Determinants of Agricultural Sector Growth in Pakistan

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Abstract: In this paper, we used annual data from 1976 to 2014 and autoregressive distributed lag approach to examine determinants of agriculture sector output growth in Pakistan. Choice of sample period is based on break up of Pakistan in two parts in December, 1971. General to specific based approach results show that lagged agriculture sector growth, external debt, foreign trade, gross fixed capital formation, gross national expenditures, inflation, population growth and real exchange rate are the relevant determinants of agriculture sector output growth in long run. Residual tests indicate that estimated model is fitted well and is stable over a time.

Keywords: Agricultural sector, ARDL, foreign trade, grosses national expenditures.

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1. Introduction

Phenomenon of economic growth has always remained hotly debated topic in history of Economics. The basic question is how to measure economic growth? Which factors determine economic growth? What policy options government should follow to boost economic growth in a country like Pakistan?

Economic growth refers to an increase in level of national income and is measured by GDP growth. It results from increase in productive capacity which is an indicator of economy's capability to produce more goods and services. Economic growth is directly / indirectly linked with our living standard. A higher output growth implies increase income level and hence higher standard of living for residents of the country (Palmer, 2102). Higher economic growth is also linked with increased employment level in the country. Three sectors namely agricultural, industrial and services sector are mainly responsible for overall economic growth of a country.

There is enough empirical evidence in literature on the determinants of economic growth. However, there is dearth of empirical evidence on sectoral specific determinants of economic growth and this study bridges that gap. It focuses upon finding out factors affecting agricultural sector output growth in Pakistan. This sector has remained one of the major contributors of overall economic growth in the country. Although its share in Gross Domestic Product has declined over the years still its importance in the country's overall economic well-being cannot be ignored. It has substantial share in national income, is a source of foreign exchange earnings, provides employment opportunities to majority of the people, sustains industrial development of the country by providing needed raw material and contributes in country's national exchequer. Given its enormous importance in country's development, we evaluate the determinants of agricultural sector output growth using auto regressive distributed lag model approach. Results obtained from annualized data reveal that external debt, foreign direct investment, food exports, foreign trade, gross domestic product, gross national expenditures, inflation, population and real exchange rate have significant effect on agricultural sector output growth in long run. In short run, external debt, foreign direct investment, food exports, foreign trade, inflation, permanent crop land and real exchange rate are relevant determinants of agricultural sector output growth.

Rest of the paper is proceeds as: in section 2 we review the literature on agricultural sector output growth determinants, followed by data discussion in section 3. Estimation procedure is discussed in section 4 and section 5 provides discussion on results. Section 6 concludes.

2. Literature Review

Agricultural sector is one of the major contributors of gross domestic product in Pakistan. No doubt sectoral share of agricultural sector in GDP has declined over a time yet it has major role in economic growth of the country. It contributed 20.90 percent in the country's GDP during fiscal year 2014-2015. Since agriculture sector has major share in economic growth therefore, it is necessary to find out determinants of agricultural sector output growth.

Odhiambo et al. (2004) evaluated the determinants of agricultural sector output growth in Kenya using neoclassical growth model and simple ordinary least square approach. Based on empirical findings, they concluded that real exchange rate, rainfall, government expenditures, primary school enrollment, roads, financial development, trade ratio and import penetration are the relevant determinants of agricultural sector output growth in Kenya. Ahmed and Heng (2012) concluded that fertilizers, human capital and credit to

agricultural sector have significant positive effect on agricultural sector productivity in Pakistan. However, effect of area under crops on agricultural productivity was negative. In Warr (2012) government expenditures, international expenditures on agricultural output and share of food crops in agricultural output were found to have positive and significant effect on total factor productivity of agriculture in Indonesia while real government expenditure on agricultural extension, total rate of government assistance to agriculture and rainfall were negatively associated with agricultural sector output growth. Enu and Obeng (2013) concluded that labor force, real exchange rate (q_t), and real gross domestic product (GDP) per capita have significant effect on agricultural output in Ghana. Khalidi and Sherazi (2013) found that labor, capital and total productivity have significant effect on value added products in Iranian agricultural sector. Camelia (2015) shows utilized agricultural area has major impact on agricultural output growth in Romania after its integration with European Union. Labor and capital per hectare however, seems less relevant for agricultural productivity. Chebil et al. (2015) found government expenditures on research and development as major determinant of wheat production in Tunisia.

Reviewed literature on determinants of agricultural growth reveals that agricultural land, labor, capital stock, fertilizer, feed, inflation, exchange rate, real GDP per capita, real international expenditure on agricultural research, real government expenditure on agricultural extension, rainfall, share of food crops in agricultural output, seeds, infrastructure development in rural area, human capital, credit to agricultural sector, area under crops, import penetration, trade ratio, real exchange rate, rainfall, government expenditures for roads, access to credit have significant effect on agricultural output across different countries.

3. Data

Annual data is taken from World Bank World Development Indicators for the period 1976-2014. All variables were converted into log form for final analysis. Real exchange rate data is not directly available. It was generated by adjusting nominal exchange rate with foreign to domestic price ratio. Choice of sample is based on structural break in the data that took place due to country's disintegration in two parts in 1971. Furthermore, data on most of the variables examined in this paper are available after 1975.

4. Autoregressive Distributed Lag Model Approach

Augmented Solow growth model (1956) is used to identify the factors affecting agriculture sector output growth in Pakistan.[4] It explains that output is a function of human and physical capital. Solow growth model (1956) is very simple and useful because it can further be extended to check the impact of other determinants on economic growth (Rao, 2006). We estimate following augmented Solow growth model for evaluating the determinants of agricultural sector output growth:

$$y_t = \alpha + \alpha_1 debt + \alpha_2\, fdi_t + \alpha_3\, fext + \alpha_4\, ftrd_t + \alpha_5 gdp_t + \alpha_6 gfcf_t + \alpha_7 gne_t + \alpha_8 \inf_t + \alpha_9\, pcl_t + \alpha_{10}\, pop_t + \alpha_{11} q_t + \alpha_{12} remt_t + \varepsilon_t \quad (1)$$

Equation (1) focuses upon the factors that affect agricultural sector output growth (y_t). The regressors included in equation (1) are external debt ($debt_t$), foreign

[4] Enu and Attah-Obeng (2013) and Biswas and Saha (2014) also employed Solow growth model for evaluating the determinants of agricultural output growth in Ghana and India respectively.

direct investment (fdi_t) as percent of GDP, food exports ($fext_t$), foreign trade ($ftrd_t$), gross domestic product per capita (gdp_t), gross fixed capital formation ($gfcf_t$), gross national expenditures (gne_t) as percent of GDP, inflation ($\inf_t$), permanent crops land (pcl_t), total population of the country (pop_t), real exchange rate (q_t) and remittances ($remt_t$). Subscript t shows that time series data is used in the analysis.

ARDL bound testing approach is used for estimating equation (1).[5] This method is preferred over other cointegrating approaches because (a) it does not care about integrating order of variables, (b) can be used even for small sample size, (c) is very simple and can be estimated by ordinary least square method if lag order of the model is confirmed and (d) short and long run relationships can be estimated simultaneously. ARDL version of equation (1) can be written as equation (2):

ARDL bound test is based on Wald Test (F-statistic). Pesaran et al. (2001) has given two critical values for testing cointegrating relationship among the variables examined. The lower bound critical values assume no cointegrating relationship and hence all variables included in the analysis are *I*(0). Upper bound critical values on the other hand, reject null of no cointegration and hence all variables are *I*(1). Null of no cointegration is rejected if calculated Wald test (F-statistic) is greater than upper bound critical value. Null of no cointegration on the other hand, is not rejected if calculated F-statistic is less than lower critical bound value. Results are inconclusive if calculated F-statistic falls between upper and lower bound critical values. We use the Akaike Information criterion (AIC) for selecting optimal lag length because it is useful for small sample size (Tsadkan, 2013). Selection of optimal lag length is essential in ARDL because it helps us explain over parameterization issue and saves the degrees of freedom (Taban, 2010).[6] Furthermore, ARDL estimates are sensitive to chosen lag length. Based on Akaike Information Criterion, we used 1 lag while estimating eqn. 1.

[5] ARDL approach is also called Pesaran et al. (2001) approach (Oyakhilomen and Zibah; 2014).

[6] Pesaran and Shin (1999) recommend 2 lags for annual data.

$$\Delta y_t = \alpha + \sum_{i=1}^{p} \alpha_1 \Delta y_{t-i} + \sum_{i=1}^{p} \alpha_2 \Delta debt_{t-1} + \sum_{i=0}^{p} \alpha_3 \Delta fdi_{t-i} + \sum_{i=0}^{p} \alpha_4 \Delta fext_{t-1} \sum_{i=0}^{p} \alpha_5 \Delta ftrd_{t-i} + \sum_{i=0}^{p} \alpha_6 \Delta gdp_{t-i} + \sum_{i=0}^{p} \alpha_7 \Delta gfcf_{t-i} +$$
$$\sum_{i=0}^{p} \alpha_8 \Delta gne_{t-i} + \sum_{i=0}^{p} \alpha_9 \Delta \inf_{t-i} + \sum_{i=0}^{p} \alpha_{10} \Delta pcl_{t-i} + \sum_{i=0}^{p} \alpha_{11} \Delta pop_{t-i} + \sum_{i=0}^{p} \alpha_{12} \Delta q_{t-1} \sum_{i=0}^{p} \alpha_{13} \Delta remt_{t-i} + \beta_1 y_{t-1} + \beta_2 debt_{t-1}$$
$$\beta_3 fdi_{t-1} + \beta_4 fext_{t-1} + \beta_5 ftrd_{t-1} + \beta_6 gdp_{t-1} + \beta_7 gfcf_{t-1} + \beta_8 gne_{t-1} + \beta_9 \inf_{t-1} + \beta_{10} pcl_{t-1} + \beta_{11} pop_{t-1} + \beta_{12} q_{t-1}$$
$$+ \beta_{13} remt_{t-1} + \varepsilon_t \qquad (2)$$

α = drift component and Δ = first difference operator.

α_1, α_2, α_3, α_4, α_5, α_6, α_7, α_8, α_9, α_{10}, α_{11}, α_{12} and α_{13} show short run dynamics of the model and $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}, \beta_{11}, \beta_{12}$ and β_{13} indicate long run effect of regressors at p[th] order lag length. Wald test or F-statistics is used to test integrating relationship between the dependent variable and independent regressors. The null hypothesis is:

H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = \beta_{12} = \beta_{13} = 0$

against alternative hypothesis:

H_a: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq \beta_8 \neq \beta_9 \neq \beta_{10} \neq \beta_{11} \neq \beta_{12} \neq \beta_{13} \neq 0$

5. Results

In this paper, we use auto regressive distributed lag (ARDL) approach to test null of no cointegration against the alternative hypothesis. Prior to testing null of no cointegration, Augmented Dickey Fuller is employed for determining integrating order of variables of interest. Table 5.1 shows ADF test results. It appears that all variables except foreign direct investment (fdi_t) and foreign trade ($ftrd_t$) are intercept stationary in levels. Inflation on the other hand is level stationary in both specifications. Population is also trend stationary in level but non-stationary at first difference and thus requires second differencing. All the remaining variables are stationary in first difference because calculated ADF test statistic is lower than critical ones taken from McKinnon (1996). Therefore, we conclude that the variables are *I*(0) and *I*(1). Hence ARDL is appropriate for testing cointegrating relationship in our case.[7]

In order to test long run relationship, we convert all variables into independent variables and calculate F-statistic. Table 5.2A shows calculated F-statistics and chi-square values. Table 5.2B on the other hand, shows one, five and ten percent upper and lower bound critical values taken from Pesaran et al. (2001) and Narayan (2004). Null of no cointegrating relationship is rejected if calculated F-statistic or Wald statistic is greater than upper bound critical values. It is evident from Table 5.2A and 5.2B that calculated F-statistics for all three models is greater than five percent Pesaran et al. (2001) and Narayan (2004) upper bound critical

[7] This approach does not require unit root testing before its application (Akinlo, 2006).

Table 5.1 Unit Root Test

Variable	Levels		First Difference	
	Intercept	Intercept + Trend	Intercept	Intercept + Trend
y_t	-1.77	-1.69	-5.97 [a]	-6.16 [a]
$debt_t$	-1.06	-0.95	-4.31	-4.58
fdi_t	-2.66 [a]	-3.13	-5.15 [a]	-5.20 [a]
$fext_t$	-2.08	-1.34	-7.53	-6.34
$ftrd_t$	-3.01 [a]	-2.97	-7.45 [a]	-7.55 [a]
gdp_t	-2.12	-2.54	-4.56 [a]	-4.95 [a]
$gfcf_t$	-1.40	-2.36	-5.88 [a]	-5.79 [a]
gne_t	-1.81	-1.92	-6.73 [a]	-6.68 [a]
$\inf_t$	-4.87 [a]	-4.93 [a]	-7.28 [a]	-7.17 [a]
pcl_t	-2.40	-1.21	-5.30 [a]	-5.76 [a]
pop_t	-2.10	-5.12 [a]	-2.02	-2.22
q_t	-0.34	-1.56	-4.49	-3.94
$remt_t$	-1.49	-1.55	-5.58 [a]	-5.55 [a]
5 % critical values	-2.60	-3.19	-2.60	-3.19

Note: y_t, $debt_t$ fdi_t, $fext_t$ $ftrd_t$, gdp_t, $gfcf_t$ gne_t, $\inf_t$, pcl_t, pop_t, q_t and $remt_t$ denote agricultural sector's growth(value added), external debt, foreign direct investment net flows as percent of GDP, food exports, foreign trade (total), gross domestic product per capita, gross fixed capital formation, gross national expenditures as percent of GDP, inflation rate (consumer price index), permanent crop land (area under crops), population, real exchange rate and personal remittances received as percent of GDP. All variables are in log form. 1% and 5% one sided critical values are taken from McKinnon (1996).

Table 5.2A Calculated F-Statistics

Test Statistic	Model 1			Model 2			Model 3		
	Value	DF	Prob	Value	DF	Prob	Value	DF	Prob
F-Statistic	3.49	(13,9)	0.03	5.45	(11,3)	0.00	7.84	(9,17)	0.00
χ^2	45.46	13	0.00	59.50	11	0.00	70.59	9	(0.00)

Note: DF and Prob refers to degrees of freed and probability. χ^2 denotes chi-square test statistic

Table 5.2B Upper and Lower Bound Critical Values

Level of significance	Model 1				Model 2				Model 3			
	Pesaran et al. (2001)		Narayan (2004)		Pesaran et al. (2001)		Narayan (2004)		Pesaran et al. (2001)		Narayan (2004)	
	LB	UB	LB	UB	LB	UB	LB	UB	LB	UB	LB	UB
1 percent	2.51	3.86	3.53	5.23	2.51	3.86	3.53	5.23	2.79	4.10	3.51	5.19
5 percent	2.06	3.21	2.61	3.92	2.06	3.21	2.61	3.92	2.22	3.39	2.58	3.88
10 percent	1.83	2.93	2.20	3.36	1.83	2.93	2.20	3.36	1.95	3.06	2.18	3.33

Note: LB and UB refers to lower bound and upper bound critical values.

Table 5.3 Estimates of long run relationship (ARDL)

Variables	Model 1	Model 2	Model 3
y_{t-1}	-1.701[-3.40] [a]	-1.63[-4.72] [a]	-1.49[-5.09] [a]
$debt_{t-1}$	0.28[2.13]	0.32[2.80] [a]	0.25[3.16] [a]
fdi_{t-1}	0.06[2.13]	0.06[2.56] [a]	0.05[3.16] [a]
$fext_{t-1}$	0.08[0.92]		
$ftrd_{t-1}$	0.79[4.33] [a]	0.73[4.94] [a]	0.71[5.20] [a]
gdp_{t-1}	0.29[-0.35]		
$gfcf_{t-1}$	-0.59[-1.64]	-0.57[-2.27] [a]	-0.46[-2.94] [a]
gne_{t-1}	0.73[0.68]	1.49[2.38] [a]	1.61[4.02] [a]
$\inf_{t-1}$	0.09[2.36] [a]	0.09[3.26] [a]	0.07[3.32] [a]
pcl_{t-1}	0.22[0.86]	0.16[0.79]	
pop_{t-1}	-2.57[-1.93] [a]	-2.20[-4.61] [a]	-1.88[-4.61] [a]
q_{t-1}	0.47[1.81]	0.46[2.52] [a]	0.45[4.23] [a]
$remt_{t-1}$	0.05[0.90]	0.04[1.19]	
C	19.27[2.03] [a]	15.64[3.70] [a]	12.66[3.83] [a]

R^2	0.87	0.85	0.83
$\overline{R}^2$	0.51	0.62	0.67
F-Statistic	2.39[0.09]	3.57[0.01]	4.89[0.00]
DW Test	3.05	2.84	2.64

Note: a and b shows the significance of estimated parameters at five and ten percent significance level.

values. Hence, based on empirical evidence, we conclude that there is evidence of long run relationship among the examined variables.

We employed Hendry (1995) general to specific approach for finding out relevant determinants of agricultural sector output growth.[8] Initially, we estimated equation (2) including all regressors and then proceeded ahead by dropping insignificant variables. Table 5.3 model 1 shows that all variables except food exports, gross domestic product, gross fixed capital formation, gross national expenditures, permanent crop land and remittances estimates are insignificant. Therefore, at first stage we dropped only $fext_{t-1}$ and gdp_{t-1} and re-estimated equation (2). Model 2 shows that all variables except pcl_{t-1} and $remt_{t-1}$ are significant at five percent significance level. In model 3 all included variables appear to be significant. Therefore, model 3 is our chosen model for finding out the relevant determinants of agricultural sector output growth in Pakistan. Thus empirical evidence tell us that external debt, foreign direct investment, foreign trade, gross national expenditures, inflation and population growth cause agricultural output to increase. Gross fixed capital formation and population growth have negative effect on agricultural sector output growth.

[8] General-to-specific modeling is the process in which the researcher simplifies an initially general model that adequately characterizes empirical evidence within his or her theoretical framework. (Campos et al. 2005)

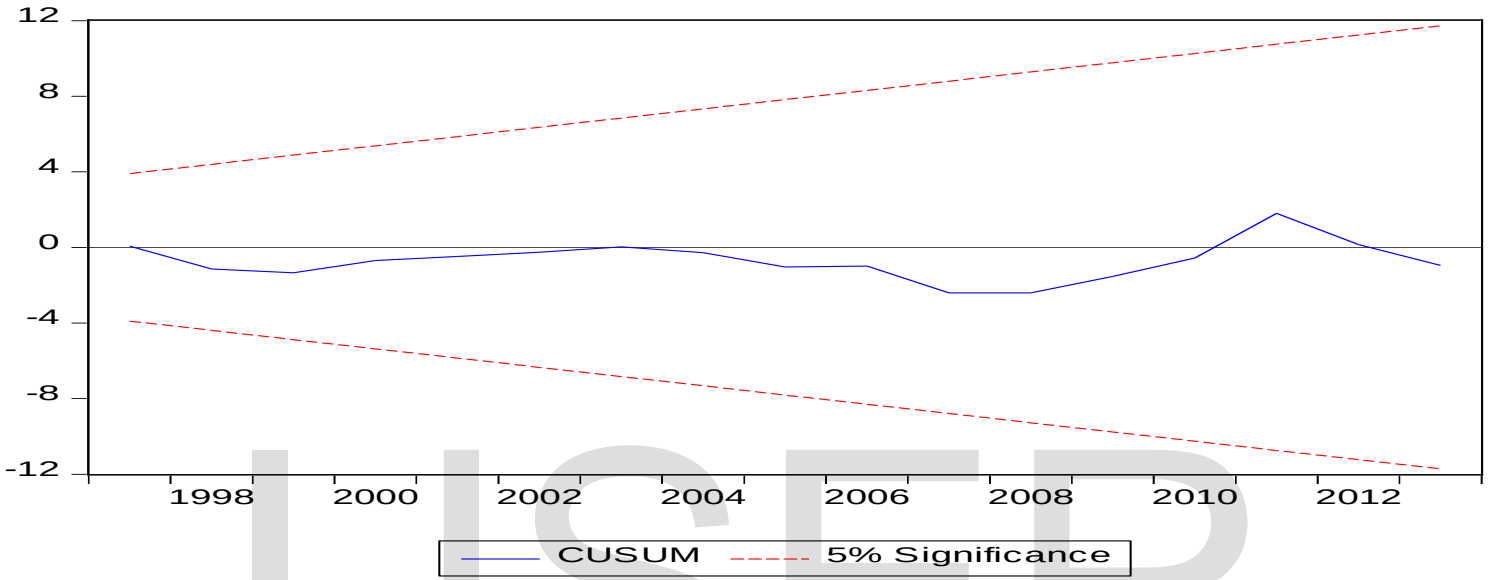
Table 5.4 Estimates of Short Run Relationship (ARDL)

Variable	Model 1	Model 2	Model 3
Δy_{t-1}	-0.00[-0.00]		
$\Delta debt_{t-1}$	-0.39[-2.60] [a]	-0.39[-3.10] [a]	-0.31[-3.07] [a]
Δfdi_{t-1}	-0.06[-1.91] [b]	-0.05[-2.16] [a]	-0.04[-2.00] [a]
$\Delta fext_{t-1}$	0.06[0.73]	0.13[2.82] [a]	0.12[3.33] [a]
$\Delta ftrd_{t-1}$	-0.81[-4.01] [a]	-0.83[-4.78] [a]	-0.76[-5.01] [a]
Δgdp_{t-1}	-0.53[-0.71]	-0.15[-0.30]	
$\Delta gfcf_{t-1}$	0.22[0.18]	0.19[1.29]	0.09[0.93]
Δgne_{t-1}	0.79[1.23]	0.70[1.26]	0.50[1.05]
$\Delta \inf_{t-1}$	-0.08[-2.87] [a]	-0.08[-4.01] [a]	-0.07[-4.30] [a]
Δpcl_{t-1}	-0.71[-2.43] [a]	-0.69[-2.82] [a]	-0.54[-3.25] [a]
Δpop_{t-1}	-2.29[-0.15]	-1.69[-0.14]	
Δq_{t-1}	-0.10[-1.03]	-0.15[-2.12] [a]	-0.17[-3.65] [a]
$\Delta remt_{t-1}$	-0.01[-0.07]		

Note: a and b shows the significance of estimated parameters at five and ten percent significance level.

Table 5.4 shows short run estimates of equation 2. It indicates that external debt, foreign direct investment, food exports, foreign trade, inflation, permanent crop land and real exchange rate exert significant effect on agricultural sector output growth. Contrary to long run estimates, food export has significant positive effect on agricultural output in short run. Remaining short run significant estimates have negative signs implying that any change in such variables has negative effect on agricultural sector output growth. Hence we conclude that in short run external debt, foreign direct investment, food exports, foreign trade, inflation, permanent crop land and real exchange are relevant determinants of agricultural sector output growth.

Fig. 5.1 Residual Based Model Stability Test



Stability of the model in long run and short run was tested using cumulative sum of recursive residuals (CUSUM). Null of model stability is rejected if the cumulative sum goes outside plus minus two standard error band. Figure 5.1 reveals that cumulative sum does not cross lower or upper bound critical values. Hence we conclude that null of estimated stability is not rejected both in short run and long run.

6. Conclusion

In this paper, we examined the determinants of agricultural sector output growth in Pakistan using ARDL approach. Annual data from 1976 to 2014 was used. Choice of sample was based on structural break that resulted country's disintegration in two wings in 1971. Furthermore, data on most of the variables used in the analysis is available after 1975.1976.

ARDL estimates provide evidence of long run relationship among the variables examined. Long run estimates of cointegrating relationship indicate that external debt, foreign direct investment, foreign trade, gross fixed capital formation, gross national expenditures, inflation, population and real exchange rate have significant effect on agricultural sector output growth. Variables that have significant effect on agricultural output in short run are external debt, foreign direct investment, foreign trade, inflation, permanent crop land, real exchange rate and food exports. Residual tests confirm absence of serial correlation and model stability. Based on these empirical findings, we conclude that government should focus on agricultural sector output growth augmenting factors while formulating any policy relevant to this sector.

References

[1]Ahmed, K. and Heng (2012) Determinants of agriculture productivity growth in Pakistan. *International Research Journal of Finance and Economics*, Vol. 95, pp.1-11

[2]Akinlo, A.E., (2006) The stability of money demand in Nigeria: an autoregressive distributed lag approach. *Journal of Policy Modeling*, Vol. 28(4), pp. 445-452.

[3]Biswas, S. and Saha, A.K. (2014) Macroeconomic determinants of economic growth in India: a time series analysis. *SOP Transactions on Economic Research*, Vol. 1(2), pp. 54-72.

[4]Camella, B. (2015) The influence of relevant factors on form output value: an analysis of agricultural holdings from Romania. *Annals of the Constantin Brâncuşi" University of Târgu Jiu, Economy Series*, Vol. 2(1), pp. 124-129.

[5]Campos, J., Ericson, N.R. and Hendry, D.F. (2005) General-to-specific Modeling: An Overview and Selected Bibliography, International Finance Discussion Papers 838.

[6]Chebil, A., Frija, A. and Alyani, R. (2015) Measurement of total factor productivity and its determinants: case of wheat sector in Tunisia. International Centre for Agricultural research in the Dry Areas Working Paper 943.

[7]Enu, P. and Attah-Obeng, P. (2013) Which macro factors influence agricultural production in Ghana? *Academic Research International*, Vol. 4(5), pp.333-346.

[8]Khaledi, K. and Shirazi, A.H. (2013) Estimates of factors affecting economic growth in the agricultural sector in the fifth development plan of Iran (emphasis on investment). *World Applied Sciences Journal*, Vol. 22(10), pp. 1492-1499.

[9]Narayan, P.K. (2004) Reforming critical values for the Bounds F-statistics approach to cointegration: an application to the tourism demand model for Fiji. Department of Economics, Monash University Australia Discussion Paper No. 02.

[10]Oyakhilomen, O. and Zibah, R.G. (2014) Agricultural production and economic growth in Nigeria: implications for rural poverty alleviation. *Quarterly Journal of International Agriculture*, Vol.53 (3), pp. 207-223.

[11]Odhiambo, W., Nyangito, H.O. and Nzuma, J. (2004) Sources and determinants of agricultural growth and productivity in Kenya. Kenya Institute of Public Policy Research and Analysis Working Paper No. 34.

[12]Pesaran, M.H., and Shin, Y. (1999) An autoregressive distributed lag modeling approach to cointegration analysis, in *Econometric and Economic Theory in the 20th Century: The Rangnar Frisch Centennial Symposium*, (Ed.) S. Storm, Cambridge University Press, Cambridge, pp. 1-33.

[13]Palmer, N.T.(2012) The Importance of Economic Growth, http://*www.cpaireland.ie*.

Pesaran, M.H., Shin, Y. and Smith, R.J. (2001) Bounds testing approaches to the analysis of level relationship. *Journal of Applied Econometrics*, Vol. 16, pp. 289-326.

[14]Rao, B.B. (2006) Time Series Econometrics of Growth Models: A Guide for Applied Economists. *http://mpra.ub.uni-muenchen.de/1547/ MPRA*, paper no.1547.

[15]Solow, R. M. (1956) A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, Vol. 70(1), pp. 65-94.

[16]Taban S. (2010) An examinations of governmental spending economic growth nexus for Turkey using the bound test approach. *International Research Journal of Finance and Economics*, Vol. 48, pp.184-193.

[17]Tsadkan A. (2013) The nexus between public spending and economic growth in Ethiopia: Empirical investigation. Unpublished Master thesis, Addis Ababa University.

[18]Warr, P. (2012) Research and agricultural productivity in Indonesia. Australian Agricultural and Resource Economics Society, 56th conference, Fremantle.