NEAR EAST UNIVERSITY

GRADUATE SCHOOL OF SOCIAL SCIENCES

BANKING AND FINANCE PROGRAM

THE NEXUS BETWEEN AGRICULTURAL PRODUCTIVITY, OIL PRICES, ECONOMIC GROWTH, AND FINANCIAL DEVELOPMENT IN THE USA

SIMBARASHE RABSON ANDREA

MASTER'S THESIS

NICOSIA

2018

NEAR EAST UNIVERSITY

GRADUATE SCHOOL OF SOCIAL SCIENCES

BANKING AND FINANCE PROGRAM

THE NEXUS BETWEEN AGRICULTURAL PRODUCTIVITY, OIL PRICES, ECONOMIC GROWTH AND FINANCIAL DEVELOPMENT IN THE USA

SIMBARASHE RABSON ANDREA

MASTER'S THESIS

THESIS SUPERVISOR

ASSOC. PROF. DR. TURGUT TÜRSOY

NICOSIA

2018

ACCEPTANCE

We as the jury members certify "The Nexus Between Agricultural Productivity, Oil Prices, Economic growth and Financial development in USA**" prepared by Simbarashe Rabson Andrea defended on 19 December 2018 has been found satisfactory for the award of degree of Master.**

JURY MEMBERS

…….

Assoc. Prof. Dr. TURGUT TÜRSOY (Supervisor)

Near East University

Faculty of Economics and Administrative / Department of Banking and Finance

…….

Assist. Prof. Dr. Nil GÜNSEL REŞATOĞLU

Near East University

Faculty of Economics and Administrative / Department of Banking and Finance

…….

Assist. Prof. Dr. Behiye TÜZEL ÇAVUŞOĞLU

Near East University

Faculty of Economics and Administrative / Department of Economics

…….

Prof. Dr. Mustafa Sağsan

Graduate School of Social Sciences

Director

DECLARATION

I Simbarashe Rabson Andrea, hereby declare that this dissertation entitled "The Nexus Between Agricultural Productivity, Oil Prices, Financial Development And Economic Growth In USA" has been prepared myself under the guidance and supervision of "**Assoc. Prof. Dr. Turgut Türsoy.**" in partial fulfilment of The Near East University, Graduate School of Social Sciences regulations and does not to the best of my knowledge breach any Law of Copyrights and has been tested for plagiarism and a copy of the result can be found in the Thesis.

- ☒ The full extent of my Thesis can be accessible from anywhere.
- ☐ My Thesis can only be accessed from the Near East University.
- ☐ My Thesis cannot be accessible for (2) two years. If I do not apply for an extension at the end of this period, the full extent of my Thesis will be accessible from anywhere.

Date: 19th of December 2018

Signature:

Name: Surname: Simbarashe Rabson Andrea

DEDICATION

….. To Jehovah Elohim ……

ACKNOWLEDGEMENTS

It is with utmost gratitude that I would like to express my sincere appreciation to my advisor Assoc. Prof. Dr. Turgut Türsoy for his outstanding and remarkable insights. His contribution greatly played a vital role in the successful completion of this study. An unimaginable token of appreciation goes to my father Rabson Andrea, mother Redi Andrea, my elder brother Munyaradzi Andrea for their unwavering support.

ABSTRACT

THE NEXUS BETWEEN AGRICULTURAL PRODUCTIVITY, OIL PRICES, FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH IN USA

The study examines the nexus between agricultural productivity, oil prices, economic growth and financial development. The study is based on observations made which suggest that having a highly developed financial system is pivotal in boosting agricultural productivity. The study argues that this can only take place when the financial system is capable of rendering the agriculture sector with the required financial services. The study also highlights that this ought to be reinforced by a strong economic ability to deal with the problem of economic misfortunes induced by oil shocks and a financial crisis. An ARDL approach was used to estimate an agricultural productivity nexus model using annual time series data from the year 1962 to 2016. This was accomplished with the aid of EViews 10. The results depicted that there is a long run relationship linking agricultural productivity, oil prices, economic growth, financial development and a financial crisis. The results also exhibited that financial development and economic growth have positive effects on agricultural productivity. The findings further unveiled that a surge in oil prices and the prevalence of a financial crisis are detrimental to an improvement in agricultural productivity. The importance of the study lies in its potency to highlight that there exists a nexus linking agricultural productivity, oil prices, economic growth and financial development which acts to promote agricultural productivity. This is also followed by a successful demonstration of the idea that financial and commodity market stability is pivotal to a sound growth in agricultural productivity.

Keywords: Agricultural productivity, economic growth, financial crisis, financial development, nexus, oil prices.

ÖZ

ABD'DEKİ TARIMSAL VERİMLİLİK, PETROL FİYATLARI, FİNANSAL KALKINMA VE EKONOMİK BÜYÜME ARASINDAKİ BAĞLANTI NOKTALARI

Bu çalışma tarımsal verimlilik, petrol fiyatları, ekonomik büyüme ve finansal gelişme arasındaki bağlantı noktalarını incelemektedir. Çalışma, oldukça gelişmiş bir finansal sisteme sahip olmanın tarımsal verimliliği artırmada çok önemli olduğunu öne süren gözlemlere dayanmaktadır.Çalışma, bunun ancak finansal sistemin tarım sektörünü gerekli finansal hizmetlerle sağlayabilmesi durumunda gerçekleşebileceğini savunuyor. Çalışma ayrıca bunun petrol şokları ve finansal krizlerin yol açtığı ekonomik talihsizlik sorunlarıyla başa çıkabilmek için güçlü bir ekonomik yetenekle güçlendirilmesi gerektiğini vurgulamaktadır. 1962'den 2016'ya kadar yıllık zaman serileri verilerini kullanarak bir tarımsal verimlilik bağıntısı modelini tahmin etmek için bir ARDL yaklaşımı kullanıldı. Bu, EViews 10'un yardımı ile başarıldı. Sonuçlar, tarımsal üretkenliği, petrol fiyatlarını, ekonomik büyümeyi, finansal gelişimi ve finansal bir krizi ilişkilendiren uzun vadeli bir ilişki olduğunu göstermiştir. Sonuçlar ayrıca finansal kalkınma ve ekonomik büyümenin tarımsal üretkenliği olumlu yönde etkilediğini göstermiştir. Bulgular ayrıca, petrol fiyatlarındaki bir artışın ve finansal krizin tarımsal üretkenliğe zarar verdiğini ortaya koymuştur. Çalışmanın önemi, tarımsal üretkenliği teşvik eden, tarımsal üretkenliği, petrol fiyatlarını, ekonomik büyümeyi ve finansal kalkınmayı bağlayan bir bağın var olduğunu vurgulama gücünde yatmaktadır.Bunu, finansal ve emtia piyasası istikrarının tarımsal üretkenlikte sağlam bir büyüme için çok önemli olduğu fikrinin başarılı bir şekilde kanıtlanması izlemektedir.

Anahtar Kelimeler: Tarımsal verimlilik, ekonomik büyüme, finansal kriz, finansal kalkınma, bağlantı noktası, petrol fiyatları.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

ADF: Augmented Dickey-Fuller

AP: Agricultural Productivity

ARDL: Auto Regressive Distributed Lag

DV_{FC}: Dummy Variable for Financial Crisis

ECT: Error Correction Term

EG: Economic Growth

FD: Financial Development

OP: Oil Prices

PP: Phillips Perron

WFP: World Food Program

INTRODUCTION

Background of the study

Agriculture used to be the centre of national and global decision making with organisations such as the United Nations and the World Food Programme underscoring the need to boost agricultural productivity (Garnett et al., 2013). This stemmed from ideas which assert that agricultural productivity goes a long way towards poverty alleviation (Irz, Lin & Thirtle, 2001; Thirtle, Lin & Piesse, 2003). With more than 9 billion stricken in poverty and in huge need of food, one cannot deny the need to promote agricultural productivity (Godfray et al., 2010). Onoja (2017) acknowledges that effort to promote food security can be made possible by promoting agricultural productivity. On a large note, agricultural productivity is mainly engineered to foster economic growth and development and its importance in an economy still remains undoubtedly significant.

It is highly believed agricultural productivity is one of the key strategies that can be used to attain Millennium Development Goals (MDGs), (McMichael & Schneider, 2011). Diao, Hazell and Thurlow (2010) believe that agricultural productivity is tied to quite a number of macroeconomic indicators. Such indicators include financial development, economic growth and stability. This, therefore, highlights the existence of a nexus linking agricultural productivity, economic growth and financial development.

Meanwhile, mass production, technological development, cost and productive efficiency in the agriculture sector are notable factors that influence the productivity of the agriculture sector. But there are ideas which posit that these factors can be made available through the provision of financial assistance by the financial market (Rizwan-ul-Hassan1, 2017; Shahbaz, Shahbaz & Shabbir, 2003). Onoja (2017) concurred with this idea and asserted that financial players make it feasible for farmers to acquire high payoff technology. The acquisition of high payoff technology helps to boost agricultural productivity. Hence, it can be noted that the financial sector plays a pivotal role in improving agricultural productivity.

On the other hand, the oil sector is one of the most lucrative economic sectors an economy can have and economies such as the United States of America (USA) have gained a lot from oil production. Oil production has a strong capacity to turn around both individual and economic fortunes. This is one of the major reasons why people may shun other sectors such as agriculture in favour of the oil sector. Alternatively, this implies that the opportunity cost of engaging in agricultural production is the huge gain that can be made from participating in oil production, selling and distribution. But challenges can be observed when oil shocks initiate an increase in oil prices. The agriculture sector together with other economic industry can suffer from an increase in oil prices (Alihu, 2009; Berument, Ceylan & Dogan, 2010). This strongly provides an indication of a negative spillover effect linking changes in oil prices and other economic sectors. Thus, it is imperative to note that there is a linkage between agricultural productivity, oil prices, economic growth and financial development. However, studies have of late confined on separating the individual effects of each macroeconomic variable, yet they combinedly work to affect agricultural productivity. Such an observation is reputably true in countries such as the USA which is characterised by tremendous economic growth and financial development levels. As a result, this research attempts to examine the presence of a nexus connecting agricultural productivity, oil prices, economic growth and financial development in the USA.

Problem statement

A sound increase in agricultural productivity requires an effectively functioning financial system that is capable of providing the agriculture sector with the required financial services. But in order to accomplish this, the economy must be growing well and in a strong position to deal with economic misfortunes caused by volatile oil prices and shocks, and the effects of a financial crisis.

Aims of the study

The core aim of this study is centred on establishing the existence of an interaction linking agricultural productivity, oil prices, economic growth and financial development. The study will also place focus on attaining the following targets;

- In the case that there exists an interaction, the study will thus seek to determine how oil prices, economic growth and financial development influence agricultural productivity.
- To examine if the agriculture sector is in a position to thrive and maintain high productivity levels in an economy such as the USA, where much of the focus is devoted towards heavy industrial products such as oil and minerals. If so, then determine how oil shocks and volatile changes in oil prices affect agricultural productivity.
- To examine if developments in the US financial sector have been capable of stimulating agricultural productivity or not. If not, then proceed to examine if any possible increases in agricultural productivity managed to stir up financial development in the USA.
- To determine possible policy implications that can be made to promote agricultural productivity.

Research inquiries

With respect to the aforementioned aims, this study thus, places focus on providing answers to the following inquiries;

- Is there an interaction between agricultural productivity, oil prices, economic growth and financial development? If so, then how do oil prices, economic growth and financial development influence agricultural productivity?
- In an economy such as the USA, where much of the focus is devoted towards heavy industrial products such as oil and minerals, will the agriculture sector be in a position to thrive and maintain high productivity levels? If so, then how do oil shocks and volatile changes in oil prices affect agricultural productivity?
- Have developments in the US financial sector been capable of stimulating agricultural productivity or not? If not, then did any possible increases in

agricultural productivity stirred up financial development in the USA? This results in the formulation of the following null hypotheses;

- **H_1:** Positive developments in US financial markets did not cause an improvement in agricultural productivity.
- **H_2:** An increase in agricultural productivity did not necessitate positive developments in US financial markets.

- What are the possible policy implications that can be made to promote agricultural productivity?

Relevance of the study

The importance of the study lies in its potency to highlight that there exists a nexus linking agricultural productivity, oil prices, economic growth and financial development which acts to promote agricultural productivity. Furthermore, its propositions play a vital role in the attainment of millennium development goals, increase food security and alleviate poverty. Of notable effect is its recognition of the importance of financial and commodity markets stability in fostering agricultural growth, financial development and economic growth. Also, resolutions presented in this study, go a long way in assisting policymakers to devise sound financial development and economic growth-related policies. The research adds to the existing research on agricultural productivity, oil prices, economic growth and financial development.

Scope of the study

The research confines on the call to examine the nexus linking agricultural productivity, oil prices, economic growth and financial development. As such, it bases its examination, arguments and propositions on findings on the United States of America. The study also relies on the use of annual secondary data from the year 1962 to 2016 to estimate an ARDL model.

Structure of the study

This thesis will initially look at issues surrounding the essence of agricultural productivity and how it links with macroeconomic variables such as oil prices,

economic growth and financial development. Consequently, it identifies and deals with empirical gaps that have of long remained unaddressed. The second part of the thesis is devoted to the application of theoretical and empirical frameworks to assist in examining the nexus linking agricultural productivity, oil prices, economic growth and financial development. The third chapter provides an overview of agricultural productivity, oil prices, economic growth and financial development trends, issues, contributions and developments. The fourth chapter outlines the methodological approaches that were undertaken to estimate an agricultural productivity nexus model. The fifth chapter deals with the presentation of findings established from the estimation process while the final chapter looks at conclusions, recommendations and proposals tendered from the research.

CHAPTER ONE

LITERATURE REVIEW

1.1 Introduction

Academic studies often contradict with each either based on theoretical or empirical foundations. Thus, theoretical or empirical studies are a base on which a study can base its defence. This is however not limited to establishing support for established ideas or arguments but also as a way of identifying theoretical and empirical gaps. This chapter, therefore, seeks to identify theoretical and empirical gaps surrounding the existence of a nexus interaction linking agricultural productivity, oil prices, economic growth and financial development. It is also from these theoretical and empirical guidelines that discussion of findings will be centred on.

1.2 Theoretical insights on agricultural productivity and its drivers

The nexus between agricultural productivity, financial development, oil prices and economic growth can be best examined by looking at theories that examine how they interact with each other. Such an interaction is best illustrated by looking at the macroeconomic determinants of agricultural productivity. The notable theory that can best illustrate the required interaction is the high payoff input model. The relevance of this theory in this study is justified by the fact that it contends that there is a positive interaction that exists between agriculture growth, economic and financial stability, and macroeconomic variables. That is, it posits that there is an interdependence between economic, commodity market and financial stability, and macroeconomic variables which act to influence agriculture growth. This model is herein examined in details.

1.2.1 The high payoff input model

This theory offers an insight into the micro and macroeconomic factors that are required to boost agricultural productivity. The microeconomic aspects of the theory are based on the need to improve labour productivity while the macroeconomic aspects are based on efforts to provide high-payoff technology and other inputs. This theory thus shows that improvements in agricultural productivity are not solely based on microeconomic factors such as labour and capital. But rather on the existence of other external players and institutions which in this case are financial institutions which provide farmers with funds to acquire high-payoff technology (Udemezue & Osegbue, 2018). Also, research institutions will serve to provide farmers with the necessary technical and professional know how that is required to engage and boost agriculture productivity. Efforts to understand how such a theory explains the nexus between agricultural productivity, oil prices, economic growth and financial development can also be achieved by looking at the model assumptions. The theory is based on the following assumptions;

- Economic growth is determined by the availability and affordability of high-payoff technology.
- Financial investments in the agriculture sector are determined by the ability of farmers to effectively allocate and use resources.

The first assumption illustrates that there is an interaction that exists between economic growth and financial development. In the sense that, the financial sector provides farmers with loans which they use to acquire high-payoff technology.

This, therefore, implies that there is a positive association that exists between economic growth and financial development. Udemezue and Osegbue (2018) acknowledge that this assumption helps to explain why there exist differences in economic growth between poor countries and well-developed economies such as the United States of America (USA). That is, it contends that poor countries do not have access to high-payoff technology. As such, their ability to attain a high level of economic growth depends on their potency to acquire high-payoff technology. This is contrary to the USA which has a high availability of high-payoff technology and hence explains why its agriculture sector productivity and growth levels are high. This can thus be traced to the viability, growth and development of their respective financial

sectors. Implying that high growth economies have high agricultural productivity levels as a result of having well developed financial sectors.

It is also imperative to note that much of the high-payoff technology that is used in the agriculture sector rely on the use of petroleum products as a source of energy. This entails that oil shocks will impose severe negative effects on the agriculture sector. Binuomote and Odeniyi (2013) concurs with the idea and established that the same happened in Nigeria. If oil prices increase to a severe and unstainable level, they may trigger a financial crisis in the form of an oil bubble (Sornette, Woodard, & Zhou, 2009). Hence, it can be noted that stability in the financial and commodity markets is essential for a sound improvement in agricultural productivity.

The second assumption illustrates that investments in the agriculture sector are determined by the effective and efficient use of resources in the agriculture sector. Effective and efficient of resources are thus indicators which investors can utilise to make investment decisions. This also translates to a decline in non-performing loans allocated to the agriculture sector by the financial sector (Louzis, Vouldis, & Metaxas, 2012). Meaning that an increase in agricultural productivity improves the ability of farmers to repay back their agriculture loans leading to a decline in non-performing loans. Alternatively, banks can be said to benefit profit wise from an improvement in agricultural productivity.

The major challenge with this theoretical aspect is that it does not offer sound explanations about the roles played by educational and research institutions. However, this theory is a close reflection of real economic situations. This is because it acknowledges the importance and role of the government in influencing economic activities. It also emphasises the importance of maintaining stability in financial and commodity markets, and the economy at large. More so, it highlights that economic growth strategies targeted at improving agricultural productivity through the effective and efficient use of resources have positive implications for financial development. This, however, relies on financial, commodity markets and economic stability. This illustrates the existence of a nexus between agriculture growth, economic and financial stability, and macroeconomic variables.

1.3 The notion of agricultural productivity

Agriculture is one of the core pillars of economic growth and development and its contribution to economic growth and development is in the form of notable aspects. Among others, one can contend that agriculture contributes towards improving domestic incomes (Diao, Hazell & Thurlow, 2010), results in increased food supply (Onoja, 2017), results in a decrease in the prices of basic foodstuffs (Dercon & Gollin, 2014) etc. however, the capacity of agriculture to institute such effects is largely determined by the agricultural productivity. Studies often define agricultural productivity in terms of the total agricultural output that has been produced (Godfray et al., 2010; Rizwan-ul-Hassan1, 2017). However, agricultural productivity can be defined in quite a number of ways. For instance, Godfray et al. (2010) defined it as the capacity of agricultural farmers to produce more output using a given combination of labour and capital resources. Onoja (2017) defined agricultural productivity as the interaction between capital and labour inputs to influence agricultural output. However, in this study, agricultural productivity will be defined based on its capacity to reduce agricultural imports. This is because the USA has in the past experienced a high rise in agricultural imports. Hence, determining how agricultural productivity helps to curb a rise in agricultural imports will be of great essence in this study. Prior to this, an examination of the macro impacts of agriculture, its spillover effects and impact on poverty will be discussed in detail.

1.3.1 The macro impacts of agricultural growth

The essence of agriculture has had its contributions towards economic development recognised way back (Johnston & Miller, 1961). Notable ideas on the importance of agriculture are based on the assertion that agriculture has positive effects on consumption and production (Dercon & Gollin, 2014). But much of the impact of agriculture were assumed to be strictly confined towards assisting and developing rural communities (Johnston & Miller, 1961). For instance, Yazdani (2008) has in the past established that agricultural growth causes a simultaneous increase in rural income. On the other hand,

The importance of agriculture on the economy can also be established by using the Johnston-Mellor model. The model is based on assertions which pointed out that the high growth levels observed in Japan and Europe were highly linked to high agricultural growth levels (Dercon & Gollin, 2014). The World Bank Report (2008)

outlined that the early stages of economic growth and development of Sub-Saharan African economies are highly driven by high agricultural productivity. Moreover, goes a long way in promoting self-sustainability thereby reducing import expenditure. This is of paramount importance to less developed economies which might be struggling to attain high growth standards. This is because most less developed economies will be having high current account deficit and debts levels (Gollin, Parente & Rogerson, 2002). Hence, expending a lot of resources towards importing agricultural produce will exacerbate the situation.

It can also be noted that a fall in the prices of agricultural produce will have huge positive macroeconomic effects on inflation. This is highly true especially when considerations are made that the prices of foodstuffs, is the notable driver of inflation (Gollin, Parente & Rogerson, 2004). But the extent to which such an effect will reduce inflation is highly determined by the extent to which agricultural productivity will drive down the prices of non-agricultural products.

On a deeper perspective, the problem of high unemployment levels in both less and highly developed economies can be eased by promoting high agricultural growth and boosting agricultural productivity. A high number of unemployed individuals are considered to be residing in rural areas (Gollin, Parente & Rogerson, 2007). Since agricultural activities are highly concentrated in rural areas, promoting agricultural growth and productivity will thus help to ease rural unemployment problems.

On a more significant term, agricultural growth and productivity play an important role in poverty reduction (World Development Report, 2008). With the surging poverty levels especially in a high number of African countries, it, therefore, remains imperative that agricultural growth is used to alleviate poverty. This goes a long way in aiding towards the attainment of Millennium Development Goals (MDGs).

Care must also be placed on noting that improvement in agricultural productivity will also ease the pressure on international organisations such as the World Food Programme (WFP) and other international bodies. The WFP and other international stakeholders work together in dealing with food security challenges in Africa and other poor countries. Poverty thus places a huge burden on these organisations to provide food assistance to numerous countries. Hence, by promoting agricultural growth and productivity will have ripple effects on other international bodies. It can thus be

deduced that agriculture growth has positive the effects on third world countries and international bodies.

1.3.2 Agricultural growth spillovers to other sectors

In relation to the perspective that agriculture has spillover effects on other sectors, it can easily be summed up that the effects are on non-agriculture sectors. The dominant paradigm is in Tiffin and Irz (2006) states that agriculture growth has causal effects on economic growth.

McArthur and Sachs (2013) argue that improvements in agricultural productivity work towards driving down the prices of food stuffs. This is important because it has multiplier effects on other sectors. This can be reinforced by Dercon and Gollin (2014) who contends that a downward spiral of prices of agricultural products results in an expansion for the market of non-agricultural products. This is because a significant number of non-agricultural products and services are complementary to agriculture products. In addition, this will result in an improvement in the competitiveness of non-agricultural products.

There are also ideas which suggest that the growth of other sectors also tied to agricultural growth (Fan et al., 2000). This can be attributed that agricultural output forms an input in other sectors. Hence, a growth in the supply of agricultural produce will boost the supplier of resources into these sectors. Ultimately, the price of factor inputs into these sectors will fall and resource supply will increase leading to an increase in productivity. It is thus, in this regard that agriculture is considered to be having spillover effects.

On the other hand, investors often look at agricultural trends and how other sectors are performing in relation to changes in agricultural trends. As such, observations made by Fan et al. (2000) will thus help to explain why other sectors witness increases in investment levels following a growth in agriculture.

Another perspective from which agricultural spillover effects can be examined is in terms of backward and forward supply mechanisms. Block (1999) posits that industries which supply agriculture with resources will also benefit from agriculture growth and productivity.

He challenges with ideas concerning the simultaneous and endogeneity effects of a growth in agriculture is lack of empirical support. This is because the idea of agriculture having multiplier effects on other sectors is very subjective. For instance, a growth in other sectors might also be linked to a growth in other sectors which are separate from agriculture. In some cases, the growth in other sectors might be tied to unnoticeable changes in other different sectors. This is because there are certain changes or effects that are difficult to notice but yet they have notable effects on other indicators (Dercon & Gollin, 2014). The size of the multiplier effects also difficult to determine. Hence, conclusions can be made in respect of this argument that there is a need for considerable research to examine the spillover effects of a growth in agriculture.

1.3.3 Agricultural growth and its impact on poverty

The implications of agricultural productivity on poverty reduced are mainly centred on the notion at a lot of individuals obtain their income from agricultural activities (Diao, Hazell & Thurlow, 2010). A lot of individuals assume that promoting agricultural growth and development will result in farmers getting a lot of income from farming activities (Christiaensen Demery & Kuhl, 2011; Ravallion & Chen, 2007; Stifel & Thorbecke, 2003). By doing so, income growth from farming activities can thus be used as a means of sustaining lives. Apart from that, there are also nutritional and food security benefits that are associated with agricultural growth and development. All in all, these benefits act together to alleviate poverty

Despite the existence of ideas which contend that agriculture growth helps to alleviate poverty there are conditions to which such an idea will hold. For instance, Stifel and Thorbecke (2003) acknowledge that agriculture growth will cause a significant reduction in poverty on the condition that prices of agricultural produce either remain constant or increase. This is because a downward change in the price of agricultural produce will necessitate a reduction in farmers' disposal incomes. It is against this background that one can dismiss that agriculture has positive implications on poverty alleviation.

With a growing concern that land for agricultural production is declining on a surging rate, arguments can thus be levelled that the impact of agriculture growth on poverty is constrained (Ligon & Sadoulet, 2008). This accompanied by a growth in industrialisation and a high number of infrastructural development projects, notably

real estate, have been at the expense of agricultural growth. Under such a scenario, it becomes a daunting task to use agricultural growth and development as a strategy for tackling problems such as poverty and unemployment.

Also, the relationship between agriculture growth and poverty hinges on the distribution of poverty levels (Christiaensen Demery & Kuhl, 2011). That is, poverty levels are in most cases high is less developed countries as posed to developed countries. This implies that the impact of agriculture growth is more likely to be distributed unequally. For example, one cannot expect an increase in agriculture growth in Africa to have the same reduction effects on poverty in the USA. This also influenced by a series of economic activities such as industrialisation, financial and economic development etc. Ravallion and Chen (2007) echoed the same sentiments and established that the effects of agriculture growth are 4 times higher than those of non-agriculture-based economies.

Lastly, differences can also be observed between what may be interpreted as cause and effect. That is, the impact of agriculture growth on poverty is often interpreted in the form of elastic responses (Dercon & Gollin, 2014). As a such, the positive implication of agriculture growth does not entail that the relevant strategy will be in favour of agricultural investment.

1.4 Oil shocks and a plunge in oil prices

Foremost, the impact of oil prices on any economy is in most cases determined by whether the country is an oil-producing economy or not. That is, oil producing economies will to some relative extent benefit from an increase in oil prices through increased foreign currency inflows (Mohaddes & Pesaran, 2017). However, this must be weighed against the impact of changes in oil prices on other macroeconomic variables. Bernanke (2016) agrees with this idea and contends that it is not every oil producing economy that benefits from an increase in oil prices. Such differences are attributed to structural and economic differences between oil producing economies. Hence, this can pose effects on the examination of the nexus between oil prices and other macroeconomic variables. This, therefore, serves as one of the secondary aims and significance of this study. As a result, the study seeks to examine how structural and economic conditions in the USA influence nexus between oil prices and other

macroeconomic variables. This, however, requires a deeper understanding of what drives oil prices and examining possible changes in oil prices that have taken place in the past years. This leads to two important aspects of oil shocks and a plunge in oil prices.

Oil shocks are in most cases the main cause of an oil crisis and a sudden upward spiral in oil prices that is accompanied by a reduction in oil supply is known as an oil crisis (Obstfeld et al., 2016). Under normal circumstance, an increase in oil prices poses severe negative effects on the global economy. This is because oil serves as a major source of energy and hence disruptions in supply caused by high prices will affect both global production and consumption activities.

The first oil crisis took place in the year 1973 following efforts by OPEC members from the Arab community to hike oil prices 4 times to US$12/barrel (Bernanke, 2016). This had severe effects on highly industrialised economies such as those in Europe including Japan and the USA. It is estimated that global oil consumption in Europe including Japan and the USA accounts for more than 50% of the world's energy (Obstfeld et al. 2016). This problem was further compounded by the fact that exports to these three major oil consuming nations were being restricted from the onset of the crisis (Chudik & Pesaran, 2016). The 1973 oil crisis was significantly blamed on the falling value of the US dollar which is the denominated currency for oil sales. But the resultant effect was a recession which was followed by inflation. Efforts were made to restructure the affected economies as fears grew that a high dependency on oil production would further plunge economies into a doldrum.

The second oil crisis took place in 1979 following the occurrence of the Iranian revolution which led to severe destruction of Iran's oil industry. This was further compounded by the Iraq-Iraq war which took place between the period 1980 to 1988 (Chudik & Pesaran, 2016). During this period the price of oil went up to US$32/barrel (Mohaddes & Pesaran, 2017).

In spite of the 1973 and 1979 oil crises which drove prices up, the plunge of oil prices in 2016 had stern downward effects on oil prices. In 2016, the price of oil went down to US$35/barrel from US$115/barrel in 2014 (Kilian, 2014). The drop-in oil prices were much attributed to a supply glut. That is, too much oil being supplied on the market way much more than what the market could handle and this was against falling

demand for oil. The plunge in oil prices had contagion effects on the financial sector and the prices of most commodities started going down. in addition, most non-oil producing economies suffered a decline in export levels as oil-producing countries started cutting down their import expenditure. This is because much of the exports from oil-producing economies such as Iraq and USA were mainly financed by oil revenue (Kilian, 2014).

From these observations, it is therefore imperative to note that changes in oil prices are either as a result of a crisis that drives prices up or a plunge in oil prices. The effects of these two scenarios on economies are totally different. Hence, in some cases, a unilateral relationship between changes in oil prices and other economic variables can be observed while in other cases the opposite is true. This can be supported from insights obtained from a study by Mohaddes and Pesaran (2017) which exhibited that there is a negative association between oil prices and economic growth. However, contrasting observations were made by Nazir (2015) who established that there is a unilateral association between oil prices and economic growth in the short run. Hence, much of the long-term policies should be centred on hedging against the effects of rising oil prices. Considerations must be placed also to notice that the effects of changes in oil prices also poses effects on a significant number of macroeconomic variables. This can thus assist in identifying and outlining the possible nexus that exists between oil prices and macroeconomic variables.

1.5 The changing context of economic growth and its drivers

Economic growth is one of the most essential topics in national and global economics and much of the problems and economic gains are being attributed to variations in economic growth (Bouis, Duval & Murtin, 2011). With gross domestic product (GDP) serving as an indicator of economic performance, economic policymakers usually devote significant effort towards maintaining growth levels above sustainable levels. Failure by economic agents to maintain GDP growth levels above these sustainable levels can have disastrous effects on an economy. For instance, a recession is widely believed to be an indicator of economic failure by the government to stir the economic towards the desired path (Warr & Ayres, 2012).

It is worthy to note also that economic performance is also an indicator of economic development and this is what is separating rich economies from poor economies. Moreover, it is the desire of any economy to attain high growth levels at all costs. However, the global economy has gone through a lot of periods of numerous and significant changes. As a result, what is currently driving economic growth nowadays is totally different from what used to stir growth in the past 40 years. Such changes have been observed to be either posing severe challenges on other economies especially less developed economies (Kramin et al., 2014). On the other hand, highly developed economies seem to have gotten better in the midst of these changes (Dao, 2014).

Successful policies designed to stir economic growth and development can thus be effective when governments are fully aware of the prevailing major drivers of economic growth. For instance, Fatas and Mihov (2009) discovered that more than 70% of the world output is being produced by rich economies. Fatas and Mihov further contended that such as an ability to dominate in terms of global output production is what is causing rich economies to become richer (2009, p.1). Thus, if poor economies are to learn from rich economies, then an examination is needed to look at major drivers of economic growth in rich and well-developed economies.

Meanwhile, the USA has risen significantly as an economic powerhouse followed by China and their share of the world output is assumed to have exceeded 50% in 2015 (Fatas & Mihov, 2009). The changing context of economic growth and its drivers has mainly driven by four aspects and these aspects are;

- **Innovation:** Innovation is much linked to new products and technology but in reality, it goes beyond developing new products and technology. Vella (2018) echoed the same sentiments and established that innovation mainly deals with the development of new ways of producing commodities and delivery services. That is, coming up with better organisation, production and management methods. Innovation is also linked to productive and technical efficiency (Fatas & Mihov, 2009). The more economies produce (mass production) at a lower cost (productive efficiency), the more resources will be expended towards the production of other commodities. Hence, highly innovative economies such as the USA are in a strong position to expend more resources to the production of

other commodities as a result of innovation. This also results in an increase in foreign currency inflows as more output is exported at lower prices. The domestic economy benefits a lot from a reduction in domestic prices (disinflationary effects) and income growth.

- **Investment:** Investment is a key catalyst to economic growth and development and this is one of the main reasons why countries around the world desire to lure foreign direct investments. This can be supported by observations made by Fatas and Mihov, (2009) which exhibited that economic convergence and divergence as a result of differences in investment levels. That is, it is believed by Kramin et al. (2014) that economies that are in a position to secure investment will converge at the same rate as the USA and other G7 economies (2009, p.7). this implies that economies that cannot access the required investment level will diverge and become poorer. Such an observation can thus aid in explaining differences in economic growth and development between rich and poor economies. A growth in investment can thus, be said to act in favour of economic growth and development. But the effective distribution of investment funds requires that the financial sector be well-developed. This brings us to the third driver of economic growth.
- **Institutional environment:** The institutional environment must be conducive for both private and public corporations to undertake production activities. Much of the challenges that hinder economic growth are as a result of a volatile macroeconomic environment that makes it difficult for corporations to thrive (Bouis, Duval & Murtin, 2011). A conducive institutional environment thus requires that governmental institutions be capable of fostering macroeconomic stability. This can be accomplished by providing incentives for economic players to foster stability. But a notable role must be played by the government through enacting policies, rules and regulations that encourage transparency, technological innovation, efficiency and human capital investment and development. Bouis, Duval and Murtin (2011) further outlined that the other key strategy that can be used to foster institutional stability is promoting financial development (Vella, 2018). This is because financial institutions work towards providing the much-needed funds to support production and consumption activities. This strategy thus links economic growth to financial development

and the interaction of these two aspects can also be linked to other economic indicators such as agricultural productivity and dealing with the effects of oil changes in oil prices. Institutional stability also extends to include how government deal with economic catastrophes such as a financial crisis. Inability to deal with economic challenges such as oil shocks and financial crisis can thus be seen as affecting a wide number of economic indicators. This, therefore, leads us back to the idea of a nexus between agricultural productivity, oil prices, economic growth and financial development and incorporating the effects of a financial crisis.

- **Initial conditions:** There is an idea that initial economic conditions are a major determinant of future growth potential (Dao, 2014). Warr and Ayres (2012) also shared the same sentiments and expressed that either initial convergence or divergence conditions will provide a strong indication of an economy's growth potential. That is, poor countries will be capable of growing faster when they are aligned to convergence patterns of well-developed economies. The same applies to rich economies and their prospects and determined by their ability to remain on a convergence path.

Using ideas derived from the given drivers of economic growth, it can be noted that innovation is required to stir both financial and economic growth and development. But efforts to attain high levels of economic performance (high GDP levels) are determined by the availability of investment funds. Of which the effective distribution of investment funds requires that the financial sector be well developed to source and distribute funds. All these activities must be done in an economic environment that is free from economic misfortunes posed by oil shocks and financial crises. In conclusion, these aspects can thus be said to be illustrating that economic activities do not act independently of each other but rather interact together in the form of a nexus.

1.6 The ever-significant role of financial development in modern economics

The notion of financial development revolves around the need to execute transactions, enforce contracts and the existence of information costs (Merton & Bodie, 2004). These three elements work together towards making it difficult for economic players

to engage in consumption and production activities. As a result, financial development is thus meant to deal with the problems posed by the need to execute transactions, enforce contracts and the existence of information costs. The resultant effect of such efforts is the emergence of financial intermediaries, markets and legal systems (Jorgenson, 2005). Thus, any financial development strategies that incorporate these aspects together will significantly have an important bearing on economic outcomes. For instance, the setting up of financial institutions to offer information about market activities will certainly affect credit provision. On the other hand, things like financial contracts serve as an assurance that investors are guaranteed to recoup their investments from investments made in other businesses. But the roles played by financial institutions also extended to include the provisions of facilities that allow customers to deposits their savings with banking institutions (Morales, 2003). Acemoglu, Aghion, and Zilibotti (2003) also acknowledged that the role of financial institutions is to facilitate investments between firms and investors.

The above-given details on financial development can help to assist in defining financial development. Financial development can thus be defined as the use of financial instruments by financial intermediaries on financial markets with the sole aim of dealing with information and transaction costs. It is from this definition that we can establish the roles of financial institutions in an economy. These roles help in examining the nexus between financial development and other macroeconomic variables.

- **Mobilize and pool savings:** Deposit-taking institutions normally thrive on deposit made by customers in the form of savings. The existence of information and transactions costs make it feasible for individuals and corporations to save their funds with financial institutions. Banks will intron use those savings to issue loans to other individuals and corporations in need of funds. When related to agricultural productivity, it can thus be established that banks help farmers to acquire agricultural inputs by either securing loans and other financing options. Banks will generate revenue by levying interest rates and service fees on loans issued to customers. As a result, an increase in savings is positively related to bank profitability (Morck, Wolfenzon & Yeung, 2005).
- **Facilitate trading, diversification, and management of risk:** A significant number of the roles of financial institutions are linked to the need by financial

institutions to provide funds, economic agents. Boyd and Smith (1992) also concur with this idea and outlined that activities such as trade can be an expense to undertake due to shortages of funds. Financial institutions, therefore, serve as a source of funds. This can prove to be too handy especially in the trading of agricultural products which has to be done across different geographical boundaries. In addition, banks can issue securities which individual farmers and other economic agents can use to diversify their investments (Acemoglu & Zilibotti, 1997). This is of paramount importance, especially when considering that commodities and other investments can suffer losses.

- **Monitoring investments and enforcing good corporate governance standards:** The existence of financial institutions is primarily centred on the need to assist economic agents in securing funds either to finance consumption or production activities. However, the extent to which banks will allocate funds to individuals and institutions hinges on credit risk. That is the risk profile of the respondents. Different individual and corporations have different risk profiles and banks must first assess the creditworthiness of the financial recipient before granting funds (Wurgler (2000). In doing so, banks therefore directly monitor and influence the use of funds and this imposes effects on savings and the allocation of funds. Also, banks are obligated by creditors and investors to maximise firm value and this causes banks to initiate measures to improve bank efficiency (Morales, 2003). This causes banks to institute good corporate governance practices. Failure to do so can cause to lose on the supply of credit and investment funds. Hence, banks help to monitor funds and enforce good corporate governance standards.
- **Allocating capital and provide investments information:** The existence of financial institutions is in contrary to the assumption of the theory of perfect competition which assumes that there is perfection information (Morck, Wolfenzon & Yeung, 2005). In reality, this does not hold and it can actually be noted that there exists some level of information asymmetry. The problem of information asymmetry always manifests itself in the form of information and search costs and such costs can be exorbitant for firms to handle. It is important to note that savers are reluctant to save when they lack the necessary

information and the same applies to investors. Hence, if savers and investors are to make sound decisions, then they must first acquire and process the necessary information. But the challenge is that acquiring and processing information can be costly and time-consuming (Caprio & Levine, 2002). Such costs and time lost acquiring and processing information can thus be reduced by involving financial institutions. By providing information at a relatively low cost, financial institutions can thus assist firms and individuals to make rational decisions. In doing so, they will thus improve the allocation of resources among economic activities. As noted from a study by Wurgler (2000), the efficient allocation of resources in an economy is positively linked to upwards changes in economic growth. The ability of financial institutions to allocate funds among productive sectors of the economy and to rational individuals is also positively related to economic growth. This, therefore, illustrates that there is a positive interaction that exists between financial development and economic growth.

1.7 The ravaging effects of a financial crisis

One of the notable misfortunes that can affect an economy is a crisis. In economic terms, there are two notable terms that can be used to describe a crisis. That is an economic crisis and a financial crisis. The major difference between the two types of crises is that a financial crisis is mainly characterised by a series of shocks in the financial markets which lead to a decline in the value of asset prices and increased insolvency among financial players (Burger et al., 2009). The discrepancy is usually in the form of disturbances in the allocation of capital. It is imperative to note that there four different types of financial crises. A financial crisis can either be in the form of a situation where the government is stuck in a huge debt situation (Debt crisis), (Puri, Rocholl & Rocholl, 2011). Campello, Graham and Harvey (2010) also outlined that an economy can be stuck in a situation which is characterised by a sudden stop in current account inflows (sudden stop). A financial crisis can also be in the form of a bank run. Hurd and Rohewedder (2010) characterised a bank run as a situation in which panic behaviour among bank customers causes them to continuously withdraw a lot of funds from banks. A financial crisis can also be in the form of a foreign currency crisis which involves a continuous decline in the value of a currency (Song & Lee, 2012).

Irrespective of the type of a financial crisis that may be prevalent in an economy, it is undoubtedly that a financial crisis imposes severe repercussions on an economy. Such effects are not limited to economic conditions but also extend to include social repercussions. For instance, Song and Lee (2012) hinted that investment levels usually drop down significantly in economies affected by a financial crisis. Nobi et al. (2014) concurs with this idea and contends such effects are attributed to a decline in productivity levels. Due to disruptions in the allocation of capital, most firms usually find it difficult to sustain operations when experiencing a financial crisis. All these effects always connect together leading to a huge decline in economic performance. That is, economic growth levels are bound to plummet as the financial crisis prolongs its duration. This is one of the most severe economic effects of a financial crisis. Economic downturns will hinder the economy in several ways as the ripple effects of a financial crisis spread to other economic sectors. One can also point out that real incomes tend to fall during the midst of a financial crisis (Allen, 2011). This can be attributed to the fact that a financial crisis is associated with a sudden increase in prices (inflation), (Aloui, Aissa & Nguyen, 2011). If not contained, then the problem of income inequality is more likely to take effect in the affected economy. This may, in the long run, lead to increased poverty. Furthermore, numerous individuals can also lose their jobs and leading to a surge in the unemployment rate. At this stage, policymakers and individual members would be seeking a quick remedy to get out of the crisis. Failure to do so will cause social unrests and political instability.

Observations can thus be made that a financial crisis is not a good economic phenomenon and that its occurrence poses stiff economic and social repercussions. Though a financial crisis is usually associated with a decline in asset prices, its effects also spread to affect a lot of economic indicators such productivity, economic performance, investment, unemployment, poverty, development, human development. This, therefore, entails that the effects of a financial crisis are not limited to the financial sector but will also spread to affect the agriculture sector. Such an ability to affect another economic sector can thus be said to be a nexus. Hence, it can be concluded under this section that the prevalence of a financial crisis has its effects linked to other economic sectors.

1.8 Empirical studies on agricultural productivity, financial development, oil prices and economic growth

A decomposition of the nexus between agricultural productivity, financial development, oil prices and economic growth helps to shed a light on how these variables interact together. Thus, empirical examinations were made in relation to how financial development, oil prices economic growth and a financial crisis individually interact with agricultural productivity.

1.8.1 The nexus between agricultural productivity and oil prices

Olomola and Adejumo (2006) established that oil price shocks have an impact on macroeconomic activities. Their results were based on the application cointegration and Variance decomposition in Nigeria suing data from 1970 to 2003. The findings revealed that there is cointegration linking oil prices with agricultural productivity. This entails that oil shocks will pose huge effects on the USA' agriculture sector. In addition, the study also established that an increase in oil prices will result in a decline in agriculture's industrial production index. Hence, it can be expected that an increase in oil prices will reduce the USA's agricultural productivity.

Nazlioglu and Soytas (2012) used cointegration and causality to determine the existence of a nexus linking oil prices and agricultural commodity prices. Based on the established cointegration results, it was discovered that an increase in oil prices causes an increase in the price of agricultural products. The results also showed that the depreciation of the US dollars makes it cheaper to buy agricultural products. This therefore serves as confirmation that an increase in oil prices results in an increase in agricultural costs. Such costs are either in the form of input and transportation costs. The fact that the value of the US dollar determined the price of agricultural products entails that there is always a nexus that that links agricultural productivity with macroeconomic variables.

Binuomote and Odeniyi (2013) used a VECM in the contextual situation of Nigeria to examine the implications of changes in crude oil price on agricultural productivity. Their study concedes that the increase in crude oil prices has ripple effects on other economic indicators such as the size of land, quantity of labour and exchange rate. The established results reinforce that volatile increases in crude oil prices tend to

hinder agriculture productivity. Hence, we can expect a similar effect in the context of USA.

Wang and McPhail (2014) concentrated on the use of a structural VAR to examine how energy shocks affect US agricultural productivity growth and commodity prices. it was discovered from their study that energy shocks can be classified as either supply or demand shocks. This entails that the impact of energy shocks is determined by the type of energy shocks prevalent in the economy. In such a case, it infers that the impact of oil prices will also vary with the type of oil shocks affecting the economy. This can be reinforced by their established results which provided evidence of the existence of an inverse association between oil prices and productivity.

McFarlane (2016) used a VECM to analyse the effect of oil prices on agricultural productivity in USA during the period 1999-2005 and 2006-2012. The results are in strong support of the existence of cointegration linking oil prices with agricultural productivity. However, the strength of the linkage varies with the period under consideration. This implies that time periods that are characterised with structural breaks such as oil shocks and financial crises tend to experience a different nexus. Hence, expectations are that the financial crisis experienced in USA will pose diverse and severe effects on agricultural productivity.

Table 2.1: Summary of the nexus between agricultural productivity and oil prices

Study	Methodology	Variables	Findings
Olomola and Adejumo (2006)	Cointegration and Variance decomposition, Nigeria (1970-2003)	Consumer price index, price level, industrial production index, real GDP	Consumer Price Index, price level, real GDP and agriculture Industrial Production Index are cointegrated in the long run.
Nazlioglu and Soytas (2012)	Cointegration and causality (January 1980-February 2010)	Oil prices, agricultural commodity prices, US exchange rate	Negative relationship between exchange rate and agricultural prices. Positive relationship between agricultural prices and oil prices
Binuomote and Odeniyi (2013).	VECM, Nigeria (1981-2010)	Amount of fertilizer, size of land, quantity of labour, the price of crude oil, exchange rate and gross domestic product from the agriculture sector.	Oil prices have negative effects on agricultural productivity. The amount of fertilizer, size of land, the quantity of labour and exchange rate are positively related to agricultural productivity.
Wang and McPhail (2014)	Structural VAR, USA (1948-2011)	Productivity growth, commodity price and energy price.	Energy shocks can be classified as either supply or demand shocks. The impact of oil prices will also vary with the type of oil shocks affecting the economy.
McFarlane (2016)	VECM, USA (1999-2005 and 2006-2012)	Agricultural productivity and oil prices	Strong cointegration in the first period and weak cointegration in the second period

1.8.2 The nexus between agricultural productivity and economic growth.

Gunawardena (2012) used a CGE model to analyse the effects of agricultural productivity on the Sri Lankan economy. Gunawardena argued that the effects of

agricultural productivity on economic growth are transmitted through productivity, prices, and employment. The variables provide insights that both micro and macroeconomic variables have important implications on agricultural productivity. This was reinforced by the established results which showed that agricultural productivity and employment have positive effects on economic growth.

Amone (2014) did a study that focused on proving that agricultural productivity has effects on quite a number of macroeconomic indicators. As a result, Amone established that agricultural productivity causes positively changes in employment, food security, poverty alleviation, economic growth and human development. This provides support that improvements in agricultural productivity will help to stir economic growth and development. Hence, we can expect a similar effect in USA. Amone also established that the relationship between Agricultural productivity and economic growth is a two-way relationship. This implies that efforts to promote economic growth will also cause an increase in agricultural productivity.

Ismail and Kabuga (2016) used a VECM to test the effects of agricultural productivity on economic growth in Nigeria from the period 1986 to 2015. The study managed to establish the existence of cointegration among agricultural output, economic growth and labour force. It was also established that positive developments in the labour and agriculture markets will lead to an increase in economic growth. This suggest the importance of the need to instil institutional stability in the economy. Arguments of our study are based on the need to prove that economic growth can also cause an increase in agricultural productivity.

Awoyemi, Afolabi and Akomolafe (2017) did an impact analysis between agricultural productivity and economic growth in Nigeria using an ECM approach. The study mainly argued that a significant variation in agricultural productivity is mainly influenced by microeconomic indicators. The study established that economic growth is positively cointegrated with agricultural value added, agricultural labour productivity and agricultural productivity. However, our arguments are based on the idea that agricultural productivity is also determined by the interaction between macroeconomic variables. This study thus seeks to prove that that agricultural productivity is also determined by the interaction between macroeconomic variables.

Amire (2016) incorporated both micro and macroeconomic determinants of agricultural productivity on economic growth using an OLS approach and time series date from 1981 to 2015. The study argued that the effective contribution of the agriculture sector on economic growth is determined by the influence of both micro and macroeconomic determinants of agricultural productivity. This therefore reinforces the importance of the financial sector in providing funds to acquire high input payoff technology. In addition, GDP can be said to increase on the condition that there is an effective use of agricultural resources.

Table 1.2: Summary of the nexus between agricultural productivity and economic growth

Study	Methodology	Variables	Findings
Gunawardena (2012)	static multi sector Computable General Equilibrium (CGE) model, Sri Lanka	Employment, prices, productivity and economic growth.	Agricultural productivity has positive interactions with other economic sectors. Overall, agricultural productivity causes an increase in economic growth.
Amone (2014)	OLS, Uganda	Agricultural productivity, unemployment, food security, poverty, economic growth and human development.	Agricultural productivity has positive effects on employment, food security, poverty, economic growth and human development.
Ismail and Kabuga (2016)	ARDL, Nigeria (1986-2015)	Agricultural output, economic growth and labour force	Positive developments in the labour and agriculture markets will lead to an increase in economic growth.
Amire (2016)	OLS, Nigeria	Bank credit, expenditure on agriculture, GDP contribution of the agricultural and GDP	There is positive relationship between economic growth and bank credit, expenditure on agriculture, GDP contribution of the agricultural
Awoyemi, Afolabi and Akomolafe (2017)	ECM, Nigeria (1981-2015)	Economic growth, agricultural value added, agricultural labour productivity and agricultural productivity	Economic growth is positively cointegrated with agricultural value added, agricultural labour productivity and agricultural productivity.

1.8.3 The nexus between agricultural productivity and financial development

Yazdani (2008) applied a VAR model on data ranging from the year 1979 to 2005 to examine the interaction between financial market development and agricultural economic growth in Iran. The results exhibited that trade, growth, interest rate, capital formation, financial development have a significant impact on agriculture growth.

Muhammad Adnan and Wizarat (2011) did a study that looks at the impact of financial liberalization on agricultural growth in Pakistan using an ARDL model. It was established that there is a long run cointegration between financial liberalization index, real interest rates and agricultural productivity. The results also showed that a long run increase in real interest rates has a negative effect on agricultural productivity. This entails that the financial sector can only cause positive developments in the agriculture sector provided that the change favours agricultural productivity. This serves as a point upon which positive implications of financial development on agricultural productivity can be dismissed.

Asghar and Chughtai (2012) applied the OLS regression model to analyse the impact of providing agricultural credit on the production of wheat in Pakistan. Significant focus was placed on the role played by microeconomic variables such as pesticide, fertiliser and agriculture seed. The estimation process also included efforts to examine how providing credit to farmers helps to enhance farm productivity. The study provided strong arguments that an effective use of farming resources requires an equitable provision of capital funding. Hence, it is always important to ensure that farmers have access to the required lines of credit.

Shahbaz et al. (2013) used an ARDL model to examine how financial development affects agricultural growth in Pakistan. Using an ARDL model on time series data from the year 1971-2011, the results established that there exist long-run cointegration between labour, capital, financial development and agriculture growth. The results also reinforced the argument that financial development has positive effects on agriculture growth. Hence, expectations can be made that the highly developed US financial sector will stir huge positive effects on agricultural productivity.

Dhrifi (2014) focused on examining the effects of financial development on agriculture on 44 African countries using a GMM panel data estimation approach. Dhrifi argues that the effects of financial development on agriculture vary with the continent. As a

such, the results illustrated that financial development has no positive implications on agricultural productivity in African countries. This implies that financial development is more likely to have positive implications for agriculture in the USA. This is because the USA has a well-developed financial sector that is capable of providing the agriculture sector with the required funds and services at affordable rates. The study also contends that the effective functioning of financial institutions is of paramount importance to the growth and productivity of the agriculture sector. This implies that anything such as a financial crisis and oil shocks that can hinder financial development will hinder agricultural productivity and economic growth.

Rizwan-ul-Hassan (2017) used a VAR model to analyse the influence of agricultural development in Pakistan from the year 1981 to 2015. The results illustrate that the interaction between agriculture growth and financial development requires positive changes in financial access, capital and labour. The results, therefore, provide strong evidence of the essential role of financial development in stirring agricultural productivity.

Table 1.3: Summary of the nexus between agricultural productivity and financial development

Study	Methodology	Variables	Findings
Shahbaz et al. (2013)	ARDL model in Pakistan (1971-2011)	Labour, capital, financial development and agriculture growth.	Long run cointegration between Labour, capital, financial development and agriculture growth. Financial development has positive effects on agriculture growth.
Dhrifi (2014)	GMM on 44 African countries (1990-2012)	Technological innovation, institutional quality, financial development and agriculture productivity	Financial development has no positive implications on agricultural productivity in African countries.
Rizwan-ul-Hassan (2017)	VAR model in Pakistan (1981-2015)	Agriculture growth, financial access, financial development, capital, labour.	Positive association between agriculture growth and financial access, financial development. Positive association between agriculture growth and labour.
Yazdani (2008)	VAR model in Iran (1979-2005)	Trade, growth, interest rate, capital formation, financial development, and real per capita formation GDP	Trade, growth, interest rate, capital formation and financial development have a significant impact on agriculture growth.
Asghar and Chughtai (2012)	OLS in Pakistan	Pesticide, fertiliser, seed and credit to farmers	Pesticide, fertiliser, seed and credit to farmers are positively related to agricultural productivity.
Muhammad Adnan and Wizarat (2011)	ARDL model in Pakistan	Financial liberalization index, real interest rates and agricultural productivity.	Long run cointegration between financial liberalization index, real interest rates and agricultural productivity. A long run increase in real interest rates has a negative effect on agricultural productivity.

1.8.4 The nexus between agricultural productivity and a financial crisis

Coyle et al. (1998) conducted an examination of the impact of how the Asian crisis affects the U.S. Agriculture. Much of the arguments were based on ideas that a financial crisis disturbs the distribution of credit to the agriculture sector. The challenge also occurs when the prices of factor inputs increases and this tends to cause an increase in production costs. This implies that there is a greater need to deal with high input costs.

Shane and Liefert (2000) did a study that examines the possible existence of relationship linking a financial crisis to agriculture. The study established that a financial crisis has linkages that are connected to interest rates, GDP growth and exchange rate. These linkages were considered to cause changes in agricultural exports and imports. But these are not the only macroeconomic linkages that exist. Shane and Liefert also acknowledge this and consider that care must be placed at examining the existence of other macroeconomic variables. Hence, their study serves as a base upon which study is based. That is, to examine the existence of linkages between agricultural productivity and other macroeconomic indicators.

Dia and Roe (2000) did a qualitative analysis of the impact of the financial crisis on agriculture. The study demonstrated that the financial crisis has ripple effects on an economy but much of the effects are also observable in the agriculture sector. In addition, their findings showed that equilibrium in agriculture markets does not remain stable during a financial crisis. Their findings implied that a disturbance in agricultural equilibrium resulted in adverse economic responses such as inflation and a decline in economic growth. This, therefore, entails agricultural productivity is linked to economic performance and market stability. Furthermore, such a link will mainly exist to drive down economic performance and increase the price of factor inputs.

Kumar, Shino and Joshi (2010) conducted a study that looked at the impact of the global economic crisis on agriculture in India. Their study argued that the global financial crisis had severe effects on a lot of economies. Their study also argues that the effects of the global economic crisis managed to spread to quite a number of countries including India. In their defence, Kumar, Shino and Joshi established that agriculture is one of the vulnerable sectors of the economy that can easily suffer from the effects of an economic crisis. This is possible because much of the focus is turned

towards other notable sectors and industries whose contributions to GDP is very high. As a result, agricultural productivity will decline and this problem can be rectified by increasing financial investments in agriculture.

Deepak (2012) also conducted a similar study in India but based much focus on the effect of both the economic crisis and financial crisis on agriculture. The study established that the effects of economic and financial crises on agriculture are determined by institutional factors. Observations made in India showed that the prices of most agricultural products remained stable. This helps to explain why some countries suffer a lot from the effects of economic and financial crises on agriculture. This, therefore, provides strong evidence that economic stability is the key to improving agricultural productivity.

Ahmed and Said (2012) did an examination of the performance of agricultural exports during the occurrence of a financial crisis. The findings revealed that there is a positive interaction between agricultural productivity related elements and economic growth. The results also showed that competition from both the formal and informal sectors can hinder agricultural productivity. This shows that other sectors have got an influence on agricultural productivity and this signals the existence of a nexus linking agricultural productivity financial stability and other macroeconomic factors.

Table 1.4: Summary of the nexus between agricultural productivity and a financial crisis

Study	Methodology	Variables	Findings
Coyle et al. (1998)	Qualitative	Agricultural productivity and financial crisis	Financial crisis can disturb the distribution of credit to the agriculture sector. An increase in input cost can hinder agricultural productivity.
Shane and Liefert (2000)	Qualitative	interest rates, GDP growth and exchange rate, agricultural exports and imports	Positive changes in GDP and exchange rate are more likely to lead to an increase in agricultural imports. An increase in interest rates and adverse changes in GDP and exchange rate will lead to a possible increase in agricultural exports.
Dia and Roe (2000)	Qualitative	Financial crisis and agriculture	A financial crisis tends to disturb agricultural equilibrium and this stirs up negative outcomes such as inflation. The prices of factor inputs rise in response to an increase in inflation.
Kumar, Shino and Joshi (2010)	India, qualitative	Global economic crisis and agriculture growth	Economic crises are detrimental to agriculture growth and development
Deepak (2012)	India, qualitative	Economic crisis, financial crisis and agriculture	The effects of economic and financial crises on agriculture are determined by institutional factors.
Ahmed and Said (2012)	OLS, Pakistan	Competition from formal sector, Competition from informal sector, Export status, Access to finance,	Positive interaction between agricultural productivity related elements and economic growth. but competition from both the formal and informal sectors can hinder productivity.

1.9 Summary of empirical studies

An examination of the existence of a nexus between agricultural productivity, financial development, oil prices and economic growth was made done using existing theoretical and empirical frameworks. Deductions were made that agricultural productivity can be measured in several ways but care should be placed on incorporating other aspects such as imports. This is because relying on one indicator can prove to be biased or may fail to meet the required standards. It is in this regard that a reduction in agricultural imports was determined to be the best-fit measure of agricultural productivity in the USA.

Agricultural productivity does not only revolve around the interaction of macroeconomic indicators such as labour and the prices of basic inputs but also on macroeconomic aspects. Macroeconomic aspects such as economic growth, financial development, oil shocks and financial instabilities (financial crisis) can disrupt agricultural productivity. All these aspects work together to influence agricultural productivity. Hence, a nexus can be said to exist linking agricultural productivity, oil prices, economic growth and financial development.

Continued investment in agriculture relies on how effective farmers are utilising agricultural inputs and financial resources. This, however, relies on the availability of high payoff technology which can be financed by securing funds from the financial market. Securing funds to acquire high payoff technology will result in an increase in economic growth through increased agricultural productivity. It can also be noted that there is a positive interaction between financial development and economic growth. This suggests that there is a bilateral causality between financial development and economic growth. However, changes in oil prices and the presence of a financial crisis tend to hinder positive developments in agriculture. The challenge is that oil is a major source of energy in the agriculture sector and increases in oil prices can hinder agricultural productivity. The effects of increases in oil prices also have multiplier effects on financial development and economic growth.

Overall, improved economic performance, financial development, financial market and oil prices stability all interact together to influence agricultural productivity. A significant number of studies have concentrated on examining the individual effects but the effects can be combined together. This is what most studies do not address and

observations have been made the possible existence of a nexus linking agricultural productivity, oil prices, economic growth and financial development is very high. The challenge is that it remains unexplored. This study thus seeks to address this deficit by examining the existence of a nexus linking agricultural productivity, oil prices, economic growth and financial development is very high. This will be done in relation to one of the fastest growing nations in the world, the USA.

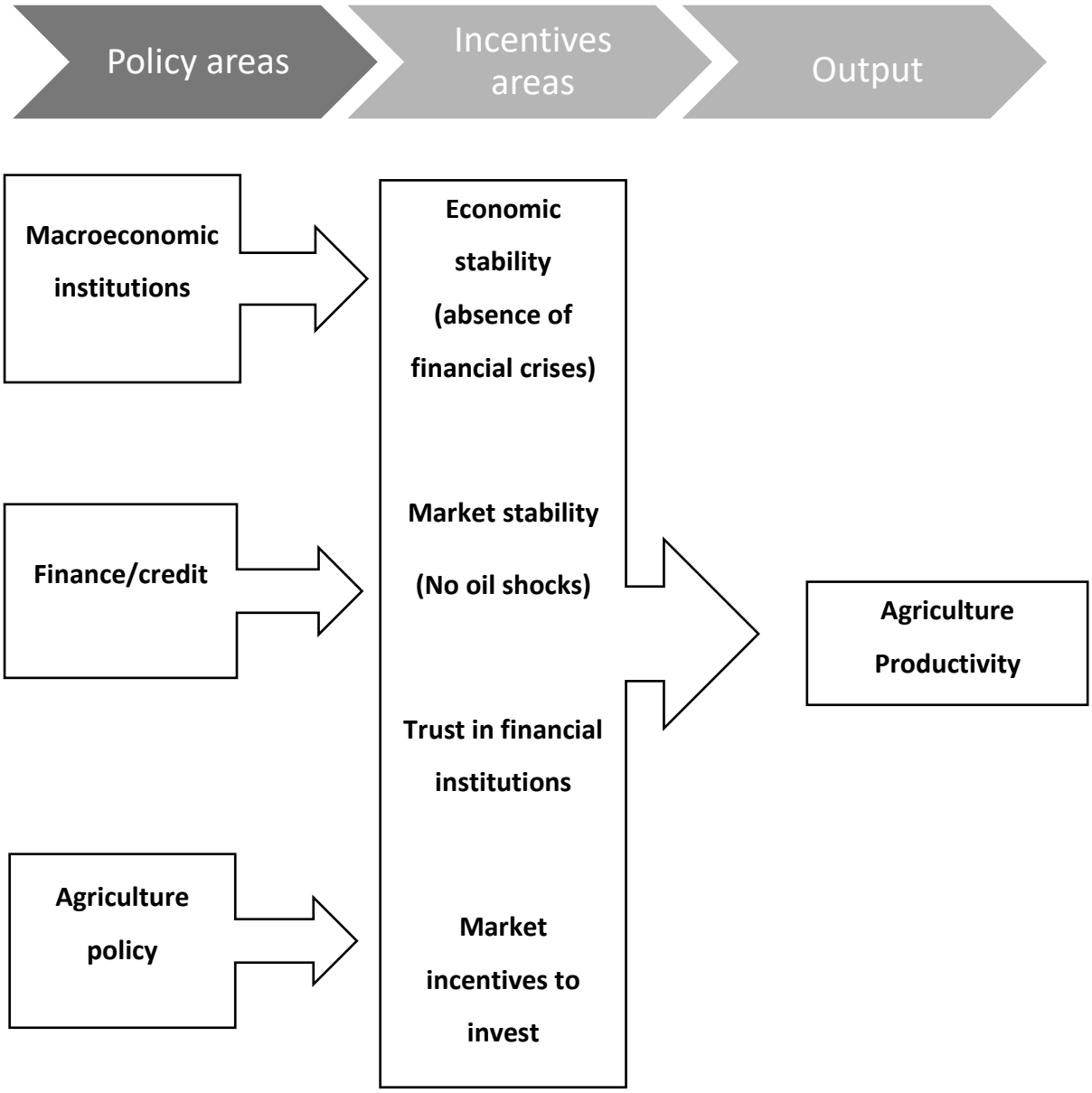


Figure 1.1: Conceptual framework

Source: Developed by Author based on deductions made from the reviewed literature

Above all things, the nexus between agricultural productivity, financial development, oil prices and economic growth can be observed to exist in three distinct areas. That is policy areas, incentive areas and output. This nexus can be illustrated in the form of a conceptual framework as depicted in figure 1.1. It is upon figure 1.1 that an econometric model will be derived and estimated.

CHAPTER TWO

AGRICULTURAL PRODUCTIVITY, OIL PRODUCTION, FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH INITIATIVES IN THE USA

2.1 Introduction

Efforts to examine the existence of a nexus linking agricultural productivity, oil prices, economic growth and financial development rely on conducting an overview analysis of what transpired in the USA before and during the period in question (1962-2016). This will include addressing aspects such economic growth patterns, agricultural initiatives and programmes, the USA's oil production initiatives and effects and causes of the 2008 financial crisis.

2.2 Overview of the USA economy

In as much as economic performance is concerned, the USA has been undoubtedly a huge figure to reckon with. It has been established that the USA's economic performance surpasses all economies in the world (Focus Economics, n,d). With a population of 326 million people in 2017 (see table 2.1), the USA has witnessed an increase in economic performance. This can be noted by an upward shift in GDP from 1.7% in 2013 to 2.3% in 2017. An improvement in the USA' economic performance had a positive implication on the level of employment as the unemployment rate went down from 7.4% in 2013 to 4.4% in 2017. This has, however, been accompanied by a decline in investment level from 5% in 2013 to 4% in 2017, rise in inflation from 1.5%

in 2013 to 2.1% in 2017 and a plummeting trade balance from -US$700.50 billion to -US$807.50 billion in 2017.

Future projects about the US economy show that the USA is destined for greatness and much can be achieved in the coming years. For instance, Focus Economics (n.d) estimates that the USA's unemployment is more likely to plummet by 3.7 and 3.5% in 2019 and 2020 respectively. Such optimistic beliefs are based on considerations that the USA has successfully managed to recover from the effects of the 2008 financial crisis. Hence, the USA's economy can be said to be at a point of recovery which is characterised by huge capital investment, increased corporate governance, financial regulation, and government intervention in economic activities.

Table 2.1: Overview of the USA economy

Indicator	2013	2014	2015	2016	2017
Population (m)	317	319	321	324	326
GDP (%)	1.7	2.6	2.9	1.5	2.3
Investment (%)	5.0	6.2	3.9	0.7	4.0
Unemployment rate (%)	7.4	6.2	5.3	4.9	4.4
Inflation (CPI) (%)	1.5	0.7	0.7	2.1	2.1
Trade balance (USD billion)	-700.5	-749.9	-761.9	-751.1	-807.5

Source: https: Focus-economics (n.d)

2.3 Agricultural initiatives and programmes

Though there are dominant sectors that play a pivotal role in the US economy, agriculture still remains as one of the most dominant sectors in the USA. It is estimated that agricultural exports from the USA averaged US$144 billion in 2018 (STATISTA, n.d). Much of the increase in the USA is attributed to huge land that is set aside for agriculture with a total of 2.2 million farms being set for agricultural activities (FAOSTAT, n.d). It is also contended that agricultural activities are highly prevalent in all the USA states. A lot of agricultural initiatives such as farm mechanisation led to an increase in farming activities. This is augmented by initiatives such as the George Washington Carver program meant to foster development in biofuels and bioplastics (MacDonald, 2018). Efforts to promote the production of biofuels was linked to an increase in oil prices as a source of energy in the USA's agriculture sector. As it stands,

there are a lot of programmes that support large commercial, small scale and hobby farming. The ability of the USA' agriculture to thrive hinges to a large extent on the USA's high level of financial development. The USA's financial sector has been a notable player in the acquisition of high input payoff technology used in the agriculture sector. As such, tremendous agricultural productivities levels were recorded in the USA.

2.4 An examination of the USA's oil production initiatives and effects

The USA benefits considerably from the fact that oil sales are priced in the US dollar. However, this poses serious effects on other economies in the sense that an appreciating USA dollar can restrict oil prices US Energy and Information Administration (EIA), 2018). Oil producing economies stand to gain a lot in the coming years as oil prices are expected to increase in 2019 to US$74/barrel from US$73/barrel (EIA, n.d).

Though the 1973 and 1976 oil shocks imposed huge negative effects on the US's economy, the USA has played a significant role in instituting sound oil production initiatives. For instance, introduced the US shale oill production resulted in an increased daily oil production to 5.7 million barrel/day in 2018. Such an initiative caused the USA to become the world largest oil producing economy (EIA, n.d). This also triggered positive developments in the USA's economy as oil imports went down in 2017 by 58% (EIA, n.d).

The effect of the oil initiatives caused panic behaviour among economic agents and commodity traders as oil market continued to experience an oil supply glut. As a result, the price of oil went down from US$76.41/barrel of West Texas Intermediate (Amadeo, 2018). On the other hand, much of the volatility that has been observed in the oil industry has been attributed to the influence of oil traders. This is because of oil traders their ability to trade oil futures contract in other markets. Amadeo (2018) contends that trading behaviour can trigger an upward change in oil prices. This is one of the notable causes of the 2008 asset bubble. On the other hand, the US share boom was hugely driven by the existence of market incentives such as low-interest rates which caused investors to increase their lending in oil companies. Also, oil prices were fairly high enough to allow shale companies to engage in exploration activities. Overall, the

USA's oil production initiatives played an essential role in reducing production costs. This extended to include a reduction in the price of raw materials and prices of basic food stuffs.

2.5 Effects of the 2008 financial crisis on agricultural productivity

The notable trigger of the USA financial crisis in 2008 is the subprime mortgage crisis. This was attributed that lending to finance the purchasing of houses in USA was made to risky individuals (Burger et al., 2009). Though banks levied high interest rates on mortgages, the demand for mortgages remained high. The trend persisted until financial institutions began to issue mortgage backed securities.

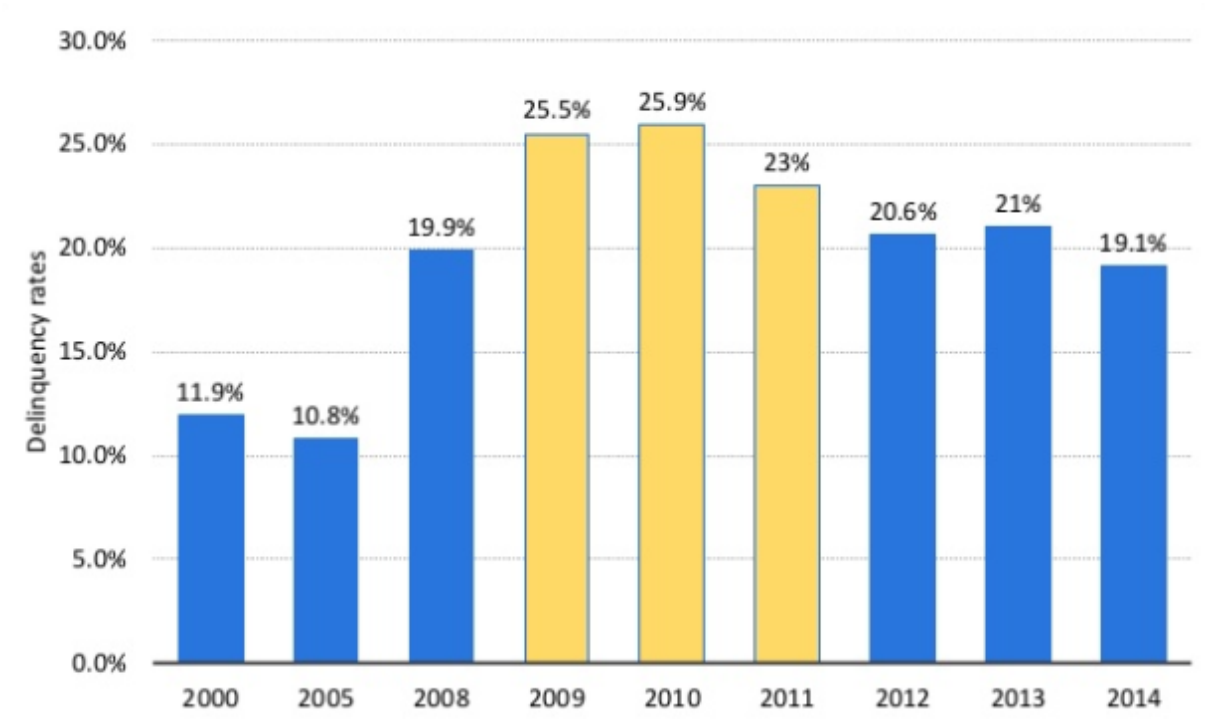


Figure 2.1: Mortgage delinquency rates for USA's subprime loans

Source: Riley (n.d)

It is exhibited in figure 3.1 that the delinquency rate went up in 2008 to 19.9% from 10.8%. High delinquency rates went above 20% since the period 2009, 2010 and 2011 with respective rates of 25.5%,25.9% and 23%. The high delinquency rates were connected to a collapse in the value of mortgage backed securities leading to the subprime mortgage crisis.

Efforts to examine how the financial crisis affected the USA's agriculture can be made possible by examining the related externalities. It can be noted that farmers secured funding from credit from financial markets but the effect of the mortgage bust imposed huge negative implications on the ability of farmers to secure funding from financial markets. Worse when the entire US economy went into a deep recession. Such a recession did not spare the US agriculture sector. In addition, the performance of the US's agriculture sector fell following a decline trade and investment in agricultural products. This was exacerbated by the imposing of austerity measure by the US government as the USA's foreign debt continued to grow severely. Figure 2.2 can also be used to depict the exist of a nexus linking agricultural productivity, oil prices, economic growth, financial stability and financial development.

Figure 2.2: Externalities from a financial crisis

Source: Riley (n.d)

2.6 Summary

The USA's economy continues to exhibit strong signs of recovery after experiencing the ravaging effects of a financial crisis in 2008. With a highly performing economy that is supported by a well-developed financial system, the USA's agriculture sector has managed to thrive well. A lot of agricultural initiatives introduced by the US government have favourably managed to boost agricultural productivity. This was supported by oil production initiatives such as the shale oil production strategy which managed to drive down costs and prices down. however, the 2008 financial crisis imposed huge negative effects on the entire US economy. Both the financial and agriculture sectors suffered severely from the effects of the financial crisis. The 2008 USA financial crisis is linked to a lot of economic indicators and this proved the existence of a nexus linking agricultural productivity, oil prices, economic growth and financial development.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research design

Secondary data from the year 1962 to 2016 was used to estimate an agricultural productivity model with oil prices, economic growth, financial development and a financial crisis as regressors. Data estimation was done with the aid of EViews 10 and the findings were presented in the form of tables and graphs. Model specification tests were also conducted to determine the reliability, validity and policy usefulness of the estimated model. Conclusions and policy implications were later deduced from the computed findings.

3.2 Assumptions

Based on observations and studies concerning the 2008 financial crisis that took place in the USA, it is highly known that most of the effects were highly evident in 2008 (Brown, 2010; Laux & Leuz, 2010). Though the effects spilt into the first quarter of 2009, it is also highly believed that the financial crisis dissipated in 2008 (Demyanyk & Van Hemert, 2009; Piskorski, Seru & Vig, 2010; Reinhart & Rogoff, 2008). As a result, an assumption was made that the financial crisis experienced in the USA ensued in 2008 and dissipated in the same year. This will have an effect on structural breaks and hence, Chow Test was applied to test for the existence of a financial break in the year 2008.

3.3 Model estimation techniques

The use of econometric models in academic research is determined by what the study seeks to accomplish and the extent to which the model variables confine to the given model stipulations. As a result, an attempt by this study to examine the nexus between agricultural productivity, oil prices, economic growth and financial development can be best accomplished by using an Auto Regressive Distributed Lag (ARDL) model. This is empirically supported by findings made by Pesaran and Shin (1978) which exhibited that an ARDL model can yield consistent and efficient estimators. Godfrey (1978) also acknowledges that an ARDL model works the best when variables are integrated of different orders. That is when the variables have mixed stationarities in which some variables are I(0) while others are I(I).

At this stage, we can posit that positive changes in agricultural productivity require a well-functioning economy which is free from the interference of a financial crisis and a developed financial system. This can mathematically be expressed in a functional form as follows;

$$AP = F[OP, EG, FD, FC] \quad \ldots\ldots (1).$$

Where AP denotes changes in agricultural productivity, OP represents variations in oil prices, EG provides an indication of changes in economic performance as a measured by gross domestic product (GDP), FD shows the economy's level of financial development and the dummy variable FC caters for structural breaks caused by the prevalence of a financial crisis.

By including a constant $\boldsymbol{\alpha}$, regression analysis coefficients ($\boldsymbol{\beta_1}$-$\boldsymbol{\beta_n}$) and error term ($\boldsymbol{\mu}$) to equation (1), the resultant expression is a regression model as expressed by equation (2).

$$\mathbf{LAP} = \boldsymbol{\alpha} + \boldsymbol{\beta_1}LOP + \boldsymbol{\beta_2}LEG + \boldsymbol{\beta_3}LFD + \boldsymbol{\beta_4}DV_{FC} + \boldsymbol{\mu} \quad \ldots\ldots (2).$$

The ARDL model will thus, be developed based on the model expression depicted by equation 2. Prior to the estimation of the ARDL model, care is placed on highlighting that an ARDL model revolves around the determination of short-run and long-model expressions (Gujarat, 2009). It is thus, in this regard that short-run and long-run model specifications were determined.

Short-run model dynamics

$$\Delta\mathbf{LAPt} = a_{01}\sum_{i=1}^{p} a_{1i}\,\Delta LAP_{t-1} + a_{2i}\sum_{i=1}^{p} a_{3i}\,\Delta LOP_{t-1} + a_{4i}\sum_{i=1}^{p} a_{5i}\,\Delta LEG_{t-1} + a_{6i}\sum_{i=1}^{p} a_{7i}\,\Delta LFD_{t-1} + a_{8i}\sum_{i=1}^{p} a_{9i}\,\Delta DV_{FCt-1} + e_{1t}d(LAP)\; c\; d(LAP(-1))\; d\big(LOP(-1)\big)d\big(LEG(-1)\big)\; d(LFD(-1))d(DV_{FC}(-1))..\ (3)$$

$$\Delta\mathbf{LOPt} = a_{01}\sum_{i=1}^{p} a_{1i}\,\Delta LOP_{t-1} + a_{2i}\sum_{i=1}^{p} a_{3i}\,\Delta LAP_{t-1} + a_{4i}\sum_{i=1}^{p} a_{5i}\,\Delta LEG_{t-1} + a_{6i}\sum_{i=1}^{p} a_{7i}\,\Delta LFD_{t-1} + a_{8i}\sum_{i=1}^{p} a_{9i}\,\Delta DV_{FCt-1} + e_{1t}d(LOP)\; c\; d(LOP(-1))\; d\big(LAP(-1)\big)\; d\big(LEG(-1)\big)\; d\big(LFD(-1)\big)\; d\big(DV_{FC}(-1)\big)...\ (4)$$

$$\Delta\mathbf{LEGt} = a_{01}\sum_{i=1}^{p} a_{1i}\,\Delta LEG_{t-1} + a_{2i}\sum_{i=1}^{p} a_{3i}\,\Delta LOP_{t-1} + a_{4i}\sum_{i=1}^{p} a_{5i}\,\Delta LAP_{t-1} + a_{6i}\sum_{i=1}^{p} a_{7i}\,\Delta LFD_{t-1} + a_{8i}\sum_{i=1}^{p} a_{9i}\,\Delta DV_{FCt-1} + e_{1t}(LEG)\; c\; d(LEG(-1))\; d\big(LOP(-1)\big)\; d\big(LAP(-1)\big)\; d\big(LFD(-1)\big)d(DV_{FC}(-1))...\ (5)$$

$$\Delta\mathbf{LFDt} = a_{01}\sum_{i=1}^{p} a_{1i}\,\Delta LFD_{t-1} + a_{2i}\sum_{i=1}^{p} a_{3i}\,\Delta LOP_{t-1} + a_{4i}\sum_{i=1}^{p} a_{5i}\,\Delta LEG_{t-1} + a_{6i}\sum_{i=1}^{p} a_{7i}\,\Delta LAP_{t-1} + a_{8i}\sum_{i=1}^{p} a_{9i}\,\Delta DV_{FCt-1} + e_{1t}d(LFD)\; c\; d(LFD(-1))\; d\big(LOP(-1)\big)d\big(LEG(-1)\big)\; d\big(LAP(-1)\big)\; d(DV_{FC}(-1))...\ (6)$$

$$\Delta\mathbf{DV_{FCt}} = a_{01}\sum_{i=1}^{p} a_{1i}\,\Delta\mathrm{DVFC}_{t-1} + a_{2i}\sum_{i=1}^{p} a_{3i}\,\Delta LOP_{t-1} + a_{4i}\sum_{i=1}^{p} a_{5i}\,\Delta LEG_{t-1} + a_{6i}\sum_{i=1}^{p} a_{7i}\,\Delta LFD_{t-1} + a_{8i}\sum_{i=1}^{p} a_{9i}\,\Delta LAP_{FCt-1} + e_{1t}d(DV_{FC})\; c\; d(DV_{FC}(-1))\; d\big(LAP(-1)\big)d\big(LOP(-1)\big)\; d\big(LEG(-1)\big)\; d\big(LFD(-1)\big)..(7)$$

Using the ARDL model estimation techniques, the long-run ARDL model was therefore specified as follows;

$\mathbf{LAP_t} = a_{01} + b_{11}\mathbf{LOP} + b_{22}\mathbf{LEG} + a_{33}\mathbf{LFD} + \mathbf{DV_{FCt}} + \mathbf{e_{1t}LAP\ c\ LOP(-1)\ LEG(-1)\ LFD(-1)\ DV_{FCt}(-1)}$ ……..(8)

3.4 Model tests

3.4.1 Stationarity tests

The concept of stationarity mainly deals with the need to determine if the variables are cointegrated of the same order (Dickey & Fuller, 1979). That is, variance and mean of the data series should not change with time. In a such a case, the data is said to be stationary and not having a u nit root. For example, a stationary time series, with for example the case where Yt follows a normal distribution N(mu, sigma^2) independent of t.

The ability of time series data to yield reliable estimates relies on the extent to which the variables are stationary. If not, then the results can suffer from a spurious effect (Madala, 2001). Dickey and Fuller Gujarat (2009) outlined that the estimation of econometric models requires that certain stationarity conditions be met before estimation a model. This is specifically true with the estimation of an ARDL model. Hence, it is always important to test for the presence of a unit root in time series data. As a result, unit root tests are done either at level or first difference either including a trend, constant or both trend and constant. This is often accomplished by using methods such as the Phillips-Perron (PP), Dickey-Fuller (ADF) and KPSS tests.

3.4.2 Granger causality tests

One of the most notable observations that can be made when interpreting econometric models is that having an effect does not always imply that there is causality among the variables. As a result, the importance of pairwise Granger causality and exogeneity block tests is often acknowledged (Toda & Yamamoto, 1995). Granger (1988) established that causality exists when lagged values of one significantly predict changes in the other variable. Given residuals $\mathbf{E_1}$ and $\mathbf{E_2}$, model coefficients grouped into matrix **A**, variables $\mathbf{X_1}$ and $\mathbf{X_2}$ and the number of lags **p** combined to form autoregressive models shown by expression (9).

$$X_1(t) = \sum_{j=1}^{p} A_{11,j} X_1(t-j) + \sum_{j=1}^{p} A_{12,j} X_2(t-j) + E_1(t)$$

$$X_2(t) = \sum_{j=1}^{p} A_{21,j} X_1(t-j) + \sum_{j=1}^{p} A_{22,j} X_2(t-j) + E_2(t) \quad \text{..... (9)}$$

We can establish that $\mathbf{X_2}$ has causal effects on $\mathbf{X_1}$ when the coefficients of matrix **A** are jointly significant. In this study, the Pairwise causality test was applied to test the undermentioned assertions;

- **H_1:** Positive developments in the US financial markets did not cause an improvement in agricultural productivity.
- **H_2:** An increase in agricultural productivity did not necessitate positive developments in the US financial markets.

3.4.3 Cointegration tests

The long-run bounds test was used to determine the existence of a long run interaction between the model variables. The bounds test works under proposition of a null hypothesis that variables are not cointegrated in the long-run (Pesaran, Shin & Smith, 2001) or simply that there exists no joint significant (Frimpong & Oteng-Abayie, 2006, p. 7). That is;

- **H_N:** $a_1 = a_2 = a_3 = a_4 = 0$
- **H_A:** $a_1 \neq a_2 \neq a_3 \neq a_4 \neq 0$

Long run cointegration is established when the computed F-statistic lies beyond both the lower and upper bounds values leading to the rejection of $\mathbf{H_N}$ and acceptance of $\mathbf{H_A}$. Computations of the bounds test are based on the inclusion of an error correction term (ECT), (Engle & Granger, 1987). The importance of an ECT is attached to its ability to offer insights about the model's speed of adjustment. Given regressors and ***X*** and ***R***, and a regressand ***Y***, the ECT can be computed as follows;

$\boldsymbol{ECT_{t-1}} = [Y_{T-1}\ \eta X_{t-1} - \xi R_{t-1}]$ ..... (10).

Based on the computed ARDL model that was utilised in this study, the error correction model can thus be specified as follows;

$$\Delta\mathbf{LAPt} = \boldsymbol{a_0} \sum_{i=1}^{p} \boldsymbol{a_{1i}}\, \Delta \boldsymbol{LAP_{t-1}} + \boldsymbol{a_{2i}} \sum_{i=1}^{p} \boldsymbol{a_{3i}}\, \Delta \boldsymbol{LOP_{t-1}} + \boldsymbol{a_{4i}} \sum_{i=1}^{p} \boldsymbol{a_{5i}}\, \Delta \boldsymbol{LEG_{t-1}} + \boldsymbol{a_{6i}} \sum_{i=1}^{p} \boldsymbol{a_{7i}}\, \Delta \boldsymbol{LFD_{t-1}} + \boldsymbol{a_{8i}} \sum_{i=1}^{p} \boldsymbol{a_{9i}}\, \Delta \boldsymbol{DV_{FCt-1}} + \boldsymbol{e_{1t}}\ \boldsymbol{d(LAP)}\ \boldsymbol{c}\ \boldsymbol{d(LAP(-1))}\ \boldsymbol{d\big(LOP(-1)\big)d\big(LEG(-1)\big)}\ \boldsymbol{d(DV_{FC}(-1))}\ \mathbf{ECT(-1)}$$

3.4.4 Sensitivity analysis

In econometrics, it is important to carry out diagnostic tests on any estimated model so as to ensure that the model is capable of offering reliable results that can be used for policy making (Greene, 2003). That is, to check to see if the model is not misspecified and can accurately predict or estimate the actual and intended effects. Notable diagnostics tests that were carried in this study are;

- **Heteroscedasticity tests:** In some cases, the variance of the error terms might be heteroscedastic and in such a case, the model is considered to be suffering from heteroscedasticity problems (Greene, 2003). Heteroscedasticity poses huge negative implications on the estimated model. For instance, Greenberg and Webster (1983) concurs with this notion and contend that heteroscedasticity causes the standard errors to be biased. Craven and Islam (2011) also concur with this idea and posit that the problem of also extends to affect the statistical significance of the model parameters. That is, heteroscedasticity can cause significant coefficients to appear as insignificant. It is in this regard that the agricultural productivity nexus model was subjected to the Arch and Breusch-Godfrey-Pagan heteroscedasticity tests. The effort was to test if the undermentioned statements hold.
    - **H_0:** The agricultural productivity nexus model does not suffer from the problem of heteroscedasticity.
    - **H_1:** The agricultural productivity nexus model suffers from the problem of heteroscedasticity.
- **Serial correlation:** Serial correlation occurs when the error terms are negatively correlated or positively correlated with each other (Gujarat, 2003). It is of paramount importance to note that serial correlation undermines the reliability of the estimated model. This is irrespective of the nature of serial correlation being observed. Hence, attention in this study was devoted towards determining if the agricultural productivity nexus model succumbs to serial correlation. The Breusch-Pagan-Serial Correlation LM test was used to test for serial correlation at 0.05% in line with the following hypothesis;
    - **H_0:** The agricultural productivity nexus model does not suffer from the problem of serial correlation.

- **H_1:** The agricultural productivity nexus model suffers from the problem of serial correlation.

- **Normality test:** Normality tests whether the distribution of the model variables is normal over the course of the period under study. It is important for an estimated model to conform to normality diagnostic tests if its reliability and validity are to be considered as up to standard (Greene, 2003). The Jarque-Bera test statistic was used to indicate whether the variables are normally distributed over the period 1962-2016 by testing the following hypothesis at 5% significance level.

    - **H_0:** LAP, LOP, LFD, LEG and FC are normally distributed over the period 1962-2016.
    - **H_1:** LAP, LOP, LFD, LEG and FC are not normally distributed over the period 1962-2016.

- **Redundancy tests:** One of the core features of a good estimated model is that it must not be redundant. That is, the variables must be jointly significant (Gujarat, 2009). This is determined in line with the hypotheses that the variables are jointly insignificant. In this case, the redundancy test will be based on the need to determine if the following hypothesis will hold at 5%;

    - **H_0:** LOP, LFD, LEG and FC are jointly insignificant.
    - **H_1:** LOP, LFD, LEG and FC are jointly significant.

- **Stability tests:** Stability tests provides an indication of how stable the estimated model is over the period under study. This is important because any model that is not stable will be incapable to offer any useful policy-making suggestions (Ploberger & Krämer, 1990). It is in this regard that attention was placed towards determining the stability of the agricultural productivity nexus model. The stability of the agricultural productivity nexus model was determined using Cusum and Cusum of squares tests. Cusum and Cusum of squares tests posit that a model is stable when the Cusum lies within the 5% significance limit (Hansen, 1992).

3.5 Definition of variables and the expected impact

Table 4.1 provides a description of the variables that will be used in this study including their expected relationships with the independent variable economic growth.

Table 3.1: Definition of variables and expected impact

	Variable	Definition	Expected Impact
Dependent Variable	Agriculture output (AO)	Refers to the total agricultural output that is produced by the agriculture sector of an economy over a given period of time. The more productive an economy is the more agricultural output is produced by the agriculture sector. Agricultural imports will be used a proxy for agricultural productivity. The idea is that the more productivity the economy will be, the less agricultural products will be imported.	
Independent variables			
	Oil prices (OP)	Provides a measure of changes in crude oil prices as of the period under study (1962 to 2016).	(-)
	Economic growth (EG)	Provides a measure of economic performance and will be measured using gross domestic product (GDP).	(+)
	Financial development (FD)	Is simply a reflection of financial sophistication and deepening of an economy's financial sector and its ability to reduce financial costs.	(+)
	Financial crisis (FC)	The economic crisis is represented by a dummy variable which either takes a value of 0 to characterise a period in which there were no incidences of an economic crisis and 1 period which an economy was considered to be suffering from an economic crisis.	(-)

3.6 Data sources

Yearly time series data on agricultural productivity was obtained from the United States Department of Agriculture. Data on economic growth, inflation and financial development and trade was obtained from the World Bank and the period under study ranged from 1962 to 2016.

Table 3.2: Variable description and data source

Variable	Variable proxy	Unit of measurement	Period
Agriculture productivity	Agricultural imports	%	1962-2016
Oil prices	Average annual OPEC crude oil price from 1960 to 2018	US$ per barrel	1962-2016
Financial development	Domestic credit to the financial sector	% of GDP	1962-2016
Economic growth	GDP	Annual % change	1962-2016
Financial crisis	Dummy variable	Categorical (0=no financial crisis, 1=presence of a financial crisis)	1962-2016

Table 4.3 draws that an improvement in agricultural productivity between the period 1962 to 2016 has been able to curtail agriculture imports to 0.8455%. It can also be heeded that there was an escalation in oil prices to record high of US$109.45 in the same period. The USA has, on the other hand, managed to post concrete gains in economic performance as noted by a high GDP growth rate of 14.9%. The USA can also be said to have been undergoing positive changes in financial development as noted by a positive skewness of 0.1338.

Table 3.3: Descriptive statistics in natural form

	Agricultural Productivity	**Oil Prices**	**Economic Growth**	**Financial Development**
Mean	2.9657	28.947769	8.523636	66.62311
Min.	0.845506	1.033000	0.100000	58.96200
Max.	10.25964	109.4500	14.90000	74.48600
Std. Dev.	2.399126	29.54498	2.895716	4.093877
Kurtosis	5.152227	4.252545	3.216373	2.012340
Skewness	1.705141	1.454501	0.033693	0.133848

Oil prices, economic growth and financial development have high elastic responses as noted by their respective mean values of 2.701, 2.033 and 4.197. Much of the variation that was observed between the period 1962 to 2016 is mainly attributed to changes in oil prices which had a high standard deviation of 1.379.

Table 3.4: Descriptive statistics in log form

	Agricultural Productivity	Oil Prices	Economic Growth	Financial Development
Mean	0.827098	2.701029	2.033206	4.197201
Min.	-0.167820	0.032467	-2.302585	4.076893
Max.	2.328218	4.695468	2.701361	4.310611
Std. Dev.	0.688733	1.379107	0.672046	0.061379
Kurtosis	2.481189	2.390054	32.80784	2.023687
Skewness	0.527485	-0.665877	-4.956793	0.041754

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.1 Unit root tests

Unit root tests were conducted to determine if the existence of innovational and additive outlier breaks influences the variables' order of integration. Denby and Martin (1979) outlined that innovational outliers have no effect on successive observations. Effort was, however, placed to determine if such an outlier has a unit root or not. Based on the computed innovational outlier unit root results, inferences can be made that all the variables are not I(2). However, LAP and LOP are I(I) while LEG and LFD are I(0).

Table 4.1: Innovational structural break unit root test

Innovational structural break					
Variable	***Level***	***Prob.***	***1st difference***	***Prob.***	***Decision***
LAP	-3.3451	0.7801	-7.0595	<0.01	I(I)
LOP	-3.1826	0.9289	-7.2744	<0.01	I(I)
LEG	-12.9838	<0.01	-16.4395	<0.01	I(0)
LFD	-5.7495	<0.01	-5.3546	0.0307	I(0)

Table 4.2: Additive structural break unit root test

Additive structural break					
Variable	***Level***	***Prob.***	***1st difference***	***Prob.***	***Decision***
LAP	-3.5226	0.8033	-7.5604	<0.01	I(I)
LOP	-3.2506	0.9103	-7.6026	<0.01	I(I)
LEG	-6.7149	<0.01	-11.1704	<0.01	I(0)
LFD	-5.6712	0.0122	-5.5437	0.0182	I(0)

On the other hand, Fox (1972) asserts that additive outliers have an effect on successive observations. It is of paramount importance to ensure that such outliers do not have a unit root. If so, then the results might turn out to be spurious (Madala, 2001). The results do provide similar confirmation as made by the innovational outlier break type test that all the variables are not I(2). This is because LAP and LOP are I(I) while LEG and LFD are I(0). These results also entail that the variables have integration orders that make it feasible to estimate an ARDL model. As a result, the researcher proceeded to estimate an ARDL model. Chow Breakpoint test was undertaken prior to the estimation of the ARDL model to verify the existence of a structural break in 2008.

4.2 Structural break test

Time series data is always prone to quite a number of challenges. One of the significant problems that can impair the reliability and forecasting capabilities is the existence of structural breaks (Mehdian & Perry, 2002). The reliability and effective forecasting capability of a model such as an ARDL model require that such structural breaks be catered for. Hence, it is always important to ensure that a dummy variable is included in the model estimation process.

In this study, the notable structural break that was observed in the USA during the concerned period under study (1960-2016) is the 2008 financial crisis. With regards to this study, the 2008 financial crisis had severe effects on a lot of macroeconomic indicators and commodity prices such as oil prices. This also extended to include economic growth and financial development as the US's GDP fell to as low as -0.83% in 2008 while the banking sector succumbed to bank runs (Multpl, 2018). As a result, Chow Breakpoint test was applied to confirm the existence of a structural break in the year 2008. The established results are depicted in table 4.3.

Table 4.3: Chow Breakpoint test

Chow Breakpoint			
F-stat.	3.6691	Prob. F(5,45)	0.0072
Log L.R.	18.8067	Prob. Chi-square (5)	0.0021
Wald stat.	18.3454	Prob. Chi-square (5)	0.00235

H_O: *No break in the year 2008*

Using the depicted breakpoint test results, it can, therefore, be affirmed that there was a structural break in 2008. This, therefore, reinforces the influence of the 2008 financial crisis on agricultural productivity, oil prices, financial development and economic growth. Hence, a dummy variable (**DV_{FC}**) was incorporated into the model estimation so as to capture the prevalence of the financial crisis.

4.3 Correlation coefficient test

Pearson correlation test was employed so as to establish the strength of the association between the variables. The results depict that oil prices and agricultural productivity are negatively and significantly correlated by 0.9227. This implies that upwards changes in oil prices are more likely to be associated with a decline in agricultural productivity. The results also depict that there is a relatively moderate positive correlation between economic growth and agricultural productivity of 0.4572. Which denotes that the US economy benefits relatively more from increases in agricultural productivity as more agricultural output is exported and less is imported.

Deductions can also be made that both agricultural productivity and economic growth are negatively and insignificantly correlated with a financial crisis by 0.1358 and 0.2501 respectively. This can be utilized as proof that not only the financial sector suffers from the effects of the financial crisis but also other sectors such as the agriculture sector. The economy at large also suffers from the ravaging adverse effects of a financial crisis. Implications can be made that agricultural productivity and financial development are negatively correlated. This is because a significant correlation of -0.4362 exists between agricultural productivity and financial development. Possible reasons can be pointed towards people switching to other assets and investments in other sectors of the economy.

Table 4.4: Pearson correlation coefficient test

		LAP	*LOP*	*LEG*	*LFD*	*FC*
LAP	**ρ**	**1**				
	P-Value					
LOP	**ρ**	-0.9227	**1**			
	P-Value	0.0000				
LEG	**ρ**	0.4572	-0.3324	**1**		
	P-Value	0.0000	0.0132			
LFD	**ρ**	-0.4362	0.4831	-0.2835	**1**	
	P-Value	0.0009	0.0002	0.0360		
FC	**ρ**	-0.1358	0.1194	-0.2501	0.0777	**1**
	P-Value	0.3227	0.3854	0.0654	0.5726	

Financial development is positively and insignificantly correlated with a financial crisis by 0.0777. This is possible because, in the short run, firms in the financial sectors will be taking advantage of the windfall gains experienced from the effects of the financial crisis. The significant negative correlation between economic growth and financial development of 0.2835 entails that developments in the financial sector are hampering economic growth and development. This can be supported by insights provided by Caporale et al. (2009) which pointed out that issues like high lending rates can reverse the positive gains of financial development. Caporale and others went on to establish that financial development can actually hinder economic growth especially when the quality of borrowers is poor. De Gregorio and Guidotti (1995) established that a negative correlation can exist especially the financial sector is liberalised in a poor regulatory environment.

4.4 ARDL Bounds test

The study adopted the bounds test with an emphasis on striving to establish if agricultural productivity, oil prices, economic growth, financial development are cointegrated in the long run. Since the obtained significant F-statistic lies above both the lower and upper bounds values, conclusions can be inferred that the model

variables are cointegrated in the long run. In addition, it can be established that 77.21% of the observed variations in agricultural productivity are explained by LOP, LFD, LEG and FC.

Table 4.5: ARDL Cointegration Test

Significance level									
	1%		2.5%		5%		10%		
F-Statistic	**L_B**	**U_B**	**L_B**	**U_B**	**L_B**	**L_B**	**L_B**	**U_B**	**DW**
9.488540 k=4	3.29	4.37	2.88	3.87	2.56	3.49	2.20	3.09	2.24
R^2 = 0.7721 Adj. R^2 = 0.6440 Prob. F stat. = 0.00000									

4.4.1 Cointegrating form

The cointegration term is negative and significant at 1% signifying the existence of cointegration in the short run between AP, OP, EG, FD, and FC. Also, the cointegration value of 0.1519 implies that the speed of adjustment is 15.19%. Thus, the previous years' deviations from long-run equilibrium are corrected in the same year at a speed of 15.19%. Alternatively, it can posit that AP, OP, FD, EG and FC will revert back to their equilibrium position in the same year at a speed of 15.19%.

Table 4.6: Cointegrating form

Variable	Coefficient	Std. Error	t-statistic	Prob.
Coint EqT (-1)	-0.151900	0.018722	-8.113368	0.0000*
Cointeq = LAM – (0.2042*LOP + 2.2714*LFD + 0.4788*LEG – 0.6413 – 9.4633)				

4.4.2 Short run bounds test results

The depicted results denote that previous levels of agricultural productivity influence proceeding levels of agricultural productivity. This is because agricultural productivity remained in an unfavourable state at both lag 1, 2 and 3 with respective values of -0.1222, -0.3079 and -0.2934.

The results also show that there were series of short run volatile changes in oil prices between the period 1962 to 2016. This can be evidenced by decline in oil prices from a positive effect of 0.0051 to a negative effect of 0.011877 in the first lag. The effect later increased from a negative effect of -0.11877 to a positive effect 0.069462 in the second lag.

In the short run, GDP can be observed to have been significantly falling at both the first lag and second lag suggesting a decline in economic performance. This can trigger negative effects in other sectors through contagion effects and this can in turn affect agricultural productivity.

Table 4.7: Short run bounds test estimations

Variable	Coefficient	Std. Error	t-statistic	Prob.
D(LAM(-1))	-0.1222204	0.106556	-1.146858	0.2599
D(LAM(-2))	-0.307906	0.086590	-3.555917	0.0012
D(LAM(-3))	-0.293390	0.075093	-3.906994	0.0005
D(LOP)	0.001573	0.020199	0.077880	0.9384
D(LOP(-1))	-0.011877	0.022889	-0.518905	0.6074
D(LOP(-2))	0.069462	0.023075	3.010206	0.0051
D(LEG)	0.027848	0.009197	3.027853	0.0048
D(LEG(-1))	-0.025061	0.013575	-1.846104.	0.0741
D(LEG(-2))	-0.046414	0.011483	-4.042071	0.0003
D(LFD)	-1.246021	0.267465	-4.658632	0.0001
D(LFD(-1))	0.628604	0.381918	1.645913	0.1096
D(LFD(-2))	-1.322145	0.344690	-3.835753	0.0006
D(LFD(-3))	0.469393	0.269363	-1.762608	0.0910
C	-1.437466	0.622676	-2.308528	0.0276
R^2 = 0.882493		*Adj. R^2 = 0.814180*		
Prob. F stat. 0.00000		*DW. Stat. = 2.254427*		

Periods of instabilities can also be observed to have existed in the USA's financial sector. This is because the extent to which financial development contributes towards improving agricultural productivity went up from -1.246021 to 0.628604 in the first lag. Also, the capacity of financial development to increase and contribute positively

towards agricultural productivity went down in the second lag. The effective capacity of financial went down from 0.628604 to -1.322145 in the second lag but later went up to 0.469393 in the third lag. 88.25% of the short run changes in agricultural productivity are attributed to changes in oil prices, economic growth, prevalence of a financial crisis and financial development.

4.4.3 Long run bounds test

After having confirmed the existence of a long run association between agricultural productivity, oil prices, financial development and economic growth, the researcher proceeded to interpret the established long run results.

The results do show that financial development and agricultural productivity are unilaterally linked by 2.271356. This entails that an improvement in financial development by 1% will initiate positive variations in agricultural productivity by 227.14%. Rizwan-ul-Hassan (2017) concurs with this result and asserts that this is as a result of the ability of the financial sector to finance the acquisition of high-payoff agricultural technology.

Table 4.8: Long run bounds test

Variable	Coefficient	Std. Error	t-statistic	Prob.
Financial Development	2.271356	1.046655	2.170110	0.0375**
Economic Growth	0.478784	0.121171	3.951310	0.0004*
Oil Prices	-0.204163	0.069567	-2.934763	0.0061*
Financial Crisis	-0.641288	0.183113	-3.502145	0.0014*
C	-9.463268	4.388919	-2.156173	0.0387**
** and ** = p < 0.01 and p < 0.05 respectively*				
R^2 = 0.772143		*Adj. R^2 = 0.643973*		
Prob. F stat. 0.00000		*DW. Stat. = 2.241140*		

The results also establish similar deductions as those made by Amone (2014), and Ismail and Kabuga (2016) who highlighted that economic growth favours agricultural productivity can also be made in this study. This is because an increase in economic growth by 1% agitates an increase in agricultural productivity by 47.88%. This is

possibly attributed to the enactment of growth strategies, agricultural policies and institutional stability measures which favour agricultural productivity.

Theoretical ideas ascertained from the high payoff input model postulate that the degree to which financial development contributes towards promoting agricultural productivity is determined by financial stability. The obtained results reinforce this assertion and denote that a surge in oil prices by US1 will result in a decline in agricultural productivity by 20.41%. Wang and McPhail (2014) also acknowledged this and hinted that it is a huge challenge for the agriculture sector to thrive when oil prices are surging up high.

The results also support ideas deduced from the high payoff input model which suggests that economic disturbances such as a financial crisis can hinder agricultural productivity. This can be heeded to be true since an increase in the financial crisis by 1% results in a decline in agricultural productivity by 64.63%. Deepak (2012) also accepted this idea and outlined that farmers usually fail to access the required capital funding during periods of a financial crisis. As a such, agricultural productivity tends to decline during a period characterised by incidences of a financial crisis.

It can further be deduced that 77.21% of the variation in agricultural productivity is attributed to changes in agricultural productivity, oil prices, economic growth, financial crisis and financial development. Thus, 22.79% of the changes in agricultural productivity, are attributed to changes in other variables outside the estimated model.

4.5 Sensitivity analysis

Ramsey Reset test by Ramsey and Schmidt (1976), was employed so as to determine whether the variables have an element of non-linearity or not. In light of the reported Ramsey Reset test findings, conclusions can be made that the ARDL model has no non-linearity features. That is, the model is linear and this is because the null hypothesis of linearity is accepted at 5% (χ^2=0.3880; **ρ**=0.5379).

Table 4.9: Sensitivity analysis

$\chi^2 RR$	χ^2N	$\chi^2 AR$	$\chi^2 BR$	$\chi^2 SC$
0.3880	0.0607	0.0495	0.5112	1.6725
(0.5379)	***(0.9701)***	***(0.8204)***	**(0.9991)**	**(0.0775)**

NOTE: RR, χ^2_{N}, χ^2_{BR} , χ^2_{AR} and χ^2_{SC} Ramsey Reset Test, langrage multiplier for normality, Arch test for heteroscedasticity at lag 1, Breusch-Godfrey-Pagan test for heteroscedasticity and serial correlation at 2 lags. The values in parenthesis are the corresponding P-Value.

Sensitivity analysis was also undertaken with respect to normality, heteroscedasticity (arch, Breusch-Pagan-Godfrey) and serial correlation tests. Respective p-values of 0.9701, 0.8204, 0.9991 and 0.0775 were recorded and this purports that the variables are normally distributed and that heteroscedasticity and serial correlation problems are not evident. As a result, it can thus be concluded that that the estimated model does meet the necessary sensitivity standards and can be safely used for policymaking.

4.6 Redundant variable test

An attempt was made to determine if OP, FD, EG and FC are jointly significant in explaining possible variations in agricultural productivity. That is, to ascertain whether the inclusion of the variables will enhance the statistical significance of the explanatory power of the exogenous variables. This was accomplished by using the redundant variable test and works to tests the validity of the following statements;

- **H_0:** LOP, LFD, LEG and FC are jointly insignificant.
- **H_1:** LOP, LFD, LEG and FC are jointly significant.

Table 4.10: Redundant variable test

Redundant test on LOP, LFD, LEG and DVFC			
	Value	**Df**	**Prob.**
F-statistic	14.33562	(4, 32)	0.0000

Having an F-statistic of 14.336 with an associated p-value of 0.0000 implies that $\mathbf{H_0}$ can be rejected at 5% ($\boldsymbol{\rho<0.05}$) and conclude that the variables are jointly significant. The results thus, provide strong evidence that OP, FD, EG and FC are jointly significant in explaining possible variations in agricultural productivity in the USA.

4.7 Stability tests

Cusum and Cusum of squares stability inquiries were employed so as to ascertain if the formulated model can be declared to be stable over the course of the study which has been established to be 1960 to 2016. Based on figure 5.1 presentation, it can be heeded that the model confines within the critical bounds. Hence, inferences can be established that the formulated ARDL model is stable over the period 1960-2016.

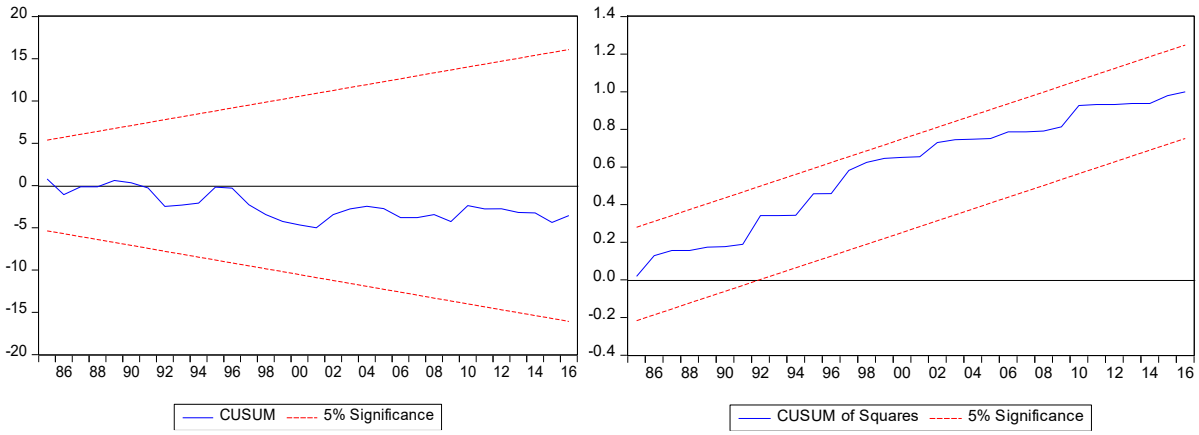
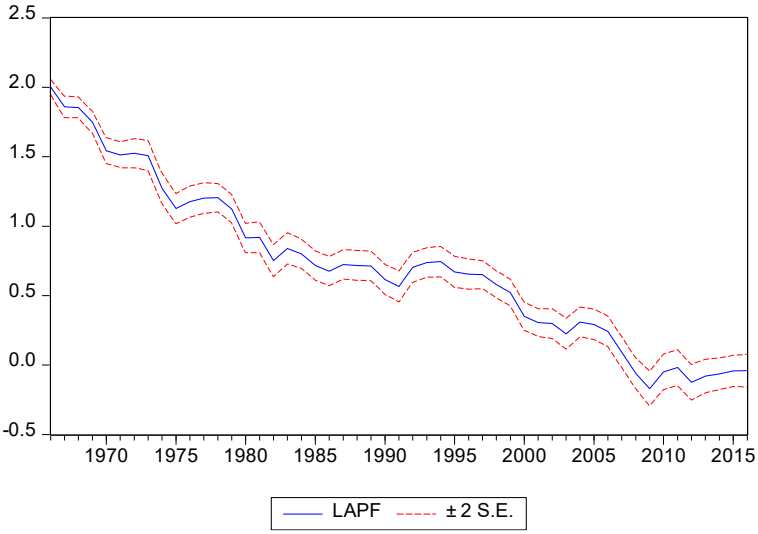


Figure 4.1: Cusum stability inquiries

Source: Developed by Author based on the formulated model

4.8 Model performance and forecast error diagnosis

Model performance and forecast error diagnosis were also undertaken to determine whether the predictive power of the computed ARDL model is satisfactory and free from biases. This was accomplished using a dynamic forecasting technique. The reason behind the use of a dynamic forecasting model is justified by the fact that it accounts for time-dependent changes or events (Evensen, 1994). This is of paramount importance, especially when considering the effect of structural breaks and seasonal changes that impose effects on economic variables.



Forecast: LAPF	
Actual: LAP	
Forecast sample: 1962 2016	
Adjusted sample: 1966 2016	
Included observations: 51	
Root Mean Squared Error	0.035457
Mean Absolute Error	0.027555
Mean Abs. Percent Error	6.900363
Theil Inequality Coefficient	0.019361
Bias Proportion	0.005014
Variance Proportion	0.000792
Covariance Proportion	0.994194
Theil U2 Coefficient	0.149725
Symmetric MAPE	7.307994

Figure 5.2: Model performance and forecast error diagnosis

Source: Developed by Author based on the formulated model

The Theil inequality of 0.0019 is almost 0 and this implies that there is a perfect fit and this is associated with a very low bias proportion or systematic error of 0.5%. The root mean square is very low and stands at 0.0354. This indicates that the forecasting model is in a good potion to offer reliable estimates for policy formulation and decision making. The estimated agricultural productivity nexus model is thus a useful tool and ought to be used to formulate economic policies at both national and global levels.

4.9 Effects of financial development on agricultural productivity

One of the fundamental aspects of econometrics states that the existence of an effect between variables does not always imply that they cause possible changes in each other (Gujarat, 2009). Propositions are thus made by the likes of Granger (1980) that causality tests be done to establish the existence of causality between the variables. The established long run bounds test results confirmed the existence of a positive linkage between financial market developments and agricultural productivity. However, it remained to be proved if financial development stirs up a surge in agricultural productivity or if agricultural productivity causes financial development. It is in this regard, that Granger causality test was applied.

Table 4.11: Pairwise Granger causality test

	AP		OP		FD		EG		FC	
	χ^2	prob.	χ^2	prob.	χ^2	prob.	χ^2	prob.	χ^2	prob.
AP	-	-	2.5605	0.0878	0.5926	0.5569	4.6894	0.0138	0.1581	0.8542
OP	6.2445	0.0039	-	-	1.2699	0.2901	2.8640	0.0668	5.5006	0.0071
FD	0.4932	0.6137	0.3625	0.6978	-	-	3.0530	0.0565	0.0289	0.9715
EG	2.0377	0.1414	0.3241	0.7247	7.1215	0.0020	-	-	1.8611	0.1665
FC	4.8648	0.0119	0.3743	0.6898	0.56144	0.5726	1.2391	0.2987	-	-

The results indicate that during the period 1960 to 2016, financial development did not Granger cause an increase in agricultural productivity. Alternatively, agricultural productivity did not also granger cause financial development during the same period of time.

Table 4.12: Summary of the hypothesis tests

Null hypothesis (H_0)	Test method	p	Decision
Positive developments in US financial markets did not cause an improvement in agricultural productivity.	Granger causality	0.6978	Accept
An increase in agricultural productivity did not necessitate positive developments in the US financial markets	Granger causality	0.2901	Reject

As a result, it can thus be rejected that positive developments in the US financial markets did not cause an improvement in agricultural productivity. Similarly, an increase in agricultural productivity did not necessitate positive developments in US financial markets.

4.10 Discussion of findings and answers to the research questions

Foremost, it can be established that agricultural productivity is vital at both national and global levels. This is because it helps in alleviating poverty and attaining MDGs. In addition, the importance of agricultural productivity mainly lies in its potency to stir economic growth and development. Furthermore, an increase in agricultural

productivity helps to ease pressure on international organisations such as the WFP to provide food relief programs to poor countries. The notable difference between poor and rich countries have been noted to be as a result of the inability of poor countries to possess high-payoff technology. This can possibly explain why the USA is dominating other countries in terms of economic growth and development. It is imperative to note that the importance of agricultural growth also extends to incorporate aspects such as nutrition, food security, subsistence income and raising domestic employment levels. However, positive changes in the agriculture sector are highly dependent on the interaction between the availability of financial support, economic stability and performance. As a result, changes in the prices of factor inputs, the ability to secure funding from financial institutions to acquire high-payoff technology, economic stability and performance are thus linked to developments occurring in the agriculture sector. Alternatively, it can be said that there is a nexus which links together agricultural productivity, oil prices, economic growth and financial development. This is highly evident in the USA which is characterised by high growth rates, has a well-developed financial system and suffered severely from the oil crisis and the prevalence of the 2008 financial crisis. The study thus, emphasises the importance of maintaining stability in financial and commodity markets, and the economy at large. More so, it highlights that economic growth strategies targeted at improving agricultural productivity through the effective and efficient use of resources have positive implications for financial development. It must, however, be noted that investments in the agriculture sector are determined by the effective and efficient use of resources by the agriculture sector. However, this relies on financial, commodity markets and economic stability. Such an interaction, therefore, illustrates the existence of a nexus between agriculture growth, economic and financial stability, and macroeconomic variables.

Determination of the existence of an interaction between agricultural productivity, oil prices, economic growth and financial development and how oil prices, economic growth and financial development influence agricultural productivity.

The computed results through the use of the Bounds test have proved the existence of a nexus linking agricultural productivity, oil prices, economic growth and financial development in both the short run and long run. This relates to the ability of farmers to secure funding for the acquisition of the high payoff input technology, deal with high oil prices and the effects of a financial crisis, and benefit from economic growth projects and strategies.

It is also imperative that supply of funds by the financial sector aids farmers in securing the high payoff input technology which enhances agricultural productivity. As a result, farmers will be capable of producing more agricultural produce at a relatively low cost. Consequently, mass production of agricultural produce will cut down agricultural imports and boost agricultural export levels. The decline in agricultural imports and an increase in agricultural exports results in an increase in economic growth through an improvement in the current account balance. Also, this will have multiplier effects on financial development because rising agriculture income allows farmers to repay back their bank loans and secure more funds from banks. Along similar lines, there will be a reduction in non-performing loans and an increase in service fees levied on bank loans. A case in point is that this will stimulate financial innovation as banks will endeavour to provide better and affordable financial services to the financial sector. A significant number of studies did not address this ripple and two-way effect between agricultural productivity, economic growth and financial development. However, the high payoff input model does emphasise the importance of providing funds to the agriculture sector. This therefore, implies that efforts to promote agriculture productivity are not solely determined by microeconomic variables but also macroeconomic aspects at large.

The ability of the US's agriculture sector to thrive and maintain high productivity levels

The positive relationship that exists between agricultural productivity and economic growth significantly proves that the US's agriculture sector can thrive and maintain high productivity levels. This is similar to what has been established from the high payoff input model which asserts that economic growth policies will target to ensure that there is increased investment in agriculture. Such a notion has been established to be true by a significant number of studies which strongly argue that economic growth and development policies inevitably work towards improving agricultural productivity. This is because economic policies such as unemployment, foreign direct investment, poverty reduction, food security etc., will inevitably incorporate agricultural productivity.

How oil shocks and volatile changes in oil prices affect agricultural productivity.

The impact of economic growth on agricultural productivity can however, be undermined by rising or volatile oil prices. This is because oil is a major source of energy in the agriculture sector and rising oil prices will therefore, undermine productive capacity and cost minimization efforts. Hence, such an observation strongly provides evidence that rising oil prices have an adverse effect on agricultural productivity. Quite a number of studies agree with this notion and establish that reducing factor input costs is pivotal in improving agricultural productivity. Hence, it remains important for policymakers to develop measures that curb the effect of rising oil prices.

The extent to which US financial sector developments have stimulated agricultural productivity and the capacity of agricultural productivity to stir up financial development in the USA.

The proposed hypothesis was rejected and conclusions were made that positive developments in the US financial markets did not cause an improvement in agricultural productivity. This is possible because the US financial market had gone through a rough period during the period 1962 to 2016. This is because the US economy

succumbs to severe effects of the 2008 financial crisis which impaired the effective distribution or allocation of funds to productive economic sectors. Thus, the US's agriculture suffered a lot during and after the occurrence of the 2008 financial crisis. Moreover, the allocation of funds was relatively biased towards real estate more as evidenced by the subprime mortgage crisis. This entails that there was a decline in the potency of farmers to fund the acquisition of high-payoff technology. As a result, economic growth plummeted as the financial sector went into a doldrum.

It was however noted that an increase in agricultural productivity resulted in positive developments in the US financial markets. This is because the agriculture sector was relatively unaffected but disturbances in the USA financial market. Also, financial players turned to other sectors such as the agriculture sector following the turbulence experienced in the real estate sector. As a result, the agriculture sector started experiencing notable improvements which resulted in financial innovation. It is in this regard that an increase in agricultural productivity resulted in positive developments in the US financial markets. This is the gap which most empirical studies do not address.

CHAPTER FIVE

CONCLUSIONS, POLICY IMPLICATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

5.1 Conclusions

The study examines the existence of a nexus linking agricultural productivity, oil prices, economic growth and financial development. The study is motivated by observations made that efforts to promote agricultural productivity are not solely determined by microeconomic variables alone. The study thus argues that macroeconomic variables such as economic growth and financial development and economic events such as oil shocks and financial crises have an important bearing on agricultural productivity. The study thus, concluded that there are short run and long run interactions linking agricultural productivity, oil prices, economic growth and financial development. Such an interaction works towards improving agricultural productivity but can be impaired by oil shocks and financial crises.

Though significant number of researches on the determinants of agricultural productivity are highly focused on the influence of microeconomic determinants, macroeconomic determinants also posed a huge effect on agricultural productivity. The effectiveness of microeconomic determinants is largely influenced by the

A combination of oil shocks and a financial crisis poses huge adverse effects on the interaction linking agricultural productivity, oil prices, economic growth and financial

development. It can be noted that oil is one of the major sources of energy used in the agriculture sector. Hence, disruptions in oil supply caused by rising oil prices are more likely to undermine productivity initiatives. More so, oil shocks have contagion effects on other economic sectors which either directly or indirectly connected to agriculture. For instance, an increase in oil prices will instantly stir an increase in transport fares. As a result, the cost of transporting agricultural inputs and products will rise in response to the price increases. The effects of price increases can be eased by a similar response on agricultural produce. However, this will in turn, result in inflation and the effects of inflation will be transmitted to other economic sectors. Ultimately, a nexus will be established between oil prices and other macroeconomic variables. This strongly reveals that there is a nexus that links macroeconomic variables.

The financial sector remains a key player in efforts to promote agricultural productivity and the ability of farmers to boost productivity hinges on the performance of the financial sector. Any economic misfortunes are thus more likely to disturb the acquisition of high input technology and this will negatively undermine agricultural productivity. This is highly notable when the economy is going through a financial crisis. A financial crisis can disrupt the provision of financial service to farmers and agriculture-related activities. Consequently, the performance of the agriculture sector. This can be reinforced by observations made in the USA which exhibited that the allocation of funds was more biased towards real estate. The agriculture was adversely affected. In addition, financial development had no causal effects on agricultural productivity during the period 1962 to 2016. But the agricultural productivity did manage to stir up financial development. This is because financial players began to innovate their operations so as to benefit from positive developments observed in the agriculture sector.

Ideas about the interaction between agricultural productivity and economic growth are diverse and most differs in terms of which variable Granger causes the other. However, conclusions can be made based on the established findings that agricultural productivity has causal effects on economic growth. but this does not disregard the idea that agricultural productivity also causes ripple and multiplier effects on economic growth. An economy can expand when the agriculture sector goes through a period of rapid growth and expansion. This clearly evidences the existence of a nexus as other sectors benefit from positive spillover effects.

To summarise, the USA has a strong capacity to benefit from improvements in agricultural productivity. This is irrespective of the existence of an opportunity cost of invest much in the agriculture sector as opposed to oil production and other industrial activities. But the potency of USA's agriculture to thrive under such conditions is heavily determined by the nexus between agricultural productivity, oil prices, economic growth and financial development. This also requires that the effects of oil shocks and financial crises be minimised and stability instilled in all markets. In short, there is a nexus that links agricultural productivity, oil prices, economic and financial stability, economic growth and financial development in the USA.

5.2 Recommendations

In line with observations made, the existence of a nexus linking agricultural productivity, oil prices, economic growth and financial development implies that recommendations will be made in respect of these variable core areas.

5.2.1 Recommendations to agricultural players

- There is a greater need to boost agricultural productivity through output maximisation and cost minimisation strategies.
- New, advanced and innovative methods and technology must be introduced in the agriculture sector so as to boost agricultural output and effectively improve the use of resources.
- Agricultural players especially farmers are strongly encouraged to develop measures to cushion against the effects of a financial crisis.

5.2.2 Recommendations to financial institutions

- Financial institutions must develop measures to curb the effects of a financial crisis.
- Financial institutions must improve the provision of financial services rendered to the agriculture sector. This can encompass the availing of new financing programs (microloans and direct operating loans) financial mechanisms and instruments (aggie bonds) to the agriculture sector.
- Financial institutions must continuously innovate their operations and engage in research and development so as to promote financial development.

5.2.3 Recommendations to the government

- The government must introduce economic policies that boost economic growth and development. This can encompass increasing investment in the agriculture and financial sectors.
- The government needs to support the effective use of the agriculture policy. This can be accomplished by promoting institutional stability, creating a conducive environment in which the agriculture sector can thrive, introducing agricultural development programs and providing subsidies to farmers.
- Governments must establish safety nets to cushion against the effects of a financial crisis.
- Governments must also come up with policies that favour financial development.

5.3 Suggestions for future studies

It is important to note that the existence of a nexus linking agricultural productivity, oil prices, economic growth and financial development are not restricted to one economy. This is because a nexus linking agricultural productivity and other macroeconomic variables can also be observed in a group of economies such as G7, Europe, African Union etc. Hence, future studies can conduct a panel examination of a nexus linking agricultural productivity, oil prices, economic growth and financial development is not restricted to one economy.

REFERENCES

Acemoglu, D., & Zilibotti, F. (1997). Was Prometheus unbound by chance? Risk, diversification, and growth. Journal of political economy, 105(4), 709-751.

Acemoglu, D., Aghion, P., & Zilibotti, F. (2006). Distance to frontier, selection, and economic growth. Journal of the European Economic association, 4(1), 37-74.

Ahmed, H., & Said, F. (2012). Determinants of Export Performance in the Wake of the Global Financial Crisis: Evidence from South Asia. The Pakistan Development Review, 51(4), 227-243. Retrieved from http://www.jstor.org/stable/23734753

Aliyu, S. U. R. (2009). Impact of oil price shock and exchange rate volatility on economic growth in Nigeria: An empirical investigation. Research Journal of International Studies, 11, 4-15. Available at https://mpra.ub.uni-muenchen.de/16319/.

Allen, F., & Giovannetti, G. (2011). The effects of the financial crisis on Sub-Saharan Africa. Review of Development Finance, 1(1), 1-27.

Aloui, R., Aïssa, M. S. B., & Nguyen, D. K. (2011). Global financial crisis, extreme interdependences, and contagion effects: The role of economic structure?. Journal of Banking & Finance, 35(1), 130-141.

Amadeo, K. (2018). What Will the Economy Do in 2018 and Beyond? November 25, 2018. Retrieved October 31, 2018, from https://www.thebalance.com/us-economic-outlook-3305669.

Amire, C. M. (2016). The Effect of Agricultural Productivity on Economic Growth in Nigeria. Journal of Advances in Social Science and Humanities, 2(4).

Amone, W. (2014). Agricultural productivity and economic development in Uganda: An inclusive growth analysis (Doctoral dissertation, Mbarara University of Science & Technology).

Asghar, N., & Chughtai, M. W. (2012). Impact of agricultural credit on production of wheat crop: A case study of district faisalabad-Pakistan. Acta Universitatis Danubius. Administratio, 4(2).

Awoyemi, B. O., Afolabi, B., & Akomolafe, K. J. (2017). Agricultural Productivity and Economic Growth: Impact Analysis from Nigeria. Scientific Research Journal (SCIRJ), ISSN 2201-2796, Volume V, Issue X, p. 1-7.

Bernanke, B. (2016). The Relationship Between Stocks and Oil Prices. Ben Bernanke's Blog on Brookings posted on February 19, 2016. Retrieved from https://www.brookings.edu/blog/ben-bernanke/2016/02/19/the-relationship-between-stocks-and-oil-prices/ on 23 October 2018.

Berument, M. H., Ceylan, N. B., & Dogan, N. (2010). The impact of oil price shocks on the economic growth of selected MENA countries. The Energy Journal, 149-176.

Binuomote, S. O., & Odeniyi, K. A. (2013). Effect of crude oil price on agricultural productivity in Nigeria (1981-2010). International Journal of Applied Agriculture and Apiculture Research, 9(1-2), 131-139.

Block, S. A. (1999). Agriculture and economic growth in Ethiopia: growth multipliers from a four-sector simulation model. Agricultural Economics, 20(3), 241-252.

Bouis, R., Duval, R., & Murtin, F. (2011). The policy and institutional drivers of economic growth across OECD and non-OECD economies. New Evidence from Growth Regressions", OECD Economics Department Working Papers, No. 843, OECD Publishing, Paris, https://doi.org/10.1787/5kghwnhxwkhj-en.

Boyd, J. H., & Smith, B. D. (1992). Intermediation and the equilibrium allocation of investment capital: Implications for economic development. Journal of Monetary Economics, 30(3), 409-432.

Brown, E. F. (2010). A comparison of the handling of the financial crisis in the United States, the United Kingdom, and Australia. Vill. L. Rev., 55, 509.

Burger, P., Tyson, J., Karpowicz, I., & Coelho, M. D. (2009). The effects of the financial crisis on public-private partnerships (Vol. 2144). Washington, DC: International Monetary Fund.

Campello, M., Graham, J. R., & Harvey, C. R. (2010). The real effects of financial constraints: Evidence from a financial crisis. Journal of financial Economics, 97(3), 470-487.

Caporale, G. M., Rault, C., Sova, R., & Sova, A. (2009). Financial development and economic growth: Evidence from ten new EU members. Brunel University West London, Economics and finance Working Paper No. 09-37. Available at https://pdfs.semanticscholar.org/92de/877b310ed89fbcccfd9ad0c8c219d063e56c.pdf

Caprio, G., & Levine, R. (2002). Corporate governance in finance: Concepts and international observations. Financial sector governance: The roles of the public and private sectors, 17-50.

Chodorow-Reich, G. (2013). The employment effects of credit market disruptions: Firm-level evidence from the 2008–9 financial crisis. The Quarterly Journal of Economics, 129(1), 1-59.

Christiaensen, L., Demery, L., & Kuhl, J. (2011). The (evolving) role of agriculture in poverty reduction—An empirical perspective. Journal of development economics, 96(2), 239-254.

Chudik, A. and M. H. Pesaran (2016). Theory and Practice of GVAR Modeling. Journal of Economic Surveys 30(1), 165–197.

Coyle, W., McKibbin, W., Wang, Z., & Lopez, M. (1998). The Asian Financial Crisis: Impact on U.S. Agriculture. Choices, 13(4), 28-33. Retrieved from http://www.jstor.org/stable/43625071.

Craven, B. D., & Islam, S. M. (2011). Ordinary least-squares regression (pp. 224-228). Sage Publications.

Dao, M. Q. (2014). Drivers of economic growth in developing countries. Studies in Economics and Econometrics, 38(1), 75-85.

Deepak, S. (2012). Implications of Economic and Financial Crisis for Agricultural Sector of India. MPRA Paper No. 39298, Gokhale Institute of Politics and Economics. Available at Online at https://mpra.ub.uni-muenchen.de/39298/.

De Gregorio, J., & Guidotti, P. E. (1995). Financial development and economic growth. World Development, 23(3), 433–448.10.1016/0305-750X(94)00132-I.

Demyanyk, Y., & Van Hemert, O. (2009). Understanding the subprime mortgage crisis. The Review of Financial Studies, 24(6), 1848-1880.

Denby, L., & Martin, R. D. (1979). Robust estimation of the first-order autoregressive parameter. Journal of the American Statistical Association, 74(365), 140-146.

Dercon, S., & Gollin, D. (2014). Agriculture in African development: theories and strategies. Annu. Rev. Resour. Econ., 6(1), 471-492.

Dercon, S., & Gollin, D. (2014). Agriculture in African development: theories and strategies. Annu. Rev. Resour. Econ., 6(1), 471-492.

Dhrifi, A. (2014). Financial development and agricultural productivity: evidence from African countries. Research article, Vol. 3(01), 1-10.

Diao, X., & Roe, T. (2000). How the Financial Crisis Affected World Agriculture: A General Equilibrium Perspective. American Journal of Agricultural Economics, 82(3), 688-694. Retrieved from http://www.jstor.org/stable/1244625.

Diao, X., Hazell, P., & Thurlow, J. (2010). The role of agriculture in African development. World development, 38(10), 1375-1383.

Diao, X., Hazell, P., & Thurlow, J. (2010). The role of agriculture in African development. World development, 38(10), 1375-1383.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. Journal of the American statistical association, 74(366a), 427-431.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. Econometrica: journal of the Econometric Society, 251-276.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. Econometrica: journal of the Econometric Society, 251-276.

Evensen, G. (1994). Sequential data assimilation with a nonlinear quasi-geostrophic model using Monte Carlo methods to forecast error statistics. Journal of Geophysical Research: Oceans, 99(C5), 10143-10162.

Fan, S., Hazell, P., & Thorat, S. (2000). Government spending, growth and poverty in rural India. American journal of agricultural economics, 82(4), 1038-1051.

FAOSTAT (n.d). Retrivedd from faostat3.fao.org on 31 October 2018.

Fatas, A. & Mihov, I. (2009). The 4 I's of Economic Growth Antonio. Retrieved from https://faculty.insead.edu/fatas/wall/wall.pdf on 31 October 2018.

Focus economics. (n.d). Focus Economics Blog. Retrieved October 31, 2018, from https://focuseconomics.wordpress.com/

Fox, A. J. (1972). Outliers in time series. Journal of the Royal Statistical Society. Series B (Methodological), 350-363.

Frimpong, J. M., & Oteng-Abayie, E. F. (2006). Bounds testing approach: an examination of foreign direct investment, trade, and growth relationships.

Garnett, T., Appleby, M. C., Balmford, A., Bateman, I. J., Benton, T. G., Bloomer, P., ... & Herrero, M. (2013). Sustainable intensification in agriculture: premises and policies. Science, 341(6141), 33-34.

Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., ... & Toulmin, C. (2010). Food security: the challenge of feeding 9 billion people. science, 327(5967), 812-818.

Gollin D, Parente SL, Rogerson R. 2007. The food problem and the evolution of international income levels. Dercon & Gollin, 2014 Dercon & Gollin, 2014J. Monet. Econ. 54(4):1230–55

Gollin, D., Parente, S. L., & Rogerson, R. (2004). Farm work, home work and international productivity differences. Review of Economic dynamics, 7(4), 827-850.

Gollin, D., Parente, S., & Rogerson, R. (2002). The role of agriculture in development. American Economic Review, 92(2), 160-164.

Granger, C. W. (1980). Testing for causality: a personal viewpoint. Journal of Economic Dynamics and control, 2, 329-352.

Granger, C. W. (1988). Some recent development in a concept of causality. Journal of econometrics, 39(1-2), 199-211.

Greenberg, E., & Webster, C. E. (1983). Advanced econometrics: a bridge to the literature. John Wiley & Sons.

Greene, W. H. (2003). Econometric analysis. Pearson Education India.

Gujarati, D. N. (2009). Basic econometrics. Tata McGraw-Hill Education.

Gunawardena, A. (2012, February). Effects of increasing agricultural productivity: A computable general equilibrium analysis for Sri Lanka. In Australian Agricultural and Resource Economics 56th Annual Conference.

Hansen, B. E. (1992). Testing for parameter instability in linear models. Journal of policy Modeling, 14(4), 517-533.

Hurd, M. D., & Rohwedder, S. (2010). Effects of the financial crisis and great recession on American households (No. w16407). National Bureau of Economic Research.

Irz, X., Lin, L., Thirtle, C., & Wiggins, S. (2001). Agricultural productivity growth and poverty alleviation. Development policy review, 19(4), 449-466.

Ismail, A. A., & Kabuga, N. A. (2016). Impact of agricultural output on economic growth in Nigeria using ARDL econometric approach. Nigerian Journal of Agricultural and Development Economics (NIJADE), 6(1), 127-138.

Jaeger, W. K., & Mundial, B. (1992). The effects of economic policies on African agriculture (Vol. 147). Washington, DC: World Bank.

Johnston, B. F., & Mellor, J. W. (1961). The role of agriculture in economic development. The American Economic Review, 51(4), 566-593.

Jorgenson, D.W. (2005), “Growth Accounting,” in Handbook of Economic Growth. Eds.: P. Aghion and S. Durlauf, Amsterdam: North-Holland Elsevier Publishers.

Kilian, L. (2014). Oil price shocks: Causes and consequences. University of Michigan and CEPR. Accessed from https://pdfs.semanticscholar.org/21e4/11e2ae3e5d69ad151ca7f3336917e545e56e.pdf on 31 October 2018.

Kramin, M. V., Safiullin, L. N., Kramin, T. V., & Timiryasova, A. V. (2014). Drivers of economic growth and investment attractiveness of Russian regions. Life Science Journal, 11(6s), 526-530.

Kumar, A., Shinoj, P., & Joshi, P. K. (2010). Global economic crisis and Indian agriculture: Impacts and perspectives. Indian Journal of Agricultural Economics, 65(3), 508.

Laux, C., & Leuz, C. (2010). Did fair-value accounting contribute to the financial crisis? Journal of economic perspectives, 24(1), 93-118.

Ligon, E., & Sadoulet, E. (2008). Estimating the effects of aggregate agricultural growth on the distribution of expenditures. Backgr. Pap. for the World Development Report 2008: Agriculture for Development, World Bank, Washington, DC

Louzis, D. P., Vouldis, A. T., & Metaxas, V. L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business and consumer loan portfolios. Journal of Banking & Finance, 36(4), 1012-1027.

MacDonald, S. (2018). Latest U.S. Agricultural Trade Data." USDA Economic Research Service. USDA, 6 Sept. 2018.

Madala, G. S. (2001). Introduction to Econometrics, 3"* edn.

McArthur, J., & Sachs, J. (2013). A general equilibrium model for analyzing rural subsistence economies and an African green revolution. Work. Pap. 12, Afr. Growth Initiat., Brookings Inst., Washington DC

McFarlane, I. (2016) Agricultural commodity prices and oil prices: mutual causation. Outlok on Agriculture, 45 (2). pp. 8793. ISSN 2043-6866 doi: https://doi.org/10.1177/0030727016649809. Available at http://centaur.reading.ac.uk/65781/

McMichael, P., & Schneider, M. (2011). Food security politics and the Millennium Development Goals. Third World Quarterly, 32(1), 119-139.

Mehdian, S. & Perry, J. M. (2002) Anomalies in US equity markets: a re-examination of the January effect, Applied Financial Economics, 12:2, 141-145, DOI: 10.1080/09603100110088067

Merton, R. C., & Bodie, Z. (2004). Design of financial systems: towards a synthesis of function and structure. In The World Of Risk Management (pp. 1-27).

Mohaddes, K., & Pesaran, M. H. (2017). Oil prices and the global economy: Is it different this time around?. Energy Economics, 65, 315-325.

Morales, M. F. (2003), “Financial Intermediation in a Model of Growth Through Creative Descruction”, Macroeconomic Dynamics, 7: 363-93.

Morck, R., Wolfenzon, D., & Yeung, B. (2005). Corporate governance, economic entrenchment, and growth. Journal of economic literature, 43(3), 655-720.

Muhammad Adnan Hye, Q., & Wizarat, S. (2011). Impact of financial liberalization on agricultural growth: a case study of Pakistan. China Agricultural Economic Review, 3(2), 191-209, https://doi.org/10.1108/17561371111131317.

Multpl (n.d). US GDP Growth Rate by Year. Retrieved from http://www.multpl.com/us-real-gdp-growth-rate/table/by-year on 23 November 2018.

Nazir S, Hameed T (2015) Impact of Oil Price and Shocks on Economic Growth of Pakistan: Multivariate Analysis (Sectoral Oil Consumption). Bus Eco J 6:182. doi:10.4172/2151-6219.1000182

Nazlioglu, S., & Soytas, U. (2012). Oil price, agricultural commodity prices, and the dollar: A panel cointegration and causality analysis. Energy Economics, 34(4), 1098-1104.

Nobi, A., Maeng, S. E., Ha, G. G., & Lee, J. W. (2014). Effects of global financial crisis on network structure in a local stock market. Physica A: Statistical Mechanics and its Applications, 407, 135-143.

Nwachukwu, I. (2008). Planning and evaluation of agricultural and rural development project. Lambhouse publishers. p. 1-6.

Obstfeld, M., G. M. Milesi-Ferretti, and R. Arezki (2016). Oil Prices and the Global Economy: It’s Complicated. iMFdirect blog posted on March 24, 2016.

Olomola, P. A., & Adejumo, A. V. (2006). Oil price shock and macroeconomic activities in Nigeria. International Research Journal of Finance and Economics, 3(1), 28-34.

Onoja, J. J. (2017). Financial Sector Development and Agricultural Productivity. University of San Francisco, CA, University of San Francisco, CAMaster's Theses,

Pesaran, M. H., & Shin, Y. (1998). An autoregressive distributed-lag modelling approach to cointegration analysis. Econometric Society Monographs, 31, 371-413.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics, 16(3), 289-326.

Piskorski, T., Seru, A., & Vig, V. (2010). Securitization and distressed loan renegotiation: Evidence from the subprime mortgage crisis. Journal of Financial Economics, 97(3), 369-397.

Ploberger, W., & Krämer, W. (1990). The local power of the CUSUM and CUSUM of squares tests. Econometric Theory, 6(3), 335-347.

Puri, M., Rocholl, J., & Steffen, S. (2011). Global retail lending in the aftermath of the US financial crisis: Distinguishing between supply and demand effects. Journal of Financial Economics, 100(3), 556-578.

Ramsey, J. B., & Schmidt, P. (1976). Some further results on the use of OLS and BLUS residuals in specification error tests. Journal of the American Statistical Association, 71(354), 389-390.

Ravallion M, Chen S. (2007). China’s (uneven) progress against poverty. J. Dev. Econ. 82(1):1–42

Reinhart, C. M., & Rogoff, K. S. (2008). Is the 2007 US sub-prime financial crisis so different? An international historical comparison. American Economic Review, 98(2), 339-44.

Rizwan-ul-Hassan, M. (2017). Development on Agricultural Growth: Empirical Evidence from Pakistan. College of Management Sciences, Vol. XII, No. 2.

Shahbaz, M., Shahbaz Shabbir, M., & Sabihuddin Butt, M. (2013). Effect of financial development on agricultural growth in Pakistan: New extensions from bounds test to level relationships and Granger causality tests. International Journal of Social Economics, 40(8), 707-728, https://doi.org/10.1108/IJSE-01-2012-0002.

Shahbaz, M., Shahbaz Shabbir, M., & Sabihuddin Butt, M. (2013). Effect of financial development on agricultural growth in Pakistan: New extensions from bounds test to level relationships and Granger causality tests. International Journal of Social Economics, 40(8), 707-728.

Shane, M., & Liefert, W. (2000). The International Financial Crisis: Macroeconomic Linkages to Agriculture. American Journal of Agricultural Economics, 82(3), 682-687. Retrieved from http://www.jstor.org/stable/1244624.

Song, K. R., & Lee, Y. (2012). Long-term effects of a financial crisis: Evidence from cash holdings of East Asian firms. Journal of Financial and Quantitative Analysis, 47(3), 617-641.

Sornette, D., Woodard, R., & Zhou, W. X. (2009). The 2006–2008 oil bubble: Evidence of speculation, and prediction. Physica A: Statistical Mechanics and its Applications, 388(8), 1571-1576.

STATISTA (n.d). Total value of U.S. agricultural exports from 2012 to 2018 (in billion U.S. dollars). Retrived from https://www.statista.com/statistics/220767/total-value-of-us-agricultural-exports-since-2000/ on 31 October 2018.

Stifel, D., & Thorbecke, E. (2003). A dual-dual CGE model of an archetype African economy: trade reform, migration and poverty. J. Policy Model. 25:207–55.

Thirtle, C., Lin, L., & Piesse, J. (2003). The impact of research-led agricultural productivity growth on poverty reduction in Africa, Asia and Latin America. World Development, 31(12), 1959-1975.

Tiffin R, Irz X. 2006. Is agriculture the engine of growth? Agric. Econ. 35(1):79–89

Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. Journal of econometrics, 66(1-2), 225-250.

U.S. Energy Information Administration - EIA - Independent Statistics and Analysis. (n.d). Retrieved October 31, 2018, from https://www.eia.gov/todayinenergy/

Udemezue, J. C. & Osegbue, E. G. (2018). Theories and Models of Agricultural Development. Juniper publishers. Annals of reviews and research, p. 001-004.

Vella, M. (2018). Understanding the key drivers of an economy. Times Malta, Tuesday 22 May, 2018. Retrieved from https://www.timesofmalta.com/articles/view/20180522/business-market-analysis/understanding-the-key-drivers-of-an-economy.679708 on 31 October 2018.

Wang, S. L., & McPhail, L. (2014). Impacts of energy shocks on US agricultural productivity growth and commodity prices—A structural VAR analysis. Energy Economics, 46, 435-444.

Warr, B., & Ayres, R. U. (2012). Useful work and information as drivers of economic growth. Ecological Economics, 73, 93-102.

World Bank (2008). World Development Report 2007: Agriculture for Development. Washington, DC: World Bank

Wurgler, J. (2000), “Financial Markets and the Allocation of Capital”, Journal of Financial Economics, 58: 187-214.

Yazdani, S. (2008). Financial market development and agricultural economic growth in Iran. American-Eurasian Journal of Sustainable Agriculture, 2(3), 338-343.

Yelkikalan, N., & Köse, C. (2012). The effects of the financial crisis on corporate social responsibility. International Journal of Business and Social Science, 3(3).

LIST OF APPENDICES

Appendix I: Chow Breakpoint test

Chow Breakpoint Test: 2008

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1962 2016

F-statistic	3.669085	Prob. F(5,45)	0.0072
Log likelihood ratio	18.80671	Prob. Chi-Square(5)	0.0021
Wald Statistic	18.34543	Prob. Chi-Square(5)	0.0025

Appendix II: ARDL model estimation

Dependent Variable: LAM
Method: ARDL
Date: 11/23/18 Time: 18:49
Sample (adjusted): 1966 2016
Included observations: 51 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LOP LFD LEG2 FC
Fixed regressors: C
Number of models evalulated: 2500
Selected Model: ARDL(4, 3, 4, 3, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LAM(-1)	0.725896	0.133758	5.426925	0.0000
LAM(-2)	-0.185702	0.142518	-1.303003	0.2019
LAM(-3)	0.014516	0.129155	0.112392	0.9112
LAM(-4)	0.293390	0.085898	3.415575	0.0017
LOP	0.001573	0.024151	0.065137	0.9485
LOP(-1)	-0.044463	0.032380	-1.373163	0.1792
LOP(-2)	0.081339	0.036066	2.255275	0.0311
LOP(-3)	-0.069462	0.028223	-2.461216	0.0194
LFD	-1.246021	0.324499	-3.839829	0.0005
LFD(-1)	2.219643	0.559790	3.965136	0.0004
LFD(-2)	-1.950749	0.689494	-2.829249	0.0080
LFD(-3)	0.852752	0.607000	1.404863	0.1697
LFD(-4)	0.469393	0.334650	1.402641	0.1704
LEG2	0.027848	0.011949	2.330508	0.0262
LEG2(-1)	0.019819	0.015406	1.286409	0.2075
LEG2(-2)	-0.021353	0.015790	-1.352351	0.1857
LEG2(-3)	0.046414	0.013992	3.317149	0.0023
FC	-0.097411	0.021234	-4.587514	0.0001
C	-1.437466	0.622676	-2.308528	0.0276

R-squared	0.996508	Mean dependent var	0.715117
Adjusted R-squared	0.994544	S.D. dependent var	0.579665
S.E. of regression	0.042817	Akaike info criterion	-3.184764
Sum squared resid	0.058665	Schwarz criterion	-2.465065
Log likelihood	100.2115	Hannan-Quinn criter.	-2.909746
F-statistic	507.3465	Durbin-Watson stat	2.254427
Prob(F-statistic)	0.000000		

Appendix III: Long run form

ARDL Cointegrating And Long Run Form
Original dep. variable: LAM
Selected Model: ARDL(4, 3, 4, 3, 0)
Date: 11/23/18 Time: 18:52
Sample: 1962 2016
Included observations: 51

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LAM(-1))	-0.111258	0.114686	-0.970116	0.3393
D(LAM(-2))	-0.300938	0.091107	-3.303115	0.0024
D(LAM(-3))	-0.278045	0.093533	-2.972709	0.0056
D(LOP)	0.001677	0.020458	0.081960	0.9352
D(LOP(-1))	-0.012111	0.023194	-0.522150	0.6052
D(LOP(-2))	0.067815	0.024088	2.815340	0.0083
D(LFD)	-1.251452	0.271541	-4.608709	0.0001
D(LFD(-1))	0.649059	0.393513	1.649396	0.1089
D(LFD(-2))	-1.292142	0.364939	-3.540708	0.0012
D(LFD(-3))	-0.462028	0.274027	-1.686070	0.1015
D(LEG2)	0.027404	0.009446	2.901207	0.0067
D(LEG2(-1))	-0.023447	0.014893	-1.574375	0.1252
D(LEG2(-2))	-0.045408	0.012164	-3.732983	0.0007
D(FC)	-0.100350	0.016019	-6.264461	0.0000
CointEq(-1)	-0.148362	0.022740	-6.524270	0.0000

Cointeq = LAM - (-0.2042*LOP + 2.2714*LFD + 0.4788*LEG2 - 0.6413*FC – 9.4633)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOP	-0.204163	0.069567	-2.934763	0.0061
LFD	2.271356	1.046655	2.170110	0.0375
LEG2	0.478784	0.121171	3.951310	0.0004
FC	-0.641288	0.183113	-3.502145	0.0014
C	-9.463268	4.388919	-2.156173	0.0387

Appendix IV: Error correction regression

ARDL Error Correction Regression
Dependent Variable: D(LAM)
Selected Model: ARDL(4, 3, 4, 3, 0)
Case 2: Restricted Constant and No Trend
Date: 11/07/18 Time: 02:59
Sample: 1962 2016
Included observations: 51

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LAM(-1))	-0.122204	0.106556	-1.146858	0.2599
D(LAM(-2))	-0.307906	0.086590	-3.555917	0.0012
D(LAM(-3))	-0.293390	0.075093	-3.906994	0.0005
D(LOP)	0.001573	0.020199	0.077880	0.9384
D(LOP(-1))	-0.011877	0.022889	-0.518905	0.6074
D(LOP(-2))	0.069462	0.023075	3.010206	0.0051
D(LFD)	-1.246021	0.267465	-4.658632	0.0001
D(LFD(-1))	0.628604	0.381918	1.645913	0.1096
D(LFD(-2))	-1.322145	0.344690	-3.835753	0.0006
D(LFD(-3))	-0.469393	0.269363	-1.742608	0.0910
D(LEG)	0.027848	0.009197	3.027853	0.0048
D(LEG(-1))	-0.025061	0.013575	-1.846104	0.0741
D(LEG(-2))	-0.046414	0.011483	-4.042071	0.0003
CointEq(-1)*	-0.151900	0.018722	-8.113368	0.0000

R-squared	0.862493	Mean dependent var	-0.042997
Adjusted R-squared	0.814180	S.D. dependent var	0.092372
S.E. of regression	0.039819	Akaike info criterion	-3.380843
Sum squared resid	0.058665	Schwarz criterion	-2.850538
Log likelihood	100.2115	Hannan-Quinn criter.	-3.178198
Durbin-Watson stat	2.254427		

* p-value incompatible with t-Bounds distribution.

Appendix V: Bounds test

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LAM)
Selected Model: ARDL(4, 3, 4, 3, 0)
Case 2: Restricted Constant and No Trend
Date: 11/07/18 Time: 02:41
Sample: 1962 2016
Included observations: 51

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	9.488540	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
Actual Sample Size	51		Finite Sample: n=55	
		10%	2.345	3.28
		5%	2.763	3.813
		1%	3.738	4.947
			Finite Sample: n=50	
		10%	2.372	3.32
		5%	2.823	3.872
		1%	3.845	5.15

Appendix VI: Log likelihood test

Redundant Variables Test
Null hypothesis: LOP LFD LEG2 FC are jointly insignificant
Equation: UNTITLED

Specification:
LAM LAM(-1) LAM(-2) LAM(-3) LAM(-4) LOP LOP(-1) LOP(-2) LOP(-3) LFD LFD(-1) LFD(-2) LFD(-3) LFD(-4) LEG2 LEG2(-1) LEG2(-2) LEG2(-3) FC C

Redundant Variables: LOP LFD LEG2 FC

	Value	df	Probability
F-statistic	14.33562	(4, 32)	0.0000

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.105125	4	0.026281
Restricted SSR	0.163790	36	0.004550
Unrestricted SSR	0.058665	32	0.001833

Restricted Test Equation:
Dependent Variable: LAM
Method: Least Squares
Date: 11/23/18 Time: 18:58
Sample: 1966 2016
Included observations: 51

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LAM(-1)	1.035931	0.180818	5.729132	0.0000
LAM(-2)	-0.167682	0.215890	-0.776699	0.4424
LAM(-3)	-0.254939	0.194238	-1.312509	0.1977
LAM(-4)	0.312289	0.131765	2.370049	0.0233
LOP(-1)	-0.105127	0.034107	-3.082287	0.0039
LOP(-2)	0.163146	0.052309	3.118865	0.0036
LOP(-3)	-0.086751	0.040979	-2.116991	0.0412
LFD(-1)	1.307867	0.571991	2.286516	0.0282
LFD(-2)	-2.528764	1.007968	-2.508774	0.0168
LFD(-3)	0.848704	0.935681	0.907044	0.3704
LFD(-4)	0.997867	0.503487	1.981912	0.0552
LEG2(-1)	-0.024199	0.019673	-1.230058	0.2267
LEG2(-2)	-0.047769	0.022051	-2.166317	0.0370
LEG2(-3)	0.055269	0.020892	2.645493	0.0120
C	-2.507262	0.894057	-2.804365	0.0081

R-squared	0.990251	Mean dependent var	0.715117
Adjusted R-squared	0.986460	S.D. dependent var	0.579665
S.E. of regression	0.067452	Akaike info criterion	-2.314886
Sum squared resid	0.163790	Schwarz criterion	-1.746702
Log likelihood	74.02959	Hannan-Quinn criter.	-2.097766
F-statistic	261.1909	Durbin-Watson stat	2.171323
Prob(F-statistic)	0.000000		

Appendix VII: Ramsey reset

Ramsey RESET Test
Equation: UNTITLED
Specification: LAM LAM(-1) LAM(-2) LAM(-3) LAM(-4) LOP LOP(-1) LOP(-2) LOP(-3) LFD LFD(-1) LFD(-2) LFD(-3) LFD(-4) LEG LEG(-1) LEG(-2) LEG(-3) DVFC C
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.622882	31	0.5379
F-statistic	0.387982	(1, 31)	0.5379
Likelihood ratio	0.634332	1	0.4258

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.000725	1	0.000725
Restricted SSR	0.058665	32	0.001833
Unrestricted SSR	0.057940	31	0.001869

LR test summary:

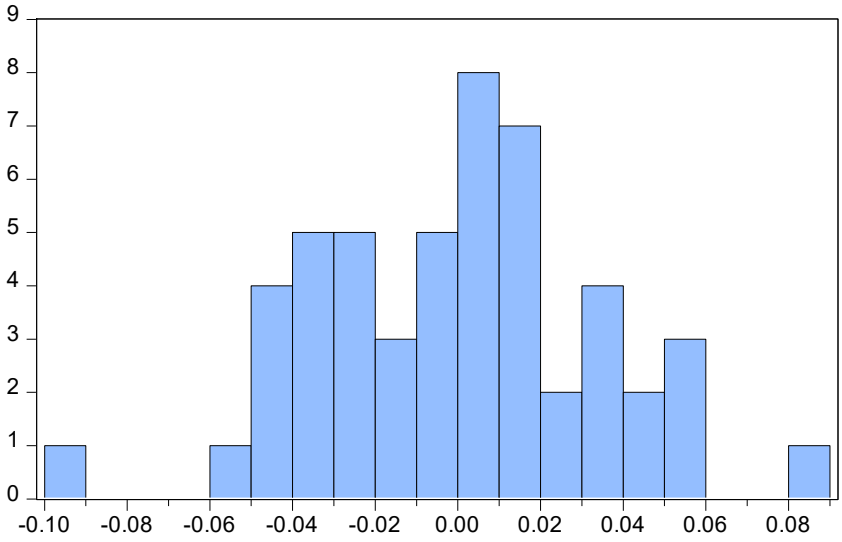
	Value
Restricted LogL	100.2115
Unrestricted LogL	100.5287

Unrestricted Test Equation:
Dependent Variable: LAM
Method: Least Squares
Date: 11/07/18 Time: 02:52
Sample: 1966 2016
Included observations: 51

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LAM(-1)	0.736053	0.136037	5.410689	0.0000
LAM(-2)	-0.176209	0.144706	-1.217704	0.2325
LAM(-3)	0.018038	0.130531	0.138190	0.8910
LAM(-4)	0.297011	0.086926	3.416839	0.0018
LOP	0.000195	0.024485	0.007963	0.9937
LOP(-1)	-0.047663	0.033095	-1.440186	0.1598
LOP(-2)	0.085367	0.036986	2.308107	0.0278
LOP(-3)	-0.070098	0.028515	-2.458303	0.0197
LFD	-1.262403	0.328701	-3.840578	0.0006
LFD(-1)	2.281325	0.573830	3.975609	0.0004
LFD(-2)	-1.960843	0.696372	-2.815799	0.0084
LFD(-3)	0.801840	0.618316	1.296813	0.2043
LFD(-4)	0.489619	0.339453	1.442376	0.1592
LEG	0.026187	0.012356	2.119307	0.0422
LEG(-1)	0.018939	0.015620	1.212485	0.2345
LEG(-2)	-0.024894	0.016926	-1.470760	0.1514
LEG(-3)	0.042710	0.015328	2.786394	0.0090
DVFC	-0.099173	0.021626	-4.585872	0.0001
C	-1.440948	0.628742	-2.291794	0.0289
FITTED^2	-0.015452	0.024807	-0.622882	0.5379

R-squared	0.996551	Mean dependent var	0.715117
Adjusted R-squared	0.994438	S.D. dependent var	0.579665
S.E. of regression	0.043232	Akaike info criterion	-3.157987
Sum squared resid	0.057940	Schwarz criterion	-2.400408
Log likelihood	100.5287	Hannan-Quinn criter.	-2.868493
F-statistic	471.4719	Durbin-Watson stat	2.259599
Prob(F-statistic)	0.000000		

Appendix VIII: Normality test



Series: Residuals	
Sample 1966 2016	
Observations 51	
Mean	7.01e-16
Median	0.001326
Maximum	0.088407
Minimum	-0.091822
Std. Dev.	0.034253
Skewness	0.035991
Kurtosis	3.152959
Jarque-Bera	0.060728
Probability	0.970092

Appendix VIV: Arch Heteroscedasticity test

Heteroskedasticity Test: ARCH

F-statistic	0.049504	Prob. F(1,48)	0.8249
Obs*R-squared	0.051514	Prob. Chi-Square(1)	0.8204

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/23/18 Time: 19:02
Sample (adjusted): 1967 2016
Included observations: 50 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001209	0.000296	4.084559	0.0002
RESID^2(-1)	-0.031976	0.143715	-0.222496	0.8249

R-squared	0.001030	Mean dependent var	0.001172
Adjusted R-squared	-0.019782	S.D. dependent var	0.001715
S.E. of regression	0.001732	Akaike info criterion	-9.840009
Sum squared resid	0.000144	Schwarz criterion	-9.763528
Log likelihood	248.0002	Hannan-Quinn criter.	-9.810885
F-statistic	0.049504	Durbin-Watson stat	1.997039
Prob(F-statistic)	0.824872		

Appendix X: Breusch-Pagan-Godfrey

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.511248	Prob. F(18,32)	0.9325
Obs*R-squared	11.39072	Prob. Chi-Square(18)	0.8770
Scaled explained SS	4.827439	Prob. Chi-Square(18)	0.9991

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/23/18 Time: 19:04
Sample: 1966 2016
Included observations: 51

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000221	0.027308	-0.008093	0.9936
LAM(-1)	-0.005309	0.005866	-0.904989	0.3722
LAM(-2)	0.002315	0.006250	0.370424	0.7135
LAM(-3)	-0.000263	0.005664	-0.046413	0.9633
LAM(-4)	0.003411	0.003767	0.905414	0.3720
LOP	0.000954	0.001059	0.900494	0.3746
LOP(-1)	-0.001364	0.001420	-0.960327	0.3441
LOP(-2)	0.000261	0.001582	0.165119	0.8699
LOP(-3)	0.000387	0.001238	0.312933	0.7564
LFD	-0.013528	0.014231	-0.950605	0.3489
LFD(-1)	-0.005732	0.024551	-0.233481	0.8169
LFD(-2)	0.020215	0.030239	0.668521	0.5086
LFD(-3)	-0.018554	0.026621	-0.696985	0.4908
LFD(-4)	0.017286	0.014677	1.177805	0.2476
LEG2	-0.000257	0.000524	-0.490764	0.6269
LEG2(-1)	0.000604	0.000676	0.893390	0.3783
LEG2(-2)	0.000421	0.000692	0.608482	0.5472
LEG2(-3)	3.06E-05	0.000614	0.049819	0.9606
FC	-0.000471	0.000931	-0.505408	0.6167

R-squared	0.223348	Mean dependent var	0.001150
Adjusted R-squared	-0.213519	S.D. dependent var	0.001705
S.E. of regression	0.001878	Akaike info criterion	-9.438423
Sum squared resid	0.000113	Schwarz criterion	-8.718723
Log likelihood	259.6798	Hannan-Quinn criter.	-9.163404
F-statistic	0.511248	Durbin-Watson stat	2.446868
Prob(F-statistic)	0.932469		

Appendix XI: Serial correlation LM test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.672472	Prob. F(2,30)	0.2048
Obs*R-squared	5.115981	Prob. Chi-Square(2)	0.0775

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 11/23/18 Time: 19:08
Sample: 1966 2016
Included observations: 51
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LAM(-1)	0.127596	0.179595	0.710466	0.4829
LAM(-2)	-0.023739	0.177011	-0.134109	0.8942
LAM(-3)	-0.068695	0.136223	-0.504287	0.6177
LAM(-4)	-0.010633	0.087300	-0.121800	0.9039
LOP	0.000592	0.023781	0.024911	0.9803
LOP(-1)	0.008504	0.032059	0.265266	0.7926
LOP(-2)	0.011685	0.037939	0.307993	0.7602
LOP(-3)	-0.016309	0.030900	-0.527823	0.6015
LFD	0.204302	0.338587	0.603398	0.5508
LFD(-1)	0.015214	0.558581	0.027238	0.9785
LFD(-2)	-0.324194	0.768439	-0.421887	0.6761
LFD(-3)	0.165820	0.666455	0.248809	0.8052
LFD(-4)	-0.030418	0.347109	-0.087633	0.9308
LEG2	-0.000679	0.011731	-0.057915	0.9542
LEG2(-1)	-0.012426	0.017374	-0.715228	0.4800
LEG2(-2)	-0.006959	0.015935	-0.436728	0.6654
LEG2(-3)	0.007545	0.014665	0.514481	0.6107
FC	0.001544	0.021215	0.072784	0.9425
C	-0.128766	0.615269	-0.209284	0.8356
RESID(-1)	-0.321553	0.250602	-1.283122	0.2093
RESID(-2)	-0.319198	0.221522	-1.440934	0.1600

R-squared	0.100313	Mean dependent var	-2.27E-16
Adjusted R-squared	-0.499478	S.D. dependent var	0.034253
S.E. of regression	0.041944	Akaike info criterion	-3.212042
Sum squared resid	0.052780	Schwarz criterion	-2.416584
Log likelihood	102.9071	Hannan-Quinn criter.	-2.908074
F-statistic	0.167247	Durbin-Watson stat	2.058832
Prob(F-statistic)	0.999947		

SIMILARITY INDEX

Thesis 1

ORIGINALITY REPORT

5%	2%	3%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	"The New Palgrave Dictionary of Economics", Springer Nature, 2018 Publication	<1%
2	www120.secure.griffith.edu.au Internet Source	<1%

ETHICAL APPROVAL

YAKIN DOĞU ÜNİVERSİTESİ

BİLİMSEL ARAŞTIRMALAR ETİK KURULU

25.10.2018

Sayın Simbarashe Rabson Andrea

Bilimsel Araştırmalar Etik Kurulu'na yapmış olduğunuz **"The Nexus Between Agricultural Productivity, Oil Prices, Financial Development And Economic Growth In Usa"** başlıklı proje önerisi, sadece ikincil kaynak kullanıldığı için Etik Kuruluruna girmesine gerek yoktur. Bu yazı ile birlikte sadece ikincil kaynak kullanmak şartıyla araştırmaya başlayabilirsiniz.

Doçent Doktor Direnç Kanol

Bilimsel Araştırmalar Etik Kurulu Raportörü

Direnc Kanol

Not: Eğer bir kuruma resmi bir kabul yazısı sunmak istiyorsanız, Yakın Doğu Üniversitesi Bilimsel Araştırmalar Etik Kurulu'na bu yazı ile başvurup, kurulun başkanının imzasını taşıyan resmi bir yazı temin edebilirsiniz.

YAKIN DOĞU ÜNİVERSİTESİ

BİLİMSEL ARAŞTIRMALAR ETİK KURULU

25.10.2018

Dear Simbarashe Rabson Andrea

Your project **"The Nexus Between Agricultural Productivity, Oil Prices, Financial Development And Economic Growth In Usa "** has been evaluated. Since only secondary data will be used the project it does not need to go through the ethics committee. You can start your research on the condition that you will use only secondary data.

Assoc. Prof. Dr. Direnç Kanol

Rapporteur of the Scientific Research Ethics Committee

Direnc Kanol

Note: If you need to provide an official letter to an institution with the signature of the Head of NEU Scientific Research Ethics Committee, please apply to the secretariat of the ethics committee by showing this document.