

Investigating the Nexus between Productivity and Export Performance of Pakistan

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Abstract

An increase in productivity has been associated with better export performance by increasing the efficiency of the factors of production. Further, productivity leads to a reduction in production costs and an increase in comparative advantage in the international market. In this study, the Autoregressive distributed lag (ARDL) bound test is used to investigate the nexus between productivity and export performance of agricultural and manufacturing sectors of Pakistan. The study uses secondary data from 1990 to 2016 to estimate the total factor productivity (TFP) and then uses it as a proxy of productivity. Our results show that TFP and gross domestic product (GDP) have a significant and positive impact on the export performance of Pakistan. Foreign direct investment (FDI), real exchange rate and cost to export are found to be negatively related to Pakistan's export performance. In the long run, both the sectors (agricultural and manufacturing) need improvement in productivity in order to be competitive in intentional markets.

Key Words:

Productivity; Total Factor Productivity; Export; Growth Accounting Framework

JEL Classification: O47, E43, F43

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Introduction

There is a continuous debate among economists on the factors responsible for the export performance of a country. Previous literature has classified these factors into two main categories. The first set of factors is concerned with the effect of a firm's productivity on their export performance. These factors include supply-side factors that directly or indirectly affect productivity. The second category is concerned with demand-side factors primarily focusing on preferences and income as motivating forces for increasing export demand. Productivity is estimated in terms of the ratio of output(s) to input(s). It reflects the technological progress and efficiency of the factors of production (Liao & Liu, 2009). Productivity significantly contributes not only to the economic growth and investment but also boosts the export performance of a country (Ahmad, Ilyas, Mahmood, & Afzal, 2010; Comin & Gertler, 2006; David Fadiran & Akanbi, 2017; Jienwatcharamongkhon, 2013). It increases export performance through increasing the efficiency of the factors of production

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which results in lowering the cost of domestic production and this in turns makes domestic products more competitive in the international market (Morley & Morgan, 2008). This relationship between productivity and export performance is commonly referred to as the productivity-led export growth hypothesis. Melitz (2003) provides the theoretical framework for exploring this relationship using heterogeneous firms, monopolistic competition, differentiated products and only one factor of production (i.e. labor). Melitz (2003) argued that firms self-select to export markets only if they have a high level of productivity. Firms with a substantial level of productivity can afford trade costs. High productive firms can expand output and this, in turn, will lead to generate exportable surplus, higher revenues, lowering prices and higher profits. Helpman, Melitz, and Yeaple (2004) include firms' foreign direct investment (FDI) in the analysis to extended Melitz model. Helpman et al. (2004) argue that firms with a considerable level of productivity attract FDI which further increases their exports. While Head and Ries (2003) extend the Melitz (2003) model by incorporating heterogeneity with respect to foreign countries and finds that less productive firms can take advantage of the lower wages in some countries. Alongside the less productive firms, high productive firms can also benefit from low labour cost in other countries. The productivity-led export growth hypothesis has been supported by most of the empirical work. Bernard and Jensen (1999) showed that it is productivity that prompts an expansion in export development. Sharma and Mishra (2009) also confirmed that productivity causes export growth.

The second category of the factors responsible for the export performance is concerned with the demand side factors of export performance. It focuses on the world's income, exchange rate and export prices as the major forces for export demand. The world income is expected to be positively associated with the expansion of world's export. However, exchange rate and export prices are associated negatively with the export demand. The association between the world's income, exchange rate, export prices and export demand has been confirmed by Nadeem et al. (2012), Gururaj, Satishkumar, and Kumar (2016).

Agriculture and manufacturing sectors are important sectors of Pakistan. These sectors are major contributors to the overall GDP and employ a large number of the labor force. Increasing the productivity of these sectors, directly and indirectly, affect the livelihood of millions of people in the country. The productivity-led export growth hypothesis states that an increase in productivity can lead to the more efficient factors of production. This may result in lowering the cost of domestic production and make domestic products more competitive in international markets (Morley & Morgan, 2008). Although, there is a wealth of the literature on the factors that that affect a country's export performance, already mentioned in the preceding paragraphs. However, limited research into the relationship between productivity and export performance exists in the case of Pakistan. Previous studies so far have focused on the relationship between productivity and export performance, with labor being the sole factor in production, ignoring the role of capital. The present study assesses the connection between Pakistan's agricultural and manufacturing sectors' productivity and export performance by expanding the theoretical model to two factors of production by including both the labor and capital in order to fill theoretical gap in the literature. The next section presents the literature review. Section 3 explains a theoretical framework to study the relationship between productivity and export performance. Section 4 discusses data and methods. Section 5 contains findings of the empirical model and the last section discusses conclusion of the study.

Research Methods

Melitz (2003) ignored the role of capital in production and focused on labor as the sole factor of production to describe the relationship between productivity and exports. His findings showed that the fixed cost of entry and productivity are the two key determinants of the firm's export. This study uses the framework based on Melitz (2003), however, it also incorporates the capital as the other factor of production. Excess demand is determined by subtracting the domestic demand function from the firm's supply function given as follows:

$$E_{ja(m)} = \varphi_{a(m)}(\sigma - 1)GDP - \frac{p_{ja(m)}^{\sigma}I}{p^{1-\sigma}} \quad (1)$$

where $E_{ja(m)}$ represents exports of varieties of product $q_{ja(m)}$ in sector a and sector m , $\varphi_{a(m)}$ is the level of productivity in sector a and sector m , σ is the elasticity of substitution, GDP is the income of the country, $p_{ja(m)}$ is the price of commodity $q_{ja(m)}$, I is total income of the consumer and P represents the price index of the economy other than $q_{ja(m)}$.

The general empirical model based on equation 1 is provided as equations 2 given as follows:

$$\text{Export} = f(\text{Productivity, Gross domestic product, FDI, real exchange rate, cost to export, world income}) \quad (2)$$

Besides the variables (productivity and gross domestic product) indicated in equation 1, other control variables such as FDI, real exchange rate, the cost to export and world income have also been added to our model. Economic theory generally indicates that GDP is positively associated with export performance. The larger the economy, the better the export performance of the agricultural and processing sectors, in general, shall be. A positive relationship between export performance and GDP results in surplus output and this surplus output can then be exported to meet the demand in international markets (Epaphra, 2016; Nadeem et al., 2012; Potelwa et al., 2016). Previous research and economic theory indicate that FDI inflows are positively linked to export performance (Barua, 2013; Gururaj et al., 2016). It can increase not only the exportable surplus of a country but could also be a better source of transfer of advance production technology to the exporting country. The high exchange rate indicates the appreciation of exchange rate which generally makes the product more expensive and less competitive in the world markets (Kohler & Ferjani, 2018; Saqib & Sana, 2012). Cost to export negatively affect the export performance. While world income is positively related to export performance (Nadeem et al., 2012).

This study uses time-series secondary data (1990 to 2016). The data on GDP, FDI, world income, exchange rate, the cost to export and real interest rate are collected from the World Bank Development Indicators (WDI). Trade data is taken from World Trade Organization (WTO). While the productivity data is calculated via the growth accounting framework. Equation 1 indicated that exports are a function of productivity, income and consumer demand. Productivity can be measured in more than one way and our case, we use the growth accounting framework to measure productivity given as follows:

The growth accounting framework assumes a production function, $Y_t = A_t F(K_t, L_t)$ where Y_t is output, A_t shows productivity, K_t and L_t represents capital and labor respectively.

Applying the natural logarithms to the production function and then differentiating it with respect to time yields equation-3 given as follows:

$$\frac{\dot{Y}_t}{Y_t} = \frac{\dot{A}_t}{A_t} + A_t \cdot Fk \cdot \frac{K_t}{Y_t} \cdot \frac{\dot{K}_t}{K_t} + A_t \cdot Fl \cdot \frac{L_t}{Y_t} \cdot \frac{\dot{L}_t}{L_t} \quad (3)$$

Assuming that input markets are competitive which implies that the share of the marginal product of capital ($A \frac{\partial Y}{\partial K} = AF_k$) and labor ($A \frac{\partial Y}{\partial L} = AF_l$) are equal to their prices r and w . Further, Solow residual can be obtained as follows:

$$\frac{\dot{A}_t}{A_t} = \frac{\dot{Y}_t}{Y_t} - r \cdot \frac{K_t}{Y_t} \cdot \frac{\dot{K}_t}{K_t} - w \cdot \frac{L_t}{Y_t} \cdot \frac{\dot{L}_t}{L_t} \quad (4)$$

Where $\frac{\dot{A}_{a(m)it}}{A_{a(m)it}}$ displays the rate of growth of TFP, $\frac{Y_{a(m)it}}{Y_{a(m)it}}$ denotes the production's rate of growth, $\frac{K_{a(m)it}}{Y_{a(m)it}}$ denotes the capital's stock to output ratio, $\frac{\dot{K}_{a(m)it}}{K_{a(m)it}}$ displays capital stock's rate of growth, $\frac{L_{a(m)it}}{Y_{a(m)it}}$ exhibits the ratio of labor to output, $\frac{\dot{L}_{a(m)it}}{L_{a(m)it}}$ shows the labor's growth rate whereas the variables i and w reveals the cost of capital and labor. Since the information for the capital's stock is not generally available, therefore the subsequent perpetual inventory technique is applied to get an estimate of it given as follows:

$$K_{a(m)it} = (1 - \sigma)K_{a(m)it-1} + I_{a(m)it} \quad (5)$$

The primary data for the stock of capital is evaluated through the following approach:

$$K_{a(m)it-1} = \frac{I_{a(m)it-1}}{\sigma + g_{a(m)}} \quad (6)$$

where $K_{a(m)t}$ displays the capital stock of existing period, $I_{a(m)t}$ indicates investment in the existing period, σ indicates the rate of decay of the capital stock and $g_{a(m)}$ displays the production growth. The present study used a 4 percent rate of decay for the capital's stock as used by Vikram and Ashok (1993) and Khan (2006) as well.

Results and Discussion

Table 1 below shows all the variables used in the analysis. The descriptive analysis in table 1 shows that the average growth rate of agricultural and manufacturing sectors' productivity is 0.123 % and 0.976 % respectively over the data period. The dependent variable is the export performance of these two sectors measured by the value of the agricultural and manufacturing sectors exports in million US\$. The average agricultural and manufacturing exports are 2476.924 million US\$ and 11.932 million US\$ respectively.

Table 1. Data and Descriptive Statistics

Variable	Definition and Measurement	Mean	Standard Deviation
<i>Agricultural TFP</i>	Agricultural Sector total factor productivity (%)	0.123	0.110
<i>Manufacturing TFP</i>	Manufacturing Sector total factor productivity (%)	0.976	4.488
<i>Gdp_i</i>	Real Gross Domestic Product per capita of exporting countries	9.11e+12	8.94e+12
<i>Fdi</i>	Inflow of foreign direct investment (% of GDP)	1.147	0.868
<i>Exr</i>	Real Exchange rate	62.045	27.371

Agricultural <i>Exp</i>	Agricultural Export (Million US\$)	2476.924	1611.003
Manufacturing <i>Exp</i>	Manufacturing Export (Million US\$)	11.932	4.857
<i>CtExp</i>	Export to Cost per container (US \$ per container)	489.660	169.140
<i>wy</i>	World Income (US GDP)	6.65e+11	1.07e+12

The selection of the appropriate empirical model for time series data is generally based on the unit root test results. This test determines the stationarity of time series data. The presence of unit root in time series data is checked via Augmented Dickey-Fuller Test (ADF) and this allows the use of ARDL model. The model is stated as follows:

$$\Delta EXP_t = \alpha_0 + \sum_{m=1}^r \beta_m \Delta EXP_{t-m} + \sum_{m=1}^r \delta_m STFP_{t-m} + \sum_{m=1}^r \delta_m \Delta GDP_{t-m} + \sum_{m=1}^r \delta_m \Delta FDI_{t-m} + \sum_{m=1}^r \delta_m \Delta REX_{t-m} + \sum_{m=1}^r \delta_m \Delta CE_{t-m} + \sum_{m=1}^r \delta_m \Delta WY_{t-m} + \phi_1 EXP_{t-1} + \phi_2 STFP_{t-1} + \phi_3 GDP_{t-1} + \phi_4 FDI_{t-1} + \phi_5 REX_{t-1} + \phi_6 CE_{t-1} + \phi_7 WY_{t-1} + \varepsilon_t \quad (7)$$

Where *Exp* is sectoral export measured as the value of exports in million dollars, *STFP* is sectoral productivity measured as total sectoral factor productivity (TFP), *GDP* is real GDP per capita of exporting country, *FDI* is the inflow of foreign direct investment in exporting country, *REX* is the real exchange rate, *CE* is the cost to export per container and *WY* is the world income measured by the US GDP, β_m and δ_m are short term coefficients, $\phi_1 \dots \phi_7$ exhibits coefficients for long term, Δ shows the operator of first difference and ε is the error term.

Therefore, before running the regression analysis, it is necessary to assess the stationarity of the data in order to avoid any spurious results. To confirm the presence of unit root which determines stationarity of the time series data, the present study employs Augmented Dickey-Fuller Test. In the Augmented Dickey-Fuller Test the null hypothesis H_0 : *A variable has a unit root or non – stationary* is tested against the alternative hypothesis H_1 : *A variable has not a unit root or stationary*. The results of the Augmented Dickey-Fuller test are specified in table 2. The test statistics in table 2 indicates that the agricultural and manufacturing sectors TFP are stationary at level. The rest of the variables such as world income, real GDP per capita, FDI, real exchange rate, agricultural and manufacturing sectors exports and cost to export are made stationary at first difference as they are not stationary at level. As some variables are stationary at level and some at first difference so in this case, ARDL model is more appropriate.

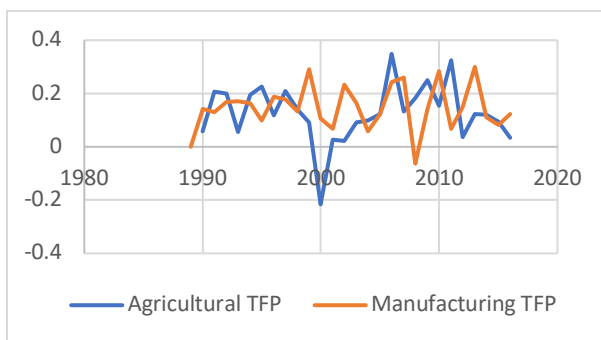
Table 2. Augmented Dickey-Fuller Unit Root Test

Variables	Level		First Difference	
	With no Trend	Trend	With no Trend	Trend
Agricultural Sector TFP	-3.872	-3.807		
Manufacturing Sector TFP	-5.330	-5.896		
World Income	-1.251	-2.343	-23.185	-21.877
GDP	-0.790	-0.706	-5.810	-5.960
FDI	-1.567	-1.716	-3.513	-3.752
Real Exchange Rate	-0.035	-1.897	-6.542	-6.278
Agricultural Export	-0.851	-1.789	-4.351	-4.405
Manufacturing Export	-0.593	-1.921	-4.587	-4.493

Cost to Export	-1.185	-2.937	-7.466	-9.846
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Note: -2.994 and -3.592 are critical values at 5% in case of no trend and in case of trend respectively.

Figure 1 displays the growth rate of TFP for the agricultural and manufacturing sectors of Pakistan. In agriculture sector the TFP growth rates are 0.058% in 1990, -0.216% in 2000, and increased to 0.349% in 2006. Since that time, a decline is observed in the rate of growth of TFP, reaching 0.034% by 2016. In 1990, the rate of growth of TFP in manufacturing sector is about 0.142%. However, it shows an increasing trend and reached to 0.30% in 2014, and since 2013, the rate of growth of the manufacturing TFP again shows a declining trend to reached to 0.122% in 2016. Thus, a significant variation has been observed in the growth rates of the TFPs of the two sectors over the study period.



Source: Author’s own calculation

Figure 1: Trends in Growth Rate of Agricultural Sector and Manufacturing Sector TFP Of Pakistan from 1990-2016.

The ARDL bound test of cointegration results is displayed in table 3. The bound test or joint F test is employed to assess whether there is an association in the long-term between productivity and export performance. The computed values for the F- statistics are compared with the Pesaran statistical table.

Table 3. The ARDL Cointegration Results for Nexus between Productivity and Export Performance of Agricultural and Manufacturing Sectors of Pakistan

ARDL Model	AIC (2 lags)	F-stat.	Result
$Faexp(aexp/atfp\ gdp\ fdi\ rex\ ce\ wy)$	(1 0 2 2 1 1 2)	5.556	Cointegration
$Fatfp(atfp/aexp\ gdp\ fdi\ rex\ ce\ wy)$	(1 2 1 2 2 2 2)	4.204	Cointegration
$Fmexp(mexp/mtfp\ gdp\ fdi\ rex\ ce\ wy)$	(1 2 2 1 2 0 1)	5.135	Cointegration
$Fmtfp(mtfp/mexp\ gdp\ fdi\ rex\ ce\ wy)$	(1 0 1 1 1 2 2)	6.429	Cointegration
	Lower Bound I	Upper Bound I	
Critical Value	(0)	(1)	
10%	1.99	2.94	
5%	2.27	3.28	
1%	2.88	3.99	

Table 3 indicates a long-term relationship between productivity, export performance, and other variables in the table based on F-statistics values as they are larger than the upper limits of the Pesaran table.

The long-term coefficient results are shown in Table 4. To verify the reliability of estimated results, various diagnostic tests such as LM test for autocorrelation, Breusch-Pagan-Godfrey test, Jerque Bera normality test and Ramsey RESET test are carried out and discussed. The results of these tests confirmed that the model has the desirable econometric properties such as the residuals of the model are normally distributed, and the model does not suffer from serial correlations and heteroscedasticity problems. It is also confirmed that the model’s functional form is correct. The results show that TFP has a positive and significant relationship with the exports in agriculture and manufacturing sectors in the long run. For everyone unit increase in TFP, agricultural and manufacturing sectors exports increase by 2098.044 and 4.595 units respectively. The possible reason for the positive and significant relationship between TFP and agricultural and manufacturing sectors exports is since that productivity increases the export growth through increasing the efficiency of the factors of production. Productivity further results in lowering the cost of domestic production and in turn make domestic products more attractive in the international market (Morley & Morgan, 2008). The GDP positively affects both sector’s export performance. A one-unit increase in GDP results in 8.042 and 0.039 units increase in the export of agricultural and manufacturing sectors. The reason for this positive relationship is that the higher level of GDP results in surplus production which can be exported to international markets. This finding is in accordance with Epaphra (2016). The FDI has a negative coefficient showing that a one-unit increase in FDI decreases export performance by -1249.642 and -2.056 units. Though the entry of a foreign investing country in recipient country could increase the exportable surplus but in case of both sectors of Pakistan it does not lead to the spillover effect on agricultural and manufacturing exports. This finding is in accordance to Gururaj et al. (2016). The real exchange rate is significantly and negatively related to exports. For each unit of exchange rate increase, agricultural and manufacturing exports decrease by -15713.010 and -9.655 units respectively. This negative relationship is understandable. This is because when the exchange rate rises, the price of the product increases, making the product expensive in foreign markets. This reduces export demand. This finding is consistent with previous research conducted by (Saqib & Sana, 2012). The coefficients of cost to export in agricultural sector and world income in manufacturing sector are contrary to expectations. While in manufacturing sector, the cost to export has a negative sign. A one-unit increase in the cost of export decreases the export performance of the manufacturing sector by -0.003 units.

Table 4. The ARDL Long Run Results for Nexus between Productivity and Export Performance of Agricultural and Manufacturing Sectors of Pakistan

Agriculture Sector		Manufacturing Sector	
Independent variables	Coefficients	Independent variables	Coefficients
<i>C</i>	4358.258*** (150.427)	<i>C</i>	-0.595 (0.33)
<i>ATFP</i>	2098.044** (818.581)	<i>MTFP</i>	4.595** (1.807)
<i>GDP</i>	8.042 (11.824)	<i>GDP</i>	0.039*** (0.011)

<i>FDI</i>	-1249.642*** (366.091)	<i>FDI</i>	-2.056*** (0.263)
<i>REX</i>	-15713.010*** (4339.025)	<i>REX</i>	-9.655** (3.129)
<i>CE</i>	8.677*** (0.464)	<i>CE</i>	-0.003*** (0.000)
<i>WY</i>	0.275 (0.151)	<i>WY</i>	-0.001*** (0.000)
Diagnostic Tests	F-stat (P Value)	Diagnostic Tests	F-stat (P Value)
Serial Correlation	3.342 (0.096)	Serial Correlation	0.351 (0.715)
Heteroskedasticity	1.132 (0.439)	Heteroskedasticity	0.504 (0.884)
Jerque Bera Normality Test	0.514 (0.773)	Jerque Bera Normality Test	0.976 (0.613)
Ramsey Reset Test	0.432 (0.529)	Ramsey Reset Test	0.194 (0.676)

Note: *, **, *** are 1 percent, 5 percent and 10 percent significance level respectively while values in parentheses are standard errors.

Similar to long-term results, short-term results also show that agricultural and manufacturing TFP have a positive and significant association with the agricultural and manufacturing sectors' export of Pakistan (table 5). The coefficient of ECT shows the speed of adjustment. The highly significant and negative sign of ECT further confirms the presence of cointegration. The value of the ECT shows that if there is any disequilibrium in the agricultural and manufacturing sectors, export will be reverted back to the long-term equilibrium at the speed of 82% in agriculture sector and 154% in manufacturing sector.

Table 5. The ARDL Short Run Results for Nexus between Productivity and Export Performance of Agricultural and Manufacturing Sectors of Pakistan

Agriculture Sector		Manufacturing Sector	
Independent Variables	Coefficients	Independent variables	Coefficients
ΔTFP	1722.443** (667.020)	ΔTFP	3.866* (1.879)
ΔGDP	-7.121 (5.069)	$\Delta TFP(-1)$	0.091** (0.036)
$\Delta GDP(-1)$	-6.571 (1.187)	ΔGDP	0.026** (0.009)
ΔFDI	-92.362 (191.232)	$\Delta GDP(-1)$	-0.015* (0.007)
$\Delta FDI(-1)$	705.030*** (143.316)	ΔFDI	-1.197*** (0.238)
ΔREX	-2203.086 (2630.021)	$\Delta FDI(-1)$	0.602** (0.273)
ΔCE	4.226*** (0.661)	ΔREX	-14.892** (4.730)
ΔWY	0.109 (0.099)	ΔCE	-0.002** (0.000)
$\Delta WY(-1)$	-0.225 (0.139)	ΔWY	-0.000** (0.000)
ECT_{t-1}	-0.821*** (0.114)	ECT_{t-1}	-1.542*** (0.202)
$R^2 - Value$	0.87	$R^2 - Value$	0.92
F-Stat. (P-Value)	4.073 (0.019)	F-Stat(P-Value)	7.233 (0.003)
Durbin. Watson Stat.	2.404	Durbin. Watson Stat.	2.575

Note: *, **, *** are 1 percent, 5 percent and 10 percent significance level respectively while values in parentheses are standard errors

The model's functional form for agricultural sector is tested through Ramsey's reset test. The respective value of the probability of its F-statistics is 0.529 which is above 5%. This suggests that the model's functional form is correct. The CUSUM test and CUSUM of square test results are given in figure 2 and figure 3 which reveals that parameters for agricultural sector are stable. Similarly, the functional form of the model for manufacturing

sector is tested and value of the probability of its F-statistics is 0.676 which is also above 5% revealing that the model's functional form is accurate. The CUSUM test and CUSUM of square test results for manufacturing sectors are given in figure 4 and figure 5 revealing that parameters are stable over the period of the study. The CUSUM test and CUSUM of square test results are given in the appendix.

Conclusion

This study estimates the effect of total factor productivity on Pakistan's export performance. The results revealed that both long-term and short-term total factor productivity have a significant and positive impact on agricultural and manufacturing export performance. Gross domestic product (GDP) also has a positive effect on export performance. However, foreign direct investment, real exchange rates and export costs are negatively associated with Pakistan's export performance. The conclusions of this study have some relevant policy implications for the policymakers. Policies should aim at improving the TFP and GDP. The exchange rate needs to be appropriately valued, and the cost of the export needs to be reduced to improve the export performance of Pakistan.

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Appendix

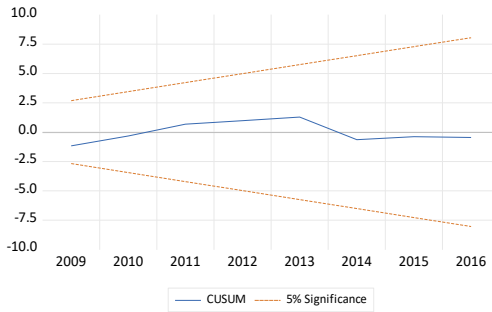


Figure 2: CUSUM for Agriculture Sector Results Stability

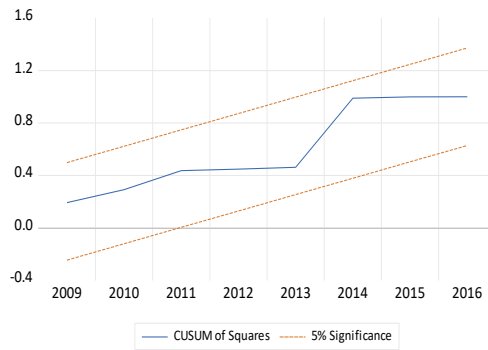


Figure 3: CUSUMSQ for Agriculture Sector Results Stability

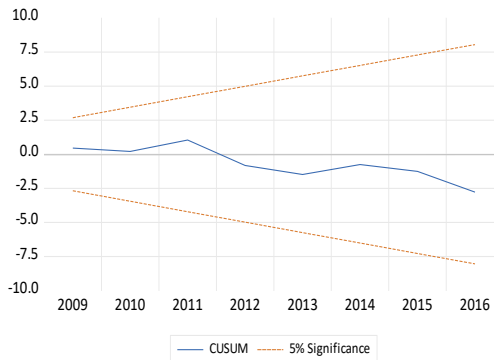


Figure 4: CUSUM for Manufacturing Sector Results Stability

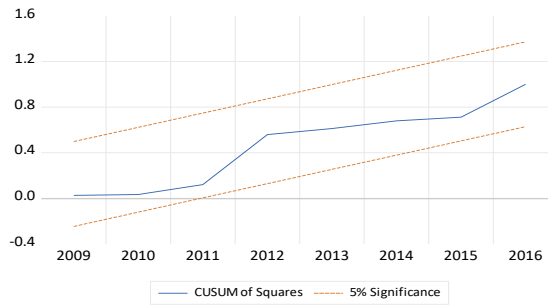


Figure 5: CUSUMSQ for Manufacturing Sector Results Stability