Journal of Applied Economics and Business Studies (JAEBS)
Journal homepage: https://pepri.edu.pk/jaebs
ISSN (Print): 2523-2614
ISSN (Online) 2663-693X

# Contribution of Agriculture Sector in Economic Growth of Pakistan: An Empirical Analysis

Sumia Bint Zaman[1], Muhammad Ishaq [2*], Muhammad Azam Niazi [3]

[1] PARC Institute of Advance Studies in Agriculture, National Agriculture Research Centre, Islamabad
[2] PARC Institute of Advance Studies in Agriculture, National Agriculture Research Centre, Islamabad
[3] PARC Institute of Advance Studies in Agriculture, National Agriculture Research Centre, Islamabad

**ABSTRACT**

*There has been controversy in the field of development economics about the significance of the role of agriculture sector in economic growth. Going through the data, it indicates that agriculture sector is significant contributor to the economy of Pakistan as it contributes about 19% in national GDP. This study was designed to statistically test the contribution of agriculture sector in economic growth of Pakistan through estimation of relationship between agriculture sector and Pakistan's economic growth using Autoregressive Distributed Lag (ARDL) bounds test and Error Correction Model (ECM). Time series data on selected variables was utilized from 1961-2018. Study found that real agricultural value added has a significant positive impact on real GDP per capita in the long-run where one percent increase in real agricultural value added increases the real GDP/capita by 0.35%. This indicated that the promotion of agriculture sector leaves far reaching effects with respect to economic growth of the country. These results advocated for the development of agriculture sector in line with the long-term goals of economic growth and emphasized in investing in agriculture sector. Coefficient of error correction term (ECT) is -0.62 meaning that if there is any disequilibrium, it will restore @ 62 percent in the first period. Results also proved the importance of capital formation both the physical capital and human capital. Finding suggested that we*

**Keywords**
Growth theory, Economic growth, Agriculture, ARDL
**JEL Classification**
O4, O49, N5

*ishaqecon@gmail.com

*should investment in human health to enhance the economic growth as suggested by exogenous growth theory. Moreover, it can also be suggested to create conducive environment and economic opportunities to reap the benefits of demographic dividends of decreased mortality in the long-run. As per analysis, maintaining stability is critically important for economic growth. Moreover, literature hypothesize the positive effect of TOT for economic growth, but analysis indicated that TOT has not been able to put any significant impact on economic growth. Further, trend analysis also pointed out that TOT has been fluctuating over the time. It can be inferred from the analysis that there is need to stabilize TOT and restructure the exports of the country to generate the significant positive impact.*

## 1. Introduction

Agriculture is considered one of the sectors which are of central importance for national economy of Pakistan, but this hypothesis needs to be tested empirically. There has been controversial debate on the role of agriculture sector in economic development especially after the periods of colonial rule (Lewis, 1954; Fei and Ranis, 1961; Johnston and Mellor, 1961; Jorgenson, 1961; and Schultz, 1964). But the factor is that most of these studies were qualitative and accentuated the possible influence of the inter-linked sectors of the economy, but direction of these relationships was not definite in sequence. Numerous studies proclaimed that overall economic growth is contingent to the advancement of agricultural sector (Schultz, 1964 and Gollin*et al*, 2002). Supporters of agriculture-led growth believed that investment in agriculture sector including supplementary infrastructure and institutions in linked sectors is a precondition for economic development of the country where many of them established that agriculture do effect the income of rural people and provide resources for industrial development to boost the economy(Schultz, 1964;Eicher and Staatz, 1984;Dowrick and Gemmell, 1991;Timmer, 1995;Datt and Ravallion, 1998; and Thirtle*et al*, 2003). Bhagwati and Srinivasan (1975) exposed that some developing countries who tried to develop their economies through industrializing without developing their agriculture sector first, ended up in gloomy economic growth rates coupled with the uneven income distribution. Johnston and Mellor (1961) advocated the agricultural contribution in economic development through different inter-sectoral linkages includingi) provision of surplus labor from agriculture to industry, (ii) increased food supply and hence higher consumption, (iii) market for industrial production, (iv) savings for investment, and (v) earnings from agricultural export. Additionally, Timmer (1995) highlighted the significance of supplementary nonmarket connections that enhance the productivity of production factors, maintain stability of food prices, and hence lessen the poverty levels

in the economy. Humphries and Knowles (1998) also complemented the assertion that relocation of labor from agriculture to other sectors is correlated with economic expansion.

In contradiction to this viewpoint, some others believed that agriculture sector does not have robust connections to other segments of the economy (Lewis, 1954; Fei and Ranis, 1961; and Jorgenson, 1961). Based on this viewpoint, many policies in developing countries were made focusing the sectors other than agriculture such as manufacturing sector (Okonkwo, 1989 and Schiff and Valdez, 2002). Similarly, based on such kind of findings, some developing countries adopted policy of heavy taxation/duties on agriculture sector for example China has been imposing heavy taxes on agriculture before 1979 and the amount collected through these taxes was used to subsidize industrial development and urbanization (Yao, 2000).

According to Tiffin and Irz, 2006;, Olsson and Hibbs, 2005;Kogel and Prskawetz, 2001; Humphries and Knowles, 1998; Echevarria, 1997; and many more, intensity of this controversy has amplified with the passage of time after extensive research both qualitative and quantitative on the topic. Criticism on earlier empirical work on agriculture sector role in economic development is that most of these studies are based on cross-sectional analysis of panel data which have substantial confines so these may not have yielded conclusive inferences (Tsakok and Gardner, 2007). Among others, Awokuse (2007) described that simple bivariate causality analyses of such type are suspected of unauthentic results because they may overlook the other significant variables which may possibly have significant effect. Recent studies that have used time series panel data and advance econometric techniques, also showed the diverse and at times contradictory proof so there is still a deficiency of harmony on the impact of agriculture on economic advancement (Awokuse and Xie 2015).

As going through the data[1], it seems that agriculture is very important for Pakistan economy, the underlying association between agriculture sector and overall economy and its impact on economic growth of the country is an empirical question that demands to be studied. In Pakistan, this issue has attracted very little consideration of the researchers. Some of the research work done by Ahmad and Ahmad, 2018; Raza *et al*, 2012 and Azra*et al*, 2013 have addressed the issue. According to Ahmad and Ahmad (2018) agricultural exports of the country proved to be influential in economic growth. Though Pakistan's export base is highly dependent on agriculture and trade of agricultural products accounts for 70% of the foreign exchange earnings of the country (Rehman *et al*, 2016) but agricultural exports are only a component of the whole sector so impact of agricultural exports cannot depict the true picture of the effect of the whole agriculture sector on economic growth. A study by Raza *et al* (2012) revealed that agriculture sub-sectors are significantly contributing in the economy except forestry which showed minimal

[1]Agriculture contributes about 19% percent of the Gross Domestic Product (GDP) of Pakistan and employs 38.5% of the labor force (GoP, 2018).

contribution. The study employed Ordinary Least Squares (OLS) regression and have not accounted for co-integration. Therefore, simple correlation coefficient tests might be having misspecification problems and results may be spurious. Azra et al (2013) explored association between agriculture and economic growth of the country by estimating Error Correction Model (ECM) and concluded that agriculture sector contributes significantly in the economy of a country. The current study was designed for further improvement and extension of the work done by Azra*et al* (2013) through: using advance techniques in time series data analysis, adding other relevant variables in growth equation, and using extended data set (Azra *et al*, 2013 used data from 1981 to 2005 while current study used data from 1961 to 2018). Therefore, this study is conducted with the objective to estimate the relationship between growth of agriculture sector and Pakistan's economic growth using recent econometric techniques and suggest informed policy guidelines for future planning.

## 2. Review of Literature

Awokuse and Xie (2015) investigated the direction of causal relationship between agriculture sector and economic growth using data from nine developing countries by applying ARDL co-integration procedure along with Directed Acyclic Graphs (DAG) technique. Study found that this direction of the relationship between agriculture sector and economic growth varies by countries. Empirical analysis supported that agriculture-led growth hypothesis is true for some of the countries while result for some countries supported long-run connecting stream from economic development to agriculture development. Ansari and Khan (2018) tried to study the significance of decreasing agriculture share in overall GDP of four countries including Pakistan, India, Sri Lanka, and Bangladesh by applying maximum likelihood technique proposed by Johansen and Juselius (1990), based on Vector Autoregression (VAR) model with application of Granger causality test. Results confirmed the hypothesis that agriculture sector has a significant positive relationship with the overall economic growth. Herath *et al* (2013) examined the possible impact of agriculture in the development of North Carolina consuming national level statistics from 2000 to 2010 through simultaneous equation analysis. Results revealed that causal relationship between agriculture and economic development exist in two-way direction. Tiffin and Irz (2006) scrutinized underlying association between agricultural and economic development using data from panel of countries with bivariate Granger causality tests and strongly inferred that agricultural growth significantly contribute in economic growth in developing countries, but no decisive results were found for developed countries. In contrast, Gardner (2005) analyzed panel data of 85 countries and found that growth of agriculture is independent of per capita income growth for those who are employed in this sector. However, features triggering agricultural growth proved to impact growth of national GDP positively. Similarly, Matsuyama(1992) negated the assertion that agricultural efficiency is an apparatus of economic development by giving comparative advantage theory and theoretically

analyzed two sector economy growth model in closed and open economy scenario and concluded that agriculture is positively linked with economic development only in the case of closed economy model while negatively linked in case of open economy.

Agriculture sector is considered important not only for the overall economy but for the growth of other vital sectors of the economy mainly the industrial sector. Hye (2009) investigated link between agriculture and industry for sustainable economic development in case of Pakistan using annual data of agricultural and industrial output from 1971 to 2007 and applied ARDL technique. Results revealed that agriculture sector do have impact on industrial sector both in short and long run. Gollin *et al* (2002) examined the role of agriculture in development through analyzing the link between industrial and agricultural productivity and relativity of the role of these two sectors in the growth in short and long run. Analysis showed that agricultural productivity enhancement can affect overall income of the country through accelerating the industrial sector. In short run, improvement in agricultural productivity affect the overall nationalgrowth more as compared to the productivity improvement of non-agricultural sector. Yao (2000) carried out co-integration analysis of five major sector of Chinese economy including agriculture and found that these sector are co-integrated but agriculture is mainspring of economic expansion as well as development of the other four sectors but these sector does not contribute in agricultural development.

This literature review concludes that there are mixed findings about the role of agriculture sector in the overall economies of different countries. There can be significant contribution of agriculture to economic growth as well as economic growth can be promoter of agriculture sector. Two-way directional link between these two variables can also coexist according to some findings. It was found that this effect may vary from country to country. Findings also pointed out that economic growth can also be independent of agriculture sector growth, but this cannot be generalized.

### 2.1. Overview of Agriculture sector growth in Pakistan over time

Sustainable growth of agriculture sector has always been desired throughout the history. Actually, there has been variations in agricultural growth over the time. After independence, there has been stagnation in this sector in 1950s. However, it started growing in later years of the decade. The sector experienced tremendous growth in 1960s especially the second half of this decade where average growth rate in second half of the decade recorded more than 6% mainly due to impressive growth in crops. This was called as Green Revolution (GR) where high growth was due to technology and high input use like seeds fertilizer etc, infrastructure development like dams building and introduction of new varieties. However, green revolution was criticized because of its unsustainability and resulting resource degradation, but agricultural growth was tremendous in that decade. Early 1970s witnessed drop in agricultural growth mainly due to decreased yields of major crops mainly rice, cotton, and sugarcane and also, low growth in livestock except poultry.

The growth recovered in second half of 70s. Growth momentum continued in first half of 1980s where non-cereal crops and livestock appeared as main growth sources but drop in growth was observed in second half of 1980s and first half of 1990s when livestock and sugarcane crop witnessed relatively high growth but low performance of wheat, rice, and cotton. Crops production has been fluctuation over the time and so as the agricultural growth (Chaudhry and Chaudhry, 1997).

Over the time of four decades (1960 to 2000), average growth rate has been around 4% which was higher than growth rate of population which has been round 2% per annum on average. However, growth has not been sustainable in 2000s and resulted in high food prices and more imports of wheat. This could be attributed to external factors like drought years in first half of that decade, flood in the end of that decade, and global food crises (GOP, 2010). Same fluctuating trends has been observed in agricultural growth in recent decade i.e. 2010s where drop down was observed in first half and it was minimum (0.154%) in 2016 due to water shortages while started recovering afterward (GOP, 2012 - 2020).

Agricultural role has changed over the time from only increasing production and high growth to ensuring food security, which is a challenge. This challenge is going to be more complex in coming time w.r.t. decreasing available resources and deteriorating quality of these resources (Farooq, 2015).

## 3. Material and Methods

### 3.1. Data and Analysis

Universe of the study consist whole Pakistan. This study used annual national level data collected from World Development Indicators (WDI) database by World Bank (WB) and database of United Nations Children's Fund (UNICEF).Annual data from 1960 to 2018 was taken on the variables including GDP, agricultural value added, exports, imports, gross capital formation, mortality rate, and GDP deflator.

Firstly, data was transformed from nominal values to the real values and then transformed into log form. Log transforming is commonly used to deal with data skewness, reduce the extent of variation, and/or to convert non-linear function like Cobb-Douglas production into linear functional form. Since model of this study was based on Cobb-Douglas function, so data was transformed by taking natural log where coefficients serve as elasticities. ARDL bounds testing technique along with Error Correction Model (ECM) was applied in the analysis as used in more recent studies of such type for determining both long and short run relationships among different variables (Awokuse*et al*,2015; Udoh*et al*,2015;Alkhatlan, 2013;Chani*et al*,2011;Hye, 2009;and Pahlavani*et al*,2005). ARDL model is based on OLS and it can be applied on both non-stationary series and on series of mix integration order (Shrestha and Bhatta,2018). ARDL furnish the procedures of engendering data from general-to-specific frame by integrating appropriate lags and

integrates the short-run equilibrium through ECM along with the evidence of long-run relationship. It also provides the coefficient of speed of adjustment in case of disequilibrium. Moreover, ARDL is suitable for small data sets (Nkoro and Uko, 2016). Though ARDL bounds testing do not require the pre-testing of data for stationarity, but it is better to confirm that none of the variables is I(2) which is a pre-condition for the approach. Stationarity characteristic of the data was examined using Augmented Dicky-Fuller (ADF) test and Phillipse Perron (PP) test to validate the findings. Schwartz Bayesian Criterion (SBC) was used for the selection of lag length. While performing the stationarity tests, trend component was tested and included where it was found to be significant.

### 3.2. Model Specification

Modified Solow–Swan growth model was used for examining the association between agriculture sector and economic growth analysis following the previous researches of such kind (Ansari and Khan, 2018;Awokuse*et al*,2015; Humphries and Knowles, 1998;Faridi*et al*,2012; and Ahmad and Ahmad, 2018). Basically, the Solow–Swan growth model is an model for measuring long-run economic growth and this model was modified by Mankiw *et al* (1992) by including variables of education and health in the model supposing that enhancement of education and health improvement of the labor force enhance the labor productivity and hence contribute in economic growth. Augmented Solow-Swan growth model is a way of including the other relevant variables in the growth model. This model undertakes the assumption of an aggregate production function with constant-return-to-scale written as:

$$Yt = f(Kt\lambda\, \beta t) \quad (1)$$

Where

Yt represent real GDP per capita in the time period under consideration.

Kt represent the real gross capital formation in the period tand denoted as GCF later on;

βt denotes productivity term in the period t; and

$\lambda$ is the output elasticity of capital.

The effect of agriculture to overall economic growth is measured through its consequences on total factor productivity captured in the model by β. Therefore, β in the model is supposed to be a function of agricultural production, terms of trade, and mortality:

$$\beta = f\,(AGR, TOT, MORT)$$

Writing this equation statistically

$$\beta t = \lambda 1 AGRt + \lambda 2\, TOT + \lambda 3 MORT + \mu t \quad (2)$$

Where AGR is for Agriculture, TOT is for terms of trade, and MORT is mortality rate (as proxy of health), and μ is error term that covers the remaining factors which can affect the productivity other than those included in the model.

By incorporating equation (2) in equation (1)

$$Yt = \lambda 1 AGRt + \lambda 2 GCFt + \lambda 3 TOT + \lambda 4\, MORTt + \mu t \qquad (3)$$

By including constant term and taking natural logs of this equation

$$lnYt = Co + \lambda 1\, ln\, AGRt + \lambda 2\, lnGCft \lambda 3\, ln\, TOTt + \lambda 4\, ln\, MORTt + \mu t \qquad (4)$$

Model in equation (4) was estimated in the study. ARDL model is as under:

$$\Delta lnYt = Co + \lambda 1 lnYt-1 + \lambda 2\, lnAGRt-1 + \lambda 3\, lnGCFt-1 + \lambda 4\, lnTOTt-1 + \lambda 5 lnMORTt-1 + \sum_{i=1}^{p} \gamma\ \Delta lnYt-i + \sum_{i=0}^{q} \gamma 1\, \Delta lnAGRt-i + \sum_{i=0}^{q} \gamma 2\, \Delta lnGCFt-i + \sum_{i=0}^{q} \gamma 3\ \Delta lnTOTt-i + \sum_{i=0}^{q} \gamma 4\ \Delta lnMORTt-i + \mu t$$

Whereas, error correction form of the model is:

$$\Delta lnYt = \alpha + \sum_{i=1}^{p} \beta o\ \Delta lnYt-i + \sum_{i=0}^{q} \beta 1\, \Delta lnAGRt-i + \sum_{i=0}^{q} \beta 2\, \Delta lnGCFt-i + \sum_{i=0}^{q} \beta 3\ \Delta lnTOTt-i + \sum_{i=0}^{q} \beta 4\ \Delta lnMORTt-i + \beta 5 ECT\ t-1 + \varepsilon t$$

Where *i* is optimal number of lags and ECT is error correction term.

### 3.3. Theoretical justification of the variables in the model

Role of agricultural output in overall economic growth may possibly be demonstrated through its impact on total factor productivity or as input to the manufacturing sector (Ruttan, 2000 and Timmer,1995). Development theories in the past took agriculture as an essential resource base for funding the expansion of manufacturing sector. Agriculture is considered as an apparatus of growth so researches including Ansari and Khan,2018;Awokuse and Xie, 2015;Herathe*et al*,2013; Azra*et al*,2013; Raza *et al*,2012; Tiffin and Irz, 2006; Yao, 2000; and many more added agriculture in the growth equation to measure its impact on economic growth. This study was mainly focused to measure the impact of agricultural output on economic growth.

Capital is considered as one of the basic factors for economic growth in endogenous

as well as in exogenous growth theory (Harrod, 1939;Domar, 1946; Solow,1956; Swan, 1956;Lucas, 1988; and Romer, 1990).Present study also included gross capital formation as independent variable in growth equation to see its impact on economy of Pakistan following the other researches (Ahmad and Ahmad, 2018;Ee, 2016;Awokuse and Xie, 2015;Metha, 2011;Awokuse,2007;and Awokuse, 2005). Other variables include TOT and mortality (as proxy of health). There is lot of literature which described that there is relationship between terms of trade and economic growth (Jebran*et al,* 2018; Awokuse and Xie, 2015; Kalumbu and Sheefeni, 2014; Awokuse, 2005; Blattmanet *al*,2004; and Mendoza, 1997). So, based on evidences that terms of trade significantly affect the overall growth, TOT was added in the model.

Moreover, health being a constituent of human capital is important as healthy labor force is expected to be more productive and efficient (Cai and Kalb (2006) and Scultz (2005). Due to the complexities in determining the measures for health proxy and data availability, commonly used indicators of health has been mortality rate and life expectancy (Poças 2012).Mortality rate at birth was added in the model as proxy of health in present analysis. Education and health both are main components of human capital. Education variable was also included in the initial estimation but this variabale was dropped due to collinearity issue. Because of that, only health variable was included the model as proxy of human capital.

# 4. Results and Discussion

## 4.1. Unit root test

Presence of unit root was examined using both ADF test and Phillipse Perron test to validate the findings (Table 1 & 2). Results revealed that all of the variables were non-stationary at level but they were stationary at first difference so all of them were I(1) and none of them was I(2) which is pre-condition for the application of ARDL.

**Table 1:Unit Root Tests using ADF test**

| Variable | Levels | First differences |
|---|---|---|
| **lnY** | -1.734 | -4.712 *** |
| **lnAGR** | -0.972 | -6.184 *** |
| **lnGCF** | -1.808 | -4.960** |
| **lnTOT** | -2.535 | -4.470*** |
| **lnMORT** | -0.189 | -3.68* |

***Source:*** *Authors calculations; *=significant @ 10% level,**=significant @ 5% level and ***=significant @ 1% level*

**Table 2:Unit Root Tests usingPhillip-Perron test**

| Variable | Levels | First differences |
|---|---|---|
| **lnY** | -1.320 | -4.139*** |
| **lnAGR** | -1.426 | -4.576 *** |
| **lnGCF** | -1.275 | -4.457 *** |
| **lnTOT** | -1.171 | -7.391 *** |
| **lnMORT** | -0.464 | -4.118 *** |

***Source:*** *Authors calculations; ***=significant @ 1% level*

### 4.2. ARDL bounds test

The ARDL bounds test was used check the co-integration which test the hypothesis that there is no level relationship which if rejected means that there is co-integration in the selected model. For bounds test, Pesaran*et al* (2001) offered two critical values (upper and lower bounds) used to test the significance where co-integration exists if calculated value is greater than upper bound. However, since critical values offered by Pesaran*et al* (2001) are calculated for large data sets, critical values offered by Narayan (2005) which are calculated for small sample sizes (from30–80) were used in the present study. Number of lags were selected using Schwartz Bayesian Criterion (SBC) for its usefulness for small sample like in this study. Results of ARDL bounds test indicted that there is co-integration in selected model which is statistically significant where calculated F-Statistic is safely greater than I(1) bound @5% level of significance (Table 3).

**Table 3: ARDL bounds test for the model**(4, 1, 0, 0, 3, 2)

| **Test Statistics** | **Value** | **K** |
|---|---|---|
| F-Statistics | 6.441** | 5 |
| **Critical value bound by Narayan (2005)** | | |
| Significance | I(0) bound | I(1) bound |
| 10% | 3.37 | 4.62 |
| **5%** | **4.04** | **5.54** |
| 1% | 5.60 | 7.17 |

***Source:*** *Author's calculations; **=significant @ 5% level*

The estimated model delivered long-run and short-run coefficients along with the coefficient of speed adjustment (Table 4). Results showed that the independent variables included in the model were significantly affecting per capita real GDP in the long run except TOT. Coefficient of ECT was -0.62 which means that if there is any disequilibrium, it will be corrected at the rate of 62 percent in the first period. Results revealed that real agricultural value added has a positive relationship with per capita real GDP in the long run where one percent increase in real agricultural value added increases the real GDP/capita by 0.35%. Results were significant and consistent with earlier researches (Ansari and Khan, 2018; Khan et el, 2013; Herath et al, 2013; Raza et al, 2012; Tiffin and Irz, 2006 and Yao, 2000). This indicated that the promotion of agriculture sector can have far-reaching effects on economic growth of the country. These results advocated for the development of agriculture sector in line with the long-term goals of economic growth and emphasized in investing in agriculture sector.

In accordance with the growth theory, gross capital formation confirmed significant positive impact on economic growth of Pakistan. Analysis depicted that one percentage increase in GCF leads to 0.48% increase in real GDP/capita in the long-run. Results were significant and consistent with theory and previous research that capital stimulates economic growth (Ahmad and Ahmad, 2018; Ee, 2016; Awokuse and Xie, 2015; Metha, 2011; and Awokuse, 2005).

Statistically significant negative relationship was found between infant mortality rate and real GDP per capita where 1 % decrease in infant mortality improve the per capita real GDP by 1.5%. Reduced mortality rate is considered as sign of good health status of the people which contribute in the economy. Results of current study suggested that we should invest in human health to enhance the economic growth as suggested by endogenous growth theory. Moreover, it also suggested to create conducive environment and economic opportunities to engage the people to reap the benefits of demographic dividends of decreased mortality.

Initially when the model was estimated, some consistency issues were found so dummy variable for structural break in 1971 (dsb71) was included to deal with the issue of inconsistency. Moreover, variables of the study showed a trend over the time except TOT, so years variable was added to capture the trend component and it was significant.

**Table 4: ARDL regression results**

| **ARDL Regression (4,1,0,0,3,2)** [2] | | | | |
|---|---|---|---|---|
| Sample: 1964 - 2018Number of observations = 55 | | | | |
| | | | | R-squared=0.9489 |
| | | | | Adj R-squared= 0.9274 |
| **Long-run Statistics** | | | | |
| **Variable** | **Coefficient** | **St. Error** | **t-statistics** | **p-value** |
| lnAGR | .3546125 | .1464733 | 2.42 | 0.020 |
| lnGCF | .4847286 | .1004735 | 4.82 | 0.000 |
| lnTOT | .0275572 | .053874 | 0.51 | 0.612 |
| lnMORT | -1.495776 | .5651091 | -2.65 | 0.012 |
| dsb71 | -.1862674 | .1033004 | -1.80 | 0.079 |
| Constant | 60.82231 | 15.97745 | 3.81 | 0.000 |
| **Short-run Statistics** | | | | |
| lnY LD. | -.0355493 | .0536052 | -0.66 | 0.511 |
| lnY L2D | -.0581824 | .0478414 | -1.22 | 0.231 |
| lnY L3D | -.0433703 | .0447619 | -0.97 | 0.339 |
| lnAGR D1. | .2943168 | .1234393 | 2.38 | 0.022 |
| lnMORTD1. | 3.440538 | 6.143966 | 0.56 | 0.579 |
| lnMORTLD. | 6.737057 | 5.864771 | 1.15 | 0.258 |
| lnMORTL2D. | -.7564336 | 6.465748 | -0.12 | 0.907 |
| dsb71 D1 | .1033921 | .0546046 | 1.89 | 0.066 |
| dsb71 LD | .0498333 | .0507127 | 0.98 | 0.332 |
| years | -.0324101 | .0076329 | -4.25 | 0.000 |
| ECT (-1) | -0.621209 | .2389056 | -4.91 | 0.000 |

***Source:*** *Author's calculations*

### 4.3. Diagnostic tests of the estimated model

There are certain other diagnostic tests which were performed for measuring the heftiness of the estimated regression model. Most common categories of diagnostics are coefficients diagnostics, lag structure, and residual diagnostics where category of residual diagnostics is the most critical. Common established techniques for residual diagnostics include tests for heteroskedasticity, autocorrelation, model specification test of omitted variable, normality test, and stability test (Shrestha and Bhatta 2018). The tests performed for the estimated model included Breusch-Godfrey LM test, Breusch-Pagan test, Autoregressive Conditional Heteroskedasticity (ARCH) LM test, Ramsey RESET test, and Jarque-Bera test.

[2] Values in parenthesis indicate the number of lags selected automatically by the software using the appropriate lag selection criteria.

Durbin Watson (D.W) test is commonly used for testing the autocorrelation but in the case of autoregressive models, Breusch–Godfrey LM test is a procedure alternative to D.W for testing higher order autocorrelation. Since this test is based on Lagrange multiplier procedure, it is also called as LM serial correlation test (Dimitrios and Hall 2011). Breusch-Pagan test is to examine that whether the variance of the residuals of the estimated regression depend on independent variables or not. Similarly, ARCH test is a statistical procedure developed for time series data where it analyzes the variance of the current error term in relation to the squares of error terms of the preceding time periods. The ARCH test is suitable when the variance of the error term in time series data consist the autoregressive properties. The time series data showing conditional heteroskedasticity or autocorrelation in the squares of the error terms is considered to have ARCH effects (Engle 1982).Ramsey RESET test was used to examine the accuracy of the model specification while normality was examined through Jarque-Bera test.. Results of these tests depicted that the estimated model was not suffering from any violation (Table 5).

**Table 5: Diagnostics tests of the model**

| **Test** | **Test Statistics** | **p-value** |
|---|---|---|
| Breusch-Pagan | 0.56 | 0.4545 |
| Autoregressive Conditional Heteroskedasticity | 0.46 | 0.4976 |
| Breusch-Godfrey LM | 0.200 | 0.6544 |
| Ramsey RESET | 0.09 | 0.9671 |
| Jarque-Bera | 2.847 | 0.2409 |

***Source:*** *Authors calculations*

In time series data analysis, the Cumulative Sum Control Chart (CUSUM) squared is a technique developed for sequential analysis. It is used to observe the change in the data and hence to test the stability of the estimated model. It tests the fluctuation in the mean, variance, and distribution function (Bai 1994). The following graph shows that the all of the deviations around the regression line are within the range of control lines.

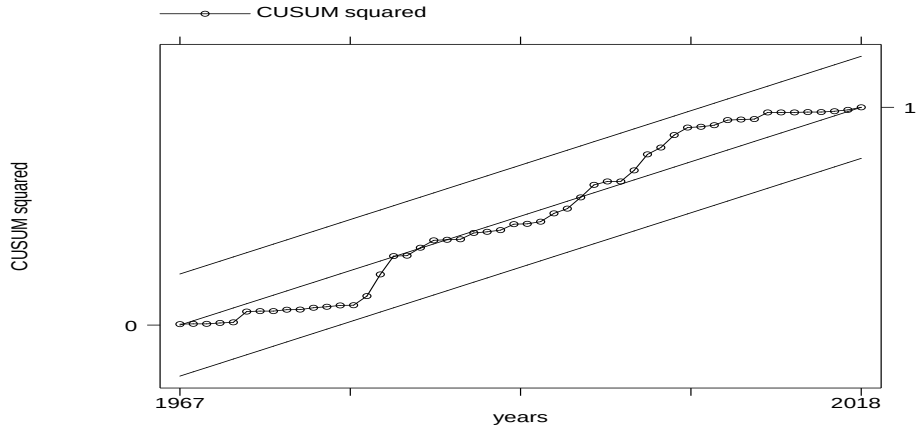


*Figure 1: CUSUM.Sq test of the estimated model*

## 5. Conclusion

There has been controversy in the field of development economics about the significance of the role of agriculture sector in economic growth. Going through the data it indicates that agriculture sector is significant contributor to the economy of Pakistan as it contributes about 19% in national GDP through different sectors including crops, livestock, fisheries, and forestry. This study was designed to statistically test the role of agriculture sector in economic growth of Pakistan through estimation of relationship between growth of agriculture sector and Pakistan's economic growth using recent econometric techniques. Study found that real agricultural value added has a significant positive impact on per capita real GDP in the long-run. This indicated that the promotion of agriculture sector leaves far reaching effects with respect to economic growth of the country. These results advocated for the development of agriculture sector in line with the long-term goals of economic growth and emphasized in investing in agriculture sector.

Results also proved the importance of capital formation both the physical capital and human capital. Finding suggested that we should invest in human health to enhance the economic growth as suggested by endogenous growth theory. Moreover, it can also be suggested to create conducive environment and economic opportunities to reap the benefits of demographic dividends of decreased mortality in the long-run.

As per analysis, structural break negatively impacts the economy which suggest that maintaining stability is critically important for economic growth. Moreover, literature hypothesize the positive effect of TOT for economic growth, but analysis indicated that TOT has not been able to put any significant impact on economic growth. Further, trend analysis also pointed out that TOT has been fluctuating over the time. It can be inferred from this analysis that there is need to stabilize TOT and to restructure the exports of the country so that significant positive impact cab be generated.

**References**

Ahmad, D. and J. Ahmad(2018). 'An empirical analysis of agricultural export on economic growth: A case of Pakistan'. International Journal of Advanced and Applied Sciences, 5, 2, pp. 25-32.

Akram, N., I. H. Padda and M. Khan(2008).'The long term impact of health on economic growth in Pakistan'. The Pakistan development review, 47, 4,pp. 487-500.

Alkhathlan, K.A(2013). 'Contribution of oil in economic growth of Saudi Arabia'. Applied Economic Letters, 20, 4, pp. 343-348.

Ansari, S. A. and W. Khan(2018). 'Relevance of Declining Agriculture in Economic Development of South Asian Countries: An Empirical Analysis'. AGRIS on-line Papers in Economics and Informatics, 10,2,pp. 3-14. ISSN. 1804-1930.

Awokuse, T.O. and R. Xie (2015). 'Does agriculture really matter for economic growth in developing countries'? Canadian Journal of Agricultural Economics, 63,pp. 77-99.

Awokuse, T.O(2007). 'Causality between exports, imports, and economic growth: Evidence from transition economies'. Economics Letters, 94, pp. 389–95.

Awokuse, T.O (2005). 'Export-led growth and the Japanese economy: Evidence from VAR and directed acyclic graphs'. Applied Economics Letters,12, pp. 849–58.

Azra, D.K., Ahmed, E. and Ahmed, S.S. 2013. Agriculture and Economic Growth: Empirical Evidence from Pakistan. Sarhad University International Journal of Basic and Applied Sciences, 1 (1): 307-313.Bai, J(1994). 'Weak convergence of the sequential empirical processes of residuals in ARMA models'. The Annals of Statistics, 22, pp. 2051-2061.

Blattman, C., J. Hwang, and J. G. Williamson (2003). 'The terms of trade and economic growth in the peripher'.National Bureau of Economic Research, pp. 1870-1938 (No. w9940).

Bhagwati, J. and T.N. Srinivasan (1975). 'Foreign Trade Regimes and Economic Development: India'.Columbia University Press, New York.

Cai, L. and G. Kalb (2006).'Health Status and Labour Force Participation: Evidence from Australia'. Health Economics, 15, 3, pp. 241-261.

Chani, M.I., Z. Pervaiz, S.A. Jan, A. Ali, and A.R. Chaudhary(2011). 'Poverty, inflation and economic growth: empirical evidence from Pakistan'. World Applied Sciences Journal, 14, 7, pp. 1058-1063.

Chaudhry, M.G. and G. M. Chaudhry. 1997. Pakistan's agricultural development since independence; Intertemporal trends and explanations. The Pakistan Development Review, 36 (4): 593-612.

Datt, G. and M. Ravallion (1998). 'Farm productivity and rural poverty in India'. Journal of Developmental Studies,34, 4, pp. 62–85.

Dowrick, S. and N. Gemmell(1991). 'Industrial catching up and economic growth: A comparative study across the world's capitalist economics'. Economic Journal,101, pp. 263–76.

Echevarria, C(1997). 'Changes in sectoral composition associated with economic growth'. International Economic Review,38, 2, pp. 431–52.

Ee, C. Y (2016). 'Export-led growth hypothesis: Empirical evidence from selected Sub-Saharan African countries'. Procedia Economics and Finance, 35, pp. 232-240.

Eicher, C.K. and J.M. Staatz(1984). 'Agricultural Development in the Third World'. Johns Hopkins University Press, Baltimore.

Faridi, M.Z(2012). 'Contribution of agricultural exports in economic growth in Pakistan'. Pakistan Journal of Commerce and Social Sciences, 6, 1, pp. 133-146.

Farooq, U. 2015. Demand-Supply Projections of Food and Fiber in Pakistan: Potentials and Constraints. Background Draft Chapter-2 for "Vision 2050: Addressing Challenges to the Agriculture Sector of Pakistan".

Fei, J. and G. Ranis (1961). 'A theory of economic development'. American Economic Review,51, 4, pp. 533–65.

Gardner, B(2005). 'Causes of rural economic development'. In: D. Colman and N. Vink (eds.). Reshaping Agriculture's Contribution to Society, pp. 21–41. Proceedings of the 25th International Conference of Agricultural Economists. Durban, Oxford: Blackwell.

Gollin, D., S.L. Parente, and R. Rogerson(2002). 'The role of agriculture in development'. American Economic Review, 92, 2, pp. 160–64.

GoP. (2012). Economic Survey of Pakistan. Ministry of Finance, Government of Pakistan.

GoP. (2014). Economic Survey of Pakistan. Ministry of Finance, Government of Pakistan.

GoP. (2015). Economic Survey of Pakistan. Ministry of Finance, Government of Pakistan.

GoP. (2016). Economic Survey of Pakistan. Ministry of Finance, Government of Pakistan.

GoP. (2018). Economic Survey of Pakistan. Ministry of Finance, Government of Pakistan.

GOP(2018). 'Agricultural Statistics of Pakistan'. Ministry of National Food Security and Research, Government of Pakistan.

GoP. (2020). Economic Survey of Pakistan. Ministry of Finance, Government of Pakistan.

Herath, J., S. Bashir, and T. Gebremedhin(2013). 'An Empirical Analysis of Agriculture inEconomic Growth of North Carolina'. Paper presented at Annual meeting of Southern Agricultural Economics Association, Orlando, Florida, 3-5 February 2013.

Humphries, H., and S. Knowles(1998). 'Does agriculture contribute to economic growth? Some empirical evidence'. Applied Economics, 30,6, pp. 775-781.

Hye, Q. M. A (2009). 'Agriculture on the road to industrialization and sustainable economic growth: An empirical investigation for Pakistan'. International Journal of Agricultural Economics & Rural Development, 2, 2, pp.

Ijirshar, V.U(2015). 'The empirical analysis of agricultural exports and economic growth in Nigeria'. Journal of Development and Agricultural Economics, 7, 3, pp. 11-122.

Johansen, S. and K. Juselius (1990). 'Maximum likelihood estimation and inference on cointegration with applications for the demand for money'. Oxford Bulletin of Economics and Statistics,52, pp. 169–210.

Johnston, B. and J. Mellor(1961). 'The role of agriculture in economic development'. American Economic Review, 51, 4, pp. 566–93.

Jorgenson, D(1961). 'The development of a dual economy'. Economic Journal, 282,pp. 309–34.

Kalumbu, S. A. and J. P. Sheefeni (2014). 'Terms of trade and economic growth in Namibia'. International Review of Research in Emerging Markets and the Global Economy, 1, 3, pp. 90-101.

Kogel, T. and A. Prskawetz(2001). 'Agricultural productivity growth and escape from the Malthusian trap'. Journal of Economic Growth,6, pp. 337–57.

Lewis, W.A(1954). 'Economic development with unlimited supplies of labour'. The Manchester School, 22, 1, pp. 139–91.

Mankiw, N. G., D. Romer, and D. N. Weil (1992). 'A contribution to the empirics of economic

growth'. Quarterly Journal of Economics, 107, 2, pp. 407-437.

Matsuyama, K(1992). 'Agricultural productivity, comparative advantage, and economic growth'. Journal of Economic Theory, 58, pp. 317-334.

Mendoza, E. G(1997). 'Terms-of-trade uncertainty and economic growth'. Journal of Development Economics, 54, 2, pp. 323–356.

Metha, R(2011). 'Short-run and long-run relationship between capital formation and economic growth in India'. Indian Journal of Management and Technology, 19, 2, pp. 170-180.

Narayan, P. K(2005). 'The saving and investment nexus for China: evidence from cointegration tests'. Applied Economics, 37, 17, pp. 1979-1990.

Nkoro, E. and A.K. Uko (2016). 'Autoregressive distributive lag (ARDL) cointegration techique: application and interpretation'. Journal of Statistical and Econometric Methods, 5, 4, pp. 63-91.

Okonkwo, I.C(1989). 'The erosion of agricultural exports in an oil economy: The case of Nigeria'. Journal of Agricultural Economics,40, 3, pp. 375–84.

Olsson, O. and D.A. Hibbs(2005). 'Biogeography and long-run economic development'. European Economic Review,49, 4,pp. 909–38.

Pahlavani, M., E. Wilson, and A.C. Owrthington(2005). 'Structural breaks and cointegration relations in Iranian Exports, imports and economic growth: An application incorporating autorgressive distributive lag (ARDL) procedure'. Americal Journal of Apllied Science, 2, 7, pp. 1158-1165.

Pesaran, M.H., Y.Shin and R.J.Smith(2001). 'Bounds testing approaches to the analysis of level relationships'. Journal of Applied Econometrics, 16, 3,pp. 289–326.

Pocas, A. I. S. A(2012). 'The interrelation between health, human capital and economic growth: Empirical evidence from the OECD countries and portugal'. Faculade De Economia. Universidade De Coimbra ((Doctoral dissertation, FEUC).

Raza, S.A, Y. Ali, and F, Mehboob (2012). 'Role of agriculture in economic growth of Pakistan'. International Research Journal of Finance and Economics, 83,pp. 180-186. ISSN 1450-2887.

Rehman, A., L. Jingdong, and M. I. Hussain(2016). 'Pakistan's major exports and imports role and importance for agriculture and economic development'. Andamios: Revista de Investigacion Social, 12, 1, pp. 174-179.

Ruttan, V(2000). 'Technology, Growth and Development: An Induced Innovation Perspective'. Oxford University Press.

Schiff, M. and A. Valdez(2002). Agriculture and the macro economy, with emphasis on developing countries'. In:B.L. Gardner and G.C. Rausser (eds.) 'Handbook of Agricultural Economics', 2, pp.1421–54. Elsevier: Amsterdam.

Shultz, T.W(2005). 'Productive Effects of Health'.In G. L. Casasnovas, B. Rivera, andL. Currais (eds.), Health and Economic Growth: Findings and Policy Implications,pp. 287-311. The MIT Press: Cambridge.

Schultz, T.W(1964). 'Transforming Traditional Agriculture'. Yale University Press, New Haven.

Shrestha, M. B. and G. R. Bhatta (2018). 'Selecting appropriate methodological framework for time series data analysis'. The Journal of Finance and Data Scient, 4, pp. 71-89.

Solow, R.M(1956). 'A contribution to the theory of econmoic growth'. Quarterly Journal of Economics, 70, 1,pp. 65-94.

Swan, T.W(1956). 'Economic growth and capital accumulation'. Economic Record, 32, 2, pp. 334-361.

Thirtle, C., L.Lin and J. Piesse(2003). 'The impact of research-led agricultural productivity growth on poverty reduction in Africa, Asia and Latin America'. World Development,31, 2, pp. 1959–75.

Tiffin, R., and X. Irz (2006). 'Is Agriculture the Engine of Growth? Agricultural Economics,35, pp. 79–89.

Timmer, C.P (1995). 'Getting agriculture moving: Do markets provide the right signals'? Food Policy,20, 5, pp. 455–72.

Tsakok, I., and B. Garner (2007). 'Agriculture in economic development: Primary engine of growth or Chicken and Egg'? American Journal of Agricultural Economics, 89, 5, pp. 1145-1151.

Udoh, E., U. Afangideh, and E.A. Udeaja(2015). Fiscal decentralization, economic growth and human resouce development in Nigeria: Autoregressive Distributive lag (ARDL) approach'. CBN Journal of Applied Statistics, 6, 1.a, pp. 69-93.

Yao, S(2000). 'How imprtant is agriculture in China's economic growth'? Oxfrod Department Studies, 28, 1, pp. 33-49.