Impact of Agriculture Sector Development on Economic Growth: Application of Robust Linear Least Squares Regression on Pakistan's Data Set

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Abstract: The objective of the study is to examine the relationship between economic growth and agricultural crops, i.e., maize, rice, sugarcane, and wheat production in the context of Pakistan by using the last 14 years time period from 2003-2016. The study used some other exogenous factors, i.e., agriculture exports and agriculture employment, which gives conclusive findings in a given country context. The study employed robust least squares regression apparatus that gives unbiased, efficient, and reliable estimates. The results show that agricultural crops, i.e., maize and wheat production substantially increases country's economic growth, while agricultural exports does not supported due to some structural flaws in agriculture commodity market. The results confirm the positive association between agriculture employment and economic growth that helpful to reduce Pakistan's internal migration issues. The study emphasized the need to support rice and sugarcane production through protective prices, economic policies, and financialization in the commodity markets.

Keywords: Agriculture crops; Agriculture employment; Economic growth; Robust least squares regression; Pakistan.

JEL Classification: Q17

1. Introduction

Agriculture sector plays a very vital role in the developing countries, which is considered as a backbone of the countries. Pakistan is basically an agricultural country, as 62% of the population of Pakistan is directly or indirectly connected with agriculture sector. The contribution of agriculture in GDP is about 21% and it employs 44% of the labor force. (Azam & Shafique, 2017) Agriculture sector largely

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overcrowded by political instability, environmental concerns, poor soil health, defective rural socio economic set-up, limited cultivated area, inadequate public policy and agriculture research. Availability of food within the country is imperative for this sector to reduce famine. (Pakistan's Economic Survey, 2017)

There is mass poverty in the village coupled with illiteracy, orthodoxy, stubbornness and traditional method for cultivation. They are largely unaware of advance methods of cultivation, fertilization process, modern type of insecticides, durable spray, the improved water-course and mechanization of farms. Due to the adoption of traditional method of farming, the farmers unable to gain enormous productive yields and economic incentives to support their livelihood in a productive manner. (Usman, 2016) According to Pakistan's Economic Survey (2012), Pakistan's total cultivatable area is about 79.6 million hectares and 22.04 million hectare area is being under cultivation. More than half of cultivable area is idle and unutilized. Pakistan has world biggest irrigation system; nearly 80% the area of cultivation is irrigated. Pakistan produced many foods like tritium asetivum (wheat) Saccharumofficinarum (sugarcane) oryza sativa (rice) gossypiun (cotton) and zea mays (maize), which contribute 5% of country's GDP while other crops contribute 2.3% of country's GDP. (Azam & Shafique, 2017)

Pakistan's Irrigation System

The prime responsibility of agriculture sector is to reduce famine, eradicate poverty, and generate employment opportunities, which is imperative for country's development. The arrangement of providing water by methods for manufactured trenches, trench, and so on, especially to advance the development of nourishment crops. A modern water systems framework is used to get the stool out of the colon. Pakistan irrigation system is the largest irrigation system in the world. Irrigation system is necessary for the production of crops, especially in the regions where there are less rainfall. Pakistan also blessed with the extensive canal system. Canal system is a substitute for the shortage of rainfall. Farming has been spine of low salary economies. It is for the most part the essential wellspring of wage acquire work in provincial zones. Farming segment of Pakistan has constantly been confronting defeat amid the most recent decade. (Awan & Mustafa, 2013)

Almost 62 percent of the country's populace resides on rural areas, also is specifically or by implication connected for agribusiness to their vocation. Today, agribusiness for Pakistan remains to be an extensive donor of the country's budgetary make up yet the manufacturing industry will be gradually developing its offer. Different parts in sustenance processing, textile, compound manufacturing iron and steel currently need solid commitment of the national economy over late quite some time. (Hussain & Ajmair, 2015)

Small Farmer Credit

Small farmer credit is a loan given to the farmers on a low interest rate for the purchasing of machinery, seeds and etc. Small famer credit idea is first time proposed by "Michael R Carter". Carter was in the favor of laissez fair credit market (i.e., it is a financial framework in which exchanges between private gatherings are free from government intercession, for example, control, benefits, taxes). In his view, it is found that most of institutions were not give credit to small farmers because the institutions have not accurate information about their farm productivity and also it was misperceive that small farmers were incapable of return the credit. (Hussain et al., 2015)

Little credit can be given in different way like giving appropriations on the costs of the pesticides, fertilizers, seeds, for propelling the innovation by acquiring the tractors, cutters, binder, spray and tube well etc., so this can inspire the little agriculturists personal satisfaction and everywhere it can contribute in net residential generation. Government should device some social safety net programmes including price protection, so the farmers may get good price for their agricultural products. Pakistan's economy should increase its agriculture credit to increase its agricultural yields.

On the basis of above discussion, the study analyzed the country's growth performance via the development of agriculture sector, which is imperative for broad-based growth. The more specific objectives are as follows:

- To analyze the contribution of agricultural crops in country's economic growth;
- To examine the role of agriculture exports in country's economic growth; and
- To observe the growth performance via the provision of agricultural employment in a given country.

These objectives are highly desirable to evaluate in a given country's context to device long-term agricultural policies for sustained growth.

2. Literature Review

The wide literature is available on the development of agriculture sector and country's economic growth, however, this study have a distinct place in a given scenario by adding agricultural exports and employment coupled with agricultural crops to analyze overall country's growth. Raza et al. (2012) evaluated the role of agriculture sector development in Pakistan's economic growth by taken a consistent time period from 1980-2010 and concluded that agriculture sector development substantially increases country's economic growth, which is imperative for

eradicating poverty, famine, and social issues. Hussain et al. (2015) analyzed the role of institutional credits on Pakistan's agriculture production by using a data from 1973-2009 and suggested that government should provide small credits to the farmers for the improvement of agriculture sector that enables farmers to adopt new technologies that support high agricultural productivity in a country. Raza and Siddiqui (2014) identified the key determinants of Pakistan's agricultural inputs, i.e., fertilizer consumption, improved seeds, labor employed in the sector, number of tractors, number of tube-wells and water availability, by using a consistent time period from 1972-2012. The results confirmed that these inputs derive maximum production to support farmers' earnings and it lead to increase country's overall growth. Faridi (2012) concluded that agricultural and non-agricultural exports supported Pakistan economic growth, which need more export oriented strategies to support country's economic growth. Usman (2016) analyzed the key role of agriculture sector development on Pakistan's economic growth by regression apparatus and confirmed that higher agricultural production leads to increase country's economic growth. Awan and Mustafa (2013) examined the role of aggregate trimmed territory, water system, farming credit, import of pesticides, and enhanced seed conveyance on development in Pakistan's agriculture sector by using a data set from 1970-2009 and found the positive association between the variables. Chandio (2016) provoked the need of proper land distribution that devoted to the agricultural production and conclude that farming area has noteworthy effect on Pakistan's economic growth. Zaman et al. (2012) argued that agricultural technology required substantial energy requirements to produce high food yield, which is necessary to optimize economic resources in more productive manner. Qureshi et al. (2016) aligned agricultural sustainability agenda by dynamic linkages of energy demand, environmental factors and agricultural value added in the context of Pakistan by using a data from 1980-2013 and found that agriculture production is largely influenced by different air pollutants, which need environmental sustainability policies to conserve natural resources in a country. Khan et al. (2014) confirmed that agricultural technologies helpful to reduce rural poverty in Pakistan, which is good sign to adopt more green options to improve the livelihood of the poor people. Zaman and Khilji (2014) evaluated sectoral data for rural-urban poverty and confirmed that sectoral decomposition of country's economic activities helpful to reduce poverty by sound economic policies in Pakistan. Zaman et al. (2016) considered a panel of 20 EU countries for a period of 1990-2013 to evaluate the relationship between food poverty and inequality across countries. The results show that agricultural sustainability substantially decreases food poverty-inequality in a panel of countries. Ren et al. (2018) concluded that agricultural crops largely influenced by climate change, which need an integrated economic model to mitigate climatic vulnerabilities across the globe. Mertellozzo et al. (2018) simulated an integrated environmental model for urban-agriculture growth and found that urban growth largely loss agricultural land and natural resources in Italy. Paramti et al.

(2018) identified multiple factors of agricultural sustainability that is imperative for long-term growth of G-20 countries. The main factors include renewable energy demand, non-renewable energy, industry value added, foreign investment, etc. These factors are vital for sustainable growth in a country.

These studies confirmed the strong relationship between agricultural commodities, different inputs, and country's economic growth that need to be explored for robust policy inferences.

3. Data and Methodology

This study employed robust least squares regression apparatus to find out the impact of agricultural crops, exports, and employment on Pakistan's economic growth by using a time series data from 2003 to 2016. The time period is chosen due to large transformation of agricultural inputs during this period in order to reduce famine, eradicate poverty, and social issues in a given country context. The study used the following linear equation, i.e.,

$$GDPpc=\alpha_0+\alpha_1 (AE)+\alpha_2 (AEX)+\alpha_3 (MAA)+\alpha_4 (RI)+\alpha_5 (SU)+\alpha_6 (WE)+\varepsilon \quad (1)$$

Where, GDPpc shows per capita GDP in constant 2010 US$, AE shows agriculture employment in %, AEX shows agriculture exports in US$, MAA shows maize production, RI shows rice production, SU shows sugarcane production,, and WE shows wheat production.

The data is taken from World Development Indicators published by World Bank (2017). The study used the set of econometric tools to achieve the studied objectives, i.e.:

Unit root test for analyzing the trend stationary of the respective variables.

Engel-Granger single equation test is used for cointegration process, and

Robust least squares regression apparatus minimizes possible outliers from regressand and regressors.

4. Results

Table 1 shows the correlation matrix of the respective variables. The results show that maize production, wheat production and sugarcane production has a positive contribution to Pakistan's per capita income, however, maize production has a greater share in terms of increase agricultural productivity, followed by wheat production and sugarcane production. The rice production has a negative correlation with per capita income, similarly, agriculture exports decreases country's per capita income, which provoked the need of structural adjustment in the commodity markets

to sustained long-term growth. There is a positive correlation found between agriculture employment and per capita income that support employment intensive growth in a country.

Table 1. Correlation Matrix

Variables	GDPpc	AE	AEX	MAA	RI	SU	WE
GDPpc	1 -----						
AE	0.941 (0.000)	1 -----					
AEX	-0.257 (0.374)	-0.234 (0.420)	1 -----				
MAA	0.903 (0.000)	0.879 (0.000)	0.016 (0.954)	1 -----			
RI	-0.615 (0.019)	-0.626 (0.016)	-0.358 (0.208)	-0.831 (0.000)	1 -----		
SU	0.180 (0.536)	0.181 (0.533)	-0.094 (0.748)	0.370 (0.192)	-0.431 (0.123)	1 -----	
WE	0.355 (0.212)	0.279 (0.334)	0.274 (0.342)	0.424 (0.130)	-0.489 (0.075)	0.141 (0.629)	1 -----

Note: GDPpc shows GDP per capita, AE shows agriculture employment, AEX shows agriculture exports, MAA shows maize production, RI shows rice production, SU shows sugarcane, and WE shows wheat production. Small bracket shows probability values.

Table 2 shows the estimation of cointegration, as it implies that there are four factors, i.e., agriculture exports, maize, sugarcane, and wheat production have a significant z-statistics that confirmed the 4 cointegrating equations in the given set of variables, hence we generally concluded that the model exhibit a long-run and cointegrated relationship between the variables.

Table 2. Engle-Granger Cointegration Test

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*			
GDP	-4.530	0.366	-14.921	0.3542			
AE	-3.625	0.677	-14.011	0.5529			
AEX	-4.965	0.257	-17.180	0.0878			
MAA	-4.865	0.280	-17.169	0.0879			
RI	-7.458	0.020	-21.687	0.2688			
SU	-4.850	0.298	-34.703	0.0000			
WE	-4.874	0.278	-17.450	0.0859			
*MacKinnon p-values.							
Intermediate Results							
	GDP	AE	AEX	MAA	RI	SU	WE
Rho - 1	-1.147	-1.077	-1.321	-1.320	-1.668	-1.577	-1.342
Rho S.E.	0.253	0.297	0.266	0.271	0.223	0.325	0.275
Residual variance	662041	196.622	0.054	0.219	0.494	0.636	1.942

Table 3 shows the estimates of robust least squares regression and found that maize production and wheat production both have a positive relationship with the country's per capita income, while rice and sugarcane production both unable to explain significant impact on GDP per capita. The results further indicate the positive impact of agriculture employment and negative impact of agriculture exports on Pakistan's economic growth, which need to re-correct by financialization in energy and commodity markets in a country.

Table 3. Estimates of Robust Least Square Regression

Variables	Coefficient	Std. Error	z-Statistic	Prob.
Constant	-35016.86	22495.90	-1.556588	0.1196
AE	40.41886	12.02975	3.359909	0.0008
AEX	-1392.171	693.7343	-2.006779	0.0448
MAA	1003.913	294.2083	3.412254	0.0006
RI	282.7486	212.2807	1.331956	0.1829
SU	-226.6776	175.7891	-1.289486	0.1972
WE	379.6756	125.3144	3.029785	0.0024
Robust Statistics				
R^2	0.656899	Adjusted R^2		0.362813
Rw-squared	0.987766	Adjust Rw-squared		0.987766

The principle discoveries of the investigation portray that agriculture exports have a negative relationship with monetary development of Pakistan, which need to do basic changes in farming trades by changing over its agriculture exports into esteem included items (Shah et al. 2015). Figure 1 shows the confidence ellipse of the respective variables and confined that all the studied variables are fall inside the ellipse, which confirm that the model is stable at 5% level of significance.

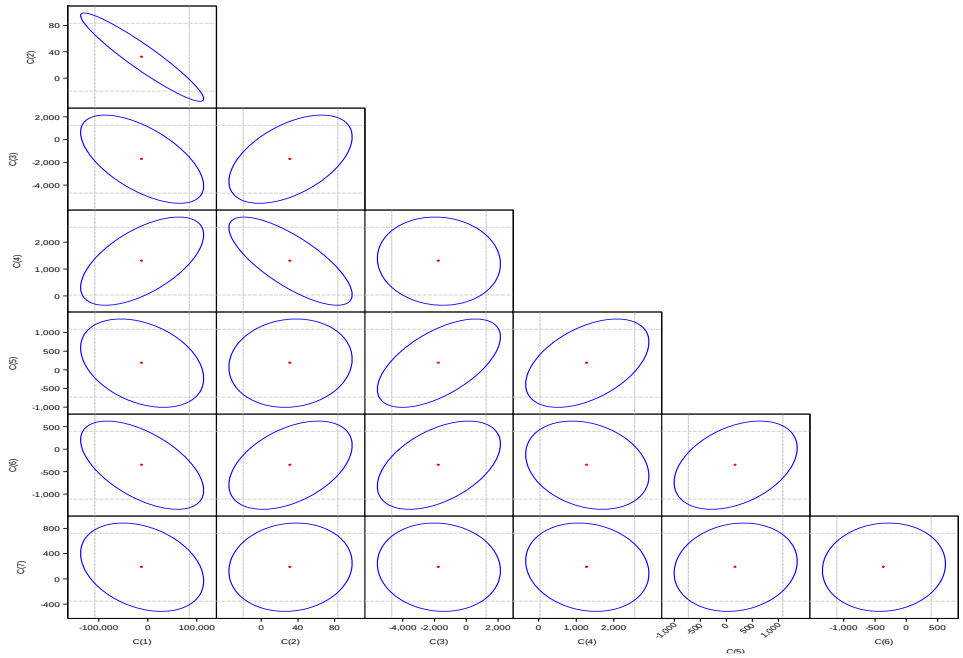

Figure 1. Confidence Ellipse

The study used number of diagnostic tests, including correlogram, histogram, autocorrelation, and heteroskedasticity tests, which is presented in the subsequent tables and figures. Table 4 shows the correlogram statistics and confirmed that there is no autocorrelation and partial correlation in the model, as Q-statistics remains insignificant at 5% level of confidence.

Table 4. Correlogram Statistics

Autocorrelation	Partial Correlation	Lags	AC	PAC	Q-Stat	Prob
. *| . |	. *| . |	1	-0.138	-0.138	0.3277	0.567
. **| . |	. **| . |	2	-0.303	-0.328	2.0427	0.360
. |* . |	. | . |	3	0.154	0.061	2.5277	0.470
.***| . |	****| . |	4	-0.377	-0.504	5.7140	0.222
. | . |	. *| . |	5	-0.043	-0.147	5.7603	0.330
. |***. |	. |* . |	6	0.404	0.076	10.321	0.112
. *| . |	. *| . |	7	-0.145	-0.112	10.991	0.139
. *| . |	. *| . |	8	-0.086	-0.149	11.264	0.187
. |* . |	. *| . |	9	0.106	-0.116	11.767	0.227
. *| . |	. | . |	10	-0.119	0.029	12.559	0.249
. | . |	. | . |	11	0.070	0.036	12.922	0.298
. |* . |	. | . |	12	0.110	-0.054	14.267	0.284

Figure 2 shows the histogram of the estimated model's residual and confined that the residual is negatively skewed with high kurtosis value, while the Jarque-Bera statistics confirmed that the model has no such normality issue, as the probability value is greater than the 5% level of significance, hence there is no such normality issue exist in the given model.

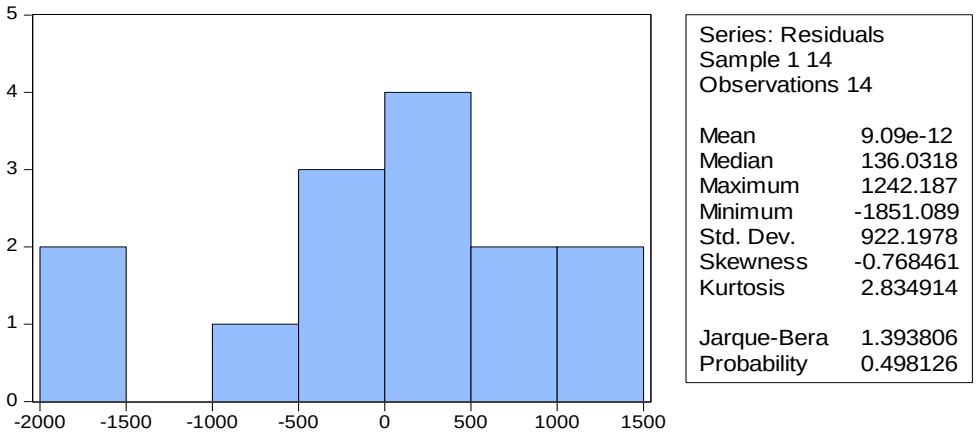

Figure 2. Histogram –Normality Issue

The serial correlation LM test estimated by Breusch -Godfrey and heteroskedasticity test by ARCH test, presented in Table 5, confirmed that the model is free from serial correlation issue and heteroskedasticity, as the probability value is greater than the 5% level of significance.

T**able 5. Serial Correlation –LM Test and Heteroskedasticity Test -ARCH Test**

Breusch-Godfrey Serial Correlation LM Test			
F-statistic	1.415289	Prob. F(2,5)	0.3258
Obs*R-squared	5.060685	Prob. Chi-Square(2)	0.0796
Heteroskedasticity Test: ARCH			
F-statistic	0.052203	Prob. F(1,11)	0.8235
Obs*R-squared	0.061403	Prob. Chi-Square(1)	0.8043

Figure 3 shows the model stability by CUSUM and CUSUM square test and confirmed that the model is fall inside the two parallel lines; hence the model is stable at 5% level of confidence.

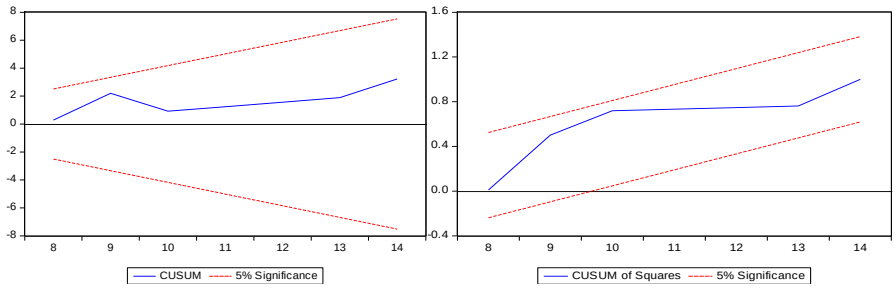

Figure 3. CUSUM and CUSUM Square Test for Model Stability

Conclusions

The objective of the study is to investigate the relationship between agriculture sector development and economic growth in the context of Pakistan by using a time series data set from 2003 to 2016. The study further included agriculture exports and agriculture employment in the stated given nexus for robust inferences. The results show that maize production and wheat product both positively contributed country's economic growth while agriculture exports has a negative impact and agriculture employment has a positive impact on country's per capita income. The study emphasized the need of re-corrective measures that should be adopted by Federal government in order to reduce market failures and provide protective prices of the agricultural commodities, thus it would get benefit to the farmers to sustain their livelihoods that further translated into high agricultural production in a country.

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