assessed long-term producton and sustainability of irrigated agriculture in the Indian and Pakistan Punjabs. They found that although output growth and crop yields were much higher in the Indian Punjab, and that there was wide temporal and regional variation with lowest growth occurring during the Green Revolution period. Policy issues that affect overall production growth and sustainability especially from public investment in research and extension, as well as education and roads were suggested. This present study, however, used the econometric analytical technique of the stochastic production frontier method to analyze producton technical efficiency in Nigeria.

From review of literature (including Olomola *et al.*, 2008), there are two perspectives on improvement of agricultural production. The first proposes a continuation of predominantly smallholder farming and argues that through provision of education, research increased use of fertilizers and inputs, improvement of marketing, credit and other services, desired rates of agricultural progress can be attained. The second school of thought believes that the existing agrarian structure (including functioning and policies) militates against a rapid increase in agricultural production and improvement in rural conditions. It is argued that large-scale farming, in the form of plantations, cooperative farms, offers better opportunities for rapid agricultural development because new techniques can then be introduced more easily, better utilization of resources and management can be achieved and new forms of capital mobilized.

Evidence also abounds in literature of the important role of increased agricultural production in transforming rural economies (Olomola *et al.*, 2008; World Bank, 2008). The Asian rural and general economy has undergone a dramatic transformation for over 30 years. The transformation led to the achievement of a speed and level of agricultural, rural, and overall economic development in most Asian countries that far exceeded expections (Olomola *et al.*, 2008). It is in the light of the foregoing evidences that this study assessed the impact of agricultural production on rural welfare in Nigeria, in order to better inform policies implementation for agricultural development in Nigeria.

2.3.2 Agricultural income and rural welfare

According to Datta and Meerman (1980), income distribution is the common measure of welfare. They stated further that interest in the distribution of income derives from the fundamental interest in the distribution of human welfare. Welfare cannot be measured but we can measure income per capita, which is generally regarded as the best proxy for welfare.

National GDP measures the value of the goods and services produced within a country during a given period of time - income. In practice, this means the production of those activities that fall within the boundary of the System of National Accounts. The production of these goods and services is generally valued at market prices, based on the assumption that these prices accurately reflect the value (to individuals and society) of the resources used for their production, since they have alternative uses. On the other hand, agricultural income is the value of the agricultural goods and services produced within a country during a given period of time. Agricultural income or agricultural GDP is the total value of the agricultural goods and services produced during a given year (Oyekale, 2008).

The monetary measure most commonly used to assess the total value of the economic resources that affect welfare is GDP per capita. Economic welfare (Nordhaus and Tobin, 1973; Hecht, 2002 and Giovannini *et al*., 2009) is measured by GDP per capita. According to Giovannini *et al*. (2009), GDP per capita provides an accurate measure of a country's capacity to deal with the material needs of its residents. They argued further that so long as the basic necessities of life remain scarce, additions to GDP per capita can be expected to equate closely with improvements in meeting the population's basic needs, and hence in greater welfare. Rural welfare is therefore, proxied by real agricultural GDP per capita. Hence, it provides an accurate measure of welfare of rural residents in current basic prices.

Besides, agricultural incomes have implications for promoting rural welfare (agricultural income per capita) in Nigeria, as improved rural welfare engenders agricultural development by enhancing more incomes through improved rural infrastructures (capital assets) such as roads, water, medical services, electricity and school; which are substances of rural welfare (CBN/NISER, 1992).

2.3.3 Impact of agricultural production on rural welfare

Literatures on the impact of agricultural production are not clear cut. However, a large body of knowledge agrees that agricultural production positively impact on agricultural incomes and rural welfare. Diagne *et al*. (2009) concurred with the Word Bank (2008) that agricultural production increases could reduce poverty by increasing the income of farmers, reducing food prices, and thereby enhancing increments in consumption (and investments) and improved rural welfare.

Ayanwale (2011) on a study on policy distortions and agricultural output in Nigeria, 1961 – 2006 found a negative but not significant coefficient of per capita income on rice production. He maintained that although improved per capita income does not encourage rice production in the short run, but over time it does encourage its production. Hence improved income of farmers will encourage the production.

Government policy instruments promote agricultural production and impact on rural welfare. In this regard, CBN/NISER (1992) assessed the impact of structural adjustment programme (SAP) on Nigerian agriculture and rural life. The study noted that SAP helped to get the macroeconomic framework right with favourable implications for level of output and farmers' income. However, the study submitted that SAP escalated the cost of production generally, thereby eroding the purchasing power of the people, especially the rural dwellers largely due to the sharp depreciation in the naira exchange rate and hike in interest rate.

Agricultural production is also known to be impacted by investment in the sector (Olomola *et al*., 2008). Past studies (Aschauer, 1989; Tanzi and Zee, 1997; Akpan, 2005; Fan *et al*., 2008) found conflicting results regarding the effects of government's expenditure on economic growth. Tanzi and Zee (1997) found no relationship between government size and economic growth. Further, many studies (Elias, 1985; Fan and

Pardey 1998; Fan *et al*., 2008) have also linked government expenditures to agricultural growth. Most of these studies have found that government expenditures contributed to agricultural production growth (Olayide and Ikpi, 2010).

The political dispensation in existence in a country also determines what will be the outcome of the country's economic reform process and impact on agricultural production and rural welfare. Each policy dispensation has definite incentives to offer the agricultural sector possibly, at the envy of other sectors within the whole economy. Findings by Anderson *et al*. (2008), World Bank (2008) and Ayanwale (2011) concurred that a country's agricultural production depends on policy choices and their changes over time.

Manyong *et al*. (2005: 70-71) assessed the opinions of agricultural stakeholders on the effectiveness of policies and regulations in the different areas of agriculture and concluded that policies aimed at stimulating agricultural production was most important. They suggested, broadly, the need for more effective policies that target upstream agricultural production (from crop planting to harvesting) activities. They further stressed that the impact of policies on the welfare of people was weak. The present study however, differs from Manyong *et al.* (2005)'s in that it identified and analyzed empirically variable inputs and estimated their elasticities on agricultural production index for Nigeria with a view for providing more empirical basis for policy formaulation and implentation in Nigeria. It went further on and assessed the impact of agricultural production on rural welfare in Nigeria.

The impact of agricultural production and rural welfare linkages is also documented in literature. Agricultural production contributes to poverty reduction. A wealth of empirical evidence shows that agricultural production growth can reduce poverty in rural areas, directly through impact on farm incomes, employment and through growth linkages with other sectors. The growth – linkage effects of agriculture have proven most powerful when agricultural growth is driven by broad-based production increases in rural economy dominated by small farms, such as that of Nigeria (Mellor, 1999). Small to medium sized farm households typically have more favourable expenditure patterns for promoting growth of local non-farm economy, including rural towns, since they spend higher shares of income on rural non-traded goods and services which are also generally more labour-intensive (Hazell and Roell, 1983; NBS, 2007).

By disaggregating different types of households in Indonesia, Thorbecke and Jung (1996) found that the agricultural sector contributes the most to overall poverty reduction, followed by the services and informal sectors. Evidences (Datt and Ravallion, 2002; Fan *et al*., 2005) from India and China have demonstrated agricultural production reduces income poverty. Using data from 1985 to 1996 for China, Fan *et al*. (2005) found that higher growth in agriculture reduces rural poverty with high pro-poor effect for rural areas. Similarly, Bourguignon and Morrison (1998) found that variables which measure agricultural production are important in explaining income inequality. Increasing agricultural production has been found to be the most effective path for many countries to reduce income poverty and inequality (Byerlee *et al*., 2005).

Overall, this study is hinged on existing body of evidence but differs from other studies in that it estimated the impact of agricultural production on rural welfare using the sustainable livelihood framework, robust econometric approach and expanded study period for Nigeria with reference to government regimes and policy development scenarios.

2.3.4 Review of methodologies

2.3.4.1 Agricultural production and technical efficiency

In literature, the general approach to agriculture production analysis is either in its non-parametric frontier form (Malmquist index[1]) or parametric form (stochastic frontier method). The non-parametric approach was developed and used by such researchers as Fare *et al*. (1994), and Nishimizu and Page (1983). Their approach relies on the methodology of linear programming activity analysis. The non-parametric approach does not impose any parametric production function on the data and hence is flexible. The non-parametric approach otherwise called Malmquist index has gained popularity in recent years because of its decomposable explanatory power.

According to Shih-Hsuu *et al*. (2003), since Data Envelopment Analysis (DEA) type of analysis can be directly applied to calculate the index, the Malmquist index has the advantage of computational ease and does not require information on cost or revenue shares to aggregate inputs or outputs. Consequently, it is less data demanding and it allows decomposition into changes in efficiency and technology and multilateral comparison. The method does not attract any of the statistic assumptions restriction; however, it is susceptible to the effects of data noise, and can suffer from the problem of unusual shadow prices when degrees of freedom are limited (Coelli and Rao, 2003).

According to Ogundele and Okoruwa (2006), the estimation of production frontiers has proceeded along two general paths: fullfrontier, which forces all observations to be on or below the frontier and hence where all deviation from the frontier is attributed to inefficiency, and stochastic frontiers, where deviation from the frontier is decomposed into random components reflecting measurement error and statistical noise, and a

[1] The Malmquist index (MI) is a productivity measure which allows for the presence of technical inefficiencies and is nonparametric. It does require the use of prices of inputs or output in its construction. The MI avoids specification bias but it is deterministic. The MI is based on the output distance function defined as $D^T(x^t, y^t \equiv \inf\left\{\theta : (x^t, \frac{1}{\theta} y^t) \in S^t\right\}$, where superscript T denotes the technology (or policy) reference period, usually T = t or T = t+1, S is the technology or policy set or variable, x^t is a vector of inputs and y^t is a vector of outputs used in year t. For details see Fare et al. (1994); Fulginiti and Perrin (1998); Nin et al. (2002), Nkamleu (2004).

component reflecting inefficiency. The estimation of full frontier could be through a non-parametric approach or a parametric approach where a functional form is imposed on the production function and the elements of the parameter. The drawback of these non-parametric techniques is that they are extremely sensitive to outliers.

In this study, however, the parametric stochastic frontier approach to production estimation was employed since it offers better explanatory powers than the non-parametric method of estimation, and because it is not susceptible to the effects of data noise and does not suffer from the problem of unusual shadow prices.

2.3.4.2 Methodologies for assessing impact on economic growth and rural welfare

Literarature abounds on empirical studies on impact assessment of policy instruments on economic growth (Idowu, 2005; Akpan, 2005; Amin and Audu; 2006). These studies have variously employed different econometric technigues including ordinary least squares (OLS) estimations and at levels of times-series data without recourse to the underlying problems of stationarity of such spurious regressions. But it is known that running a time-series data with ordinary least squares approach leads to spurious regression results (Yusuf and Falusi, 1999).

Apart from problems of stationarity and spurious regression that are commonplace in time-series data, the problems of biased estimation as well as heterogeneity often arise with lagged variables and dependent variable. Similarly, dynamic panel model, including an individual effect together with a lagged dependent variable generates biased estimates for a standard least square dummy variable (LSDV) estimator, especially when N is much larger than T (Hsiao, 1986).

Literature has however, provided ways of resolving these issues in order to estimate best unbiased estimators. A common way to deal with this problem is to take the first difference and exploit a different number of instruments in each time period using either an instrument variable estimator or a generalized method of moments (GMM) estimator as an estimation method (Arellano and Bond, 1991; Holtz-Eakin *et al*., 1988).

Blundell and Bond (1998), proposed to use an extended system estimator that used lagged differences as instruments for equation in levels, in addition to lagged levels as instruments for equation in first difference. In other words, we “stack” both difference and level equations together for estimation. This implies a set of moment conditions relating to the equations in first differences and a set of moment conditions relating to the equations in levels. If the simple autoregressive AR(1) model is mean-stationary, the first difference Δy_{it} will be uncorrelated with individual effects, and thus $\Delta y_{i,t-1}$ can be used as instruments in the level equations. Zhang and Fan (2004) applied a system GMM method to empirically test the causal relationship between production growth and infrastructure development using the India district-level data from 1970 to 1994.

The GMM involves the estimation technique which employs lagged variables in difference. The choice of GMM was informed because the ordinary least squares estimation technique may lead to a biased estimation. Another estimation issue that may cause spurious regressions is the possible existence of unit roots or nonstationarity of variables included in the analysis. This problem was overcome by differencing. Also, to avoid the potential endogeneity problem of the independent variable(s), the GMM instrumental variables approach was employed in the estimation procedure (Fan *et al*. 2008).

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This section enumerates the methodology of the study. It covers the scope, type and sources of data, analytical methods as well as the description of variable used for the estimation of the empirical analyses of the study.

3.1 Coverage of the Study

Nigeria is located approximately between Latitudes 4^0 and 14^0 north of the equator and between Longitude 2^0 $2^/$ and 14^0 $30^/$ east of the Greenwich Meridian. To the north, Nigeria is bordered by the Republic of Niger and Chad; to the east by the Republic of Cameroon, to the south by the Atlantic Ocean, and to the west by the Republic of Benin. Nigeria is located in sub-Sahara Africa (SSA) in the western part of Africa on the Gulf of Guinea. Nigeria has a population of about 140 million people with a population growth rate of 3.2 percent, the largest in sub-Sahara Africa (Beintema and Ayoola, 2004; NBS, 2009). Nigeria has a total surface area of 923, 770 km^2. About 35 percent of the land mass is believed to be arable while 15 percent is said to be used as pasture land, 10 percent as forest reserves, another 10 percent for settlements and the remaining 30 percent is composed of water bodies or are simply uncultivable (FGN, 2007). Nigeria has more than 60 percent of its population in the rural areas that largely practice agriculture (NBS, 2007 and 2008; World Bank, 2008).

By virtue of its location, Nigeria enjoys a warm tropical climate with relatively high temperatures throughout the year and two seasons, the dry and wet seasons, which support agricultural production activities, including crops, livestock, fishery and forestry. Based on the climatic conditions, the following vegetation types are recognized in the country: the mangrove and fresh water swamps, the rain forest (RF), the Guinea savannah (GS), the Sudan savannah, and the Sahel savannah in the south-north transect. Between the RF and the GS is a modified vegetation transition consisting of light deciduous forest and derived savanna. The southern forest, that is, both the swamps and the rain forest constitute the country's main source of wood. The derived savannah zone, about 250 km wide, was once the northern part of the forest zone; but became transformed by agricultural activities into a vegetation type consisting largely of deciduous trees and grasses. Most of the remaining part of the country is the Sudan savannah (SS), accounting for more than 25 percent of the surface area, and expanding at the expense of the GS. At the northeast and northwest corners of the country is the Sahel that ordinarily does not account for more than 5-10 percent of the surface area (FME, 2000).

Admistratively, Nigeria (see Figure 4) is made up of 36 States and the Federal Capital territory (NBS, 2009).

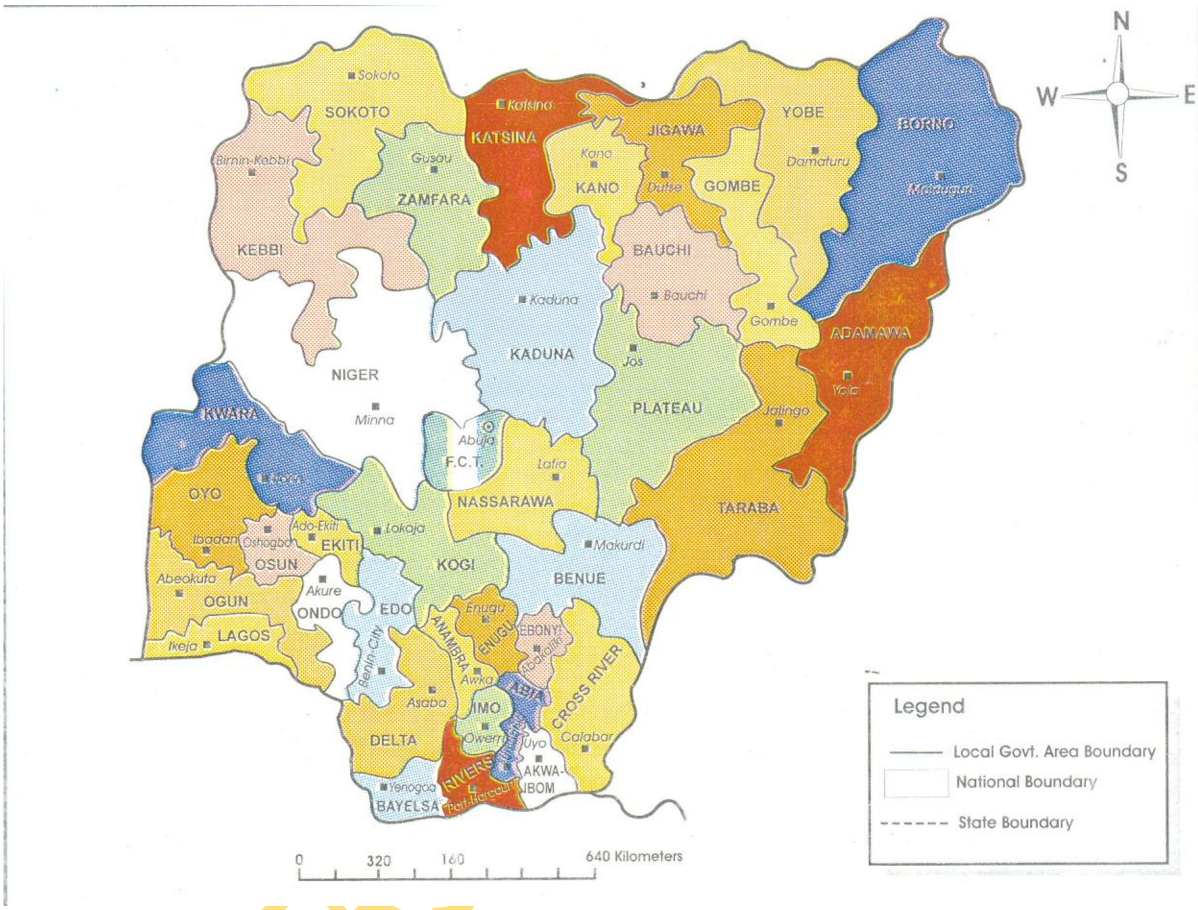

Figure 4. Administrative map of Nigeria

Souce: NBS (2008).

3.2 Type and Sources of Data

Data for the study came from many sources such as: Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS), and the Food and Agriculture Organization (FAO). Secondary data collected included: agricultural input and production indices, Agricultural Gross Domestic Product (AGDP), agricultural budgets, health index, infrastructural index, industrial development index, private investments in agriculture, and government regimes.

3.3 Analytical Methods and Framework

A multiple of analytical techniques were employed to analyze the objectives of the study. These include descriptive statistics, trends and econometric analyses. Tests of statistical significance were carried out under broad policy development scenarios of the Nigerian context. These policy development scenarios are the Millennium Development Goals (MDGs) and government regimes of the military or democracy. These policy development scenarios consist of pre-MDGs period (1970-1999) and the MDG period (2000-2007) as well as the military (1970-1979 and 1984-1999) and democratic (1980-1983 and 1999-2007) periods. The NEEDS I (2004-2007) period is subsumed in the MDGs period (IMF. 2007; Marcellus 2009).

It has been said (Ajakaiye and Adeyeye, 2003; Marcellus 2009) that the persistence and pervasiveness of poverty in several countries has been linked to the lack of popular participation in governance and decision- making as well as weak institutional base. This has led, among other things, to poor accountability, transparency in resource allocation, weak programme implementation and monitoring. Ultimately, development programmes are rendered ineffective and resources wasted. Therefore, the analyses in this study were done to account for the impact of these policy development stages (governance/political structure and the MDGs) on agricultural production and rural welfare in Nigeria. The fact is that, it has been observed that developmental state approach as the core of development strategy enables Africa, including Nigeria, to transform its economies and to achieve its primary economic and social development goals (UNECA, 2011).

3.3.1 Descriptive statistics and ratios

Descriptive tools used included cross tabulations, percentages and graphs. The summary statistics like means and standard deviations were also provided. The focus was on the analysis of levels, trends, size, composition, and variability in key variables of interest which provided insights into the pattern of movement of variables over time and space, under different agricultural policy development scenarios.

Agricultural trade and food self-sufficiency analyses were carried out following Yusuf and Falusi (2000) and Idachaba (2006). Agricultural trade ratios and food self-sufficiency index were computed as follow:

i. Import ratio $= \dfrac{\text{Total value of agriculture import}}{\text{Agriculture GDP}}$ ……………………… (1)

ii. Export ratio $= \dfrac{\text{Total value of agriculture export}}{\text{Agriculture GDP}}$ ……………………… (2)

iii. Food self-insufficiency index $= \dfrac{\text{Total value of agriculture export}}{\text{Total value of agriculture import}} * 100\%$ ..… (3)

iv. Food self-sufficiency index $= 1 - \dfrac{\text{Total value of agriculture export}}{\text{Total value of agriculture import}} * 100\%$ ……. (4)

The agricultural policy and development initiatives in Nigeria have the overall objective of enhancing food self-sufficiency and improving welfare of Nigerians through the contribution of agriculture to growth and economic development (UNECA, 2011).

3.3.2 Econometric analyses

3.3.2.1 Stochastic production frontier function

As stated earlier, the Stochastic Production Frontier Function (SPFF) is preferred to non-parametric methods. The stochastic production function can be written implicitly as:

$\ln Y_{it} = f(X_{it}, t, \alpha, v_{it} - u_{it})$ …………………………………………………........ (5)

$i = 1, 2, \ldots N$ and $t = 1, 2, \ldots T$.

Where $\ln Y_{it}$ is production index in year t, α is the vector of parameters to be estimated. The v_{it} are the error component and are assumed to follow a normal distribution N(0, σ^2_{it}), u_{it} are non negative random variables associated with technical inefficiency in production which are assumed to arise from a normal distribution with mean μ and variance σ^2_{μ} which is truncated at zero. The *f* (.) is a suitable functional form (e.g double log), *t* is a time trend representing the technical change. The technical efficiency of production for the *i*th year can be predicted using Coelli *et al*. (1998). The technical efficiency are obtained as

TE_{it} = E(exp)($-u_{it}$)/ $v_{it} - u_{it}$ ……………………..…………………………………… (6)

Empirical specification

This study utilized data on inputs and outputs of agricultural production to analyse agricultural production technical efficiency. The data used comprise annual measures of agricultural production and inputs (including land area, fertilizer, irrigated area, machinery and labour).

Following Alene and Manyong (2006) and Ajetomobi (2008), the stochastic production frontier approach was specified. The output (agricultural production) is assumed to be a function of inputs (cultivated land area, irrigated area, seed, fertilizer, machinery and labour) used. A non neutral technical change is specified and the error term is assumed to have 2 components. The production function is as stated in equation (7).

$\ln Y_{it} = \beta_0 + \beta_1 \ln X_{1it} + \beta_2 \ln X_{2it} + \beta_3 \ln X_{3it} + \beta_4 \ln X_{4it} + \beta_5 \ln X_{5it} + \beta_6 \ln X_{6it} + V_{it} - U_{it}$ ……………………………………………………………………………………..….. (7)

Where

Y_{it} is the agricultural production index in the *i*th year

$X1_{it}$ is total area under irrigation in hectares in the *i*th year

$X2_{it}$ is total number of tractors in use in the *i*th year

$X3_{it}$ is the quantity of fertilizer used in '000 tonnes in the *i*th year

$X4_{it}$ is the hectares of land cultivated in '000 in the *i*th year

$X5_{it}$ is the agricultural seed index in the *i*th year

$X6_{it}$ is number of agricultural labour is measured in stock terms as the number of persons engaged in agriculture in the *i*th year

ln is the natural logarithm

α_is are unknown parameters to be estimated

V_{it}s are *iid* $N(0, \sigma_{v^2})$ random errors and are assumed to be independently distributed of the U_{it}*s* which are non-negative random variables associated with TE inefficiency. The distributions of the U_{its} are obtained by truncation at zero. While i = 1,2,…,N, t = 1,2,…,T.

The agricultural output index was reported by the FAO and CBN (CBN, 2007), where agriculture is broadly defined to include crops, livestock, forestry, and fishery production. The estimated total production technical efficiency, which also measures the overall performance of agriculture, was used as an exogenous variable to capture the impact of agricultural production on rural welfare. The estimating equations were in indexes and in logarithm form to minimize the bias that may arise from using different scales or units (Fan *et al*. 2008).

3.3.2.2 Generalized method of moments

The basic approach used in assessing the performance of agriculture had been largely the descriptive statistics or proportional analysis. Others have reviewed specific targets set and compared mean values of selected economic indicators in pre- and post policy periods. This descriptive method, often referred to as "before and after approach", has been used by Igbedioh (1990), CBN/NISER (1992), Garba 1999 and Manyong *et al*. (2005). However, descriptive analyses cannot establish causal effects since other factors that may have affected these indicators might have not been taken into consideration. To this end and following Fan *et al*. (2008), Fan *et al*. (2004), and Arellano and Bond (1991) the impact of agricultural production on rural welfare is estimated here using the generalized method of moments (GMM).

The GMM involves the estimation technique which employs lagged variables in difference. The choice of GMM was informed because the ordinary least squares estimation technique may lead to a biased estimation. Another estimation issue that may cause spurious regressions is the possible existence of unit roots or nonstationarity of variables included in the analysis. This problem was overcome by differencing. Also, to avoid the potential endogeneity problem of the independent variable(s), the GMM instrumental variables approach was employed in the estimation procedure (Fan *et al*., 2008).

Following Fan *et al*. (2008) and Arellano and Bond (1991), a GMM estimator as an estimation method was stated as:

$$\Delta y_{it} = \sum_{e=1}^{m} a_e \Delta y_{it} + \sum_{e=1}^{n} \beta_e \Delta x_{it-e} + \Delta u_{it} \quad \ldots\ldots (8)$$

Where y is the dependent variable; *x* is a set of independent variables, i = 1,…, N; m and n are the lag lengths sufficient to ensure that u_{it} is a stochastic error.

In order to ensure efficiency gain in GMM model estimation, Blundell and Bond (1998) proposed an extended system estimator that used lagged differences as instruments for equations in levels, in addition to lagged levels as instruments for equations in first difference. In other words, we "stack" both difference and levels equations together for estimation. According to Fan *et al*. (2008), this implies a set of moment conditions relating to the equations in first differences and a set of moment conditions relating to the equations in levels. If the simple autoregressive AR(1) model is mean-stationary, the first differences Δy_{it} will be uncorrelated with individual effects, and thus $\Delta y_{i,t-1}$ can be used as instruments in the level equations.

Zhang and Fan (2004) applied a system GMM method to empirically test the causal relationship between production growth and infrastructure development using India district-level data from 1970 to 1994; and Fan *et al*. (2008) applied a system GMM method to assess the impact of public expenditure in developing countries.

The GMM estimated for impact of agricultural production on rural welfare was specified as:

$$y_{it} = \alpha_0 + \sum_{e=1}^{m} \alpha_e y_{i,t-e} + \sum_{k=1}^{n} \beta_k x_{i,t-k} + \eta_i + \mu_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Where y is the dependent variable (that is, real agricultural GDP per capita; *x* is a set of specific variables representing the capital assets, governance dummies), i = 1,…, N; t = m + 2, …, T; α's and β's are parameters; and the lag lengths m and n are sufficient to ensure that μ_{it} is a stochastic error.

Government regime captures the fixed effects of political systems (Olayide and Ikpi, 2010). The variables (including the capital assets) were incorporated into the estimating equations (SPFF and GMM) as indexes and in logarithm form to minimize the bias that may arise from using different scales or units. Also, lagged levels of variables were used as instrumental variables for equations in first difference for the GMM estimation (Fan *et al*., 2008).

Similarly, as a procedure for time series regression analysis, and given the necessary conditions for using time series data, the data analysis procedures involved examining the nature of the relevant variables in the study for stationarity; and whether or not there exists a long-run relationship between the dependent variables and the independent variables.

Engel and Granger (1987) stated that a homogenous non-stationary series, which can be transformed to a stationary series by differencing d times, is said to be integrated of order d. Thus, Y, a time series is integrated of order d [Y ~I(d)] if differencing d times induces stationarity in Y_t. If $Y_t \sim I(0)$, then no differencing is required as Y is stationary. The test proposed by Dickey-Fuller to determine the stationarity properties of a time series is called the Unit Root test denoted by DF. The regression equation for the DF class of unit root test is:

$$\Delta Y_t = \varphi Y_{t-1} + \varepsilon_t \, ; \; \varepsilon_t \sim N(0, \sigma^2), \; Y_0 = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

The unit root test above is valid only if the series is an AR(1) process. If the series is correlated at higher order of lags, the assumption of white noise disturbance is violated. In such cases, the Augmented Dickey-Fuller (ADF) or the Phillips-Perron (PP) tests use a difference method to control for higher-order serial correction in the series. The PP test allows for individual unit root process so that the autoregressive coefficient can vary across units (Ajetomobi, 2008). The tests make a parametric correction for higher-order correlation by assuming that the y series follows an AR(p) process and adjusting the test methodology. It is identical to the standard DF regression, but augmented by k lags of the first difference of the series as follows:

$$\Delta Y_t = \alpha Y_{t-1} + \sum_{i=1}^{k} \omega i \, \Delta Y_{t-1} + \varepsilon_t \quad \text{...} (11)$$

Where the lag k is set so as to ensure that any autocorrelation in Y_t is absorbed and that a reasonable degree of freedom is preserved, while the error term is white noise.

The concept of cointegration derives from the fact that if two series X_t and Y_t are said to be cointegrated if there exist a unique value b which ensures that the residuals, $(Y_t - bX_t)$ is I(0). Testing for cointegration, therefore, amounts to testing for a unit root in the residuals of regression equation (12). If the residuals are stationary, then the series are cointegrated. The equation of the regression for this test is thus:

$$\Delta \varepsilon_t = \alpha \, \varepsilon_{t-1} + \sum_{i=1}^{k} \alpha_i \, \Delta \, \varepsilon_{t-1} + \mu_i \quad \text{...} (12)$$

Where ε_t is the residual from the static regression and test for the null of no cointegration is conducted by comparing the t-statistic of the coefficients to the Mackinnnon critical values. The null hypothesis of no cointegration is H_0: $\alpha = 0$. Significant negative values would lead to a rejection of the null. The stationarity of the residual implies cointegration of the variables (Engel and Granger, 1987).

3.4 Variables Used for the Estimation of the GMM

The dependent variable used for the estimation is rural welfare as proxied by real agricultural GDP per capita. The independent variables were broadly classified as natural, physical, financial, human and social capitals (DFID, 2001). The variables were identified from literature, including FGN (2001b). Theoretically, the independent variables are either acting as constraints or as vibrant and sustaining contributors to rural welfare.

Natural capital

The variables under the natural capital are mean rainfall and share of forest in agricultural land. These variables were identified based on empirical studies (DFID, 2001; Kristjanson, 2005; Fan *et al*. 2008). The directions of the signs of these variables based on available literature were missed. Increases in mean rainfall could lead to agricultural activities and better rural welfare. It could at the same time lead to flooding that will worsen rural welfare. In the same vein, reducing the share of forest in agricultural land (deforestation) for the the purpose of agricultural activities could increase rural welfare in the short-run but will lead to soil degradation that will impact rural welfare negatively in the long-run.

Physical capital

The physical capital variables were the share of goods conveyed by road (transportation/traffic density), housing construction index (number of buildings started), total electricity generation (mega watt per hr), communication/teledensity (number of phone lines per 100 people), agricultural production (technical efficiency score), and manufacturing capacity utilization rates (%). These variables were identified based on empirical studies (FGN, 2001b; Kristjanson, 2005; Fan *et al*. 2008). Overall, the capital assets are theoretical and empirically established relationships (Olayemi, 1995; Ikpi, 2000; DFID 2001; Beintema and Ayoola, 2004; Kristjanson *et al*. 2005; and Thornton *et al*., 2006).

Financial capital

The financial capital variables are total agricultural credit (N '000), share of agriculture in foreign private investment (%), share of capital expenditure of state governments (%), net imports (foreign trade) (N million), inflation rate (%), exchange rate (%), external reserves (N million), agriculture budget as percentage of national budget, and capital expenditure as percentage of total federal expenditure. These variables were identified based on empirical studies (FGN, 2001b; Beintema and Ayoola, 2004; Kristjanson, 2005; Fan *et al*., 2008).

Human capital

Literacy rate (%), life expectancy at birth (years), and share of female workers economically active in agriculture are the human capital variables. Omonona (2010) found that education was a major determinant of rural welfare in Nigeria. These variables were identified based on empirical studies (FGN, 2001b; DFID, 2001; Kristjanson, 2005; Fan *et al*., 2008).

Social capital

The social capital variable was specified as dummy for democratic period. This variable was identified based on empirical studies (Ikpi, 1997; Fan *et al*. 2008; Olayide and Ikpi, 2010; UNECA, 2011). Aberman *et al*. (2009) posited that the existence of a strong political will to ensure that the policy was successfully formulated and adopted was essential for agricultural development. The variable was hypothesized to impact rural welfare positively.

Overall, the natural capital indicates high potentials for crops, livestock and fisheries production as well as potentials for extensification/intensification. The physical capital assets facilitate the market access, inputs delivery, and also indicate infrastructure development, and resilience to shocks through technology development and better services leading to improved welfare and sustainable development. The financial capital assets underscore the importance of financing and fiscal responsibility in developing the economy as well as reducing susceptibility to development challenges. The human capital assets in form of literacy, health and gender mainstreaming are emerging global issues in sustainable development. The social capital assets promote good inter-governmental relationships, good governance, sustainability of policies and sustainable economic transformation (UNECA, 2011). The *a priori* expectations on direction of impact of most of the independent variables are not clear cut on the basis of literature and empirical studies. However, the findings of this study have confirmed and/or provided more information on past empirical studies.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.0 Introduction

This section of the analyses reveals the performance of agriculture in Nigeria from 1970 to 2007. Basically, the analyses were disaggregated by government regimes involving military and democratic regimes. Further analyses by the MDGs/NEEDS period are encapsulated in the government regimes for the purpose of emphasing the policies within the periods and full description of the data.The empirical analysis (regression) was however, limited to the military and democratic regimes. Total factor production technical efficiency index measured the overall agricultural performance and underscores the importance of boosting agricultural production in Nigeria.

4.1. Growth Rates in Agricultural Inputs

The study identified six basic inputs in agricultural production activities. The six basic inputs are land, labour (agricultural employment), machines, seeds, fertilizer (agrochemicals), and irrigation (water supply). The use of these inputs is crucial to increasing agricultural output, enhancing agricultural production and improving rural welfare in Nigeria. Studies (Okoruwa and Oni, 2002; World Bank, 2008) have revealed that the level of use or supply of agricultural inputs influences the agricultural yields and welfare level of farmers.

The figures in Table 2 show that agricultural inputs use vary by macroeconomic policy development scenarios – MDGs/NEEDS and government regimes. The agricultural land use recorded significant use ($p<0.001$) in the MDGs policy period. Land use indicated that the policy on agricultural land use had tended towards land expansion rather than land use intensification. This result is consistent with the policy dictate contained in the NEEDS Document (NPC, 2004). Similarly, results from agricultural labour/employment analysis revealed a downward trend and significant decreases in agricultural employment based on policy development scenarios. Agricultural machines are important for enhancing agricultural production and are also labour-saving (Akinyosoye, 2005).

Deliberate policies to enhance agricultural mechanization include importation of tractors, establishment of National Centre for Agricultural Mechanization (NCAM, in Ilorin, Kwara State) and tractor hiring services. The results of the analysis on the use of agricultural machinery revealed significant increases in the number of tractors used in Nigeria between pre-MDGs and MDGs periods. The effect of the goal-oriented development of MDGs/NEEDS scenario led to significant increase from 16,660 to 30,000 tractors. This is because of import liberalization on agriculture machines within the MDGs/NEEDS era. In particular, agricultural machineries and quantity of fertilizerss used increased significantly in the MDGs/NEEDS scenario.

However, agricultural machines as a proportion of arable land and irrigated areas as a proportion of arable land are still at a very low ebb. The overall agricultural machines as a proportion of arable land was 7 tractors per 100 hectares of land while that of irrigated area as a proportion of arable land was 0.78 percent. The finding is perhaps due to the fact that irrigated areas had remained consistently low. Areas under irrigation had hardly reached 280,000 ha which is about one percent of the arable land in Nigeria.

Table 2. Growth rates in agricultural inputs, 1970-2007

Indicators	Military Regime (1970-1979 & 1984-1999)	Democratic Regime (1980-1983 & 1999-2007)	Significant Difference	Pre-MDGs/NEEDS (1970-1999)	MDGs/NEEDS (2000-2007)	Significant Difference	Overall (1970-2007)
Agricultural land (arable land in '000 ha)	28583 (979.40)	29725 (2218.89)	2.213**	28453 (942.53)	30925 (2033.12)	5.039***	28974 (1587.81)
Agricultural labour/employment (total economically active population in agriculture in '000 people)	15534 (1088.21)	15381 (976.35)	3.873***	15528 (1101.78)	15348 (435.85)	5.365***	15498 (1041.89)
Machines (number of tractors in use)	17504 (8945.97)	23246 (10545.82)	1.766*	16660 (9122.49)	30000 (0.00)	4.095***	19468 (9777.67)
Fertilizer (Metric tons)	24656 (18259.62)	33374 (21987.21)	1.302	22777 (19207.27)	60870 (7429.14)	3.307***	33602 (19764.30)
Irrigation (total area equipped for irrigation in '000 ha)	212 (16.12	251 (40.60)	4.285***	211 (15.79)	279 (19.72)	10.302***	225(32.59)
Agriculture machines (tractors/ 100 ha of arable land)	6.05 (3.00)	7.71 (3.38)	1.546	5.78 (3.08)	9.74 (0.64)	3.577***	6.62 (3.19)
Irrigated land area as % of agric. land	0.74 (0.03)	0.84 (0.09)	4.742***	0.74 (0.04)	0.9 (0.03)	10.004***	0.78 (0.08)

Source: Computed from data obtained from www.faostat.org. Figures in parentheses are standard deviations. Astericks ***, ** and * represent 1%, 5% and 10% levels of significance, respectively.

Fertilizer use rate (see Table 3) also fell below the recommended use (Olayide *et al*., 2006; Banful and Olayide 2010). The average fertilizer use rate for the study period was 14.42kg/ha. Besides, none of the policy scenarios had made significant contributions to fertilizer use rates in Nigeria. The fertilizer sub-sector as well as the subsidy rates it enjoys has always generated much interest in the agriculture and rural development policy issues (Idachaba, 2000; Nagy and Edun, 2002 and Akinyosoye, 2005). The results of the analyses on fertilizer use, subsidy rate and farm price are contained in Table 3. Despite the policy thrust and subsidy on fertilizers in Nigeria, fertilizer use rate had been pitiably low as fertilizer use had only recently reached 15kg/ha. There has been no significant change (increases) in the rate of fertilizer use in Nigeria despite the fertilizer subsidy policy in Nigeria. Worse still, the average farm price of fertilizer has consistently been on the increase. High subsidy rate is negatively related to fertilizer use and average farm price of fertilizer. This situation might be due to the rent-seeking activities and policy distortions by some individuals (Idachaba, 2000 and Akinyosoye, 2005). This implies that fertilizer subsidy has not influenced the desired increase and impact on fertilizer use in order to bring about the desired increased agricultural production.

The missing link, therefore, could be the problem of affordability as a result of widespread poverty rather than availability of fertilizer (Banful and Olayide, 2010). Therefore, agricultural policy strategies that are intended to boost agricultural production should be targeted towards resource poor farmers in order to improve farmers' incomes and welfare by promoting better adoption and intensification of agricultural inputs like fertilizers in Nigeria.

Overall, the results on the performance of agriculture in terms of agricultural inputs use revealed that there had been some measurable and significant increases in the agricultural inputs use in Nigeria, notwithstanding the need for strategic policy to enhance increases in specific inputs that are at pitiably low levels of use and intensification.

Table 3. Fertilizer use rate, subsidy rates and average farm price in Nigeria, 1970-2007

Indicators	Military Regime (1970-1979 & 1984-1999)	Democratic Regime (1980-1983 & 1999-2007)	Significant Difference	Pre-MDGs/NEEDS (1970-1999)	MDGs/NEEDS (2000-2007)	Significant Difference	Overall (1970-2007)
Fertilizer use rate (kg/ha)	13.34 (3.46)	15.51 (3.47)	1.327	13.95 (3.80)	15.01 (3.35)	0.615	14.42 (3.54)
Subsidy rate (%)	60.56 (34.98)	22.22 (8.33)	3.198***	57.00 (34.85)	21.89 (8.84)	2.765**	41.39 (31.58)
Average farm price (adjusted for current price) (₦/50kg bag)	397.78 (566.34)	2238.88 (1019.74)	4.735***	488.00 (605.40)	2356.25 (1023.10)	4.833***	1318.33 (1239.98)

Sources: Computed from data obtained from various. Figures in parentheses are standard deviations. Astericks ***, ** and * represent 1%, 5% and 10% levels of significance, respectively.

4.2 Indices of Agricultural Production

The figures in Table 4 show the trends in agricultural production by activity type in Nigeria (the base year is 1990). Generally, most of the agricultural activities – crops, livestock, fishery and forestry showed significant increases in outputs (relative performance) above the base year period. It could be implied that the policy development scenario impacted the agricultural production with level of production increases in most of the agricultural activities. The results revealed that policies of the democratic regime significantly impacted upon crops, livestock, fishery and forestry in Nigeria. Particularly, livestock production witnessed most significant increase in the democratic regime. Also, the development scenario of the MDGs/NEEDS impacted significantly on all the agricultural activities.

Overall, agricultural production indices increased significantly in all agricultural activities (and above the base year) in Nigeria during the study period. More importantly, the results reveal the need for more policy strategy to increase fishery activities, including aquaculture.

Table 4. Indices of agricultural production in Nigeria, 1970 to 2007

Agricultural activities	Military Regime (1970-1979 & 1984-1999)	Democratic Regime (1980-1983 & 1999-2007)	Significant Difference	Pre-MDGs/NEEDS (1970-1999)	MDGs/NEEDS (2000-2007)	Significant Difference	Overall (1970-2007)
All agriculture	86.40	130.52	3.250***	84.41	165.58	6.864***	101.49
	(31.22)	(52.73)		(32.30)	(14.85)		(44.54)
Crops	88.23	137.70	3.016***	86.11	176.58	5.979***	105.15
	(39.64)	(61.33)		(40.91)	(22.53)		(52.95)
Livestock	87.61	166.59	3.871***	84.96	225.91	8.975***	114.64
	(39.48)	(86.99)		(40.14)	(36.54)		(70.05)
Fishery	128.43	158.62	2.561**	135.81	149.83	0.953	138.76
	(36.57)	(29.79)		(37.90)	(33.06)		(36.96)
Forestry	88.51	112.47	3.406***	87.98	129.42	6.479***	96.70
	(17.13)	(26.12)		(16.93)	(11.89)		(23.33)

Source: Computed from data obtained from CBN's Statistical Bulletin (various issues). Figures in parentheses are standard deviations. Astericks ***, ** and * represent 1%, 5% and 10% levels of significance, respectively.

4.3 GDP Growth Rates and Contributions from Agriculture

There have been significant increases in the real GDP growth rate from 1970 to 2007 (Table 5). The share of agriculture in the total GDP has increased significantly. There were significant contributions from all the agricultural activities. Agricultural GDP which was 4.5 percent in the pre-MDGs/NEEDS scenario had increased to over six percent under the MDGs/NEEDS scenario. However, NEPAD, of which Nigeria is a prominent member, through its CAADP, sets a minimum of 6.0 percent for agricultural growth in Africa. According to the NEEDS/CAADP documents, the 6.0 percent minimum growth level is envisaged to lead to an agricultural revolution in Nigeria (NPC, 2004; AU, 2006). The implication of this increasing trend in agricultural GDP is that Nigeria might soon enter into the agricultural revolution era if she strives further to exceed the 6.0 percent benchmark in agricultural growth, all things being equal. Improved agricultural production and rural welfare are precursors for sustainable agricultural and rural development (DFID, 2001 and World Bank, 2008).

The overall performance of the agriculture sector in relation to its contribution to GDP reveals that the agriculture sector performed well in terms of its contributions from crops, livestock, and forestry to the total national income and economic growth.

Table 5. GDP and contributions from agriculture in Nigeria, 1970 to 2007

Items	Military Regime (1970-1979 & 1984-1999)	Democratic Regime (1980-1983 & 1999-2007)	Significant Difference	Pre-MDGs/NEEDS (1970-1999)	MDGs/NEEDS (2000-2007)	Significant Difference	Overall (1970-2007)
Total GDP (₦ Million)	257863.95 (67692.95)	460781.83 (93425.09)	7.684***	277528.97 (76351.48)	513861.67 (80233.34)	7.701***	327283.22 (123777.85)
Agric. GDP (₦ Million)	85241.23 (32318.77)	192112.07 (38968.79)	9.013***	97108.24 (40104.44)	214405.14 (32590.20)	7.606***	121802.32 (61725.99)
Growth rate of total GDP (%)	4.31 (3.87)	4.82 (2.26)	0.122	4.02 (3.49)	6.12 (1.61)	0.447	4.49 (11.96)
Growth rate of agric. GDP (%)	4.50 (10.56)	5.17 (1.61)	0.227	4.46 (9.58)	6.18 (1.34)	0.378	5.76 (8.45)
Agric. GDP as % of total	37.67 (4.03)	41.70 (0.81)	3.514***	38.72 (3.89)	41.76 (0.64)	2.179**	39.62 (3.55)
Contribution of crops to total GDP (%)	32.65 (3.86)	37.09 (0.69)	4.084***	33.79 (3.85)	37.15 (0.53)	2.436**	34.78 (3.57)
Contribution of livestock to total GDP (%)	3.08 (0.44)	2.73 (0.09)	2.848***	3.02 (0.39)	2.67 (0.07)	2.478**	2.92 (0.37)
Contribution of fishery to total GDP (%)	1.14 (0.36)	1.35 (0.17)	2.025**	1.13 (0.32)	1.38 (0.03)	2.184**	1.25 (0.29)
Contribution of forestry to total GDP (%)	0.82 (0.12)	0.60 (0.06)	4.364***	0.78 (0.12)	0.56 (0.04)	3.611***	0.71 (0.17)

Source: Computed from data obtained from CBN's Statistical Bulletin (various issues). Figures in parentheses are standard deviations. Astericks ***, ** and * represent 1%, 5% and 10% levels of significance, respectively.

4.4 Exports, Imports and Food Self-insufficiency

The importance of agriculture in promoting exports and food self-sufficiency cannot be over-emphasized. In fact, agricultural trade policies support imports substitution, exports promotion and food self-sufficiency (FGN, 2001a&b and Idachaba, 2006). It is in view of these that the performance of agriculture was assessed. The findings (Table 6) reveal the exports, imports and net imports of total agricultural trade. Specifically, the results show that Nigeria remains a net-importing nation. Also, there were significant increases in imports and exports in the agriculture sector under the various development scenarios. Specifically, agricultural import grew significantly from ₦20b in the pre-MDGs/NEEDS period to ₦320b in the MDGs/NEEDS period. This fact reveals low performance in the agricultural trade in Nigeria and has implications for the country's self-sufficiency. The net import situation puts Nigeria in a negative agricultural trade balance. The value of total exports grew significantly from ₦218 billion in the pre-MDGs/NEEDS to ₦4.2 trillion in the MDGs/NEEDS period. The results suggest agricultural policy failure in stemming the tide of massive importation without deliberate efforts at boosting agricultural exports. Therefore, there is need to re-examine the agricultural policy framework on trade expansion and import substitution in Nigeria.

The figures on growth rates in the agricultural trade indices presented in Table 7 reveal that there were no significant differences in the trade indices by policy development scenarios. The average growth rate in agricultural imports was 45 percent for the study period. This is astronomically high given the comparative advantage of agricultural commodities potentials in Nigeria. Most importantly, the food self-sufficiency had been influenced most by government regimes. The food self-insufficiency index which averaged 49.21 percent in the military period decreased significantly ($p<0.05$) to 28.86 percent in the democratic period. This implies that the agricultural trade policy of the democratic regime was less concerned about improving the food self-insufficiency in the country. Overall, the food self-insufficiency index averaged 29.35 percent (that is, 71 percent food self-sufficiency) for the study period. This result is consistent with the submission of Akinyosoye (2005) that Nigeria is in a sticky point in food self-sufficiency due to its unfavouarable agricultural trade balance.

Table 6: Nigerian agricultural trade indices, 1970 to 2007

Trade indicators (₦ Million)	Military Regime (1970-1979 & 1984-1999)	Democratic Regime (1980-1983 & 1999-2007)	Significant Difference	Pre-MDGs/NEEDS (1970-1999)	MDGs/NEEDS (2000-2007)	Significant Difference	Overall (1970-2007)
Total imports	31,048 (51,216)	1,935,841 (1,542,139)	6.250***	154,653 (288,678)	2,662,817 (1,580,398)	8.478***	682,688 (1,269,520)
Agric. Imports	3,050 (4,791)	238,327 (187,079)	6.366***	20,490 (40,290)	319,975 (200,149)	7.891***	83,539 (155,438)
Total exports	43,997 (69,933)	2,995,539 (2,419,605)	6.174***	218,087 (410,140)	4,187,415 (2,405,094)	8.886***	1,053,735 (1,978,795)
Agric. exports	1,501 (1,730)	68,773 (51,682)	6.586***	5,556 (9,596)	95,613 (49,187)	9.698***	24,515 (43,753)

Source: Computed from data obtained from CBN's *Statistical Bulletin* (various issues). Figures in parentheses are standard deviations. *** indicates significance at 1% level.

Table 7. Average growth rate in agricultural trade indices (imports, exports and food self-insufficiency), 1970 to 2007

Items (in %)	Military Regime (1970-1979 & 1984-1999)	Democratic Regime (1980-1983 & 1999-2007)	Significant Difference	Pre-MDGs/NEEDS (1970-1999)	MDGs/NEEDS (2000-2007)	Significant Difference	Overall (1970-2007)
Average growth rate in imports (%)	32.11 (49.40)	47.27 (99.46)	0.623	40.04 (77.91)	27.97 (29.04)	0.426	37.43 (70.08)
Average growth rate in agric. Imports (%)	36.81 (71.21)	60.46 (145.48)	0.667	49.89 (114.63)	27.82 (24.96)	0.536	45.12 (102.11)
Average growth rate in total exports (%)	35.96 (62.22)	50.90 (99.59)	0.653	43.99 (84.71)	31.14 (33.74)	0.416	41.21 (76.37)
Average growth rate in net imports (%)	36.88 (55.32)	51.55 (110.19)	0.542	45.54 (86.57)	29.32 (30.26)	0.517	42.03 (77.80)
Import ratio	3.82 (4.27)	7.54 (4.43)	2.514 **	3.66 (4.15)	10.42 (0.88)	4.542***	5.09 (4.63)
Export ratio	1.64 (1.31)	2.54 (1.37)	1.999*	1.57 (1.27)	3.36 (0.69)	3.803***	1.95 (1.38)
Food self-insufficiency	49.21 (4.430	28.86 (2.33)	2.331**	27.12 (4.48)	29.88 (1.94)	0.705	29.35 (4.08)

Source: Computed from data obtained from CBN's *Statistical Bulletin* (various issues). Figures in parentheses are standard deviations. Astericks ***, ** and * represent 1%, 5% and 10% levels of significance, respectively.

4.5 Agricultural Credit

Credit is considered as a veritable support in agricultural production activities. Past studies have shown that agricultural credit enhances adoption of agricultural innovation and investment in agriculture (Manyong *et al*., 2005 and CBN, 2007). To this end, government, commercial and micro-finance banks make credit available to farmers in Nigeria. Agricultural enterprises funded in Nigeria are categorized into livestock, food crops, cash crops, and other agricultural enterprises including fishery (CBN, 2007). The analysis of agricultural credit by enterprises (Table 8) reveals that the food crop sub-sector received the largest share of 59.4 percent of the total agricultural credit of ₦19 trillion for the study period. The cash crop sub-sector received the least share of 0.01 percent of the total agricultural credit for the study period. The figure revealed government policy effort at boosting food crops production in Nigeria from agricultural financing.

The pattern of investment and agricultural enterprise financing by development scenarios did not change significantly. However, credit per capita was significantly influenced by development scenarios. For instance, the average credit per capita of ₦15,000 in the pre-MDGs/NEEDS increased significantly to ₦62,000 in the MDGs/NEEDS period. A similar trend was observed under the government regimes scenario. Overall, the agricultural credit policy could be said to favour the food crops sector, even as agricultural credit per capita increased in Nigeria. This result is in tandem with the critical role of the food crops sector and consistent with the agricultural policy strategy on sustainable food security (FGN, 2001a&b).

Table 8. Agricultural credit by enterprises and credit per capita, 1970 to 2007

Indicators	Military Regime (1970-1979 & 1984-1999)	Democratic Regime (1980-1983 & 1999-2007)	Significant Difference	Pre-MDGs/NEEDS (1970-1999)	MDGs/NEEDS (2000-2007)	Significant Difference	Overall (1970-2007)
Food crops (%)	57.24 (27.70)	63.17 (24.36)	0.589	55.35 (28.13)	70.57 (16.95)	1.429	59.41 (26.25)
Cash crops (%)	0.02 (0.01)	0.01 (0.01)	0.781	0.02 (0.01)	0.01 (0.01)	0.839	0.01 (0.01)
Livestock (%)	26.97 (24.28)	20.45 (23.72)	0.714	28.84 (24.97)	12.85 (16.67)	1.672	24.58 (23.88)
Others (including fishery) (%)	15.78 (9.31)	16.37 (13.09)	0.144	15.79 (8.73)	16.56 (15.45)	0.174	15.99 (10.63)
Credit per capita (₦'000)	12.90 (9.65)	52.74 (34.73)	4.746***	14.90 (10.56)	62.18 (36.53)	5.607***	27.51 (29.24)

Note: Total agricultural credit for the study period was ₦19,116,839,200,000. Source: Computed from CBN's Statistical Bulletin (various issues). Figures in parentheses are standard deviations. Astericks ***, ** and * represent 1%, 5% and 10% levels of significance, respectively.

4.6 Government Expenditure on Agriculture and Foreign Private Investments in Agriculture

Agricultural investment is critical for improvement in rural welfare, and it facilitates economic growth and development (Manyong *et al*., 2005). Also, agricultural investment provides the opportunity to escape low equilibrium trap (Akinyosoye, 2005). It is in the realization of the theoretical and empirical importance of agricultural investments (government budgetary expenditure and foreign private investment) that analysis of trends in government expenditure on agriculture as well as foreign private investment in agriculture was undertaken to underscore the performance of agriculture in Nigeria (Tables 9a). Besides, governments in Africa agreed to devote 10 percent of their annual budgets to agriculture (AU, 2006). How has Nigeria performed in terms of the continental agreement to agricultural development?

The results (Table 9b) reveal that agriculture's share of the total national budgets averaged 3.5 percent for the study period, with no significant changes by development scenarios. The results show low level of performance in agricultural investment in Nigeria. The breakdown of the agricultural budgets into capital and recurrent expenditures, however, revealed that there had been gradual shifts in proportional allocations of government in agriculture from capital expenditures to recurrent expenditures in agricultural investments/budget expenditures in Nigeria. This is an undesirable anomaly.

Additionally, the performance of agricultural policy in attracting Foreign Private Investments (FPI) to Nigerian agriculture revealed that the total FPI to Nigeria had been been increasing (Table 9a). However, the agricultural share of FPI revealed declining trends in both development scenarios (Table 9b). This perhaps, implies that agriculture is losing funds to other sectors of the economy and that the agricultural policy has not been able to grow or sustain the FPI in the agriculture sector.

Table 9a. Government expenditure on agriculture and foreign private investments in agriculture, 1970 to 2007

Items (₦ million)	Military Regime (1970-1979 & 1984-1999)	Democratic Regime (1980-1983 & 1999-2007)	Significant Difference	Pre-MDGs/NEEDS (1970-1999)	MDGs/NEEDS (2000-2007)	Significant Difference	Overall (1970-2007)
Total national budget (₦ m)	61440.51 (89198.59)	881387.15 (749179.38)	4.995***	65134.57 (99521.57)	1380001.08 (458225.75)	10.962***	341948.57 (585321.15)
Total agric budget (₦ m)	2010.71 (3186.57)	30780.00 (29124.56)	4.945***	3041.01 (7271.38)	44897.19 (26466.05)	7.867***	11852.84 (21748.79)
Total agric budget capital (₦ m)	1585.26 (2424.50)	21513.78 (25774.96)	3.882***	1637.07 (2444.25)	33774.82 (26222.88)	6.862***	8402.91 (17637.42)
Total agric budget recurrent (₦ m)	425.45 (817.96)	9266.22 (9159.97)	4.850***	1403.94 (5705.72)	11122.37 (4640.99)	4.429***	3449.92 (6761.15)
Total foreign private investments in agric. (₦ m)	382.12 (486.29)	883.40 (530.34)	2.924***	374.81 (478.19)	1224.11 (42.74)	4.968***	553.61 (550.18)

Source: Computed from CBN's Statistical Bulletin (various issues). Figures in parentheses are standard deviations. Astericks ***, ** and * represent 1%, 5% and 10% levels of significance, respectively.

Table 9b. Government expenditure on agriculture and foreign private investments in agriculture, 1970 to 2007

Items (%)	Military Regime (1970-1979 & 1984-1999)	Democratic Regime (1980-1983 & 1999-2007)	Significant Difference	Pre-MDGs/NEEDS (1970-1999)	MDGs/NEEDS (2000-2007)	Significant Difference	Overall (1970-2007)
Share of agric in national budgets (%)	3.67 (2.77)	3.21 (2.87)	0.479	3.57 (2.99)	3.31 (1.90)	0.232	3.51 (2.78)
Share of capital in agric expenditure (%)	86.33 (9.38)	69.59 (22.18)	3.282***	84.07 (15.13)	67.59 (17.12)	2.665**	80.61 (16.78)
Share of recurrent in agric expenditure (%)	13.67 (9.38)	30.41 (22.18)	3.282***	15.93 (15.13)	32.41 (17.12)	2.665**	19.40 (16.78)
Share of agric in total FPI (%)	1.62 (0.85)	1.30 (1.27)	2.603**	1.77 (1.03)	0.53 (0.22)	3.339***	1.51 (1.05)

Source: Computed from CBN's Statistical Bulletin (various issues). Figures in parentheses are standard deviations. Astericks ***, ** and * represent 1%, 5% and 10% levels of significance, respectively.

4.7 Government Regimes and Agricultural Policy Actors

Government regimes in Nigeria influence stability of agricultural production and rural welfare level in Nigeria (Idachaba, 2006). Also, the structure government regimes bear testimonies of governance in any country. Since "governance is the total ability to organize, synthesize and direct the various actions of the working parts of a government machinery in order for such a government to perform meaningfully, creditably and acceptably" (Ikpi, 1997; Olayide and Ikpi 2009; Olayide and Ikpi 2010), it is expedient to identify this key variable with a view to assessing the performance of government regimes on agriculture in Nigeria. We also know that government regime policies influence agricultural policy making process (Idachaba 1995, 2000, and 2006). Findings in Tables 10a-10c reveal the nature and characteristics of instability in the agricultural policy governance structure as revealed by frequent changes and instability in the name of the Ministry and Ministers.

It is evident from the results that political instability has resulted in frequent changes in the name of the Federal Ministry of Agriculture. The name of the Ministry was changed eight times between 1975 and 1993, giving an average life-span of just two years per name for the Ministry. This finding is consistent with that of Idachaba (2006). It was only during the recent democratic governance of Chief Olusegun Obasanjo (1999 to 2007) did we have a stable name for the Ministry - Federal Ministry of Agriculture & Rural Development. The period (1999 to 2007) has been the longest life-span of eight consistent years for the name of the Ministry. However, the nomenclature of the Ministry was shortly thereafter changed to the Federal Ministry of Agriculture and Water Resources. As observed, the name of the Ministry often changed to mark the entry of a new government or regime (Gen. Murtala Mohammed in 1975, Alhaji Shehu Shagari in 1979, Major Gen. M. Buhari in 1983, Gen. Ibrahim Babangida in 1986, Gen. Sanni Abacha in 1993, and Chief Olusegun Obasanjo in 1999).

The frequent changes of name of the ministry have implications for new Ministers and policies. Besides, political instability and poor governance have also produced a high turnover of Ministers for agriculture. Each new regime appoints its own Minister for

Agriculture – introducing what is called the "new regime effect" (Garba, 1999). The problem is more debilitating by the fact that within the same regime, agriculture has the highest turnover of Ministers. For instance, the Babangida-Shonekan (1985 – 1993) administration had seven Ministers of Agriculture in eight years, giving an average tenure of one year per Minister. Similarly, the spiral of changing nomenclature has not stopped. Recently, the Ministry of Agriculture and Water Resources was demerged into two separate Ministries – Ministry of Agriculture and Rural Development, and the Ministry of Water Resources. This situation shows the high level of instability in the agriculture sector in Nigeria.

Overall, the high rate of change in nomenclature of the Ministry of Agriculture and Ministers introduces instability and can be attributed to poor performance of the agriculture sector; making it difficult to plan and execute a programme for agriculture and rural development in Nigeria (Idachaba, 2006).

Table 10a. Government regimes and agricultural policy actors in Nigeria, 1975-2011.

S/N	Name of Minster	Name of Ministry	Duration in Office	Regime	Head of State/President	Geopolitical zone of national leader
1.	Prof. L.U.W. Osiogu	Federal Ministry of Agriculture & Natural Resources (FMANR)	1975-1976	Military	Gen. Murtala Mohammed	Kano (Northwest)
2.	Ibrahim Yakubu	FMANR	1976-1978	Military	Gen. Olusegun Obasanjo	Ogun (Southwest)
3.	Alhaji N. Mamudu	Federal Ministry of Agriculture Federal Ministry of Water Resources (FMAWR)	1979-1982	Democracy	Alhaji Shehu Shagari	Sokoto (Northwest)
4.	Alhaji Adamu Ciroma	FMAWR	1982	Democracy	Alhaji Shehu Shagari	Sokoto (Northwest)
5.	Chief Eteng Okoi Obuli	Federal Ministry of Agriculture & Rural Development (FMARD)	1983	Democracy	Alhaji Shehu Shagari	Sokoto (Northwest)
6.	Dr Bukar Shuaib	Federal Ministry of Agriculture, Water Resources & Rural Development (FMAWRRD)	1983-1985	Military	Major Gen. M. Buhari	Katsina (Northwest)
7.	General Alani Akinrinde	FMARD	Aug. 1985-Sept. 1986	Military	Gen. Ibrahim Babangida	Niger (Northcentral)
8.	Major General M.G. Nasko	FMAWRRD	Sept. 1986-March 1989	Military	Gen. Ibrahim Babangida	Niger (Northcentral)
9.	Alhaji Sama'ila Mamman	FMANR	March 1989 - Sept. 1990	Military	Gen. Ibrahim Babangida	Niger (Northcentral)
10.	Dr Shettima Mustapha	FMANR	Sept. 1990-Jan. 1992	Military	Gen. Ibrahim Babangida	Niger (Northcentral)

Sources: Various sources.

Table 10b. Government regimes and agricultural policy actors in Nigeria, 1975-2011.

S/N	Name of Minster	Name of Ministry	Duration in Office	Regime	Head of State/President	Geopolitical zone of national leader
11.	Abubakar Habu Hashidu	FMAWRRD	Jan. 1992 - Dec. 1992	Military	Gen. Ibrahim Babangida	Niger (Northcentral)
12.	Dr Garba J.A. Abdulkardir (OFR)	FMARD & FMAWRRD	Jan. 1993 – Aug. 1993	Military	Gen. Ibrahim Babangida	Niger (Northcentral)
13.	Prof. Jerry Gana	FMAWRRD	Sept. 1993 – Nov. 1993	Interim National Government	Chief Earnest Shonekan	Ogun (Southwestern)
14.	Alhaji Isa Mohammed	FMAWRRD	Dec. 1993- Aug. 1994	Military	Gen. Sanni Abacha	Kano (Northwest)
15.	Mallam Adamu Ciroma	FMANR	1994 -1995	Military	Gen. Sanni Abacha	Kano (Northwest)
16.	Mohammadu Gambo Jimeta	FMANR	March 1995- June 1997	Military	Gen. Sanni Abacha	Kano (Northwest)
17.	Alhaji Alfa Wali	FMANR	1997	Military	Gen. Sanni Abacha	Kano (Northwest)
18.	Dr Mallam Buwai	FMANR	Jan. 1998-July 1998	Military	Gen. Sanni Abacha	Kano (Northwest)

Sources: Various sources.

Table 10c. Government regimes and agricultural policy actors in Nigeria, 1975-2011.

S/N	Name of Minster	Name of Ministry	Duration in Office	Regime	Head of State/President	Geopolitical zone of national leader
19.	Alhaji Sani Zango Daura	FMANR	1998-1999	Military	Gen. Abdulsalam Abubakar	Niger (Northcentral)
20.	Chief Chris Agbobu	FMARD	1999-2000	Democracy	Chief Olusegun Obasanjo	Ogun (Southwest)
21.	Amb. (Dr) Hassan Adamu	FMARD	2000-2001	Democracy	Chief Olusegun Obasanjo	Ogun (Southwestern)
22.	Mallam Adamu Bello (CFR)	FMARD	2001-2007	Democracy	Chief Olusegun Obasanjo	Ogun (Southwest)
23.	Dr Sayyadi Abba Ruma	FMAWR	June 2007 – April 2010	Democracy	Alhaji Umaru Yar'Adua	Katsina (Northwest)
24.	Prof. Sheikh Abdullahi	FMARD	May 2010 – May 2011	Democracy	Dr Goodluck Jonathan	South-south
25	Dr Akinwumi Adesina	FMARD	June 2011 to date	Democracy	Dr Goodluck Jonathan	South-south

Sources: Various sources.

4.8 Agricultural Production Technical Efficiency

The distribution of the agricultural production technical efficiency by development scenarios shows that the average agricultural production technical efficiency index levels in the government regime and MDGs/NEEDS policy periods hovered around 85 percent (Figure 4). The average efficiency score for the study period was 86 percent. The result indicates some improvement in agricultural production in Nigeria, especially during the democratic period.

Various policies implemented during this period may be attributable to the improvement over the military period. Some of the policies and programmes implemented during the democratic periods include: the agricultural policies on fertilizer subsidies at 25%, producer price support scheme for grains, food security programme, the Fadama projects as well as the Presidential Initiatives on crops. All these programmes and projects were aimed at improving the level of agricultural production in Nigeria.

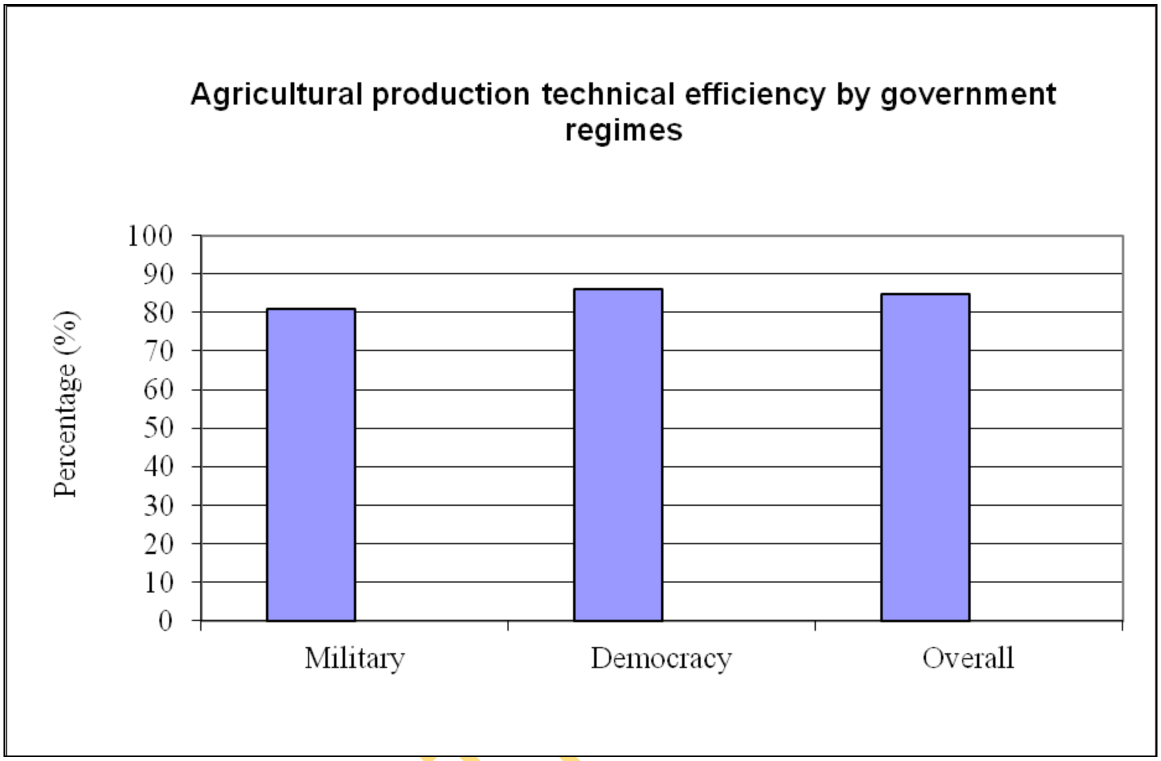

Figure 4. Agricultural production technical efficiency scores by government regimes.

4.9 Rural Welfare Levels

Rural welfare in Nigeria was proxied by real agricultural GDP per capita. Past studies (Aigbokhan, 2000; Alayande, 2003; Awoyemi, 2004; Ajakaiye and Adeyeye. 2003) indicated low rural welfare levels in Nigeria. The figures contained in Table 11 butressed the point that the rural welfare level in Nigeria is comparatively lower than the average national welfare level. This underscores the sectoral (rural and urban) dimensions of income and welfare levels in Nigeria as observed by Aigbokhan (2000), Alayande (2003), Awoyemi (2004) and Omonona (2010).

Since, increase in agricultural production, however is only an output that should sufficienctly lead to rural welfare improvement (World Bank, 2008). Increasing agricultural incomes therefore, enhances rural welfare and reduces rural inequality (Oyekale *et al*., 2006). Hence, the finding of this study is consistent with the need to focus on improvements in rural welfare as a catalyst and an engine for national economic transformation and development (FGN, 2001a&b).

Table 11. Welfare levels in Nigeria, 1970 - 2007

Indicators	Military Regime (1970-1979 & 1984-1999)	Democratic Regime (1980-1983 & 1999-2007)	Significant Difference	Pre-MDGs/NEEDS (1970-1999)	MDGs/NEEDS (2000-2007)	Significant Difference	Overall (1970-2007)
Total welfare level (real total GDP per capita in ₦'000)	3489.44 (430.64)	3782.25 (427.93)	1.993*	3480.87 (400.62)	3997.39 (385.84)	3.263***	3589.61 (446.66)
Rural welfare level (real agric. GDP per capita)	1950.75 (398.76)	2472.19 (491.75)	3.530***	1955.44 (384.82)	2780.49 (253.47)	5.712***	2129.14 (494.39)
Rural welfare level as share of total (national)	56.64 (12.95)	65.10 (8.87)	2.106**	56.85 (12.52)	69.60 (1.06)	2.848***	59.54 (12.28)

Figures in parentheses are standard deviations. Astericks ***, ** and * represent 1%, 5% and 10% levels of significance, respectively.

4.10 Descriptive Statistics of Variables Used for the GMM Estimation

The description of the variables used for the estimation of the GMM is contained in Tables 12a and 12b. The natural capitals comprised mean rainfall and share of forest area in agricultural land. Average mean rainfall for the study period was 525.49±373 mm while share of forest area in agricultural land averaged 25.23±6.75%. The natural capital variables could either enhance (positive sign) or constrained (negative sign) rural welfare.

Physical capital category consists of variables like share of goods conveyed by road, housing construction index, electricity generation index, communication index, agricultural production index and manufacturing capacity utilization rates. The average share of goods conveyed by road was 60.42±27.31%. Agricultural production technical efficiency averaged 85.02±10.05%. The manufacturing capacity utilization rates averaged 52.99±17.02%. The variables were considered to either enhance or constrain rural welfare. Increase in agricultural production may lead to expansion of agricultural product manufacturing that will lead to more incomes and improved rural welfare. In the same vein, increase in electricity generation will boost manufacturing of agricultural products as well as in rural welfare improvement.

The financial capital category includes such variables as agricultural credit, share of agriculture in foreign private investments, share of agricultural budget in national budgets and inflation rates. The share of agriculture in foreign private investments averaged 1.51±1.02%. Inflation rate in Nigeria has remained a 2-digit figure. The average inflation rate in Nigeria for the study period was 19.95±16.69%. High inflation depletes agricultural incomes and worsens rural welfare levels. Agricultural budgets as a percentage of total national budgets averaged 3.51±2.78%. This level of expenditure on agriculture is lower that the continental agreement of 10% of national budgets. Also, the fact that agriculture contributes more than 40% of the national GDP would have suggested that a larger percent of the national income be re-invested through budgetary expenditures in agriculture.

The variables in the human capital category include literacy rate, life expectancy at birth and share of females economically active in agriculture. Literacy rate averaged 45.83±15.49%. Life expectancy at birth averaged 46.92±2.69 years while share of females economically active in agriculture averaged 37.12±0.71%. Literacy promotes adoption of agricultural innovation needed to increase agricultural technical know-how that enhances agricultural production. Also, farmers in their active ages will more importantly invest their energies (labour force) in boosting agricultural production. Similarly, women play key roles both in the upstream (planting to harvesting) and downstream (processing and marketing) of agricultural produce and products. These activities might contribute to improving rural welfare.

The social capital variable is the government regimes. The variable embodies the various policies that were implemented by each regime in government in Nigeria – military or democracy. The impact of such policies is important in improving or worsening the rural welfare levels.

Table 12a. Descriptive statistics of variables used for the GMM estimations, 1970 – 2007.

Classification of variables	Variables and measurement	*A priori* expectations	Mean	Std. Deviation	Minimum	Maximum
Dependent variable	Real agricultural GDP per capita (₦'000)		2,129.14	494.39	1,165.47	3,179.19
Natural capital	Mean rainfall (in milimetre)	+ or –	525.49	373.32	193.00	1,300.00
	Share of forest area in agricultural land (%)	+ or –	25.23	6.75	14.47	36.63
Physical capital	Share of goods conveyed by road (transportation/traffic density)	+ or –	60.42	27.31	7.97	96.35
	Housing construction index - number of buildings started	+ or –	364.60	175.18	132.00	1,300.00
	Total electricity generation index (mega watt per hr)	+ or –	1,480.40	1,128.27	176.60	6,180.00
	Communication index/ teledensity (nos per '00)	+ or –	2.37	6.59	0.01	29.98
	Agricultural production index (technical efficiency score, %)	+ or –	85.02	10.05	66.03	94.2

Table 12b. Descriptive statistics of variables used for the GMM estimations, 1970 – 2007.

Classification of variables	Variables and measurement	*A priori* expectations	Mean	Std. Deviation	Minimum	Maximum
	Manufacturing capacity utilization rates (%)	+ or –	52.99	17.02	29.29	78.70
Financial capital	Total agricultural credit (₦ '000)	+ or –	505,450.00	1,108,530.00	11,284.40	4,430,000.00
	Share of agriculture in FPI (%)	+ or –	1.51	1.02	0.24	4.11
	Share of total capital expenditure of state governments (%)	+ or –	38.47	8.31	17.65	59.66
	Net agricultural imports (₦ million)	+ or –	59,024.10	114,736.89	-1,109.40	570,960.60
	Inflation rate (%)	+ or –	19.95	16.69	3.20	72.80
	Exchange rate (%)	+ or –	33.49	49.71	0.55	133.50
	External reserves (₦ million)	+ or –	610,740.00	1,427,850.00	104.60	6,060,000.00
	Agricultural budgets (as % of national budgets)	+ or –	3.51	2.78	0.82	10.68
	Total national capital expenditure (as % of total federal expenditure)	+ or –	42.78	13.60	17.41	67.90
Human capital	Literacy rate (%)	+	45.83	15.49	25.00	72.00
	Life expectancy at birth (years)	+ or –	46.92	2.65	42.00	53.00
	Share of females economically active in agriculture (%)	+ or –	37.12	0.71	35.67	38.27
Social capital	Government regimes (democracy dummy)	+ or –	0.37	0.49	0.00	1.00

Source: Author's computation.

The correlation analysis (Table 13) of the dependent and independent variables revealed that most of the independent variables are correlated with the independent variables. For instance, water resources, housing construction index, energy consumption index, communication/teledensity, agricultural credit, trade, exchange rate, external reserve, literacy rates, life expectancy, and government regimes bear a positive relationship with rural welfare.

Table 13. Correlation coefficients of independent variables with dependent variable

Categories of capital	Independent variable	Real agricultural GDP per capita	
		Correlation coefficient	Probability /significance
Natural	Mean rainfall	0.648	0.000
	Share of forest area in agricultural land	-0.913	0.000
Physical	Share of goods conveyed by road	0.625	0.000
	Housing construction index	0.162	0.000
	Total electricity generation index	0.786	0.000
	Communication index/teledensity	0.630	0.000
	Agricultural production technical efficiency index	0.188	0.258
	Manufacturing capacity utilization rates	0.601	0.000
Financial	Total agricultural credit	0.672	0.000
	Share of agricultural in total foreign private investments	-0.582	0.000
	Share of total capital expenditure of state government	-0.160	0.337
	Net agricultural imports	0.759	0.000
	Inflation rate	0.012	0.942
	Exchange rate	0.788	0.000
	External reserve	0.692	0.000
	Agricultural budgets	0.263	0.110
	Total national capital expenditure	0.423	0.008
Human	Literacy rate	0.019	0.000
	Life expectancy at birth	0.640	0.000
	Share of females economically active in agriculture	-0.128	0.445
Social	Government regimes	0.403	0.012

Source: Author's computation.

4.11 Stationarity Tests

The unit roots tests were undertaken as necessary conditions for the estimation of the GMM because if the variables are non-stationary, ordinary panel estimation by least square regression are inconsistent, spurious and standard inference of the coefficients is impossible (Quah, 1990; Breitung and Meyer, 1991; Yusuf and Falusis, 1999; Ajetumobi, 2008; Fan *et al*., 2008). In this study, unit root test was applied to assess stationarity using Phillips-Perron method. The ADF and Phillips-Perron tests allow for individual unit root process so that autoregressive coefficients can vary across units. The tests are provided by the econometric package E-View 7.

Results on Table 14 show that the logarithm levels of all the variables used for the estimation of the stochastic production frontier model became stationary at first difference. This result indicates that the variables are I(1); hence, the imperatives of differencing once in order to obtain I(0). Similarly, results in 15 show that the logarithm levels of all the variables used for the estimation of the GMM became stationary at first difference. This result indicates that the variables are also I(1); hence, the imperatives of differencing once in order to obtain I(0).

Having confirmed the status of stationarity of the variables, the various estimations (stochastic production frontier and GMM) were estimated. The stochastic frontier estimation revealed the input factors that contribute to limit aggregate agricultural production index. Its estimation also yields the agricultural production technical efficiency scores that measures overall performance and impact of agricultural production on rural welfare.

Table 14. Results Phillips-Perron stationarity tests of variable used for the estimation of the stochastic production frontier model

Variable	At Levels		At first difference	
	Phillips-Perron test statistic (adj. t-stat)	Probability	Phillips-Perron test statistic (adj. t-stat)	Probability
Aggregate agricultural production index	1.1397	0.9971	-5.2976	0.0001
Irrigated area	1.0043	0.9958	-4.5587***	0.0008
Tractors	-3.9832***	0.0039	-36277**	0.0100
Fertilizer	-3.4252**	0.0163	-5.34407***	0.0001
Cultivated area	0.2664	0.9732	-4.0071***	0.0037
Seed	-0.6912	0.8367	-5.6373***	0.0000
Labour	-2.1960	0.2110	-2.7131**	0.0817

Note: Test critical values (Mackinnnon critical values) are -3.6268 and -2.9458 at 1% and 5%, respectively. ** and *** indicates 5 perccent and 1 percent levels of significance, respectively.

Table 15. Results Phillips-Perron stationarity tests of variable used for GMM estimation

Variable	At levels		At first difference	
	Phillips-Perron test statistic	Probability	Phillips-Perron test statistic	Probabi-lity
Real agricultural GDP per capita	-0.4301	0.8935	-3.7085***	0.0081
Mean rainfall	-0.1655	0.6789	-7.3218***	0.0000
Share of forest area in agricultural land	3.1690	1.0000	-3.0392**	0.0407
Share of goods conveyed by road	-2.2078	0.2070	-9.1461***	0.0000
Housing construction index	-3.2123**	0.0272	-8.1476***	0.0000
Total electricity generation index	-2.8020*	0.0677	-8.9389***	0.0000
Communication index/teledensity	0.7593	0.9919	-5.4611***	0.0001
Agricultural production technical efficiency index	-5.9679***	0.0000	-16.0777***	0.0000
Manufacturing capacity utilization rates	-1.4528	0.5459	-3.6297***	0.0099
Total agricultural credit	1.3306	0.9983	-8.5103***	0.0000
Share of agricultural in total foreign private investments	-0.9964	0.7445	-5.2524***	0.0001
Share of total capital expenditure of state government	-3.0027**	0.0439	-6.5012***	0.0000
Net agricultural imports	-2.7968*	0.0685	-7.9258***	0.0000
Inflation rate	-3.2489**	0.0249	-11.4135***	0.0000
Exchange rate	-3.6210	0.9605	-4.8676***	0.0003
External reserve	-0.3066	0.9144	-6.5509***	0.0000
Agricultural budgets	-3.0291**	0.0414	-9.7163***	0.0000
Total national capital expenditure	-2.5071	0.1220	-6.2098***	0.0000
Literacy rate	-0.6288	0.8519	-7.1729***	0.0000
Life expectancy at birth	-2.2962	0.1784	-6.8682***	0.0000
Share of females economically active in agriculture	-1.1496	0.6855	-3.8614***	0.0034

Note: Test critical values (Mackinnnon critical values) are -3.6268 and -2.9458 at 1% and 5%, respectively.
** and *** indicates 5 perccent and 1 percent levels of significance, respectively.

4.12 Impact of Agricultural Production on Rural Welfare in Nigeria

4.12.1 Stochastic production frontier estimates

The result of the estimation of the stochastic production analysis is presented in Table 16. The maximum-likelihood estimates of the parameters of the Cobb-Douglas stochastic production frontier model was obtained, following Coelli and Battese (1996; Alene and Manyong, 2006). The Cobb-Douglas production function has the advantage for best-practice production function since its estimates/coefficients could be interpreted as the elasticities of production. The diagnostic statistics of the Cobb-Douglas production function shows that the model is fit, and at 1 percent level of significance.

The frontier output elasticities of irrigated area, tractors, fertilizer, seeds, cultivated area and labour are positive, suggesting that these resources are under-utilized. Besides, irrigated area, labour and the index of seeds are positive and significant ($p<0.01$). The elasticity obtained for irrigated area is consistent with that of Adeoti (2001). The implication of the finding is that irrigated area in Nigeria is low and resources have not been fully harnessed. Therefore, government and farmers need to explore the policy strategies like the Fadama farming programme and dams construction for irrigation purposes in order to increase agricultural production in Nigeria. Past irrigation by Nigerian government have been on a large scale, but were not sustainable (Kay, 2001).

Small-scale irrigation in the floodplains (Fadamas) that uses tube wells to lift water from shallow aquifers has been successful in northern Nigeria (Kay, 2001), and largely in form of small-scale private irrigation with attendant high transaction costs (Takeshima *et al*., 2010). Efforts such as the on-going Fadama III project show how a single programme can simultaneously address a number of constraints. Fadama projects supported the acquisition of irrigation equipment and infrastructure, the development of feeder roads, and provision of demand-driven extension services. It supported an increase in the capacity of local institutions to resolve natural resource conflicts. The welfare gains from increase in area under irrigation are enoumous. Nkonya *et al*. (2010) reported that per capita household income of Fadama II project beneficiaries increased by about 60 percent in only one year, demonstrating the effectiveness of the small-scale irrigation approach. The result, therefore, gives policy direction and empirical evidence for expanding the irrigated area for agricultural production in Nigeria.

The result on the elasticity of fertilizer use is consistent with that of Ogundele and Okoruwa (2006). The variable was not significant in boosting agriculture in Nigeria. This result might be due to the low level of fertilizer application rate in Nigeria. Fertilizer rate in Nigeria is far below the recommended rate by the Comprehensive Africa Agriculture development programme of 50kg per ha. Hence, fertilizer adoption is low (Olayide *et al*., 2009; Banful and Olayide, 2010). This has often led to abandonment of improved production technologies. Therefore, the National Policy on fertilizer and related institutions in the Federal Ministry of Agriculture and Rural Development should be repositioned to encourage farmers to adopt improved production inputs like fertilizer with a view to increasing agricultural production in Nigeria.

Result of the elasticity of seed index also underscores the importance of adoption of high yielding varieties of seeds so as to enhance agricultural production. The finding is consistent with findings of Alene and Manyong (2006). To this end, the National Seed Develoment Programme and the National Seed Council of Nigeria should ensure that farmers adopt improved seed by ensuring availability and affordability, especially to resource-poor farmers.

The elasticity of labour is in agreement with that of Amaza and Olayemi (2002). Ayanwale (2011) found that rural population (indicating agriculture's share of labour force) showed a positive and statistically significant value both for Cocoa and Palm oil, but negative for Groundnut. However, the lagged value of the coefficient was both negative for and statistically significant for selected crops except for Groundnut for which it is positive. The implication of these results is that when agricultural labour force increases, agricultural production also increases. This result suggests that the more the rural populace takes part in agricultural production enterprises, the better because of the real profit margin evident in agricultural production enterprises. Policies aimed at encouraging agricultural labour are germane to steming the decline in the agricultural labour force (Diao *et al*., 2010; Ayanwale, 2011).

Land area cultivated is significant in promoting agricultural production. A unit increase in land area cultivated would lead to 0.42 percent in agricultural production. This finding is consistent with the policy thrust of government on land extensification (FGN, 2001). Similarly, the policy Document on NEEDS promotes land extensification. Therefore, agricultural land expansion is evidently supported for enhancing agricultural production in Nigeria. This result is also consistent with the finding of Diao *et al*. (2012) that economic growth (through agricultural production) results from land expansion.

Overall, the results suggest the need for policy intervention geared towards increasing the area under irrigation, improved seeds, land area cultivated and encouraging increase in agricultural labour force in Nigeria in order to increase agricultural production in Nigeria.

Table 16. Estimates of stochastic production frontier

Variables	Coefficients	*t*-values
Constant	-72.022	-1.475
Irrigated area	2.110***	5.960
Tractors	0.150	1.359
Fertilizer	0.034	1.157
Cultivated area	0.422***	3.227
Seed	0.275***	3.280
Labour	6.869***	4.578
Lambda	1.876***	3.005
Sigma	0.138***	5.043
Sigma-squared (v)	0.000	
Sigma-squared (u)	0.019	
Log likelihood	41.836	
Pseudo R-squared	0.972	
Pseudo adjusted R-squared	0.967	
Overall significance of model (probability)	0.000	

*** indicates 1% level of significance.

4.12.2 Impact of agricultural production on rural welfare in Nigeria

The results of the GMM estimations of the impact factors of agricultural production (and other factors) on rural welfare is given in Table 17. The diagnostic statistics of the model estimated shows that the model is fit and significant at one percent level. The R-squared indicates that 76 percent variation in the dependent variable was explained by the independent variables. Most of the independent variables have expected signs.

Natural capital

None of the natural capital variables had significant impact on rural welfare. This, perhaps, reflects the fact that average rainfall amount and share of forests in agricultural lands had not been harnessed efficiently so as to impact on rural welfare. The results are consistent with the findings of Kristjanson *et al*. (2005) but contrast with those of Bekure *et al*. (1991).

Physical capital

Agricultural production index significantly impacted on rural welfare by 0.28%. This result is consistent with that of the World Bank (2008) and Diagne *et al*. (2009) that found increases in agricultural production as key to improving welfare in developing economies. Similarly, industrial development index and road infrastructure index significantly increased rural welfare by 0.01% and 0.11%, respectively. Sachs (2004) and Fan *et al*. (2008) pointed out that investment in roads and improvements in industrial capacity utilization were critical factors influencing welfare. Past government programmes like the Directorate of Food, Roads and Rural Infrastructures (DFRRI) were focused on improving agricultural production and road infrastructures in the rural areas of Nigeria.

Financial capital

Increased agricultural budgets significantly increased rural welfare by 0.29%. This result underscores the need to increase the share of agricultural budget in Nigeria. Agricultural budget share of total national budget was less than four percent, despite its over 40 per cent contribution to the total national GDP. This situation is contrary to the 2003 African

Union Maputo Declaration that directed member countries to increase investment in the agricultural sector to at least 10 per cent of the national budget by 2008 (AU, 2006). Foreign investment in agriculture as measured by proportion of agricultural expenditure in total foreign investments has unexpected welfare-reducing impact. A percentage positive change in foreign investments in agriculture reduces rural welfare by 0.04 percent. The implication of this result is perhaps the endemic corruption in Nigeria that short-changes foreign investment/donations to the intended beneficiaries of agricultural projects and programmes coupled with debt over-hang.

Human capital

Health index as captured by life expectancy was an important factor that impacted rural welfare in Nigeria. Life expectancy has a significant welfare-increasing impact. Health index significantly positively impacted on rural welfare by 2.53%. The results on health index have implications for the ageing agricultural practitioners and the realties that younger people are leaving agriculture/farming activities. The result also brings out clearly the importance of health as a critical factor in enhancing sustainable agricultural development and rural economy in Nigeria.

Social capital

Policies of the democratic regimes significantly increased rural welfare by 0.65%. Past studies indicate that economic growth and welfare development reflect levels of political development (Essien and Bawa, 2005; Olayide and Ikpi, 2010). Besides, it has been said that the developmental state (democracy) approach as the core of the development strategy enables African countries to transform their economies and to achieve their primary economic and social development goals (UNECA, 2011).

Table 17. Factors impacting on rural welfare in Nigeria

Capitals	Variable	Coefficient	*t*-value	Probability
Natural	Mean rainfall	0.223	0.465	0.649
	Share of forest area in agricultural land	-6.062	-1.173	0.260
Physical	Share of goods conveyed by road	0.105**	2.235	0.048
	Housing construction index	0.405	0.686	0.504
	Total electricity generation index	0.300	0.626	0.541
	Communication index/teledensity	0.111	0.315	0.757
	Agricultural production technical efficiency index	0.276**	2.993	0.033
	Manufacturing capacity utilization rates	0.006**	2.844	0.025
Financial	Total agricultural credit	0.188	0.456	0.655
	Share of agriculture in total foreign private investments	-0.039**	-2.522	0.045
	Share of total capital expenditure of state government	-0.746	-1.077	0.300
	Net agricultural imports	0.770	1.204	0.248
	Inflation rate	0.094	0.313	0.759
	Exchange rate	-0.080	-0.157	0.877
	External reserve	0.178	1.273	0.224
	Agricultural budgets	0.291***	3.008	0.003
	Total national capital expenditure	0.329	0.570	0.577
Human	Literacy rate	0.316	0.115	0.910
	Life expectancy at birth	2.513***	5.511	0.002
	Share of females economically active in agriculture	-10.485	-1.093	0.293
Social	Government regimes (dummy)	0.650**	2.020	0.041
	R-squared	0.760		
	Adjusted R-squared	0.572		
	Durbin-Watson statistic	1.937		
	J-statistic	5.32E-06		

** and *** indicates 5 perccent and 1 percent levels of significance, respectively.

CHAPTER FIVE

CONCLUSION

5.0 Introduction

This chapter is the conclusion of this study whose main objective is to assess the impact of agricultural production on rural welfare in Nigeria. It presents the summary of the major findings, policy and economic implications of the major findings, contributions of the study to knowledge, and recommendations as well as suggestions for further studies.

5.1 Summary of Major Findings

The motivation for this study stems from the need to understand the extent to which agricultural production impacts on rural welfare in Nigeria using data from 1970 to 2007. This is because until we understand the impact of agricultural production on the rural welfare in Nigeria, policies to boost agricultural production and improve rural welfare will be misguided or implementers will be poorly equipped to give useful advice on how to effect positive change in those policies.

Also, the poor performance of Nigeria's agriculture has to a large extent been attributed to the inability to fill the gap created by a shortfall in agricultural production with the attendant problems of rural poverty and poor welfare (Idachaba, 2006; Olomola *et al*., 2008; World Bank 2008; Diao *et al*. 2010). Hence, getting agricultural production right is of utmost importance not only to foster economic growth and development, but also to directly improve rural welfare in Nigeria. To increase efficiency of government interventions, to foster agricultural production and promote rural welfare improvement, policy makers need detailed information on appropriate policy instruments to effect changes.

Hence, this study investigated the impact of agricultural production on rural welfare in Nigeria. Specifically, the study assessed the performance of agriculture in Nigeria from 1970 to 2007, estimated agricultural production technical efficiency and assessed the impact of agricultural production on rural welfare in Nigeria.

Secondary data covering the military period (1970-1979 and 1984–1999) and democratic (1980–1983 and 1999-2007) periods were used for the study. The pre-Millennium Development Goals - MDGs (1970 – 1999) and MDGs (2000 – 2007) periods also fall within the study period (1970 – 2007). The government regimes (military and democratic) as well as the pre-MDGs and MDGs periods captured the various policies implemented. Data were obtained from the National Bureau of Statistics (NBS), Central Bank of Nigeria and the Food and Agriculture Organization. Data were extracted on agricultural inputs and production, Agricultural Gross Domestic Product (AGDP), foreign private investments in agriculture, agricultural budgets as well as infrastructural and industrial development indices. These were analysed against extant policy regime at the periods of data collection. Rural welfare was proxied by real AGDP per capita. Data were analysed using descriptive statistics, stochastic frontier function and generalized method of moments at $p = 0.05$ to achieve the objective of the study.

The results presented revealed that government policies influenced the performance of agriculture in Nigeria. Irrigated area as a percentage of arable land was highest in the MDGs period (0.90±0.03) and lowest during the pre-MDGs period (0.74±0.04). Use of tractors per ha of arable land was highest during the MDGs (9.74±0.64) and lowest at pre-MDGs era (5.78±3.08). Rate of fertilizer use was highest (15.51±3.47) during the democratic period and lowest during military rule (13.34±3.46) kg ha^{-1}. Aggregate index of agricultural production peaked during the MDGs period (165.58 ± 14.85).

Production indices for crop, livestock, and forestry were highest during the MDGs period (176.58±22.53, 225.91±36.54, and 129.42±11.89) but that of fishery peaked during the democratic period (158.62±29.79). The AGDP as a percentage of national GDP was highest during the MDGs period (41.76%) and lowest during the pre-MDGs period (38.72%). Agricultural budget as a percentage of total national budgets was highest during the military period (3.67±2.77) and lowest during the democratic period (3.21±2.87). Improvements on roads were highest during the military era (63.00±26.51) while industrial development peaked during the democratic period (53.83±11.47). Percentage of foreign private investments in agriculture peaked during the pre-MDGs periods (1.77±1.03). Agricultural production technical efficiency index was highest during the MDGs period (0.87±0.09) and lowest during pre-MDGs era (0.84±0.11). Real AGDP per capita was also highest during the MDGs era (₦2872.19±491.75) and ebbed during military era (₦1950.75±398.76).

Empirical (regression) results revealed that a unit change in area under irrigation led to increase in agricultural production by 2.11%. Agricultural production and agricultural budgets significantly improved rural welfare by 0.28% and 0.29%. Also, industrial development and road infrastructure indices significantly improved rural welfare by 0.01% and 0.11%. The policies implemented during democratic period significantly improved rural welfare by 0.65%.

5.2 Implications of Major Findings

Policy implications are drawn based on the following major findings of the study. Specifically, the factors influencing agricultural production, and its impact on rural welfare in Nigeria were estimated.

The elasticities of irrigated area, tractors, fertilizer, seeds, cultivated area and labour influenced agricultural production. These resources are also currently under-utilized. These have implications for harnessing irrigated areas in Nigeria. Therefore, government and farmers need to explore the policy strategies like the Fadama farming programme and dams construction for irrigation purposes in order to increase agricultural production. Small-scale irrigation in the floodplains (Fadamas) that uses tube wells to lift water from shallow aquifers that have been promoted in the country should be intensified throught the on-going Fadama III projects.

The result on the elasticity of fertilizer use is consistent with prevailing low adoption rates of fertilizer in Nigeria (AU, 2006; Ogundele and Okoruwa, 2006; Olayide *et al*., 2009; Banful and Olayide, 2010). Fertilizer rate in Nigeria is far below the recommended rate by the Comprehensive Africa Agriculture development programme of 50kg per ha.

The low use of fertilizer has implications for increased agricultural production, improved level of incomes and rural welfare.

Result of the elasticity of seed index also underscores the importance of adoption of high yielding varieties of seeds so as to enhance agricultural production. To this end, the National Seed Develoment Programme and the National Seed Council of Nigeria should ensure that farmers adopt improved seeds by ensuring availability and affordability, especially to resource-poor farmers.

The result on elasticity of labour is in agreement with that of Amaza and Olayemi (2002). Ayanwale (2011) found that rural population (indicating agriculture's share of labour force) showed a positive and statistically significant value both for Cocoa and Palm oil, but negative for Groundnut. However, the lagged value of the coefficient was both negative for and statistically significant for selected crops except for Groundnut for which it is positive. The implication of these results is that as agricultural labour force increases, agricultural production also increases. This result suggests that the more the rural populace takes part in agricultural production enterprises, the better because of the real profit margin evident in agricultural production enterprises. Policies aimed at encouraging agricultural labour are germane to steeming the decline in agricultural labour force (Diao *et al*., 2010; Ayanwale, 2011).

Land area cultivated is significant in promoting agricultural production. A unit increase in land area cultivated would lead to 0.42 percent in agricultural production. This finding has implications for the policy thrust of government on land extensification (FGN, 2001). Similarly, the policy Document on NEEDS promotes land extensification. Therefore, agricultural land expansion is evidently supported for enhancing agricultural production in Nigeria.

The significance of the impact of agricultural production index rural welfare has implications for policies and programmes that focus on increasing that are geared towards increasing agricultural production in Nigeria like the Presidential Initiatives and NEEDS.

Also, there is implication for promoting agro-industrial processing in Nigeria. Road infrastructure development has implication for the movement of agricultural produce and products with the country for the purpose of marketing and distribution.

The low level of agricultural budget share of total national budget has implicatoions for the implementation of the 2003 African Union Maputo Declaration that directed member countries to increase investment in the agricultural sector to at least 10 per cent of the national budget by 2008 (AU, 2006) and how agriculture is under-funded by governments in Nigeria. The result of the positive impact of agricultural budget has implications for increasing the share of agricultural budgets in Nigeria. Foreign investment in agriculture as measured by proportion of agricultural expenditure in total foreign investments has unexpected welfare-reducing impact. The implication of this result is perhaps the endemic corruption in Nigeria that short-changes foreign investment/donations to the intended beneficiaries of agricultural projects and programmes coupled with debt over-hang.

The significant inpact of the health index on rural welfare underscored the implication for promoting the involvement of youth and the active labour force participation in agriculture. Also, the result has implications for the ageing agricultural practitioners and the realties that younger people are leaving agriculture/farming activities. The result also brings out clearly the importance of health as a critical factor in enhancing rural economy in Nigeria.

The significance of policies implemented during the democratic regime on rural welfare has implications for political development and participation in policy formulation and implementation process by the people. The result also lends credence to the support of the developmental state (democracy) approach as the core of the development strategy enables Nigeria to transform its rural economy.

5.3 Recommendations

From the results obtained in this study, the following recommendations are hereby made to enhance agricultural production and to improve rural welfare in Nigeria:

First, there is the need to expand irrigated areas in Nigeria. Policies and programmes on Fadama farming and dams construction should be pursued more vigorously. The River Basins Development Authorities (RBDAs) should be repositioned for better performance.

Second, fertilizer should be made accessible to farmers and at affordable prices so as to increase the rate of use and enhance agricultural production. The on-going voucher system of fertilizer purchases should be pursued to a logical end. Similarly, there is need to promote adoption of high yielding varieties of seeds. To this end, the National Seed Develoment Programme and the National Seed Council of Nigeria should be repositioned in order to ensure that farmers adopt improved seed by ensuring availability and affordability, especially to resource-poor farmers in the rural areas.

Third, agricultural labour force should be boosted with policies that encourage more youths to go into agricultural production enterprises. The policies on employment should be such that encourages the youth to go into agricultural production. The National Directorate of Employment (NDE) should be repositioned and refocused to expose the youths into agricultural production activities.

Fourth, land area cultivated should be increased for agricultural production purposes. The policy Document on NEEDS that promotes land extensification should be strategically implemented in areas of comparative advantages.

Fifth, the significance of the impact of agricultural production index rural welfare calls for full implantation of agricultural production-related policies in Nigeria. Specifically, agricultural policies like the Presidential Initiatives on crops (food and exports) and livestock and those enumerated in the NEEDS should be vigorously pursued and implemented. Similarly, there is need to promote agro-industrial processing in Nigeria. Road infrastructure development should also be given priority attention.

Sixth, share of agricultural budget in the national budget should be increased as a way of showing commitment to agricultural development and to international agreements like the 2003 African Union Maputo Declaration that directed member countries to increase investment in the agricultural sector to at least 10 percent of the national budgets.

Finally, it is essential to channel the abundance of youthful populations towards agricultural enterprises and employment. Active youth labour force participation in agriculture is needed to replace the ageing agricultural workforce. There is also need for democratic participation in policy formulation and implementation processes by the people in Nigeria.

5.4 Contributions to Knowledge

The contributions to knowledge from this study derive basically from its robust empirical analyses of the impact of agricultural production and rural welfare in Nigeria. Specifically, the study highlights that:

1. Land area cultivated is significant in promoting agricultural production supports policy thrust of government on land extensification (FGN, 2001). Also, irrigated areas and fertilizer are under-utilized in Nigerian agriculture (AU, 2006; Ogundele and Okoruwa, 2006; Olayide *et al*., 2009; Banful and Olayide, 2010; Takeshima *et al*., 2010; Nkonya *et al*., 2010).

2. Labour use in agriculture enhances agricultural production (Amaza and Olayemi, 2002; Ayanwale, 2011). The more the rural populace takes part in agricultural production enterprises, the better because of the real profit margin evident in agricultural production enterprises (Diao *et al*., 2010; Ayanwale, 2011).

3. Agricultural production significantly impacted on rural welfare in Nigeria. This finding contributes to past studies (World Bank 2008, Diao *et al*., 2010) that agricultural production is pro-rural welfare improvement. Similarly, promoting agro-industrial capacity, road infrastructure development, agricultural budget share of total national budget as well as involvement of active labour force participation in agriculture (Manyong *et al*., 2005; AU, 2006; Mogues *et al*., 2008; Fan *et al*., 2008; Aberman *et al*., 2009; Ayanwale, 2011) lead to increased agricultural production and improvement in rural welfare.

4. The policies (NEEDS, MDGs, Presidentail Initiatives, etc) implemented during the democratic regime impacted significantly on rural welfare in Nigeria. This evidence has implications for promoting people's participation in policy formulation and implementation processes. The result also lends credence to the support of democratic principles as the core of the development strategy with a view to transforming the rural economy in Nigeria (Adebayo *et al*., 2010; UNECA, 2011).

5.5 Suggestions for Further Studies

The following suggestions are made for further studies:

1. Since the analyses in this study were based on the national level, it is suggested that future analyses should be conducted on the performance of agriculture at the regional, state and local government levels in Nigeria.

2. Further study is also needed in the area of impacts of specific agricultural programmes and initiatives on rural welfare at the regional, state and local government levels in Nigeria.

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APPENDICES

Appendix 1

Summary of objectives, data requirement and analytical tools

Objective	Data requirement and source	Method/technique of analysis	Literature
1. To assess the performance of agriculture in Nigeria	Agricultural inputs, domestic agricultural production, area harvested, import and export data, real agricultural GDP, rural population, fertilizer use, annual budgets, and governance. FMA&RD, NBS, CBN.	Descriptive statistics and trends analysis	Dorosh and Valdes, 1990; CBN/NISER, 1992, Munnel, 1992; Long, 1992; Serageldin, 1993; Ikpi, 1995; Olayemi, 1995; Garba, 1999; Idachaba, 2000, 2006; Arene 2003; McGee, 2004; Manyong *et al.*, 2005
2. To estimate agricultural production technical efficiency in Nigeria	Agricultural output and inputs (land area cultivated, seeds index, fertilizer used, labour used, total area under irrigation, number of tractors). FAO.	Technical efficiency using stochastic frontier method	Fare *et al.*, 1994; Nin *et al.*, 2002, Nkamleu, 2004, 2007; Ajetomobi, 2008; World Bank, 2008; Diao *et al.*, 2012
3. To assess the impact of agricultural production on rural welfare in Nigeria	Real agricultural GDP per capita, and the five categories of capital assets. CBN, NBS, FAO.	Unit root tests, Generalized Method of Moments (GMM)	Arellano and Bond 1991; Ogiogio, 1995; Blundell and Bond, 1998; Yusuf and Falusi, 1999; Zhang and Fan, 2004; Idowu, 2005; Akpan, 2005; Essien and Bawa, 2005; Amin and Audu, 2006; Fan *et al.*, 2008; Oni *et al.*, 2009 ; Fan and Rao, 2008; and Phillips *et al.*, 2009

Appendix 2

Estimation of the GMM

To illustrate the GMM, assume the *N* cross-sectional units are observed over *T* periods. Let *i* index the cross-sectional unit and *t* the time periods. Further assume the existence of an individual effect η_i for the *i*th cross-sectional unit. According to Fan *et al.* (2008), the model to be estimated is specified as

$$y_{it} = \alpha_0 + \sum_{e=1}^{m} \alpha_e y_{i,t-e} + \sum_{k=1}^{n} \beta_k x_{i,t-k} + \eta_i + \mu_{it} \quad \text{(1)}$$

Where y is dependent variable; x is a set of independent variables, $i = 1, \ldots, N$; t = $m + 2, \ldots$, T; α's and β's are parameters; and the lag lengths *m* and *n* are sufficient to ensure that μ_{it} is a stochastic error. Although it is not essential that *m* equal *n*, we follow typical practice by assuming that they are identical.

But in this dynamic panel model, including an individual effect together with a lagged dependent variable generates biased estimates for a standard LSDV (least square dummy variable) estimator, especially when *N* is much larger than *T* (Hsiao, 1986). A common way to deal with this problem is to take the first difference and exploit a different number of instruments in each time period using either an instrument variable estimator or a GMM estimator as an estimation method (Holtz-Eakin *et al*., 1988; Arellano and Bond, 1991);

$$\Delta y_{it} = \sum_{e=1}^{m} a_e \Delta y_{it-e} + \sum_{e=1}^{n} \beta_e \Delta x_{it-e} + \Delta u_{it} \quad \text{(2)}$$

Expressed in matrix, the general model is a single equation,

$Y_i = W_i \delta + \phi_i \eta_i + u_i$,

Where δ is a parameter vector including the α's and β's, W_i is a data matrix containing the time series of lagged y's and x's, and ϕ_i is a vector of ones. Assuming that we found a set of suitable instrumental variables $Z_{i,}$ and that H_i is the covariance matrix of the transformed errors, the linear GMM estimator of δ could be computed as

$$\hat{\delta} = \left[(\sum_i {}_i^{*'} Z_i) A_N (\sum_i Z_i^{'} W_i) \right]^{-1} (\sum_i W_i^{*'} Z_i) A_N (\sum_i Z_i^{'} Y_i^{*}) \text{, ………………………………(3)}$$

Where $A_N = \frac{1}{N}(\sum_i Z_i^{'} H_i Z_i)^{-1}$ and W_i^{*} and Y_i^{*} denote some transformation of W_i^{*} and Y_i (levels, first difference, combinations of first differences and levels).

For first-difference equation, suitably lagged endogenous variables can be used as instruments, Z_i may consist of submatrixes with the block diagonal form (exploiting all or part of the moment restrictions available). A judicious choice of the Z_i matrix should strike a compromise between prior knowledge (from economic theory and previous empirical work) and the characteristics of the sample. For example, if u_{it} are not serially correlated with each other, for time $t = m + 2$ ($y_{i1}, y_{i2}, \ldots, y_{im}$) are uncorrelated with $y_{i,m+2}$ and therefore can be used as valid instrument at times $m + 2$. Similarly, the instruments for time period T are ($y_{i1}, y_{i2}, \ldots, y_{i(T-2)}$). In the case of first-order difference with one lag, $Y_i^{*} = (\Delta y_{i3},\ldots,\Delta y_{iT}), W_i^{*} = (\Delta y_{i2},\ldots,\Delta y_{i,T-1}),$

$$Z_i = Z_i^{D} = \begin{bmatrix} y_{i1} & 0 & 0 & \ldots & 0 & 0 & \ldots & 0 \\ 0 & y_{i1} & y_{i2} & \ldots & 0 & 0 & \ldots & 0 \\ 0 & 0 & 0 & \ldots & 0 & 0 & \ldots & 0 \\ 0 & 0 & 0 & \ldots & y_{i1} & y_{i2} & \ldots & y_{i,T-2} \end{bmatrix}, \text{ ………………………… (4)}$$

$$\text{And } H_i = H_i^{D} = \begin{bmatrix} 2 & -1 & . & . & 0 \\ -1 & 2 & . & . & 0 \\ . & . & . & . & . \\ . & . & . & 2 & -1 \\ 0 & 0 & . & -1 & 2 \end{bmatrix} \text{. ……………………………………… (5)}$$

In models with explanatory variables, a predetermined regressor x_i correlated with individual effect could be added to the instrumental variable matrix, and the corresponding Z_i matrix would be given by

$$Z_i = \begin{bmatrix} y_{i1} & x_{i2} & x_{i2} & 0 & 0 & 0 & 0 & 0 & \ldots & 0 & \ldots & 0 & 0 & \ldots & 0 \\ 0 & 0 & 0 & y_{i1} & y_{i2} & x_{i1} & x_{i2} & x_{i3} & \ldots & 0 & \ldots & 0 & 0 & \ldots & 0 \\ . & . & . & . & . & . & . & . & \ldots & . & \ldots & . & . & \ldots & . \\ . & . & . & . & . & . & . & . & \ldots & . & \ldots & . & . & \ldots & . \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & . & \ldots & y_{i1} & \ldots & y_{i,T-2} & x_{i1} & \ldots & x_{iT1} \end{bmatrix} \ldots. (6)$$

But this technique may lead to efficiency loss during estimation. Blundell and Bond (1998), therefore, proposed to use an extended system estimator that used lagged differences as instruments for equation in levels, in addition to lagged levels as instruments for equation in first difference. In other words, we “stack” both difference and level equations together for estimation. This implies a set of moment conditions relating to the equations in first differences and a set of moment conditions relating to the equations in levels. When combined together, we are able to obtain a dramatic efficiency gain over the basic first difference GMM estimator. If the simple autoregressive AR(1) model is mean-stationary, the first difference Δy_{it} will be uncorrelated with individual effects, and thus $\Delta y_{i,t-1}$ can be used as instruments in the level equations. Zhang and Fan (2004) applied a system GMM method to empirically test the causal relationship between productivity growth and infrastructure development using the India district-level data from 1970 to 1994.

In this case, they defined

$$Y_i^* = \left(\Delta y_{i3},\ldots,\Delta y_{iT}, y_{i3},\ldots,y_{iT}\right)', W_i^* = \left(\Delta y_{i2},\ldots,\Delta y_{i,T-1}, y_{i2},\ldots,y_{i,T-1}\right)', \ldots\ldots\ldots\ldots\ldots\ldots \text{(7)}$$

$$Z_i = \begin{bmatrix} Z_i^D & 0 & \ldots & 0 \\ 0 & \Delta y_{i2} & \ldots & 0 \\ 0 & \Delta y_{i2} & \ldots & 0 \\ . & . & \ldots & . \\ 0 & 0 & \ldots & \Delta y_{i,T-1} \end{bmatrix}, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(8)}$$

and the covariance matrix $H_i = \begin{bmatrix} H_i^D & 0 \\ 0 & I_i \end{bmatrix}, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(9)}$

where Z_i^D is the matrix of instruments for the equations in first differences, as described earlier, and I_i an identity matrix with dimension equal to the number of level equations. Again Z_i would include instruments of suitably lagged explanatory variables if they were uncorrelated with individual effects and the error terms. Using these instruments and following the estimation strategy outlined by Blundell and Bond (1998), the coefficients for the lagged dependent variables and predetermined variables can be estimated.

Appendix 3

Data and Measurement of Variables

Classification of variables	Variables and measurement
Dependent variables	Real agricultural GDP per capita (₦'000) per annum
Natural capital	Mean rainfall (in mm) per year
	Share of forest area in agricultural land (in %)
Physical capital	Share of goods conveyed by road is used as proxy for transportation/traffic density (in %)
	Housing construction index is the number of buildings started per year
	Total electricity generation (mega watt per hr) per year
	Communication/ teledensity is the number of telephone lines per 100 people
	Agricultural productivity growth index was obtained from the stochastic production frontier estimation and proxied by total factor technical efficiency score per year.
	Manufacturing capacity utilization rates (in %)
Financial capital	Total agricultural credit (₦ '000) per year.
	Share of agriculture in Foreign Private Investment, FPI (%)
	Share of total capital expenditures of state govts (%). Proxied States' subdiarity in agriculture, infrastructure and rural development
	Net imports (foreign trade) (₦ m). Net agriculture import values
	Inflation rate (%)
	Exchange rate (%)
	External reserves (₦ million)
	Agriculture budgets as % of national budget
	Capital expenditure as % of total federal expenditure. Proxied for government expenditures in infrastructure and rural development
Human capital	Literacy rate (%). Data for missing years were estimated by exponential growth rate interpolation
	Life expectancy at birth (years). Data for missing years were estimated by exponential growth rate interpolation
	Share of females economically active in agriculture (in %)
Social capital	Government regime (democracy dummy)

Appendix 4

Stationarity tests of Variables Used for Estimation of Agricultural Production Technical Efficiency at First Difference

Null Hypothesis: D(LNY(-1)) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.297617	0.0001
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.001915
HAC corrected variance (Bartlett kernel)	0.002417

Phillips-Perron Test Equation
Dependent Variable: D(LNY(-1),2)
Method: Least Squares
Date: 03/13/10 Time: 15:56
Sample (adjusted): 1973 2007
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNY(-2))	-0.742030	0.139174	-5.331663	0.0000
C	0.032224	0.009053	3.559547	0.0012

R-squared	0.462774	Mean dependent var	0.006148
Adjusted R-squared	0.446494	S.D. dependent var	0.060578
S.E. of regression	0.045069	Akaike info criterion	-3.305794
Sum squared resid	0.067030	Schwarz criterion	-3.216917
Log likelihood	59.85140	F-statistic	28.42663
Durbin-Watson stat	1.711868	Prob(F-statistic)	0.000007

Null Hypothesis: D(LNX1) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.558658	0.0008
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000694
HAC corrected variance (Bartlett kernel)	0.000694

Phillips-Perron Test Equation
Dependent Variable: D(LNX1,2)
Method: Least Squares
Date: 03/13/10 Time: 15:58
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX1(-1))	-0.758702	0.166431	-4.558658	0.0001
C	0.008191	0.004863	1.684500	0.1012

R-squared	0.379351	Mean dependent var	0.000000
Adjusted R-squared	0.361097	S.D. dependent var	0.033917
S.E. of regression	0.027110	Akaike info criterion	-4.323842
Sum squared resid	0.024989	Schwarz criterion	-4.235869
Log likelihood	79.82915	F-statistic	20.78136
Durbin-Watson stat	2.019710	Prob(F-statistic)	0.000064

Null Hypothesis: D(LNX2) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.627682	0.0100
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.006877
HAC corrected variance (Bartlett kernel)	0.005186

Phillips-Perron Test Equation
Dependent Variable: D(LNX2,2)
Method: Least Squares
Date: 03/13/10 Time: 16:02
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX2(-1))	-0.548254	0.145234	-3.774980	0.0006
C	0.028500	0.016987	1.677784	0.1026

R-squared	0.295344	Mean dependent var	-0.006566
Adjusted R-squared	0.274619	S.D. dependent var	0.100191
S.E. of regression	0.085332	Akaike info criterion	-2.030585
Sum squared resid	0.247572	Schwarz criterion	-1.942612
Log likelihood	38.55053	F-statistic	14.25047
Durbin-Watson stat	1.837423	Prob(F-statistic)	0.000614

Null Hypothesis: D(LNX3) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.344074	0.0001
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.094686
HAC corrected variance (Bartlett kernel)	0.093887

Phillips-Perron Test Equation
Dependent Variable: D(LNX3,2)
Method: Least Squares
Date: 03/13/10 Time: 16:05
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX3(-1))	-0.914464	0.171033	-5.346724	0.0000
C	0.118067	0.057697	2.046338	0.0485

R-squared	0.456760	Mean dependent var	-0.006639
Adjusted R-squared	0.440783	S.D. dependent var	0.423414
S.E. of regression	0.316632	Akaike info criterion	0.591802
Sum squared resid	3.408706	Schwarz criterion	0.679775
Log likelihood	-8.652438	F-statistic	28.58746
Durbin-Watson stat	1.948167	Prob(F-statistic)	0.000006

Null Hypothesis: D(LNX4) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.007137	0.0037
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000182
HAC corrected variance (Bartlett kernel)	0.000192

Phillips-Perron Test Equation
Dependent Variable: D(LNX4,2)
Method: Least Squares
Date: 03/13/10 Time: 16:06
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX4(-1))	-0.635245	0.160379	-3.960903	0.0004
C	0.003418	0.002438	1.401999	0.1700

R-squared	0.315741	Mean dependent var	0.000389
Adjusted R-squared	0.295615	S.D. dependent var	0.016548
S.E. of regression	0.013888	Akaike info criterion	-5.661566
Sum squared resid	0.006558	Schwarz criterion	-5.573593
Log likelihood	103.9082	F-statistic	15.68875
Durbin-Watson stat	2.062557	Prob(F-statistic)	0.000362

Null Hypothesis: D(LNX5) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.637345	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.027754
HAC corrected variance (Bartlett kernel)	0.027754

Phillips-Perron Test Equation
Dependent Variable: D(LNX5,2)
Method: Least Squares
Date: 03/13/10 Time: 16:08
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX5(-1))	-0.875454	0.155295	-5.637345	0.0000
C	0.029582	0.028742	1.029237	0.3106

R-squared	0.483123	Mean dependent var	0.011942
Adjusted R-squared	0.467921	S.D. dependent var	0.235012
S.E. of regression	0.171426	Akaike info criterion	-0.635374
Sum squared resid	0.999157	Schwarz criterion	-0.547401
Log likelihood	13.43673	F-statistic	31.77966
Durbin-Watson stat	2.135492	Prob(F-statistic)	0.000003

Null Hypothesis: D(LNX6) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.713122	0.0817
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	3.04E-06
HAC corrected variance (Bartlett kernel)	2.99E-06

Phillips-Perron Test Equation
Dependent Variable: D(LNX6,2)
Method: Least Squares
Date: 03/13/10 Time: 16:09
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX6(-1))	-0.355319	0.130125	-2.730594	0.0099
C	-0.000291	0.000327	-0.887413	0.3811

R-squared	0.179856	Mean dependent var	7.24E-05
Adjusted R-squared	0.155734	S.D. dependent var	0.001954
S.E. of regression	0.001796	Akaike info criterion	-9.753075
Sum squared resid	0.000110	Schwarz criterion	-9.665101
Log likelihood	177.5553	F-statistic	7.456146
Durbin-Watson stat	2.024009	Prob(F-statistic)	0.009946

Stationarity Tests Variables used for Estimation of Agricultural Production Technical Efficiency at Levels

Null Hypothesis: Y has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		1.139696	0.9971
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.003024
HAC corrected variance (Bartlett kernel)	0.004777

Phillips-Perron Test Equation
Dependent Variable: D(Y)
Method: Least Squares
Date: 09/12/12 Time: 06:36
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y(-1)	0.032542	0.019847	1.639587	0.1101
C	-0.099476	0.080987	-1.228289	0.2275

R-squared	0.071328	Mean dependent var	0.032432
Adjusted R-squared	0.044795	S.D. dependent var	0.057851
S.E. of regression	0.056540	Akaike info criterion	-2.855195
Sum squared resid	0.111887	Schwarz criterion	-2.768119
Log likelihood	54.82112	Hannan-Quinn criter.	-2.824497
F-statistic	2.688246	Durbin-Watson stat	1.085437
Prob(F-statistic)	0.110050		

Null Hypothesis: X1 has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		1.004374	0.9958
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000698
HAC corrected variance (Bartlett kernel)	0.000698

Phillips-Perron Test Equation
Dependent Variable: D(X1)
Method: Least Squares
Date: 09/12/12 Time: 06:39
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1(-1)	0.035181	0.035028	1.004374	0.3221
C	-0.179484	0.189249	-0.948398	0.3494

R-squared	0.028015	Mean dependent var	0.010541
Adjusted R-squared	0.000243	S.D. dependent var	0.027177
S.E. of regression	0.027174	Akaike info criterion	-4.320598
Sum squared resid	0.025844	Schwarz criterion	-4.233521
Log likelihood	81.93106	Hannan-Quinn criter.	-4.289899
F-statistic	1.008768	Durbin-Watson stat	1.635694
Prob(F-statistic)	0.322092		

Null Hypothesis: X2 has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.983234	0.0039
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.005940
HAC corrected variance (Bartlett kernel)	0.008274

Phillips-Perron Test Equation
Dependent Variable: D(X2)
Method: Least Squares
Date: 09/12/12 Time: 06:39
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X2(-1)	-0.090100	0.019752	-4.561652	0.0001
C	0.934622	0.191703	4.875371	0.0000

R-squared	0.372857	Mean dependent var	0.062162
Adjusted R-squared	0.354939	S.D. dependent var	0.098661
S.E. of regression	0.079241	Akaike info criterion	-2.180117
Sum squared resid	0.219768	Schwarz criterion	-2.093040
Log likelihood	42.33216	Hannan-Quinn criter.	-2.149418
F-statistic	20.80867	Durbin-Watson stat	1.512294
Prob(F-statistic)	0.000060		

Null Hypothesis: X3 has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.425256	0.0163
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.073310
HAC corrected variance (Bartlett kernel)	0.057258

Phillips-Perron Test Equation
Dependent Variable: D(X3)
Method: Least Squares
Date: 09/12/12 Time: 06:40
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X3(-1)	-0.088505	0.028202	-3.138232	0.0034
C	0.972713	0.271554	3.582020	0.0010

R-squared	0.219595	Mean dependent var	0.132703
Adjusted R-squared	0.197298	S.D. dependent var	0.310722
S.E. of regression	0.278387	Akaike info criterion	0.332930
Sum squared resid	2.712477	Schwarz criterion	0.420006
Log likelihood	-4.159198	Hannan-Quinn criter.	0.363628
F-statistic	9.848502	Durbin-Watson stat	2.140317
Prob(F-statistic)	0.003441		

Null Hypothesis: X4 has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.266369	0.9732
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000197
HAC corrected variance (Bartlett kernel)	0.000336

Phillips-Perron Test Equation
Dependent Variable: D(X4)
Method: Least Squares
Date: 09/12/12 Time: 06:41
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X4(-1)	0.056499	0.054461	1.037424	0.3067
C	-0.580163	0.563928	-1.028788	0.3106

R-squared	0.029833	Mean dependent var	0.004865
Adjusted R-squared	0.002114	S.D. dependent var	0.014457
S.E. of regression	0.014442	Akaike info criterion	-5.584834
Sum squared resid	0.007300	Schwarz criterion	-5.497757
Log likelihood	105.3194	Hannan-Quinn criter.	-5.554135
F-statistic	1.076249	Durbin-Watson stat	1.261996
Prob(F-statistic)	0.306653		

Null Hypothesis: X5 has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.691176	0.8367
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.033179
HAC corrected variance (Bartlett kernel)	0.044724

Phillips-Perron Test Equation
Dependent Variable: D(X5)
Method: Least Squares
Date: 09/12/12 Time: 06:42
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X5(-1)	-0.025348	0.056452	-0.449017	0.6562
C	0.121163	0.227990	0.531442	0.5985

R-squared	0.005727	Mean dependent var	0.019730
Adjusted R-squared	-0.022680	S.D. dependent var	0.185195
S.E. of regression	0.187283	Akaike info criterion	-0.459851
Sum squared resid	1.227626	Schwarz criterion	-0.372774
Log likelihood	10.50724	Hannan-Quinn criter.	-0.429152
F-statistic	0.201617	Durbin-Watson stat	1.579001
Prob(F-statistic)	0.656187		

Null Hypothesis: X6 has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.196029	0.2110
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	2.30E-05
HAC corrected variance (Bartlett kernel)	2.75E-05

Phillips-Perron Test Equation
Dependent Variable: D(X6)
Method: Least Squares
Date: 09/12/12 Time: 06:42
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X6(-1)	-0.181742	0.086759	-2.094780	0.0435
C	1.752337	0.837042	2.093488	0.0436

R-squared	0.111407	Mean dependent var	-0.001081
Adjusted R-squared	0.086018	S.D. dependent var	0.005155
S.E. of regression	0.004929	Akaike info criterion	-7.735010
Sum squared resid	0.000850	Schwarz criterion	-7.647933
Log likelihood	145.0977	Hannan-Quinn criter.	-7.704311
F-statistic	4.388104	Durbin-Watson stat	2.038654
Prob(F-statistic)	0.043496		

Appendix 5

Computer print-out of stochastic frontier regression analysis

```
+----------------------------------------------------------------------+
| Limited Dependent Variable Model - FRONTIER   Regression             |
| Ordinary    least squares regression    Weighting variable = none    |
| Dep. var. = LNY      Mean=    4.076689234    , S.D.=   .4907519164   |
| Model size: Observations =      38, Parameters =   7, Deg.Fr.=     31 |
| Residuals:  Sum of squares= .2460642758    , Std.Dev.=         .08909 |
| Fit:        R-squared=  .972386, Adjusted R-squared =         .96704 |
| Model test: F[  6,     31] =  181.94,    Prob value =         .00000 |
| Diagnostic: Log-L =     41.8356, Restricted(b=0) Log-L =     -26.3639 |
|             LogAmemiyaPrCrt.=   -4.667, Akaike Info. Crt.=     -1.833 |
+------------------------------------------------------------------------------
-+
+----------+--------------+----------------+--------+---------+---------
-+
|Variable | Coefficient   | Standard Error |b/St.Er.|P[|Z|>z] | Mean of
X|
+----------+--------------+----------------+--------+---------+---------
-+
 Constant-72.021458306      .820675          -1.475   .7354
 LNX1       2.110217594      .35593194         5.960   .0000   5.4080918
 LNX2       .1487175394      .10945618         1.359   .1742   9.6994911
 LNX3       .3446590347E-01  .39516247E-01     1.156   .2478   9.5213254
 LNX4       .4224744999      .65111719         3.227   .0007   10.357612
 LNX5       .2751512876      .61019080E-01     3.280   .0010   4.0228760
 LNX6     6.8687476686     2.7864644           4.578   .0003   9.6473771
```

Source: Computer print-out.

Maximum Likelihood Estimates of technical efficiency model

Maximum iterations reached. Exit iterations with status=1.

```
              +---------------------------------------------+
              | Limited Dependent Variable Model - FRONTIER |
              | Maximum Likelihood Estimates                |
              | Dependent variable                  LNY     |
              | Weighting variable                  ONE     |
              | Number of observations               38     |
              | Iterations completed                101     |
              | Log likelihood function        47.57413     |
              | Variances: Sigma-squared(v)=     .00000     |
              |            Sigma-squared(u)=     .01916     |
              +---------------------------------------------+
+---------+--------------+----------------+--------+---------+----------
-+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of
X|
+---------+--------------+----------------+--------+---------+----------
-+
          Primary Index Equation for Model
 Constant -72.02197718      .82042739      -1.475   .1403
 LNX1      2.110331655      .28581130       7.384   .0000   5.4080918
 LNX2      .1500215359      .13996425       1.072   .2838   9.6994911
 LNX3      .3448330977E-01  .46430990E-01   1.173   .2629   9.5213254
 LNX4      .4216227251      .62183701       3.178   .0007   10.357612
 LNX5      .2753232020      .62736900E-01   4.389   .0000   4.0228760
 LNX6      6.869590434     3.45845953       4.541   .0003   9.6473771
          Variance parameters for compound error
 Lambda    1.875989295      .17823452E+10   3.005   .0099
 Sigma     .1384137447      .27448230E-01   5.043   .0000
```

Appendix 6

Stationarity tests of the Variables Used for the GMM Estimations at Levels

Null Hypothesis: Y has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.430050	0.8935
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.006029
HAC corrected variance (Bartlett kernel)	0.006980

Phillips-Perron Test Equation
Dependent Variable: D(Y)
Method: Least Squares
Date: 09/12/12 Time: 06:25
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y(-1)	-0.016957	0.055593	-0.305023	0.7622
C	0.145494	0.424033	0.343120	0.7336

R-squared	0.002651	Mean dependent var	0.016216
Adjusted R-squared	-0.025844	S.D. dependent var	0.078823
S.E. of regression	0.079835	Akaike info criterion	-2.165170
Sum squared resid	0.223077	Schwarz criterion	-2.078093
Log likelihood	42.05564	Hannan-Quinn criter.	-2.134471
F-statistic	0.093039	Durbin-Watson stat	1.200542
Prob(F-statistic)	0.762155		

Null Hypothesis: X1 has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.165485	0.6789
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.079257
HAC corrected variance (Bartlett kernel)	0.083507

Phillips-Perron Test Equation
Dependent Variable: D(X1)
Method: Least Squares
Date: 09/12/12 Time: 06:07
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1(-1)	-0.100287	0.090425	-1.109073	0.2750
C	0.649417	0.549841	1.181101	0.2455

R-squared	0.033951	Mean dependent var	0.041892
Adjusted R-squared	0.006350	S.D. dependent var	0.290381
S.E. of regression	0.289458	Akaike info criterion	0.410925
Sum squared resid	2.932507	Schwarz criterion	0.498002
Log likelihood	-5.602113	Hannan-Quinn criter.	0.441624
F-statistic	1.230043	Durbin-Watson stat	2.247021
Prob(F-statistic)	0.274961		

Null Hypothesis: X2 has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		3.169036	1.0000
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	6.75E-05
HAC corrected variance (Bartlett kernel)	9.49E-05

Phillips-Perron Test Equation
Dependent Variable: D(X2)
Method: Least Squares
Date: 09/12/12 Time: 06:09
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X2(-1)	0.019865	0.005231	3.797890	0.0006
C	-0.088806	0.016822	-5.279093	0.0000

R-squared	0.291842	Mean dependent var	-0.025135
Adjusted R-squared	0.271609	S.D. dependent var	0.009894
S.E. of regression	0.008444	Akaike info criterion	-6.658087
Sum squared resid	0.002496	Schwarz criterion	-6.571010
Log likelihood	125.1746	Hannan-Quinn criter.	-6.627388
F-statistic	14.42397	Durbin-Watson stat	1.475280
Prob(F-statistic)	0.000558		

Null Hypothesis: X3 has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.207752	0.2070
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.180538
HAC corrected variance (Bartlett kernel)	0.169954

Phillips-Perron Test Equation
Dependent Variable: D(X3)
Method: Least Squares
Date: 09/12/12 Time: 06:09
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X3(-1)	-0.243305	0.107856	-2.255829	0.0304
C	0.945620	0.430376	2.197193	0.0347

R-squared	0.126937	Mean dependent var	-0.011622
Adjusted R-squared	0.101993	S.D. dependent var	0.461010
S.E. of regression	0.436868	Akaike info criterion	1.234169
Sum squared resid	6.679891	Schwarz criterion	1.321246
Log likelihood	-20.83213	Hannan-Quinn criter.	1.264868
F-statistic	5.088765	Durbin-Watson stat	1.957811
Prob(F-statistic)	0.030435		

Null Hypothesis: X4 has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.212287	0.0272
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.104241
HAC corrected variance (Bartlett kernel)	0.102796

Phillips-Perron Test Equation
Dependent Variable: D(X4)
Method: Least Squares
Date: 09/12/12 Time: 06:10
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X4(-1)	-0.482263	0.149436	-3.227219	0.0027
C	2.814600	0.870339	3.233911	0.0027

R-squared	0.229329	Mean dependent var	0.011351
Adjusted R-squared	0.207309	S.D. dependent var	0.372851
S.E. of regression	0.331961	Akaike info criterion	0.684938
Sum squared resid	3.856927	Schwarz criterion	0.772015
Log likelihood	-10.67135	Hannan-Quinn criter.	0.715637
F-statistic	10.41494	Durbin-Watson stat	2.020043
Prob(F-statistic)	0.002713		

Null Hypothesis: X5 has a unit root
Exogenous: Constant
Bandwidth: 34 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.801979	0.0677
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.051254
HAC corrected variance (Bartlett kernel)	0.009562

Phillips-Perron Test Equation
Dependent Variable: D(X5)
Method: Least Squares
Date: 09/12/12 Time: 06:11
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X5(-1)	-0.090395	0.047456	-1.904815	0.0650
C	0.710782	0.333637	2.130406	0.0402

R-squared	0.093929	Mean dependent var	0.079459
Adjusted R-squared	0.068041	S.D. dependent var	0.241119
S.E. of regression	0.232772	Akaike info criterion	-0.024977
Sum squared resid	1.896397	Schwarz criterion	0.062100
Log likelihood	2.462077	Hannan-Quinn criter.	0.005721
F-statistic	3.628322	Durbin-Watson stat	2.609220
Prob(F-statistic)	0.065048		

Null Hypothesis: X6 has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.759277	0.9919
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.272366
HAC corrected variance (Bartlett kernel)	0.278581

Phillips-Perron Test Equation
Dependent Variable: D(X6)
Method: Least Squares
Date: 09/12/12 Time: 06:12
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X6(-1)	0.029577	0.037755	0.783391	0.4387
C	0.278574	0.118589	2.349079	0.0246

R-squared	0.017232	Mean dependent var	0.216486
Adjusted R-squared	-0.010847	S.D. dependent var	0.533704
S.E. of regression	0.536591	Akaike info criterion	1.645376
Sum squared resid	10.07754	Schwarz criterion	1.732453
Log likelihood	-28.43947	Hannan-Quinn criter.	1.676075
F-statistic	0.613701	Durbin-Watson stat	1.949725
Prob(F-statistic)	0.438667		

Null Hypothesis: X7 has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.967934	0.0000
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.014199
HAC corrected variance (Bartlett kernel)	0.015269

Phillips-Perron Test Equation
Dependent Variable: D(X7)
Method: Least Squares
Date: 09/12/12 Time: 06:13
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X7(-1)	-0.966288	0.161878	-5.969221	0.0000
C	-0.160798	0.034991	-4.595365	0.0001

R-squared	0.504471	Mean dependent var	0.010000
Adjusted R-squared	0.490313	S.D. dependent var	0.171610
S.E. of regression	0.122516	Akaike info criterion	-1.308605
Sum squared resid	0.525360	Schwarz criterion	-1.221528
Log likelihood	26.20919	Hannan-Quinn criter.	-1.277906
F-statistic	35.63159	Durbin-Watson stat	1.772922
Prob(F-statistic)	0.000001		

Null Hypothesis: X8 has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.452799	0.5459
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.007969
HAC corrected variance (Bartlett kernel)	0.015170

Phillips-Perron Test Equation
Dependent Variable: D(X8)
Method: Least Squares
Date: 09/12/12 Time: 06:14
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X8(-1)	-0.057851	0.046102	-1.254843	0.2179
C	0.218194	0.181188	1.204243	0.2366

R-squared	0.043053	Mean dependent var	-0.008378
Adjusted R-squared	0.015711	S.D. dependent var	0.092512
S.E. of regression	0.091782	Akaike info criterion	-1.886262
Sum squared resid	0.294838	Schwarz criterion	-1.799185
Log likelihood	36.89584	Hannan-Quinn criter.	-1.855563
F-statistic	1.574632	Durbin-Watson stat	1.136378
Prob(F-statistic)	0.217850		

Null Hypothesis: X9 has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		1.330568	0.9983
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.228475
HAC corrected variance (Bartlett kernel)	0.077487

Phillips-Perron Test Equation
Dependent Variable: D(X9)
Method: Least Squares
Date: 09/12/12 Time: 06:14
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X9(-1)	0.009796	0.048006	0.204050	0.8395
C	0.050136	0.550995	0.090992	0.9280

R-squared	0.001188	Mean dependent var	0.161351
Adjusted R-squared	-0.027349	S.D. dependent var	0.484872
S.E. of regression	0.491458	Akaike info criterion	1.469657
Sum squared resid	8.453576	Schwarz criterion	1.556733
Log likelihood	-25.18865	Hannan-Quinn criter.	1.500355
F-statistic	0.041636	Durbin-Watson stat	2.706731
Prob(F-statistic)	0.839496		

Null Hypothesis: X10 has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.996398	0.7445
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.133137
HAC corrected variance (Bartlett kernel)	0.157890

Phillips-Perron Test Equation
Dependent Variable: D(X10)
Method: Least Squares
Date: 09/12/12 Time: 06:15
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X10(-1)	-0.071049	0.091018	-0.780599	0.4403
C	-0.026105	0.064695	-0.403505	0.6890

R-squared	0.017112	Mean dependent var	-0.041351
Adjusted R-squared	-0.010971	S.D. dependent var	0.373119
S.E. of regression	0.375160	Akaike info criterion	0.929609
Sum squared resid	4.926072	Schwarz criterion	1.016686
Log likelihood	-15.19777	Hannan-Quinn criter.	0.960308
F-statistic	0.609335	Durbin-Watson stat	1.713984
Prob(F-statistic)	0.440286		

Null Hypothesis: X11 has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.002770	0.0439
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.032098
HAC corrected variance (Bartlett kernel)	0.036727

Phillips-Perron Test Equation
Dependent Variable: D(X11)
Method: Least Squares
Date: 09/12/12 Time: 06:15
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X11(-1)	-0.381587	0.133117	-2.866553	0.0070
C	1.384139	0.483337	2.863716	0.0070

R-squared	0.190136	Mean dependent var	0.001351
Adjusted R-squared	0.166997	S.D. dependent var	0.201827
S.E. of regression	0.184206	Akaike info criterion	-0.492989
Sum squared resid	1.187611	Schwarz criterion	-0.405912
Log likelihood	11.12030	Hannan-Quinn criter.	-0.462290
F-statistic	8.217123	Durbin-Watson stat	1.614382
Prob(F-statistic)	0.006979		

Null Hypothesis: X12 has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.796833	0.0685
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.056153
HAC corrected variance (Bartlett kernel)	0.053754

Phillips-Perron Test Equation
Dependent Variable: D(X12)
Method: Least Squares
Date: 09/12/12 Time: 06:16
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X12(-1)	-0.352287	0.124393	-2.832056	0.0076
C	0.940148	0.328027	2.866067	0.0070

R-squared	0.186435	Mean dependent var	0.018108
Adjusted R-squared	0.163190	S.D. dependent var	0.266342
S.E. of regression	0.243642	Akaike info criterion	0.066307
Sum squared resid	2.077655	Schwarz criterion	0.153384
Log likelihood	0.773314	Hannan-Quinn criter.	0.097006
F-statistic	8.020542	Durbin-Watson stat	2.226155
Prob(F-statistic)	0.007619		

Null Hypothesis: X13 has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.248927	0.0249
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.470873
HAC corrected variance (Bartlett kernel)	0.354876

Phillips-Perron Test Equation
Dependent Variable: D(X13)
Method: Least Squares
Date: 09/12/12 Time: 06:17
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X13(-1)	-0.544462	0.155189	-3.508377	0.0013
C	1.460216	0.438974	3.326431	0.0021

R-squared	0.260178	Mean dependent var	-0.025135
Adjusted R-squared	0.239041	S.D. dependent var	0.808794
S.E. of regression	0.705535	Akaike info criterion	2.192818
Sum squared resid	17.42230	Schwarz criterion	2.279895
Log likelihood	-38.56713	Hannan-Quinn criter.	2.223517
F-statistic	12.30871	Durbin-Watson stat	1.690565
Prob(F-statistic)	0.001259		

Null Hypothesis: X14 has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.087670	0.9605
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.088052
HAC corrected variance (Bartlett kernel)	0.111130

Phillips-Perron Test Equation
Dependent Variable: D(X14)
Method: Least Squares
Date: 09/12/12 Time: 06:18
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X14(-1)	0.005075	0.023984	0.211595	0.8337
C	0.131098	0.064652	2.027767	0.0503

R-squared	0.001278	Mean dependent var	0.139730
Adjusted R-squared	-0.027257	S.D. dependent var	0.301021
S.E. of regression	0.305096	Akaike info criterion	0.516159
Sum squared resid	3.257930	Schwarz criterion	0.603236
Log likelihood	-7.548945	Hannan-Quinn criter.	0.546858
F-statistic	0.044772	Durbin-Watson stat	1.638202
Prob(F-statistic)	0.833650		

Null Hypothesis: X15 has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.306617	0.9144
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.532522
HAC corrected variance (Bartlett kernel)	0.341887

Phillips-Perron Test Equation
Dependent Variable: D(X15)
Method: Least Squares
Date: 09/12/12 Time: 06:19
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X15(-1)	-0.020533	0.040523	-0.506699	0.6155
C	0.496145	0.412894	1.201630	0.2376

R-squared	0.007282	Mean dependent var	0.296486
Adjusted R-squared	-0.021081	S.D. dependent var	0.742515
S.E. of regression	0.750301	Akaike info criterion	2.315854
Sum squared resid	19.70331	Schwarz criterion	2.402931
Log likelihood	-40.84330	Hannan-Quinn criter.	2.346552
F-statistic	0.256743	Durbin-Watson stat	2.142788
Prob(F-statistic)	0.615544		

Null Hypothesis: X16 has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.029141	0.0414
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.398362
HAC corrected variance (Bartlett kernel)	0.345324

Phillips-Perron Test Equation
Dependent Variable: D(X16)
Method: Least Squares
Date: 09/12/12 Time: 06:20
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X16(-1)	-0.410414	0.130955	-3.134007	0.0035
C	0.416118	0.164479	2.529915	0.0161

R-squared	0.219133	Mean dependent var	0.023784
Adjusted R-squared	0.196823	S.D. dependent var	0.724102
S.E. of regression	0.648942	Akaike info criterion	2.025590
Sum squared resid	14.73938	Schwarz criterion	2.112667
Log likelihood	-35.47342	Hannan-Quinn criter.	2.056289
F-statistic	9.821999	Durbin-Watson stat	2.393751
Prob(F-statistic)	0.003480		

Null Hypothesis: X17 has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.507139	0.1220
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.041742
HAC corrected variance (Bartlett kernel)	0.047751

Phillips-Perron Test Equation
Dependent Variable: D(X17)
Method: Least Squares
Date: 09/12/12 Time: 06:20
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X17(-1)	-0.242174	0.099964	-2.422610	0.0207
C	0.907047	0.372444	2.435394	0.0201

R-squared	0.143606	Mean dependent var	0.008649
Adjusted R-squared	0.119138	S.D. dependent var	0.223820
S.E. of regression	0.210065	Akaike info criterion	-0.230266
Sum squared resid	1.544449	Schwarz criterion	-0.143189
Log likelihood	6.259915	Hannan-Quinn criter.	-0.199567
F-statistic	5.869038	Durbin-Watson stat	1.898356
Prob(F-statistic)	0.020723		

Null Hypothesis: X18 has a unit root
Exogenous: Constant
Bandwidth: 36 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.628835	0.8519
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.002398
HAC corrected variance (Bartlett kernel)	0.000308

Phillips-Perron Test Equation
Dependent Variable: D(X18)
Method: Least Squares
Date: 09/12/12 Time: 06:21
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X18(-1)	-0.014557	0.024116	-0.603607	0.5500
C	0.083283	0.090891	0.916298	0.3658

R-squared	0.010303	Mean dependent var	0.028649
Adjusted R-squared	-0.017975	S.D. dependent var	0.049898
S.E. of regression	0.050344	Akaike info criterion	-3.087327
Sum squared resid	0.088709	Schwarz criterion	-3.000250
Log likelihood	59.11554	Hannan-Quinn criter.	-3.056628
F-statistic	0.364342	Durbin-Watson stat	1.746577
Prob(F-statistic)	0.549997		

Null Hypothesis: X19 has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.296262	0.1784
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000866
HAC corrected variance (Bartlett kernel)	0.000705

Phillips-Perron Test Equation
Dependent Variable: D(X19)
Method: Least Squares
Date: 09/12/12 Time: 06:22
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X19(-1)	-0.210383	0.088814	-2.368808	0.0235
C	0.812208	0.341657	2.377259	0.0230

R-squared	0.138170	Mean dependent var	0.002973
Adjusted R-squared	0.113546	S.D. dependent var	0.032134
S.E. of regression	0.030255	Akaike info criterion	-4.105803
Sum squared resid	0.032037	Schwarz criterion	-4.018727
Log likelihood	77.95736	Hannan-Quinn criter.	-4.075105
F-statistic	5.611252	Durbin-Watson stat	2.141891
Prob(F-statistic)	0.023495		

Null Hypothesis: X20 has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.149556	0.6855
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	4.67E-05
HAC corrected variance (Bartlett kernel)	7.82E-05

Phillips-Perron Test Equation
Dependent Variable: D(X20)
Method: Least Squares
Date: 09/12/12 Time: 06:23
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X20(-1)	-0.045620	0.060877	-0.749385	0.4586
C	0.165894	0.219934	0.754290	0.4557

R-squared	0.015792	Mean dependent var	0.001081
Adjusted R-squared	-0.012329	S.D. dependent var	0.006986
S.E. of regression	0.007029	Akaike info criterion	-7.025136
Sum squared resid	0.001729	Schwarz criterion	-6.938060
Log likelihood	131.9650	Hannan-Quinn criter.	-6.994438
F-statistic	0.561577	Durbin-Watson stat	1.821058
Prob(F-statistic)	0.458633		

Stationarity tests of the Variables Used for the GMM Estimations at First Difference

Null Hypothesis: D(LNY) has a unit root
Exogenous: Constant
Bandwidth: 12 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.708450	0.0081
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.005100
HAC corrected variance (Bartlett kernel)	0.001418

Phillips-Perron Test Equation
Dependent Variable: D(LNY,2)
Method: Least Squares
Date: 04/03/10 Time: 06:57
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNY(-1))	-0.615265	0.156487	-3.931737	0.0004
C	0.012313	0.012491	0.985741	0.3312

R-squared	0.312556	Mean dependent var	0.002661
Adjusted R-squared	0.292337	S.D. dependent var	0.087355
S.E. of regression	0.073485	Akaike info criterion	-2.329512
Sum squared resid	0.183603	Schwarz criterion	-2.241538
Log likelihood	43.93121	F-statistic	15.45856
Durbin-Watson stat	1.762379	Prob(F-statistic)	0.000394

Null Hypothesis: D(LNX1) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.321829	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.077269
HAC corrected variance (Bartlett kernel)	0.094993

Phillips-Perron Test Equation
Dependent Variable: D(LNX1,2)
Method: Least Squares
Date: 04/03/10 Time: 07:02
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX1(-1))	-1.223430	0.163994	-7.460227	0.0000
C	0.042520	0.048194	0.882270	0.3838

R-squared	0.620768	Mean dependent var	-0.010269
Adjusted R-squared	0.609615	S.D. dependent var	0.457791
S.E. of regression	0.286032	Akaike info criterion	0.388526
Sum squared resid	2.781685	Schwarz criterion	0.476499
Log likelihood	-4.993468	F-statistic	55.65499
Durbin-Watson stat	1.939977	Prob(F-statistic)	0.000000

Null Hypothesis: D(LNX2) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.039195	0.0407
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	6.58E-05
HAC corrected variance (Bartlett kernel)	6.67E-05

Phillips-Perron Test Equation
Dependent Variable: D(LNX2,2)
Method: Least Squares
Date: 04/03/10 Time: 07:03
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX2(-1))	-0.421438	0.139260	-3.026276	0.0047
C	-0.010698	0.003788	-2.824250	0.0079

R-squared	0.212203	Mean dependent var	-3.59E-05
Adjusted R-squared	0.189033	S.D. dependent var	0.009270
S.E. of regression	0.008348	Akaike info criterion	-6.679720
Sum squared resid	0.002369	Schwarz criterion	-6.591747
Log likelihood	122.2350	F-statistic	9.158346
Durbin-Watson stat	2.021214	Prob(F-statistic)	0.004695

Null Hypothesis: D(LNX3) has a unit root
Exogenous: Constant
Bandwidth: 27 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-9.146082	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.209093
HAC corrected variance (Bartlett kernel)	0.041045

Phillips-Perron Test Equation
Dependent Variable: D(LNX3,2)
Method: Least Squares
Date: 04/03/10 Time: 07:16
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX3(-1))	-1.095046	0.169984	-6.442056	0.0000
C	-0.005830	0.078447	-0.074320	0.9412

R-squared	0.549669	Mean dependent var	0.007346
Adjusted R-squared	0.536424	S.D. dependent var	0.691068
S.E. of regression	0.470523	Akaike info criterion	1.384010
Sum squared resid	7.527335	Schwarz criterion	1.471984
Log likelihood	-22.91218	F-statistic	41.50009
Durbin-Watson stat	2.020306	Prob(F-statistic)	0.000000

Null Hypothesis: D(LNX4) has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.147613	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.126735
HAC corrected variance (Bartlett kernel)	0.092718

Phillips-Perron Test Equation
Dependent Variable: D(LNX4,2)
Method: Least Squares
Date: 04/03/10 Time: 07:17
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX4(-1))	-1.292907	0.166784	-7.751984	0.0000
C	0.011928	0.061053	0.195377	0.8463

R-squared	0.638656	Mean dependent var	0.011014
Adjusted R-squared	0.628029	S.D. dependent var	0.600629
S.E. of regression	0.366320	Akaike info criterion	0.883334
Sum squared resid	4.562473	Schwarz criterion	0.971307
Log likelihood	-13.90001	F-statistic	60.09326
Durbin-Watson stat	2.118559	Prob(F-statistic)	0.000000

Null Hypothesis: D(LNX5) has a unit root
Exogenous: Constant
Bandwidth: 11 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.938930	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.052062
HAC corrected variance (Bartlett kernel)	0.028918

Phillips-Perron Test Equation
Dependent Variable: D(LNX5,2)
Method: Least Squares
Date: 04/03/10 Time: 07:18
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX5(-1))	-1.294863	0.163254	-7.931594	0.0000
C	0.099757	0.041252	2.418235	0.0211

R-squared	0.649160	Mean dependent var	-0.003804
Adjusted R-squared	0.638841	S.D. dependent var	0.390681
S.E. of regression	0.234786	Akaike info criterion	-0.006333
Sum squared resid	1.874229	Schwarz criterion	0.081640
Log likelihood	2.113997	F-statistic	62.91018
Durbin-Watson stat	2.176261	Prob(F-statistic)	0.000000

Null Hypothesis: D(LNX6) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.461063	0.0001
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.281674
HAC corrected variance (Bartlett kernel)	0.286270

Phillips-Perron Test Equation
Dependent Variable: D(LNX6,2)
Method: Least Squares
Date: 04/03/10 Time: 07:19
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX6(-1))	-0.931408	0.170690	-5.456717	0.0000
C	0.207537	0.098229	2.112778	0.0420

R-squared	0.466882	Mean dependent var	0.005972
Adjusted R-squared	0.451202	S.D. dependent var	0.737189
S.E. of regression	0.546116	Akaike info criterion	1.681982
Sum squared resid	10.14025	Schwarz criterion	1.769955
Log likelihood	-28.27568	F-statistic	29.77576
Durbin-Watson stat	2.011466	Prob(F-statistic)	0.000004

Null Hypothesis: D(LNX7) has a unit root
Exogenous: Constant
Bandwidth: 7 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-16.07769	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.017981
HAC corrected variance (Bartlett kernel)	0.006275

Phillips-Perron Test Equation
Dependent Variable: D(LNX7,2)
Method: Least Squares
Date: 04/03/10 Time: 07:21
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX7(-1))	-1.480168	0.134235	-11.02665	0.0000
C	0.003387	0.023032	0.147040	0.8840

R-squared	0.781473	Mean dependent var	-0.010618
Adjusted R-squared	0.775046	S.D. dependent var	0.290919
S.E. of regression	0.137981	Akaike info criterion	-1.069449
Sum squared resid	0.647317	Schwarz criterion	-0.981476
Log likelihood	21.25009	F-statistic	121.5871
Durbin-Watson stat	2.138195	Prob(F-statistic)	0.000000

Null Hypothesis: D(LNX8) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.629650	0.0099
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.006898
HAC corrected variance (Bartlett kernel)	0.006790

Phillips-Perron Test Equation
Dependent Variable: D(LNX8,2)
Method: Least Squares
Date: 04/03/10 Time: 07:22
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX8(-1))	-0.563012	0.154527	-3.643458	0.0009
C	-0.004748	0.014316	-0.331656	0.7422

R-squared	0.280801	Mean dependent var	0.000496
Adjusted R-squared	0.259648	S.D. dependent var	0.099323
S.E. of regression	0.085461	Akaike info criterion	-2.027562
Sum squared resid	0.248321	Schwarz criterion	-1.939589
Log likelihood	38.49612	F-statistic	13.27479
Durbin-Watson stat	2.024279	Prob(F-statistic)	0.000888

Null Hypothesis: D(LNX9) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.510301	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.207143
HAC corrected variance (Bartlett kernel)	0.179687

Phillips-Perron Test Equation
Dependent Variable: D(LNX9,2)
Method: Least Squares
Date: 04/03/10 Time: 07:23
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX9(-1))	-1.338464	0.161258	-8.300151	0.0000
C	0.221694	0.082457	2.688598	0.0110

R-squared	0.669558	Mean dependent var	0.001041
Adjusted R-squared	0.659839	S.D. dependent var	0.802979
S.E. of regression	0.468324	Akaike info criterion	1.374640
Sum squared resid	7.457133	Schwarz criterion	1.462614
Log likelihood	-22.74352	F-statistic	68.89250
Durbin-Watson stat	2.021394	Prob(F-statistic)	0.000000

Null Hypothesis: D(LNX10) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.252404	0.0001
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.137157
HAC corrected variance (Bartlett kernel)	0.120559

Phillips-Perron Test Equation
Dependent Variable: D(LNX10,2)
Method: Least Squares
Date: 04/03/10 Time: 07:24
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX10(-1))	-0.901360	0.170539	-5.285362	0.0000
C	-0.039697	0.063906	-0.621177	0.5386

R-squared	0.451038	Mean dependent var	-0.002352
Adjusted R-squared	0.434892	S.D. dependent var	0.506938
S.E. of regression	0.381084	Akaike info criterion	0.962357
Sum squared resid	4.937642	Schwarz criterion	1.050330
Log likelihood	-15.32243	F-statistic	27.93505
Durbin-Watson stat	1.853360	Prob(F-statistic)	0.000007

Null Hypothesis: D(LNX11) has a unit root
Exogenous: Constant
Bandwidth: 9 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.501238	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.040026
HAC corrected variance (Bartlett kernel)	0.008943

Phillips-Perron Test Equation
Dependent Variable: D(LNX11,2)
Method: Least Squares
Date: 04/03/10 Time: 07:25
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX11(-1))	-0.927015	0.171558	-5.403526	0.0000
C	0.001448	0.034312	0.042192	0.9666

R-squared	0.462009	Mean dependent var	0.002587
Adjusted R-squared	0.446186	S.D. dependent var	0.276633
S.E. of regression	0.205866	Akaike info criterion	-0.269226
Sum squared resid	1.440953	Schwarz criterion	-0.181253
Log likelihood	6.846067	F-statistic	29.19809
Durbin-Watson stat	1.975605	Prob(F-statistic)	0.000005

Null Hypothesis: D(LNX12) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.925825	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.063948
HAC corrected variance (Bartlett kernel)	0.067064

Phillips-Perron Test Equation
Dependent Variable: D(LNX12,2)
Method: Least Squares
Date: 04/03/10 Time: 07:27
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX12(-1))	-1.312293	0.164522	-7.976399	0.0000
C	0.021691	0.043415	0.499618	0.6206

R-squared	0.651721	Mean dependent var	0.005622
Adjusted R-squared	0.641478	S.D. dependent var	0.434576
S.E. of regression	0.260210	Akaike info criterion	0.199297
Sum squared resid	2.302114	Schwarz criterion	0.287270
Log likelihood	-1.587347	F-statistic	63.62294
Durbin-Watson stat	1.941239	Prob(F-statistic)	0.000000

Null Hypothesis: D(LNX13) has a unit root
Exogenous: Constant
Bandwidth: 35 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-11.41346	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.649875
HAC corrected variance (Bartlett kernel)	0.056135

Phillips-Perron Test Equation
Dependent Variable: D(LNX13,2)
Method: Least Squares
Date: 04/03/10 Time: 07:28
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX13(-1))	-1.048667	0.171876	-6.101316	0.0000
C	-0.030827	0.138273	-0.222944	0.8249

R-squared	0.522647	Mean dependent var	-0.016711
Adjusted R-squared	0.508607	S.D. dependent var	1.183347
S.E. of regression	0.829520	Akaike info criterion	2.518013
Sum squared resid	23.39550	Schwarz criterion	2.605986
Log likelihood	-43.32424	F-statistic	37.22606
Durbin-Watson stat	1.900384	Prob(F-statistic)	0.000001

Null Hypothesis: D(LNX14) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.867584	0.0003
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.087372
HAC corrected variance (Bartlett kernel)	0.086176

Phillips-Perron Test Equation
Dependent Variable: D(LNX14,2)
Method: Least Squares
Date: 04/03/10 Time: 07:29
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX14(-1))	-0.822507	0.168735	-4.874559	0.0000
C	0.118785	0.056235	2.112311	0.0421

R-squared	0.411371	Mean dependent var	0.000126
Adjusted R-squared	0.394058	S.D. dependent var	0.390736
S.E. of regression	0.304157	Akaike info criterion	0.511410
Sum squared resid	3.145399	Schwarz criterion	0.599383
Log likelihood	-7.205378	F-statistic	23.76132
Durbin-Watson stat	2.012336	Prob(F-statistic)	0.000025

Null Hypothesis: D(LNX15) has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.550949	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.545728
HAC corrected variance (Bartlett kernel)	0.366976

Phillips-Perron Test Equation
Dependent Variable: D(LNX15,2)
Method: Least Squares
Date: 04/03/10 Time: 07:30
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX15(-1))	-1.086151	0.171000	-6.351771	0.0000
C	0.324076	0.136785	2.369240	0.0236

R-squared	0.542673	Mean dependent var	-0.003474
Adjusted R-squared	0.529222	S.D. dependent var	1.107877
S.E. of regression	0.760151	Akaike info criterion	2.343353
Sum squared resid	19.64619	Schwarz criterion	2.431326
Log likelihood	-40.18035	F-statistic	40.34500
Durbin-Watson stat	2.033606	Prob(F-statistic)	0.000000

Null Hypothesis: D(LNX16) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-9.716342	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.421656
HAC corrected variance (Bartlett kernel)	0.362992

Phillips-Perron Test Equation
Dependent Variable: D(LNX16,2)
Method: Least Squares
Date: 04/03/10 Time: 07:31
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX16(-1))	-1.443492	0.153738	-9.389290	0.0000
C	0.034207	0.111413	0.307028	0.7607

R-squared	0.721674	Mean dependent var	0.002792
Adjusted R-squared	0.713488	S.D. dependent var	1.248300
S.E. of regression	0.668176	Akaike info criterion	2.085422
Sum squared resid	15.17961	Schwarz criterion	2.173396
Log likelihood	-35.53760	F-statistic	88.15877
Durbin-Watson stat	2.267932	Prob(F-statistic)	0.000000

Null Hypothesis: D(LNX17) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.209818	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.049504
HAC corrected variance (Bartlett kernel)	0.057969

Phillips-Perron Test Equation
Dependent Variable: D(LNX17,2)
Method: Least Squares
Date: 04/03/10 Time: 07:32
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX17(-1))	-1.053551	0.169584	-6.212541	0.0000
C	0.014096	0.038186	0.369152	0.7143

R-squared	0.531652	Mean dependent var	0.004913
Adjusted R-squared	0.517878	S.D. dependent var	0.329725
S.E. of regression	0.228945	Akaike info criterion	-0.056717
Sum squared resid	1.782138	Schwarz criterion	0.031256
Log likelihood	3.020906	F-statistic	38.59566
Durbin-Watson stat	1.718724	Prob(F-statistic)	0.000000

Null Hypothesis: D(LNX18) has a unit root
Exogenous: Constant
Bandwidth: 35 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.172972	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.002334
HAC corrected variance (Bartlett kernel)	0.000286

Phillips-Perron Test Equation
Dependent Variable: D(LNX18,2)
Method: Least Squares
Date: 04/03/10 Time: 07:33
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX18(-1))	-0.871018	0.170066	-5.121643	0.0000
C	0.025593	0.009675	2.645279	0.0123

R-squared	0.435509	Mean dependent var	-1.23E-17
Adjusted R-squared	0.418906	S.D. dependent var	0.065208
S.E. of regression	0.049708	Akaike info criterion	-3.111349
Sum squared resid	0.084010	Schwarz criterion	-3.023376
Log likelihood	58.00429	F-statistic	26.23123
Durbin-Watson stat	1.928543	Prob(F-statistic)	0.000012

Null Hypothesis: D(LNX19) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.868224	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000997
HAC corrected variance (Bartlett kernel)	0.000826

Phillips-Perron Test Equation
Dependent Variable: D(LNX19,2)
Method: Least Squares
Date: 04/03/10 Time: 07:34
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX19(-1))	-1.147875	0.169785	-6.760772	0.0000
C	0.003475	0.005442	0.638570	0.5274

R-squared	0.573443	Mean dependent var	-0.000166
Adjusted R-squared	0.560898	S.D. dependent var	0.049031
S.E. of regression	0.032490	Akaike info criterion	-3.961803
Sum squared resid	0.035891	Schwarz criterion	-3.873830
Log likelihood	73.31245	F-statistic	45.70804
Durbin-Watson stat	2.026172	Prob(F-statistic)	0.000000

Null Hypothesis: D(LNX20) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.861383	0.0034
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	7.08E-06
HAC corrected variance (Bartlett kernel)	7.35E-06

Phillips-Perron Test Equation
Dependent Variable: D(LNX20,2)
Method: Least Squares
Date: 04/03/10 Time: 07:35
Sample (adjusted): 1972 2007
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNX20(-1))	-0.179508	0.097996	-1.831789	0.0758
C	0.000137	0.000469	0.291756	0.7722

R-squared	0.089825	Mean dependent var	-6.28E-05
Adjusted R-squared	0.063055	S.D. dependent var	0.002829
S.E. of regression	0.002739	Akaike info criterion	-8.908833
Sum squared resid	0.000255	Schwarz criterion	-8.820860
Log likelihood	162.3590	F-statistic	3.355450
Durbin-Watson stat	1.924205	Prob(F-statistic)	0.075756

Appendix 7

Johansen cointegration test of dependent variables and residuals

Date: 03/28/10 Time: 16:22
Sample (adjusted): 1974 2007
Included observations: 34 after adjustments
Trend assumption: Linear deterministic trend
Series: LNY RESID
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.524493	26.76545	15.49471	0.0007
At most 1	0.042898	1.490734	3.841466	0.2221

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

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.524493	25.27472	14.26460	0.0006
At most 1	0.042898	1.490734	3.841466	0.2221

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LNY	RESID
0.542890	12.29924
4.442086	-0.078513

Unrestricted Adjustment Coefficients (alpha):

D(LNY)	0.002228	-0.015169
D(RESID)	-0.129780	-0.007431

1 Cointegrating Equation(s):	Log likelihood	63.19679

Normalized cointegrating coefficients (standard error in parentheses)

LNY1	RESID

1.000000	22.65515
	(3.91232)

Adjustment coefficients (standard error in parentheses)

D(LNY1)	0.001210
	(0.00726)
D(RESID)	-0.070456
	(0.01275)

Appendix 8

GMM Results for Factors Impacting on Rural Welfare

Dependent Variable: LNY
Method: Generalized Method of Moments
Date: 04/08/10 Time: 09:06
Sample (adjusted): 1971 2007
Included observations: 37 after adjustments
Kernel: Bartlett, Bandwidth: Fixed (3), Prewhitening
Simultaneous weighting matrix & coefficient iteration
Convergence achieved after: 3 weight matrices, 4 total coef iterations
Instrument list: LNX1(-1) LNX2(-1) LNX3(-1) LNX4(-1) LNX5(-1) LNX6(-1)
LNX7(-1) LNX8(-1) LNX9(-1) LNX10(-1) LNX11(-1) LNX12(-1)
LNX13(-1) LNX14(-1) LNX15(-1) LNX16(-1) LNX17(-1) LNX18(-1)
LNX19(-1) LNX20(-1) X21(-1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNX1	0.222645	0.478582	0.465223	0.6489
LNX2	-6.062134	5.167668	-1.173089	0.2603
LNX3	0.104706	0.046856	2.234621	0.0476
LNX4	0.405292	0.591069	0.685694	0.5041
LNX5	-0.299625	0.478342	-0.626381	0.5411
LNX6	-0.110863	0.351896	-0.315045	0.7574
LNX7	0.276088	0.069146	2.992778	0.0326
LNX8	0.006431	0.002184	2.843671	0.0251
LNX9	0.188219	0.412625	0.456153	0.6553
LNX10	-0.039171	0.014392	-2.521662	0.0452
LNX11	-0.746356	0.693125	-1.076799	0.2998
LNX12	0.770196	0.639441	1.204484	0.2484
LNX13	0.094431	0.301684	0.313013	0.7589
LNX14	-0.079906	0.508785	-0.157052	0.8774
LNX15	-0.177711	0.139619	-1.272828	0.2238
LNX16	0.291097	0.096790	3.007506	0.0031
LNX17	0.329431	0.577502	0.570442	0.5774
LNX18	-0.316301	2.750755	-0.114987	0.9101
LNX19	2.532594	0.459575	5.510730	0.0058
LNX20	-10.48466	9.594085	-1.092826	0.2929
X21	0.201864	0.566063	0.356614	0.7267
X22	0.651521	0.322573	2.019763	0.0427

R-squared	0.760196	Mean dependent var	7.639993
Adjusted R-squared	0.572601	S.D. dependent var	0.248422
S.E. of regression	0.429318	Sum squared resid	2.702006
Durbin-Watson stat	1.937016	J-statistic	5.32E-05

Appendix 9

Synthesis of major agricultural policies, projects and programmes aimed at boosting agricultural production in Nigeria, 1972 - 2007

	Policies, projects and programmes	**Commencement date**
1.	Agricultural Development Projects (ADPs)	1972
2.	National Accelerated Food Production Project (NAFPP)	1975
3.	Tree Crop Programme	
4.	Reorganization of Agricultural Research Institutes Research Institutes Decree 33 Research Institutes Establishment Order National Science and Technology Development Agency (NSTDA) Decree 5	 1973 1975 1975
5.	Commodity Boards Commodity Boards Decree 29	 1977
6.	River Basin Development Authorities River Basin Development Authorities Decree 25 (amended 1977, 1979)	 1976
7.	Farm Input Subsidies Fertilizer Subsidy Programme	 1976
8.	Federal Government Parastatals National Grains Production Company National Livestock Company National Fish Production Company	
9.	Strategic Grain Reserve Scheme	1976
10.	Farm Credit Nigerian Agricultural and Cooperative Bank The Rural Banking Scheme Agricultural Credit Guarantee Scheme	 1973 1973 1978
11.	Operation Feed the Nation -Subsidy on fertilizer, livestock products and inputs, fisheries inputs, seeds, etc.	 1976
12.	The Green Revolution Programme - The National Food Production Plan	 1980
13.	Agricultural Policy Initiatives and Reforms Directorate of Food, Roads and Rural Infrastructures (DFRRI) Streamlining of RBDAs Economic deregulation and disengagement of government from direct involvement in agricultural production and distribution Statewide ADPs Universities of Agriculture (UNAAB, UAM) National Agricultural Land Development Authority (NALDA) (1) Privatization of Agriculture (disengagement of government from fertilizer procurement and distribution) (2) Withdrawal of fertilizer subsidies (3) Scrapping of Commodity Boards (4) Transfer of Agricultural Research Institutes from Federal Ministry of Science and Technology to the Federal Ministry of Agriculture (5) Agriculture under the Structural (SAP) (6) Support for Farmer Associations and the formation of Federation of Farmers' Association of Nigeria (FOFAN).	1985-1993 1986 1991 1988 Mid 1990 1987 1992 1992
14.	Agricultural policies under the Obasanjo Administration Restoration of fertilizer subsidies at 25% Establishment of Department of Fertilizer, FMA Restoration of Producer Price Support Scheme for Grains Food Security and Poverty Alleviation Programme Presidential Initiatives on some export crops National Economic Empowerment and Development Strategy The seven-point Agenda Millennium Development Goals	1999-2007 1999-2000 2001 2004 2007 2000s

Source: CBN/NISER (1992); Idachaba (2006); Adebayo *et al*. (2009).