

## **Impact of Trade Openness on Output Growth: Co integration and Error Correction Model Approach**

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**ABSTRACT:** This study analyzed the long run relationship between trade openness and output growth for Pakistan using annual time series data for 1972-2010. This study follows the Engle and Granger co integration analysis and error correction approach to analyze the long run relationship between the two variables. The Error Correction Term (ECT) for output growth and trade openness is significant at 5% level of significance and indicates a positive long run relation between the variables. This study has also analyzed the causality between trade openness and output growth by using granger causality test. The results of granger causality show that there is a bi-directional significant relationship between trade openness and economic growth.

**Keywords:** Trade openness; output growth; cointegration; error correction model

**JEL Classifications:** F00; F1

### **1. Introduction**

After the emergence of WTO and to liberalize trade among countries, tariff cuts are being suggested by YRUGUAY ROUND which had its final act MOROCCO in April 1994. Such cuts in tariffs will not only liberalize the world economies but may also accelerate the output growth. Pakistan has gradually liberalized its trade regime after the acceptance of the first IMF structural adjustment program in 1988. After 1995, by joining WTO trade agreement, its policies induced Pakistan to decrease different quantitative measures on trade such as import duties and various subsidies, Siddiqui and Iqbal (2005). The nature of relationship between trade openness and growth is a widely debated topic among researchers in the recent past. The empirical literature shows that trade openness affects output growth. A wide range of the studies provides evidence that the openness of the trade regime has a positive association with GDP growth [Ahmed and Anoruo (2000), Edwards (1998), Edwards (1992), Harrison (1996), Iscan (1998), Wacziarg (2001), Yanikkaya (2003)]. However a large number of studies also concluded that the growth of GDP stimulates expansion of trade Bhagwati, 1988; Findlay, 1984; and Vernon, 1996). In view of above contradictory findings, it is better to re-examine this issue in the context of Pakistan economy.

In this paper we analyze the impact of trade openness on GDP growth of Pakistan for the period ranging from 1972 to 2010. The rest of this study consists of five sections. The next section provides the empirical literature on trade openness. Section 3 presents the model and data sources. Section 4 reports the estimation results. Finally section 5 concludes the study.

### **2. Literature Review**

Liargovas and Konstantinos (2012) have analyzed the importance of trade openness for attracting foreign direct investment. This study has used sample of 36 developing countries for the period 1990-2008. This study has measured trade openness by eight different indicators. The findings of this study suggest that in the long run trade openness contributes positively to the inflow of foreign direct investment. Hur and Cheolbeom (2012) has used sample of 90 developed and developing countries for 1958-2003. The findings of this study suggest that Free trade agreement has insignificant relation with

output growth during initial 1-10 years after its launch but finds a significant upward trend among the participating countries.

Yanikkaya (2003) analyzed the impact of trade liberalization on per capita income growth for 120 countries for the time period 1970 to 1997. His study used two types of trade openness measures. The first openness measure was estimated by using trade volumes which include different ratios of trade variables (exports, imports, exports plus imports and trade with developed countries) with GDP. The second measure based on trade restrictiveness estimated by calculating restrictions on foreign exchange on bilateral payments and current transactions. The results of the GMM (Generalized Method of Moments) estimates showed that openness based on trade volumes were significant and positively related with per capita output growth. However, for developing countries openness based on trade restrictions were significant and positively related with per capita output growth.

Edward (1992) used a cross country data set to estimate the relationship between trade openness and GDP growth of 30 developing countries over the period 1970 to 1982. His study used two basic sets of trade policy indicators, constructed by Leamer (1988). The first set refers to openness and measures of trade policy (tariff and Non Tariff Barriers - NTB) which restrict imports. The second set measures trade intervention and captured the extent to which trade policy distorted trade. His study has used OLS, and the results showed that all the four openness indicators has positive relationship with real per capita GDP growth, while trade intervention indexes were found significantly negatively associated with GDP growth.

Santos-Paulino (2002) has analyzed the impact of trade liberalization on export growth for a sample of 22 developing economies between 1972 and 1998. His export growth function, postulate that the determinants of exports volume are real exchange rate and world income. Trade openness is measured in two ways. First, by the ratio of export duties to total export, as indicator of the degree of anti-export bias and second by a dummy variable of timing of the introduction of trade liberalization measures. The results of OLS estimates showed that export duty significantly and negatively associated with export growth and in the second measure trade openness is significantly positively associated with output growth. Therefore it was concluded exports grow faster in open economies.

Edwards (1998) used comparative data for 93 countries to analyze the robustness of the relationship between openness and total factor productivity (TFP) growth. He used nine indexes of trade policy to analyze the relationship between trade policy and TFP growth for the period 1980 to 1990. Among these nine indexes, three were related to openness, a higher value of which denotes a lower degree of policy intervention in international trade. The other six were related to trade distortions, for which higher values denote a greater departure from free trade. According to the results of OLS estimates trade openness indexes were significantly and positively associated with TFP growth whereas trade distortion indexes were significantly and negatively associated with TFP growth.

Ann Harrison (1996) has analyzed the relationship between openness and GDP growth. He specified GDP as a function of capital stock, years of primary and secondary education, population, labour force, arable land and technological changes. He used seven openness measures to test the statistical relationship between openness and GDP growth. The cross-section estimation results show only black market rate significant with negative sign. The country time series panel result showed that three variable, tariff and non tariff barriers with positive sign, black market rate and price distortion index used in dollar with negative sign, were found significant. Estimation for Annual data show two variables, tariff and non-tariff barriers, and black market rate, significant with negative sign. He therefore concluded that the choice of period for analysis, of relationship between trade openness measures and GDP growth, is critical.

### **3. Model and Data**

The main objective of our study is to find the causality between trade growth and GDP growth of Pakistan during (1972-2010). Data for output growth and trade openness are in log form, collected from World Development Indicators. Trade variable is being used as a proxy of openness, and calculated as a sum of real exports and imports divided by real GDP.

#### **3.1. Co-integration Analysis**

To capture both long-run adjustments and short-run dynamics between real trade openness and output growth, co-integration analysis is used (Banerjee et al, 1986; and Engle and Granger, 1987). First, both trade openness and the output growth data series need to be stationary. Unit root tests are

performed for each variable on the original data, the data being first differenced, second differenced and so on until the stationarity is achieved. The Dickey and Fuller approach (1979) can be considered as an appropriate and simple method of testing the order of integration. In this approach, the autoregressive coefficient is stated in:

Which is consistent with

$$Y_t = \alpha_0 y_{t-1} + e_t \tag{1}$$

$$\Delta Y_t = (\alpha_0 - 1)y_{t-1} + e_t \tag{2}$$

If  $\alpha_0 < 1$ ,  $Y_t$  is integrated of order zero, and if not, then:

$$\Delta \Delta Y_t = (\alpha_1 - 1)\Delta y_{t-1} + e_t \tag{3}$$

is tested. If  $\alpha_1 < 1$ , then  $Y_t$  is integrated of order one. This process can be continued until stationarity is achieved, although Charemza and Deadman (1992) argue that it is unusual in practice for economic series to be integrated of orders higher than two. However, the DF test may not be perfect because it does not take into account the possibility of autocorrelation in the error process  $\epsilon_t$ . So, to reduce autocorrelation of the residuals in the original Dickey-Fuller tests, the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981) simply solves this problem by using lagged left-hand side variables as additional explanatory variables to approximate the autocorrelation as follows:

$$\Delta Y_t = \delta y_{t-1} + \sum_{i=1}^k \delta_i \cdot y_{t-i} + e_t \tag{4}$$

Where  $k$  represents the number of lags for  $\Delta Y_{t-1}$ , which should be relatively small in order to save the degrees of freedom but large enough to allow for the existence of autocorrelation in  $e_t$ .

### 3.2. The Co-integration through Error Correction Models

To be co-integrated, the variables must drift together through time (Dickey, Jansen and Thornton, 1991). To test for co-integration, since all variables are integrated of the same order as mentioned above, This study follow the Engle and Granger (1987) two-stage procedure. First, the ordinary least squares (OLS) regressions for the static long-run relationship between output growth and trade openness are performed as follows:

$$y_t = \alpha + \beta_1 X_t + V_t \tag{5}$$

Where  $Y_t$ : the dependent variable, in this case growth of output, which is integrated of order one;  $X_t$ : the independent variable, in this case, trade openness which is also integrated of order one; and  $V_t$  the estimated residual from the equation, which refers to the deviation of dependent variable from its long-run path. In fact,  $V_t$  in this case reflects the error correction mechanism (ECM). If the residual from the long-run equation is found to be stationary in the ADF test that is, integrated of order zero then there is a co-integrating relationship (Charemza and Deadman, 1992). But because this test has low power, and therefore might incorrectly conclude that the variables are co-integrated, the ECM should be tested for significance. However, the ECM states that changes in the dependent variable depend not only on changes in the independent variables but also on the extent of disequilibrium between the levels of both dependent and independent variables (Dolado, et al., 1990). So, the second stage is that the residual from the co-integrating regression is lagged and also appropriate lags are applied to the differenced variables. The lagged residual, in fact, can be described as the equilibrium errors in the long-run regression. Hence, the EC model takes the following form:

$$\Delta Y_t = b_1 \Delta X_t - \pi [Y_{t-1} - \alpha - \beta_1 X_{t-1}] + V_t \tag{6}$$

where  $\Delta$  refers to a first difference i.e.  $\Delta Y_t = Y_t - Y_{t-1}$ . As you can see, the model uses differences in both the dependent variables and the independent variables. The inclusion of the second term  $Y_{t-1} - \alpha - \beta_1 X_{t-1}$  is the explicit formulation of the fact that we assume that  $X$  and  $Y$  have a long-term equilibrium relationship. More specifically, we know that any change in  $Y_t$  is a sum of two effects: (i) the short-run impact of the change in  $X_t$  on  $Y_t$  and (ii) the long-run impact of the deviation from the equilibrium value in period  $t$  adjusted at each period at the rate  $\pi$ . Thus,  $b_1$  captures the short-run relationship between  $X$  and  $Y$ . It indicates how  $Y$  and  $\Delta Y$  immediately change if  $X$  goes up one period.  $\pi$  gives the rate at which the model re-equilibrates i.e. the speed at which it returns to its equilibrium level. Formally,  $\pi$  tells us the proportion of the disequilibrium which is corrected with each passing period. This coefficient should be negative and less than the absolute value of one indicating re-equilibrating properties. If  $\pi = 0$ , then the process never re-equilibrates and if  $\pi = -1$ , then

re-equilibration occurs in one period. However, if the Y and X deviate from the long run equilibrium, the error correction term ( $\pi$ ) will be nonzero and each variable adjusts to partially restore the equilibrium relation. The coefficient  $\pi$  measures the speed of adjustment of endogenous variable towards the equilibrium.

### 3.3. Granger causality test

Finally we use Granger the causality test to analyze the causality between variables. The null hypothesis for equation (i) is that X does not Granger cause Y. On the other hand, the null hypothesis for equation (ii) is that Y does not Granger cause X. The rejection of null hypothesis could indicate the causal relationship between the two variables.

## 4. Empirical Results

The first step in co-integration analysis is to test the stationarity properties of the variables under consideration. Table-1 presents the Augmented Dickey Fuller test. It indicates that all variables have been found stationary at first difference. Since all variables are integrated of the same order, the second step is to test for co-integration between real GDP and trade openness variables. As a result, this study performs the first stage of Engle and Granger (1987) two-stage procedure mentioned in the previous section.

**Table 1. Unit Root Test**

VARIABLES	LEVEL	Ist DIFFERENCE
LN REAL GDP	-0.96	-3.17**
LN TRADE OPENNESS	-1.24	-5.14**

\*, \*\* and \*\*\* denotes significance at 1%, 5% and 10%, respectively

The outcome of this analysis is given in Table 2, which summarizes the results of this test. Most importantly here is that the results from the ADF unit root tests upon the residuals from the bivariate static long-run equation given in Table 2 indicate that the residuals from the static long-run equations are integrated of order zero, suggesting that the variables in bivariate relationship are co-integrated, that is, there is a long-run relationship between these variables. Additionally, the static long-run relationships between these output growth and trade openness are positive. The second stage of Engle and Granger two-stage procedure is to confirm this co-integration relationship by employing the error correction models (Equation 6) to explain both long-run and short-run relationships simultaneously.

**Table 2. Static Long Run Models For The Impact Of Trade Openness On Output Growth**

VARIABLES	Coefficient	Std. Error	t-Prob.	F- Prob.	R <sup>2</sup>
LN(TRADE OPENNESS)	0.79	0.039	20.02	400.838	0.92
CONSTANT	3.32	0.14	22.62		

Table 3 shows that Error Correction Term (ECT) for output growth and Trade openness is significant at 5% level of significance. Trade openness and output growth significantly are a component of the long-term co-integrating relations as shown by the ECTs. The important outcome of this study is that, trade openness cause GDP growth. Moreover the coefficients of lagged differenced dependent variable (GDP growth) are also significant. From the results mentioned above, it could be concluded that trade openness have a significant impact on the output growth in the long-run, indicates a positive long run relation between the variables.

**Table 3. The Specific Error Correction Model For The Impact Of Trade Openness Upon output Growth**

VARIABLES	Coefficient	Std. Error	t-Prob.	F- Prob.	R <sup>2</sup>
LAG OF GDP	1.00	0.011	91.01	634.28	0.98
LAG OF TRADE OPENNESS	-0.012	0.018	-0.66		
ECT	-0.077	0.04	-1.85		

We introduced a second model by separating the trade variables in equation (5), into export and import separately. Again the first step in co-integration analysis is to test the stationarity properties of the variables under consideration. Table 4 presents the Augmented Dickey Fuller test. It indicates that all variables have been found stationary at first difference. Since all variables are integrated of the same order, the second step is to test for co-integration between real GDP, Exports and imports variables. As a result, this study performs the first stage of Engle and Granger (1987) two-stage procedure mentioned in the previous section.

**Table 4. Unit Root Test**

VARIABLES	LEVEL	Ist DIFFERENCE
LN REAL GDP	-0.96	-3.17**
LN EXPORTS	-0.85	-4.01*
LN IMPORTS	-1.45	-5.03*

\*, \*\* and \*\*\* denotes significance at 1%, 5% and 10%, respectively.

The outcome of this analysis is given in Table 5, which summarizes the results of this test. Most importantly here is that the results from the ADF unit root tests upon the residuals from the bivariate static long-run equation given in Table 5 indicate that the residuals from the static long-run equations are integrated of order zero, suggesting that the variables in bivariate relationship are co-integrated, that is, there is long-run relationship between these variables. The second stage of Engle and Granger two-stage procedure is to confirm this co-integration relationship by employing the error correction models (Equation 6) to explain both long-run and short-run relationships simultaneously.

**Table 5. Static Long Run Models For The Impact of Exports and Imports On Output Growth**

VARIABLES	Coefficient	Std. Error	t-Prob.	F- Prob.	R <sup>2</sup>
LN EXPORTS	0.22	0.022	10.00	1104.823	0.98
LN IMPORTS	0.16	0.04	3.87		
CONSTANT	2.72	0.22	11.984		

Table 6 shows that Error Correction Term (ECT) for output growth and trade openness is significant at 5% level of significance. The important outcome of this study is that, trade variables (import and export) cause GDP growth. Moreover the coefficient of lagged differenced dependent variable (GDP growth) is also significant. From the results mentioned above, it could be concluded that trade variables (import and export) have a significant impact on the output growth in the long-run, indicates a positive long run relation between the variables.

**Table 6. The Specific Error Correction Model For The Impact Of Exports And Imports Upon Output Growth**

VARIABLES	Coefficient	Std. Error	t-Prob.	F- Prob.	R <sup>2</sup>
LAG OF GDP	1.00	0.04	22.15	2220.269	0.99
LAG OF EXPORTS	-0.004	0.06	-0.68		
LAG OF IMPORTS	-0.02	0.03	-0.81		
ECT	-0.20	0.10	-1.93		

Table 7 presents the results of the Granger causality test for Pakistan. The results indicate that Pakistan has bi-directional relationship between trade openness and economic growth. The direction of causality runs from trade openness (LN OPEN) to real GDP (LN RGDP) and then GDP to openness. It means trade openness Granger cause economic growth in Pakistan and then economic growth granger cause trade openness.

**Table 7. Granger Causality Test**

NULL HYPOTHESIS	F-STATISTIC	PROBABILTY
<b>LNOPEN does not granger cause LNRGDP</b>	2.48	0.09
<b>LNRGDP does not granger cause LNOPEN</b>	4.99	0.01

## 5. Conclusion

This study follows the Engle and Granger (1987) two-stage procedure. The first step in co-integration analysis is to test the stationarity properties of the variables under consideration. The results of the Augmented Dickey Fuller test indicate that all variables have been found stationary at first difference. To test for the co-integration this study follows the Engle and Granger (1987) two-stage procedure i.e. the results of the ordinary least squares (OLS) regressions for the static long-run relationship between output growth and trade openness are significant and positive. The ADF residuals from the static long-run equations are integrated of order zero, suggesting that there is a long-run relationship between these variables. The second stage of Engle and Granger two-stage procedure is to confirm this co-integration relationship by employing the error correction models to explain both long-run and short-run relationships simultaneously. The Error Correction Term (ECT) for output growth and Trade openness is significant at 5% level of significance. From the results mentioned above, it could be concluded that trade openness have a significant impact on output growth in the long-run, indicates a positive long run relation between the variables. When we separate the total trade volume in export and import, we find insignificant positive relationship between GDP and trade variables (export and import). The ADF unit root test upon the residual derived from the ordinary least squares (OLS) regressions from the static long-run relationship between output growth and trade variables indicate that the residual are stationary at level so we may conclude there is long run relationship between these variables. The Error Correction Term (ECT) for output growth and Trade variables is significant at 5% level of significance. So, we may conclude that there is a long run relationship exists among variables. Finally, the results of granger causality show that there is a bi-directional significant relationship between trade openness and economic growth.

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