

Determinants of agricultural sector growth in the united states of america during the period 1986 - 2017

محددات نمو القطاع الفلاحي في الولايات المتحدة الأمريكية خلال الفترة 1986 – 2017

Déterminants de la croissance du secteur agricole aux états-unis d'amérique au cours de la période 1986 - 2017

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ملخص: تهدف هذه الدراسة إلى تبيان المحددات الرئيسية لنمو القطاع الفلاحي في الولايات المتحدة الأمريكية خلال الفترة 1986-2017، وذلك باستخدام منهج الانحدار الذاتي لفترات الإبطاء الموزعة (ARDL) لتحديد العلاقة الطويلة الأجل بين متغيرات الدراسة. وقد توصلت الدراسة إلى أن أهم محددات نمو القطاع الفلاحي تتمثل في إجمالي تكوين رأس المال الثابت في الفلاحة، الدعم الفلاحي، الاستثمار الأجنبي المباشر في القطاع الفلاحي، القروض الفلاحية وتمويل البحوث الفلاحية، كما توصلت الدراسة إلى تأثير هذه المحددات إيجاباً على نمو القطاع الفلاحي باستثناء الدعم الفلاحي والاستثمار الأجنبي المباشر في القطاع الفلاحي.

الكلمات المفتاحية: القطاع فلاحى؛ محددات نمو القطاع الفلاحي؛ التكامل المشترك؛ منهج الانحدار الذاتي لفترات الإبطاء الموزعة؛ الولايات المتحدة الأمريكية.

Abstract: The study aims to show the agricultural sector growth determinants in the United State of America over the period 1986 - 2017. The autoregressive distributed lag (ARDL) approach is used in determining the long run relationship between Study variables. The study found that the most significant agricultural sector growth determinants are gross fixed capital formation in agriculture, agricultural support, direct foreign investment in agriculture, agricultural loans and agricultural research funding. The study also found a positive impact of these determinants on the growth of the agricultural sector, with the exception of agricultural support and foreign direct investment in agriculture.

Keyword: Agricultural sector; agricultural sector growth determinants; cointegration; autoregressive distributed lag approach; the United State of America.

Résumé: L'étude vise à montrer les déterminants de la croissance du secteur agricole aux États-Unis d'Amérique sur la période 1986-2017. L'approche d'autorégressif à retards échelonnés (ARDL) est utilisée pour déterminer la relation à long terme entre les variables de l'étude. L'étude a révélé que les principaux déterminants de la croissance du secteur agricole sont la formation brute de capital fixe dans l'agriculture, le soutien agricole, l'investissement étranger direct dans l'agriculture, les prêts agricoles et le financement de la recherche agricole. L'étude a également révélé un impact positif de ces déterminants sur la croissance du secteur agricole, à l'exception du soutien à l'agriculture et de l'investissement étranger direct dans l'agriculture.

Mots clés: le secteur agricole; les déterminants de la croissance du secteur agricole; co-intégration; l'approche d'autorégressif à retards échelonnés; États-Unis d'Amérique.

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Introduction

The United States of America is one of the world's largest producers and exporters of agricultural commodities because of increasing agricultural productivity, and the efficiency of the agricultural sector, which is an important sector of the American economy.

In this context, Agricultural sector plays a strategic role in process of economic development in United State of America by ensuring a safe and reliable food supply, improving energy security and supporting a number of sectors, from farm machinery manufacturers to food processing companies, in addition to the importance of agriculture for the economies of small towns and rural areas.

Given the importance of the American experience in developing the agricultural sector, this study examines the most important factors determining the growth of the American agricultural sector, by answering the following question:

What are the most important determinants of agricultural sector growth in the United States of America during the period 1986 - 2017?

The problematic of the Study is sub-divided into the following two questions:

- What is the reality of agricultural sector growth in the United States of America?
- What is the nature of the relationship between agricultural sector growth and its determinants in the United States of America?

Study hypotheses

Based on the problematic of this Study and secondary questions, the following hypotheses can be formulated:

- The most important determinants of agricultural sector growth in the United States of America are: gross fixed capital formation in agriculture, agricultural support, direct foreign investment in agriculture, agricultural loans and agricultural research funding
- The existence of a long-term relationship between agricultural sector growth and its determinants in the United States of America, where the gross fixed capital formation, agricultural support, and agricultural research funding affect positively on agricultural sector growth.

The importance of the study

The subject of the study is important because it seeks to clarify the most important factors that can contribute to developing agricultural sector, which plays a vital role in process of economic development, by studying the experience of one of the most successful countries in developing this strategic sector.

Objectives of the study

The aim of this study is to find the determinants of agricultural sector growth in the United States of America, through an econometric model that determines the relationship between agricultural sector growth as a dependent variable and its determining factors as independent variables, based on the available data during the study period.

Previous studies

There are a number of studies that have examined the determinants of agricultural sector growth. These studies varied in terms of treatment methods and asymmetric results. A review of these studies is given below.

Ajmair Muhammad and all (2018) examined the determinants of agricultural sector output growth in Pakistan during the period 1976 - 2014. They employed time varying parametric approach. The findings of the study suggested that gross fixed capital formation, permanent cropland and remittances receipt adversely affect agricultural sector growth, Whereas, gross national expenditure is directly related to agricultural sector growth. (Ajmair & all, 2018, p. 80)

bouatelli mohamed (2019) studied the growth of the agricultural sector and its determinants in Algeria during the period 2000-2016 by using the R program . The results of the study showed that there is a negative impact of both agricultural raw material imports and the share of agricultural land in the total area of land on the growth of the agricultural sector in Algeria, while the same results showed a positive effect for both exports of agricultural raw materials in addition to The volume of grain production on the growth of the agricultural sector. (bouatelli, 2019, p. 237)

Udah, S. C and Nwachukwu I.N. (2015) examined the determinants of growth of agricultural sector in Nigeria. Their study adopted regression analysis on micro and macro economic variables to find the significant relationship between the different variables chosen. The results of their study indicated that 49% of the variations in the dependent variable were explained by the explanatory variables. The results further showed that agricultural labour, infrastructural development and total factor productivity had positive relationship with agricultural GDP, while agricultural land, inflation rate and agricultural GDP in the previous period were negatively related to agricultural GDP (Udah & Nwachukwu, 2015, p. 184)

Elumalai Kannan (2011) analyzed the trends in crop sector growth at national and sub-national levels in India. Data on important variables such as area, production, input use, and value of output were compiled for the periods 1967-1968 to 2007-2008. The analysis reveals that the cropping pattern in India has changed significantly over time, with a marked shift from the cultivation of foodgrains to commercial crops. Among foodgrains, the area planted to coarse cereals that is generally cultivated in dry regions declined by 13.3 percent between triennium ending (TE) 1970-1971 and TE 2007-2008. Similarly, the performance of pulses in terms of area and output was not impressive during the study period and the technological breakthrough witnessed in other crops was not conspicuous in pulses. (Elumalai, 2011, p. 79)

Ildephonse Musafiri¹ and Alisher Mirzabaev (2014) analyzed the household level drivers of agricultural output in Nyabihu District, a densely populated area of rural Rwanda, over the past 26 years. They used a unique two-wave panel dataset spanning a 26-year period, linking the split-off households in 2012 to the original households in 1986. The findings identify the relative importance of labor, land, and capital for output growth in the study area. Over the studied period, the agricultural output has been characterized by decreasing elasticities of land and capital, whereas the elasticity of labor has grown three-fold. The findings also suggest a substantial impact of mobile phone technology adoption by farm households. Using propensity score matching, we find that agricultural output for mobile phone users is at least 38 percent higher than non-users. (Ildephonse & Alisher, 2014, p. 1)

In general, the literature shows that determinants of agricultural sector growth vary depending on the period studied, the econometric methods used, and the country.

In the light of the above survey, this study is presented as follows. Section one presents the reality of Agricultural sector, Section two discusses the methodology used in the study, the third

section provides the results and discusses the findings, and the final section draws the appropriate conclusion from the study.

1- Agricultural sector in United state of America

The agricultural sector plays an important role in the United States, which is one of the world's largest producers, consumers, exporters and importers of agricultural commodities.

1-1. American agricultural trends

American agriculture is marked by several trends. The first is the continuing decline of small family farms. Since 1979, 300000 small farms have disappeared in the United States. Increasingly, large companies have come to dominate American agriculture, because many Americans moved from rural to urban areas of the United States, resulting in large population decreases in farming regions. Even though the number of farms has been declining, overall production has increased because of more efficient operations. The owners of larger farms make greater use of modern machinery and other equipment. By the 1990s, farm operations were highly mechanized. By applying mechanization, technology, efficient business practices, and scientific advances in agricultural methods, larger farms produce great quantities of agricultural output using small amounts of labor and land. In 2017 there were 2.04 million farms and ranches in the United States, down more than 3% from 2012. As smaller farms have been consolidated into larger units, the average farm size in the United States increased from about 63 hectares (about 155 acres) to 178.5 hectares (441 acres) by 2017, and out of the total value of production of \$389 billion in 2017, two-thirds of it came from farms making 1 million USD or more. (<https://www.nass.usda.gov>).

The second trend is the increasing productivity of agricultural sector. Agricultural production in the United States has increased by an average of 5 percent each year since 1990. In addition, the output of each agricultural worker has grown by an average of 0.84 percent each year. On average, one American farmer produces enough food for 96 people. This improvement is partially as a result of the consolidation of farms and partially a result of new technologies and farming methods (<https://www.nass.usda.gov>), which include increased use of computers, scientific soil and crop analysis, and more sophisticated machinery. There has subsequently been a decrease in soil erosion caused by over-farming and an overall decline in the use of pesticides and fertilizers. Progress in technology and crop yields has made the United States among the most productive agricultural producers in the world.

The third trend is the growth in both exports and imports. In 2018 total agricultural exports were 140 billion USD. That same year, total imports were 129 billion USD. (<https://www.ers.usda.gov>).

The fourth and final trend is the loss of agricultural subsidies. Some of these subsidies are in the form of outright payments in exchange for farmers not growing certain crops and are provided to keep the price of crops high. Since the early 1990s, Congress has gradually reduced these subsidies. However, support and aid for certain types of farmers, including tobacco farmers, continue. After declining to a low point of 9 billion USD in 1997, government spending on agriculture increased to 33.812 billion USD in 2017. The increases mainly came from emergency aid to farmers because of natural disasters during this year. (<https://stats.oecd.org>).

1-2. Overview The of the US agricultural sector

The Overview of the US agricultural sector is summarized in Table (1). As can be seen, the share of agricultural population in the total population is quite low (almost 1 %) and the share of

agriculture in the GDP is also low at around 1 %. However, total agricultural value added is quite high (166.464 billion USD), Moreover, agriculture, food, and related industries contributed \$1.053 trillion to the US GDP in 2017, while the output of America's farms contributed 136.7 billion USD of this sum (United States Department of Agriculture), because the United States contains some of the best cropland in the world. Cultivated farmland constitutes 19 percent of the land area of the country and makes the United States the world's richest agricultural nation (<https://www.voyagesphotosmanu.com>).

Table -1-: Overview of Agricultural Sector in the United State of America in 2017

Agricultural Population	2200000
Share of Agricultural Population, %	0.67
Agricultural Land Area, ha	422826200
Agricultural Land, ha	40555200
Agricultural value added, current USD(billions dollars)	166.464
Employment in agriculture	2200000
Share of Agriculture, % of GDP	1.05

Source: <http://www.fao.org>.

1-3. Agricultural production

The US is major producer of many commodities in the world. Major commodities produced in the United State in terms of quantity are maize, soybeans, and cow milk. The table (2) below shows the agricultural production in the United State of America.

Table -2-: Main Production of the United State of America in 2017

Commodity	Quantity (MT)	Percentage of world production (%)
Maize	371	32.7
Soybeans	119.5	33.9
Wheat	47.37	6.14
Sorgo	9.24	16.04
cows milk	97.7	14.5
Meat (red)	12.1	19.6

Source : prepared by the author from:

-Food Agriculture Organization of the United Nations (FAO), Top Country Production, (2019): <http://www.fao.org>.

-World's Top Export (WTEX), Top Country Export, (2019): <http://www.worldstopexports.com>.

The statistical data in the previous table show that the United States of America controls a large share of world agricultural production, because it ranks first in the production of many products, such as corn, soybeans and wheat, due to the size and variety of production, especially cereal and livestock production.

1-4. Foreign trade

The United States of America is the main exporter of many agricultural commodities in the world. Major export items of the US in terms of value are soybeans, maize, wheat and cotton, while the major import items are distilled beverages, wine, coffee, beer, and natural rubber (Tables 3).

Table - 3 -: main agricultural exports and imports of the United State of America in 2017

Commodity	The value of exports(Billion dollar)	Commodity	The value of imports(Billion dollar)
Maize	9.6	Fresh & Processed Vegetables	11.7
Soybeans	21.7	Coffee, Unroasted	11.64
Wheat	6.1	Oils (ex. Soybean)	12.22
Cherry	0.62	Cocoa Paste & Butter	12.27
Spinach	0.121	Sugars, Sweeteners, Beverage Bases	12.13
Meat (red)	6.2	Live Animals	12.65

Source: ers.usda.gov.

With the productivity of U.S. agriculture growing faster than domestic demand, farmers and agriculturally oriented firms rely heavily on export markets to sustain prices and revenue. According to the U.S. Department of Agriculture's (USDA) Economic Research Service (ERS), agricultural exports have exceeded agricultural imports in every year since 1960 (Table 4). The value of agricultural exports has exceeded imports by a wide margin in recent years, but this trend reversed course in 2015. U.S. agricultural exports reached a peak of 152.3 USD billion in 2014, topping the previous record high of 141.1 billion USD in 2013. Agricultural imports have risen steadily over this period, climbing from 103.9 billion USD in 2013 to 138.26 billion USD in 2017.

Table - 4 -: Value of U.S. Agricultural Trade between 1960 and 2017

(USD billions)							
year	1960	1965	1970	1975	1980	1985	1990
exports	4.52	6.10	6.96	21.82	40.47	31.20	4035
imports	4.01	3.99	5.69	9.44	17.29	19.74	22.71
year	1995	2000	2005	2010	2015	2016	2017
exports	54.31	50.76	62.52	108.53	139.74	125	138.26
imports	35.65	38.86	57.71	78.96	114.03	118.5	117.3

Source: <http://www.ers.usda.gov>.

2- Methods and Materials:

2- 1. Sample and data:

The data employed in this study are annual data covering the period 1986 – 2017. The main types of data are taken from OECD stat, United States Department of Agriculture (USDA), and from The Bureau of Economic Analysis (BEA) of the United States Department of Commerce.

2-2. Variables of the study:

The most important goal of this empirical study is to investigate the determinants of agricultural sector growth. Data includes agricultural value Added as indicator of agricultural sector growth, gross fixed capital formation in agriculture, agricultural support, direct foreign investment in agriculture, agricultural loans, and agricultural research funding. Variables with their symbols are given in table (5).

Table -5-: Variables of study

Variables	symbol	type
Agricultural value Added	(VA)	Dependent
direct foreign investment in agriculture	(FDI)	Independent
agricultural research funding	(RD)	Independent
agricultural support	(TSE)	Independent
gross fixed capital formation in agriculture	(GFCF)	Independent
agricultural loans	(AL)	Independent

2-3. Model design:

This study uses the autoregressive distributed lag (ARDL) approach, or bound test of cointegration technique, suggested by Pesaran and Shin (1995); Pesaran and Shin (1999) and extended by Pesaran et al. (2001).

Autoregressive Distributed Lag (ARDL) cointegration test is used due to a number of econometric advantages compared to other cointegration procedures, such as, the Granger (1981), Engle and Granger (1987), and Johansen and Juselius (1990). It allows the long and short-run parameters of the model in question to be estimated simultaneously yet evade the problems posed by non-stationary data. In addition, and according to Narayan (2004), the small sample properties of the bounds testing approach are far more superior to that of multivariate cointegration. Also, there is no need to determine the order of the integration among the variables in advance. Other approaches however, do require that variables have the same order of integration.

3- Results and Discussion

3-1. Order of Integration and Stationary of Serial

Non-stationary in data time series can include the spurious correlation error into the econometric methodology. For this explanation, the differencing and logarithmic transformation is needed to stabilize the time series. A chronological serial is stationary if not contain no trend and intercepts, so we must establish the order of variables integration, we say that variables are integrate in order p if her deference's in order p is stationary so we shall be checking are this variables got unit root or not. That means her deference's in order p is null growth. There are many tests permit to put on evidence the stationary of serial. In this study we use test of Phillips Perrons (PP) and augmented Dickey-Fuller test (ADF), in order to ensure that the variables are not I(2). The ADF and PP tests results for both level and first difference tests with their significance levels are presented in Table (6) below.

Table -6-: Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) Test Results

Variables		Test Equations					
		ADF			PP		
		With Intercept	With Intercept & Trend	With Intercept & Trend	With Intercept	With Intercept & Trend	With Intercept & Trend
VA	At Level	-1.1012	-2.6527	0.7849	-0.9890	-2.6905	1.5824
	1 st Difference	-6.1006***	-5.9880***	-5.9241***	-6.5526***	-6.4066***	-5.9261***
FDI	At Level	-4.0689***	-4.5208***	-3.7057***	-4.0769***	-4.4075***	-3.6667***
	1 st Difference	-6.0430***	-5.9273***	-6.1633***	-11.6428***	-12.1679***	-11.7870***
GFCF	At Level	-1.4000	-3.4790	0.4798	-1.2971	-1.9058	0.9543
	1 st Difference	-4.7133***	-4.1812**	-4.6546***	-5.4270***	-5.0370***	-4.6306***
TSE	At Level	-1.6390	-2.5010	0.2674	-1.1611	-2.1783	0.3139
	1 st Difference	-4.2190***	-4.1231***	-4.2019***	-4.2103***	-4.1152**	-4.2022***
RD	At Level	0.4720	-1.9172	1.5876	1.7555	-1.4131	2.3260
	1 st Difference	-4.8801***	-5.0777***	-4.5032***	-4.9811***	-6.9186***	-4.4849***
AL	At Level	1.1561	-2.9470	2.2025	1.2102	-2.9505	2.2025
	1 st Difference	-5.0498***	-5.6144***	-4.4087***	-5.0496***	-6.3923***	-4.4248***

Note: ** Significant at the 5% ; *** Significant at the 1%.

Source: Author computation using Eviews10.

The results depicted in table (6) revealed that FDI is stationary in level while others variables are stationary in first difference. On the based ADF and PP tests results, we select to use the ARDL technique to perform the long term and short-run analysis. The ARDL approach is preferable when variables have mixture of results at stationary in level $I(0)$ and stationary in $I(1)$. It is intimate that among the variables; no one is integrated of order two. Thus, our result is free of spurious regression.

3-2. ARDL Model Estimation

In recent times, an emerging body of work led by (Pesaran & Shin, 1999) and further extended by (Pesaran et al, 2001), has introduced an alternative cointegration technique recognized as the 'Autoregressive Distributed Lag' or ARDL bound test (Benanaya & Bakdi, 2017, p. 24). The advantage of the ARDL model is flexible and provides both short- and long-run relationship. Table (7) provides if there is a short run relationship among variables or not.

Table -7-: ARDL Model Estimation:

Dependent Variable: VA				
Method: ARDL				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (2 lags, automatic): GFCF RD TSE FDI AL				
Fixed regressors: C				
Number of models evaluated: 243				
Selected Model: ARDL(1, 0, 2, 1, 2, 0)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
VA(-1)	-0.418498	0.204015	-2.051307	0.0581
GFCF	1.200208	0.655929	1.829783	0.0872
RD	4.423150	3.942934	1.121792	0.2796
RD(-1)	-2.435321	4.130305	-0.589622	0.5642
RD(-2)	11.93459	3.199435	3.730218	0.0020
TSE	-0.301236	0.244075	-1.234197	0.2361
TSE(-1)	-0.352675	0.301474	-1.169835	0.2603
FDI	-0.008324	0.014265	-0.583549	0.5682
FDI(-1)	-0.028449	0.013550	-2.099605	0.0531
FDI(-2)	-0.041837	0.013572	-3.082506	0.0076
AL	1.017687	0.462469	2.200553	0.0438
C	-105.3333	32.58936	-3.232138	0.0056
R-squared	0.973811	Mean dependent var		122.3332
Adjusted R-squared	0.954605	S.D. dependent var		36.63780
S.E. of regression	7.806072	Akaike info criterion		7.248783
Sum squared resid	914.0215	Schwarz criterion		7.824711
Log likelihood	-85.85857	Hannan-Quinn criter.		7.420037
F-statistic	50.70478	Durbin-Watson stat		2.379441
Prob(F-statistic)	0.000000			

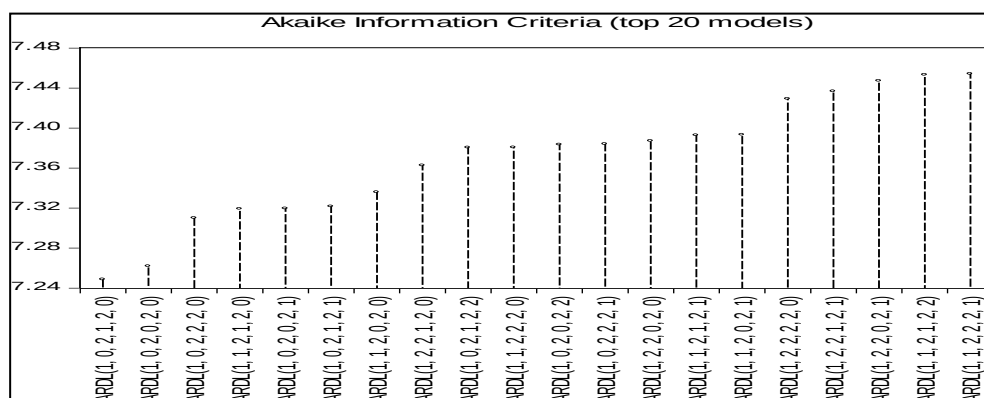
Source: Author computation using Eviews10.

The results of the model estimation show that some of agricultural sector growth determinants affect it in different lag, which are VA (-1), RD (-2), FDI (-1), FDI (-2) in addition to the constant and the variable AL, which mean that there is a short run from the independent variables to the dependent variable. The statistical tests of the regression equation indicate that the estimated model is good, as the coefficient of determination is equal to 0.9738, meaning that the model interprets 97.38% of the changes in the rate of agricultural sector growth. Furthermore, the results indicate that the relationship between the dependent variable and the explanatory variables is not false; the value of F-statistics has a significant value of 50.70.

3-3. Optimal Lag Length Selection

Before estimating the ARDL model, we must determine the optimum degrees delays for the model. For this purpose, the Akaike Information Criterion (AIC) was used to select the number of lags required in the cointegration test. The lag length chosen are showed in graph (1) below.

Graph - 1- : optimal lags Optimal Lag Length Selection



Source: Author using Eviews10.

The lag order of model based on Akaike Information Criterion (AIC) is: ARDL(1, 0, 2, 1, 2, 0); The ARDL model can be specified as:

$$\Delta VA = C + \alpha_1 VA_{t-1} + \alpha_2 GFCF_{t-1} + \alpha_3 RD_{t-1} + \alpha_4 TSE_{t-1} + \alpha_5 FDI_{t-1} + \alpha_6 AL_{t-1} + \beta_{11} \Delta VA_{t-1} + \beta_{4i} \Delta TSE_{t-1} + \sum_{i=1}^2 \beta_{3i} \Delta RD_{t-1} + \sum_{i=1}^2 \beta_{5i} \Delta FDI_{t-1} + \varepsilon_t$$

Where :

Δ : the first-difference operator.

$\beta_1, \beta_3, \beta_4, \beta_5$: The coefficients of short-run relationship.

$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6$: The coefficients of long- run dynamic relationship.

3-4. Bound Test for Cointegration

To determine the existence of long run relationship among the variables of the study, the (Pesaran, M. H., Shin, Y., & Smith, R. J, 2001) Bound test procedure was used. Narayan, 2004 tabulated two sets of critical values, the upper bound critical values refers to the I(1) series, meaning that there is cointegration among the variables and the lower bound critical values to the I(0) series, meaning that there is no co-integration relationship between variables. For some significance level, if the F-statistics falls outside the critical bound, a conclusive inference can be made without considering the order of integration of the explanatory variables. The bound test results were presented in Table (8) below.

Table -8-: ARDL bounds Test

Test Statistic	Value	k
F-statistic	7.508966	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Note: k is the number of regressor for dependent variable in ARDL model.

Source: Author computation using Eviews10.

The bound test results indicate that the F-statistic value is 7.508966, which is more than the upper bound critical value at all levels of significance. The bounds test results support the presence of cointegration relationship among the variables running from the independent variables to dependent variable.

3-5. Cointegration of long run relationship

The two popular co-integration tests in applied time series modeling are the (Engel & Granger, 1987) cointegration test and the (Johansen & Juselius, 1990) cointegration test. The (Engel & Granger) cointegration test is adopted in cases of single equation models, while, the (Johansen & Juselius) co-integration test is used for system equation models. The autoregressive distributed lag (ARDL) model is based on single equation modeling (Pesaran & al, 2001) 21 . For the purpose of our study we chose the Autoregressive Distributed Lag (Benanaya & Bakdi, 2017, p. 25). The long-run regression results are presented in table (9).

Table -9-: ARDL Cointegrating and Long Run Form

ARDL Cointegrating And Long Run Form				
Dependent Variable: VA				
Selected Model: ARDL(1, 0, 2, 1, 2, 0)				
Sample: 1986 2017				
Included observations: 27				
Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GFCF)	1.200208	0.655929	1.829783	0.0872
D(RD)	4.423150	3.942934	1.121792	0.2796
D(RD(-1))	-11.934590	3.199435	-3.730218	0.0020
D(TSE)	-0.301236	0.244075	-1.234197	0.2361
D(FDI)	-0.008324	0.014265	-0.583549	0.5682
D(FDI(-1))	0.041837	0.013572	3.082506	0.0076
D(AL)	1.017687	0.462469	2.200553	0.0438
CointEq(-1)	-1.418498	0.204015	-6.952895	0.0000
Cointeq = VA - (0.8461*GFCF + 9.8149*RD -0.4610*TSE -0.0554*FDI + 0.7174*AL -74.2569)				
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFCF	0.846112	0.402545	2.101906	0.0529
RD	9.814900	3.483561	2.817491	0.0130
TSE	-0.460988	0.142592	-3.232916	0.0056
FDI	-0.055418	0.020912	-2.650062	0.0182
AL	0.717440	0.335475	2.138579	0.0493
C	-74.256926	25.215181	-2.944929	0.0100

Source: Author computation using Eviews10.

As show the results in table above table (9), the error correction estimator is significant at 1%, which support the presence of long run relationship between variables (ECT =-1.41), this means that

when agricultural sector growth (Measuring with agricultural value added) deviate from his equilibrium value in the short period (t-1), it correct which was equivalent to 141% of this deviation in the period (t). This ratio reflects the speed of return to the equilibrium position after the impact of any shock on the model as a result of the change in the determinants of agricultural sector growth. Furthermore, all variables (GFCF, RD, TSE, FDI, AL) were statistically significant determinants of agricultural sector growth in the United State of America. The long-term coefficients for the model show that agricultural research funding has a very significant effect on agricultural sector growth, as 1 billion USD increase in this variable will increase agricultural sector growth by 9.81 billion USD, and an increase of agricultural loans and gross fixed capital formation in agricultural sector by 1 billion USD will increase the agricultural sector growth by 0.84 billion USD and 0.71 billion USD respectively. On the other hand, the impact of direct foreign investment and agricultural support on agricultural sector growth found to be negative and statistically significant at 1% and 5% levels.

3-6. Diagnostic tests

Now, we perform some diagnostic tests to ensure that the model is best fit and the stability of the model.

- **Serial Correlation LM Test:** the serial correlation problems in the data were examined through the Breusch Godfrey serial correlation LM test. The examined results (table 10) indicated that there is no serial correlation in the study data because the calculated P value is higher than 0.05.

Table -10-: Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.072779	Prob. F(2,13)	0.3705
Obs*R-squared	3.824888	Prob. Chi-Square(2)	0.1477

Source: Author computation using Eviews10.

- **Heteroskedasticity Test:** The Breusch Pagan-Godfrey test was applied to examine the problem of heteroskedasticity in the residuals. The examined results of heteroskedasticity indicate that no problem of heteroskedasticity exists in our data based on the calculated P-value of chi-square.

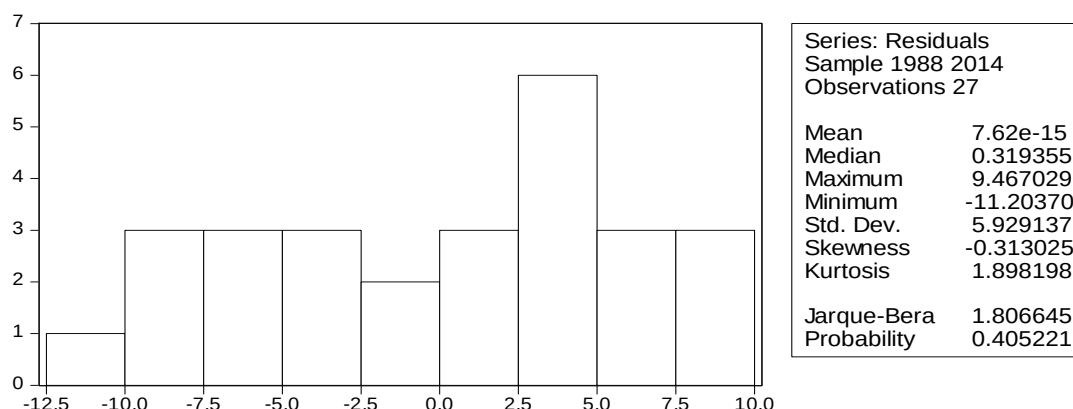
Table -11-: Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.118365	Prob. F(11,15)	0.4110
Obs*R-squared	12.16593	Prob. Chi-Square(11)	0.3513
Scaled explained SS	1.686328	Prob. Chi-Square(11)	0.9993

Source: Author computation using Eviews10

- **The test for normality:** The result of the test for normality in table graph 2 demonstrates that the error term is also proved to be normally distributed.

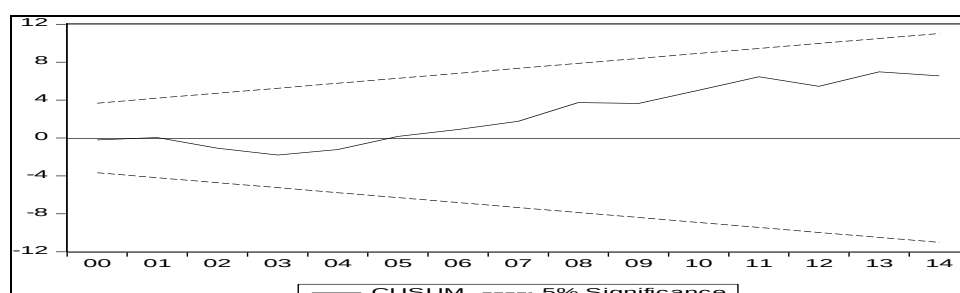
Graph -2- : Histogram – normality test



Source: Author using Eviews10.

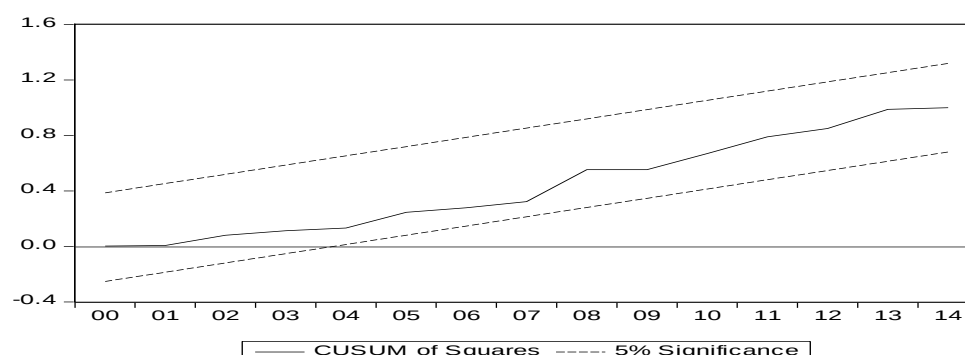
- **Test of parameters stability:** To make sure, that the data used in this study, does not contain any structural changes, we should use one of the appropriate tests CUSUM and CUSUM of squares, which developed in order to clarify the extent of stability and consistency of long-term parameters with short-term parameters. If the plot of CUSUM-SQ and CUSUM statistic stays within 5% significance level, then the estimated coefficients are said to be stable. A graphical presentation of this test for our ARDL model is provided in graphs 3, 4 below.

Graph -3-: The Cumulative Sum of Recursive Residual (CUSUM) test.



Source: Author using Eviews10.

Graph -4-: The Cumulative Sum squares of Recursive Residual of (CUSUM CUSUM OF SQUARES) test.



Source: Author using Eviews10

The results in the graphs show that the curve CUSUM within critical limits is 5%, as well

as for the curve CUSUM OF SQUARES located within the critical area, which explains that the model is stable at 5%.

Conclusion

This study investigated the determinants of agricultural sector growth in United State of America over the period of 1986 - 2017. We have applied ADF and PP unit root tests to test stationarity of the variables. Further, the ARDL bounds testing approach to cointegration was employed to investigate the long and short-run relationships between the variables. The results are:

- The agricultural sector growth determinants affect it in different lag, which are VA (-1), RD (-2), FDI (-1), FDI (-2) in addition to the constant and the variable AL, which mean that there is a short run from the independent variables to the dependent variable.
- The statistical tests of the regression equation indicate that the estimated model is good, as the model estimation interprets 97.38% of the changes in the rate of agricultural sector growth.
- The error correction estimator is significant at 1%, this means that when agricultural sector growth (Measuring with agricultural value added) deviate from his equilibrium value in the short period (t-1), it correct which was equivalent to 141% of this deviation in the period (t). This ratio reflects the speed of return to the equilibrium position after the impact of any shock on the model as a result of the change in the determinants of agricultural sector growth.
- Agricultural research funding has a very significant effect on agricultural sector growth, as 1 billion USD increase in this variable will increase agricultural sector growth by 9.81 billion USD. The positive relationship between agricultural R&D expenditure and agricultural sector growth is as result of the role of agricultural research and development in fostering innovation and productivity in agriculture, and the spillover effects of agricultural knowledge generated through agricultural R&D.
- Capital formation in agriculture is one of the major engines of agricultural growth, as an increase of gross fixed capital formation in agricultural sector by 1 billion USD will increase the agricultural sector growth by 0.71 billion USD.
- Agricultural loans Agricultural loans have positive effect on agricultural sector growth. Facilitation of access to loans can raise amount of productive investment. loans have a crucial role for elimination of farmer's financial constraints to invest in farm activities, increasing productivity and improving technologies. Generally, loans accessibility is important for improvement of quality and quantity of farm products so, that it can increase farmer's income and avoid from rural migration.
- The changes over time in a farmer's subsidy have a negative impact on agricultural sector growth, because agricultural support negatively affected farm productivity.
- Foreign direct investment has a negative impact on the growth of the agricultural sector, because foreign investors have converted agricultural land produced for purposes outside of agriculture, which has negatively affected agricultural production.

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