Impact of Trade Openness on Economic Growth of Pakistan: An ARDL Approach

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Abstract

This study examines the impact of trade openness on economic growth of Pakistan by employing autoregressive distributed lag (ARDL) approach over the period 1960-2011. Overall empirical results show that trade volume, investment and human capital have positive and significant impact on economic growth. Findings further reveal that trade restriction measures have negative and significant impact on economic growth in long run. Moreover, results show that the impact of trade openness on economic growth is not obvious in short run The findings suggest that developing countries like Pakistan need to consider trade openness policy as a long term plan of the country. The policy direction of Pakistan should emphasize on more liberal policies to enhance economic growth which will eventually lead towards poverty reduction in Pakistan.

Keywords: Trade openness, economic growth, Autoregressive Distributed Lag (ARDL), Pakistan

JEL Classification: F14, F43, O40

1. Introduction

Trade openness has been a prominent component of policy advice to developing countries for the last few decades. Trade openness is considered as important element of globalization which has been mostly described as the increasing interaction or integration of national economic systems with the help of growth in international trade and other socio-economic variables. It is connected with growing internationalization of production, marketing of goods and services, and the associated growing production and commercial activities. Trade openness involves the dismantling of all forms of tariff structures like import and export duties, quotas and tariffs and other restrictions to the free flow of goods and services across countries.

In the middle 1970s, there has been considerable progress in trade reforms in most developing countries, turning from import substitution strategy to export-oriented approach. Pakistan's trade policy has also been moving towards more openness; fewer control specially after 1988. Steadily the tariff rates have fall over, almost all type of quantitative restrictions except for customs duty were removed on imports. The accelerated pace of liberalization improved the trade balance significantly and Pakistan's trade deficit reduced from US$3.12 billion in 1995 to US$0.83 billion in 2003 and in 2012 over all trade deficit contracted by US$2.5 billion. In spite of various challenges faced by economy, successive trade policies attempted to diversify the export base by export infrastructure to increase exports in Pakistan. *As seen in Figure1, Pakistan's trade volume as percentage of GDP showing constant from 1960 to 2011. In figure 2 average tariff went on falling from 1972 to 2011 and international trade tax in figure 3 showing up and down trend from 1990 to 2003, after 2003 it keep constant from 1990 to 2011.*

Figure 1: Log of Trade Volume as Percentage of GDP

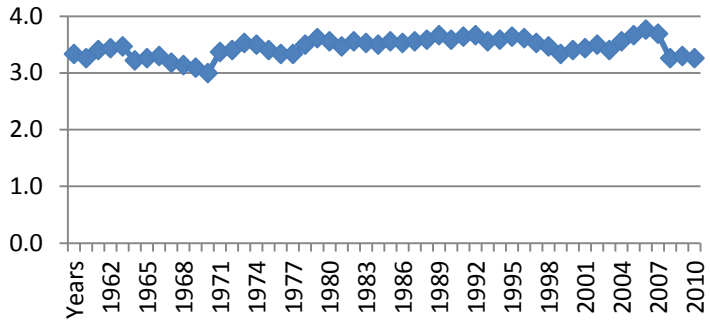


Figure 2: Log of Average Tariff Rate

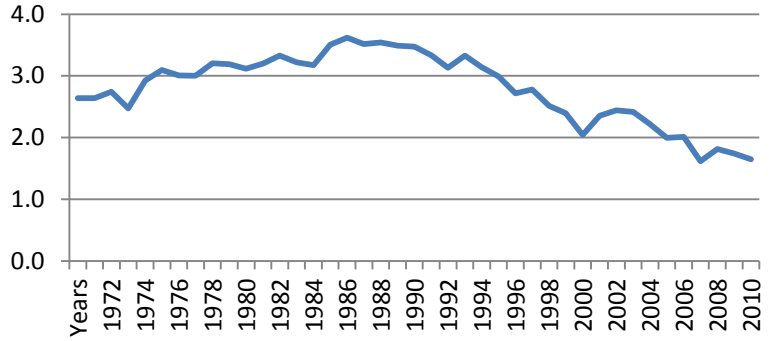
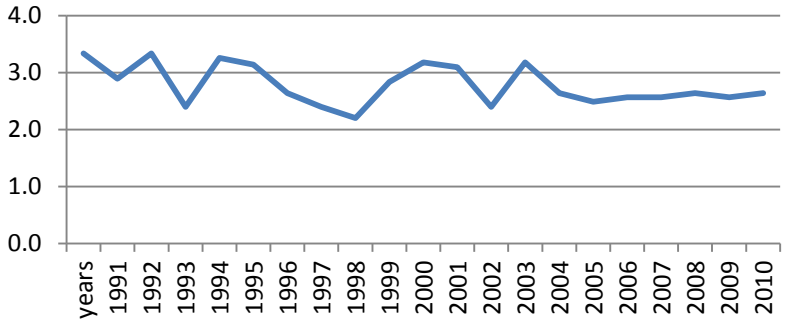


Figure 3: Log of Taxes on International Trade



Note: Source of figures 1, 2 and 3 is based on data obtained from WDI and author's own calculations.

Government of Pakistan in *2011* facilitated the accessibility of local business in international markets by Foreign Trade Agreements (FTAs) and Prefential Trade agreements (PTAs) with different countries. The main role of *2011-12* trade policy were to facilitate and encourage export sector by allowing import from India for export oriented textile, brown sugar industry and leather sector. In order to explore a more nuanced view, present study investigates that whether trade liberalization matter to promote economic growth in Pakistan?

However the impact of the trade policy reforms[1] on economic growth is debatable issue in developing economic in the last many decades. There are a number of empirical studies which examined the effects of trade openness on economic growth in developing countries by using range of econometric tools, but the empirical evidence is inconclusive. On one hand, most of the cross country studies supporting the strong link between trade openness and economic growth such as Dollar (1992), Sachs and Warner (1995), Edwards (1993, 1997, 1998), Levine and Raut (1997), Ben-David and Loewy (1998), Frankel and Romer (1999), Gwartney et al. (2000), Badinger (2001), Dollar and Kraay (2001) and Rutherford and Tarr (2003) and Winters (2003).

[1] For complete discussion about strategic trade policies issues see Krugman & Smith (1994) and Leamer (1988).

The existing empirical literature shows that the effect of trade liberalization on economic growth has four main channels; increased capital mobility, factor price equalization, knowledge spillovers and the trade-influencing technology. The effect of trade on growth can be characterized by openness influencing technological change. Afonso (2001) suggested that trade openness tends to be beneficial to growth, as it facilitates exchange of technology and enhances the flow of goods and services.

On other hand, the empirical literature which show strong link between trade openness and growth has been critiqued for several reasons; the problem of measurement and the quality of data, problem of endogeneity, problem of omitted variable biased and the possible non-inclusion of other policies. The association between openness and growth performance is affected by a number of factors including country, region and other attributes. Hence, some empirical findings appeared to contradict the existence of a positive link between free trade and growth. The neoclassical growth model observed no direct link with openness and economic growth (Krueger, 1997, 1998). Model explains that the sole determinant of long-run growth is the exogenously total factor productivity, which suggests that the long run economic growth cannot be influenced by the interaction with other countries. Rodrik and Rodriguez (2000) emphasized that whether free trade is good for growth? They concluded that more research needs to be done to prove that free trade brings benefits. Rodrik and Rodriguez and (2001) and Brock and Durlauf (2001) explained that geographical variables could have effects on growth which change sole effects of trade openness on economic growth. These questions although, just been answered by Frankel and Rose (2002) who explained again the instrumental variables approach and showed that the basic conclusion is vigorous to the inclusion of geographical and institutional variables in the growth equation. This proposes that openness actually play a role after geographical variables is also used in growth equation. Esterly and Levine (2001) investigated more than a decade of empirical work on growth. They concluded trade policies do affect growth, but to what extent is not clear. From the above discussion it is obvious that the there is need to conduct more empirical research to verify that whether trade openness policies matter for economic growth or not?

It is most important to note that the theoretical growth literature discussed more about the relationship between trade policies and growth as compare to the relationship between trade volumes and growth. Therefore, the conclusion drawn from the relationship between trade barriers and growth cannot be directly comparable to the effects of changes in trade volumes on growth (Yanikkaya, 2003). Therefore, this study divides trade openness measures into two broad categories: measure of trade volumes and measures of trade restrictions. Even though these two concepts, trade volumes and trade restrictions, are very closely related, their relationship with growth may differ considerably. Moreover, one of the important aspects of previous studies is that they are based on cross countries regression analyses which are based on very restricted assumptions of homogeneity and same quality of data. Hence, the empirical results from cross countries studies are dubious in nature. Therefore it would be more beneficial to examine the measures of trade openness and growth based on individual country like Pakistan. The present study examines the impact of trade openness on economic growth both in the long and short run in Pakistan by using the bounds testing approach to co-integration.

The remainder of this paper is organized as follows. Section 2 discusses the brief summary of trade policy regimes in Pakistan Theoretical and empirical literature is presented in section 3. Data sources, description of variables and Econometric methodology are discussed in section 4. Empirical results are reported in the section 5. Section 6 presents a concluding summary and some policy implications that emerge from the study.

2. Overview of Trade Policies in Pakistan

During *time of independence* and in *1950s*, import substitution strategy (IS) followed which overvalued the Rupee, after IS strategy failed in *1950s* then during *1960s*, Government of Pakistan (GoP) introduced export bonus scheme which raised manufactured exports because of that created multiple exchange rate system, the basic aim of GoP was to compensate exporters of manufactured items from *1950s* overvaluation.

In *1970s* three policy measures (devaluation of Rupee, termination of export bonus scheme and ending the licensing system) were taken to reduce anti-export biasness. Hence trade liberalization policy indicated that *1970s* measures diverted export from Pakistan to other countries, but all these measures not cut down the biasness of exports of *1970s*.

Reduction in non-tariff barriers and unfair import systems were two basic components of *1980s* import regime. Import quota and banned on capital goods was removed. The banned was imposed to protect the domestic industries and luxury items. Moreover, in order to promote the export, the fixed exchange regime had shifted to flexible regime.

In *1990s,* the Government launched tariff reforms program with an aim to increase export. The result of implementation of the tariff rate policy is ambiguous and need to visit, although tariff structure of this era was simple. In *1996-1997,* Government had also taken tariff reform package to promote export and industrial production. The policies of 1990s helped to promote export however in the end of this era some changes were made and to cover the shortage of revenue.

The trade policy of *2000s* was to promote export culture in the country by keeping interest of Government and upper class community. The main objective of the policy was to trim down anti-export biasness by imposing banned on tariff for attaining sustainable export-led higher economic growth on the basis of market driven forces. The policy makers tried hard and specifically used exchange and monetary policy tools to support trade and to achieve more value addition in the goods and services being exported for enhancing export earnings.

In 2010 current account surplus was observed. This was possible by increasing remittances and robust growth in exports primarily because of positive terms of trade shock that overshadowed the strong growth in imports and stable exchange rate. The trade policy of *2010 era* was to facilitate export sector by export oriented textile and leather sector. The growth in exports remained broad based as almost all the groups (textile and non-textile) witnessed a high positive growth. However, lion's share of this year' exports came from textile sector and food group.

3. Literature Review

3.1 Endogenous Growth Models in Open Economies-Theory and Evidence

The mechanics linking trade and growth is yet an open question in the theoretical literature. Building on this exposition, Romer (1980) and Lucas (1988) developed the "Endogenous Growth Theory" where trade leads to higher growth through dynamic gains. Romer (1991) generally imply in the endogenous growth theories or new growth theories that openness to trade fosters open competition that drives innovation, greater resource allocation, efficiency and technological advancement. Similarly Srinivasan (2001) stated there are three sources of economic growth accumulation of resources, productivity transfusion and innovation. The Heckscher-Ohlin Model explained that if there are two resources in two economies i.e. one is labour-intensive and the other is capital-intensive) then trade openness can lead to higher productivity, hence higher incomes in both countries. Krugman (1979) replied in his "new" trade theory that the total output increases as a country liberalizes its trade.

Trade openness can potentially enhance the growth prospects of a country by influencing any of these three sources of growth. For instance, an open economy can obtain factors (or their services) more easily from abroad compared to a closed economy. Trade openness also leads to better allocation of resources. When an economy opens up, forces of comparative advantage forces the economy to specialize in the sector for which it has better factor endowments. As a result, productivity of that sector goes up. The exports from that sector also increase which consequently boosts growth. Romer (1991) and Chuang (2000) also stated that trade openness increase competition that drives innovation, greater resource allocation, efficiency and technological advancement. Also openness and trade may stimulate economic expansion in some countries while reducing growth in others.

Rivera-Batiz (1995) outlines several key mechanisms through which trade and knowledge are related. The first effect is the re-allocation effect whereby the international trade can affect economic growth by reallocating resources among different sectors. The second effect of international trade is the transmission of knowledge and spillover effect. Trade restrictions reduce flows of technological information across countries and this has a negative effect on long-run growth. Third trade openness and increase competition among domestic firms and innovation dependent growth would rise. This third type of effect called the competition effect, which is linked to the issue of simulation. Here the developed economy innovates and therefore the less developed economy imitates (Grossman and Helpman, 1991).

The machinist mentioned above is incorporated with the standard neo classical production to realize a reduced form that gives trade liberalization role in growth.

The Solow growth accounting technique is based on the assumption of constant returns to scale in the production function and perfect competition. Denoting output by Y, the Cobb-Douglas production function for country written as:

$Y= F (K^{\alpha}, L^{1-\alpha}, T)$ $0 < \alpha <1$ (A)

F is a function that is homogenous of degree one in its two arguments
K symbolized by capital
L is the country's labor force
T denotes is total factor productivity or knowledge

The parameter α determines exactly how capital and labor combine to produce output.

The variable T shows that if neutral the shifts in production leave all marginal rates of substitution constant, production function looks like that:

$$Y= \{A (T) F (K, L)\} \quad (B)$$

Where

A (T) is the technological change and stock of knowledge and it is product of the growth of K and L or investment.

If we differentiate equation 2 with respect to time and then divided by Y we obtain:

$$\frac{\Delta Y}{Y} = \frac{\Delta A}{\mathrm{A}} + \alpha_{\mathrm{K}} \frac{\Delta K}{\mathrm{K}} + \alpha_{\mathrm{L}} \frac{\Delta L}{\mathrm{L}} \quad (C)$$

Where,

$$\alpha_{\mathrm{K}} = A \frac{\partial f}{\partial K} \frac{\mathrm{K}}{\mathrm{Y}}$$

And

$$\alpha_{\mathrm{L}} = A \frac{\partial f}{\partial L} \frac{\mathrm{L}}{\mathrm{Y}}$$

These refers to differences in productivity explains most of the variation in per capita income observed across countries.

Solow showed that the production function above yields the following growth accounting identity:

$$\hat{A} = \hat{y} - \alpha_{\mathrm{K}} \hat{k} - \alpha_{\mathrm{L}} \hat{l} \quad (D)$$

Where, technological change $\frac{\Delta A}{\mathrm{A}} = \hat{A}$ is equal to the rate of growth of output $\frac{\Delta Y}{Y} = \hat{y}$ less the rates of growth in capital $\frac{\Delta K}{\mathrm{K}} = \hat{k}$ and labor $\frac{\Delta L}{\mathrm{L}} = \hat{l}$. This theoretical model with constant returns to scale implies that the knowledge is enhancing by economic growth i.e. labor and capital.

Inputs weighted by their output shares α_{K} and α_{L} capital and labor respectively in above equation.

Some other studies also described trade openness and growth relationship. Young (1991) described that trade liberalization between developed and less developed countries may hinder learning by doing and therefore the growth of general knowledge in developing countries. Young much argued about the trading partner countries. The model suggests that both developed and developing countries produced infinite number of goods but developing countries are labor intensive and produced the less refined goods. The produce of developed countries reflects this difference in the stock of technological knowledge. Youngdge.ped countries reflects this difference in the stock of techno likely trade with their less developed counterparts while less developed countries would most likely trade between themselves. This second argument of model is reflect the argument of Grossman and Helpman (1991, 1996), which described to consider dynamic comparative advantage.

Hence both theoretical and empirical work diagnose that it is difficult to operate growth and trade openness measures relationship effects in different types of trade policies and therefore still controversial.

3.2 Review of Empirical Literature

There are many studies available in the relevant literature which investigated the impact of trade openness on economic growth. Edwards (1992) used data for the period 1970-82 of thirty developing countries to analyze the relationship between trade openness (trade intervention and distortions) and GDP growth. He used two basic sets of trade policy indicators in his model constructed by Leamer (1988).The first set comprises of openness and second is measures of trade policy: tariff and non tariff barriers which restrict imports. The second set is trade intervention and it captured the level to which trade policy distorted trade. The findings suggested that all the four openness indicators had positive effect on real GDP growth, while trade intervention indices had found significantly negatively impact on GDP growth. Hence the conclusion supported the evidence that a country with a high degree of economic openness can grow faster by absorbing new technologies at a faster rate, and a country more distorted trade regime will tend to grow slower with a lower degree of openness.

Wacziarg (2001) analyzed the association between trade policy and economic growth by taking 57 countries over the period 1970-1989 by employing fully specified empirical model. He constructed openness index with the help of three trade policy variables, tariff barrier, non-tariff barriers and a dummy variable of liberalization. The results concluded that trade openness affects growth mainly by raising the ratio of domestic investment to GDP and by FDI.

Nath and Mamun (2006) investigated the causality between trade, investment and growth through Vector Auto regression (VAR) framework for the period 1971-2000 in Bangladesh. They presented that trade openness has promoted investment in Bangladesh. Although study suggested that growth causes trade but this study found little evidenced that trade affecting economic growth in Bangladesh.

By employing ARDL Approach to Co-integration on two Asian countries, India and Korea, Sarkar (2005) has found no meaningful relationship between the per capita real GDP and trade openness. Although India and Korea, opened trade and shares of trade in their GDPs also rose significantly. But none of the countries experienced a positive long-term relationship between opening up and economic growth.

Parikh and Stirbu (2004) used fixed effects, random effects, OLS and SURE models for panel of 42 developing countries i.e. Asia, Africa and Latin America over the period 1970-1999. They analyzed the relationship between liberalization, growth and trade balance or current account. Their results concluded that liberalization contributes significantly to economic growth, openness and investment rates.

In a similar study for 93 developed and developing countries over the period 1960-90, Edwards (1998) examined the empirical relationship among total factor productivity growth and nine indicators of openness, and concluded that six indicators have significant impact on total factor productivity growth with the positive sign. He although argued that the equilibrium growth rate in the poorer economies does not depend only on openness but also on its new level of stock of knowledge and the simulation cost.

Several studies have used different measures to examine the effects of trade openness on economic growth.

Harrison (1996) used a general production function to examine the relationship between trade openness and GDP growth in developing countries using cross section, time series data for the period 1960 to 1987. He used seven openness measures. He founds the cross-section estimation results corroborated black market rate is negative and significant. The panel result showed that three variables, tariff & non tariff barriers with positive sign, black market rate and price distortion index with negative sign, were significant. Annual data estimation show two variables, tariff & non-tarrif bariers, and black market rate, significant with negative sign.

Yanikkaya (2002), used 3SLS, OLS fixed effect and SUR method for panel of 100 developed and developing countries during 1970 to 1997 period. Various measures of trade openness he used in his study. Findings of his study showed that trade volumes, export shares, and import shares in GDP significantly and positively correlated with growth. Measures of trade barriers are significantly and positively correlated with growth except restrictions on current account payments, which is negatively but insignificantly correlated with growth.

Kee, Nicita and Olarreaga (2009) investigated empirical implementation of the work of Anderson and Neary (1992; 1994; 1996; 2003; 2007) by providing three theory-based indicators of trade restrictiveness. The first index is trade restrictiveness index. The second index, the OTRI, sum up the impact of each country's trade policies on its own imports.

The third index, the MA-OTRI, reviews the impact of other countries trade policies on each country's exports. Their results concluded that poor countries have more restrictive trade regimes, so they face higher barriers on their exports.

Mamoon and Mursed (2006) used data of different countries which have differences in per capita income by employing instrumental technique; their study examined the importance of institutions, openness/trade policies relevant to economic growth. However findings of their study showed that openness measures have insignificant impact on growth.

4. The Data, Model and Methodology of the Study

4.1 Description of Variables and Data Sources

Data obtained from the WDI (World Development Indicators) for the period *1960-2011*. All variables are in *natural logarithm form* and are in US million dollars. The GDP growth rate is in percentage terms. The two kind of *trade openness* measures are use in this study such as trade volumes (Import + Export) as a share of GDP ratio and trade restrictions measures such as average tariff rates and international trade tax. Tariff is called total import duties taken as percentage of the value of import, trade tax is taken as % of total revenue it includes import and export duties, exchange profits and taxes. (See table 1)[2]. Other important variables which might effect growth are also included in model. Investment or gross fixed capital formation is taken in terms of GDP share or ratio and use as proxy for physical capital and years of schooling (secondary school enrolment) act as proxy for human capital.[3]

[2] Sinha (2000), Wacziarg (2001), Yanikkaya (2003) and Iscan &Talan (1998) have used trade volumes as (exports + imports)/GDP as proxy of trade openness and find positive effects on growth. The trade volumes measure is not explicitly explains trade openness .Trade volume is also affected by population, transportation cost and other trading partner of the country. Therefore to capture different aspects of openness this study also uses two other trade openness measures which are tariff and trade tax. Yanikkiya(2003) used tariff rate and trade tax measure in their study but he not found evidenced that these trade barriers lower growth.

[3] This measure as a control variable is used by Marelli and Signorelli (2011) and Chaudry, Malik and Fridi (2010) and find positive and significant impact on economic growth. Chattergi, Mohan and Dastidar (2013) uses education expenditure as a proxy for human capital and found also find positive and significant effect on growth.

Table: 1 Measures of Openness to Trade

Name of Measure	Theory	Formula
Import Penetration rate (IP)	Micro studies generally shows that that the relationship between imports and productivity growth is often negative	IP= Import/(GDP +{Import-Export})
Exports to Output ratio (EI)	Empirical literature shows that only a few studies have attempted to explore the scale effects of trade liberalization on productivity growth	EI=E/GDP
Price Comparisons (QR)	Price comparisons between goods sold in the domestic and the international markets could provide an ideal measure of the impact of trade policy. In the study researchers use TOT as a proxy measure	QR=TOT
Trade Flows (TF)	This measure show a positive association with GDP growth rate	Imports + Exports/GDP
Import substitution and Export promotion (IS & EP)	This measure of openness to trade also been incorporated to account for trade liberalization impact	IS = 1-Import/[GDP +(import-Export)] EP = Export/GDP
Average tariff rate	This measure show a negative association with GDP growth rate	Tariff rate = import revenue divide by import value
International trade tax	This measure show a negative association with GDP growth rate	Trade tax= tax on trade as a % of total current revenue

4.2 Methodology and Model Specification

In this study ARDL bound testing approach is applied to examine the effect of trade openness measures and relevant social development indicators on economic growth.

ARDL Bound Testing Approach

Prior to test the long run co-integration relation, it is imperative to establish the order of integration among variables because in the presence of $I(2)$ or above, variables computed *f*-statistics are not valid [Ouattara (2004)]. For this purpose, Augmented Dickey Fuller (ADF) test is applied to test the stationary assumption for all variables under consideration. After knowing the stationarity level or order of integration of different time series, study applying the bound testing approach. Perasan, et al. (2001) introduced this new method of testing for co-integration. The main advantage of this approach lies in the fact that there is no need to classify variables into $I(1)$ or $I(0)$ as Johansen framework. The other advantages of this approach include that the variables are assumed to be endogenous and the existence of a long run relationship is investigated by estimating the following unrestricted error correction model. This technique is suitable for small or finite sample size (Pesaran et al., 2001).

The Model

In this study real GDP per capita (GRY) as the dependent variable is considered as the proxy of economic growth in the model[4]. The explanatory variables are tariffs and tax on trade (trade restrictions), trade volume, human capital and investment, investment works in form of fixed capital or physical capital[5]. To examine the impact of these variables on the economic growth, the following relationship is tested:

$$M_t = \chi + \sum_{i=1}^{p} \beta_i M_{t-i} + \varepsilon_t \quad \text{……………………………………………………………………} (1)$$

[4] See figure 10 in appendix. In figure 10 GDP growth showings up and down trend. In over all time period Pakistan GDP growth rate is worst and in 2010 it was 0.9 percent only which is very poor figure.

[5] Data of average tariff rate available from 1971 and trade tax from 1990s onwards.

where M_t is the vector of both X_t and Y_t, where Y_t is the dependent variable defined as economic growth (real GDP per capita growth rate), X_t is the vector matrix which represents a set of explanatory variables i.e., trade openness (OP), average tariff rate (TARIFF) and international trade tax (TAXTR), investment (I) and years of schooling (YS) and *t* is a time or trend variable. (All variables are in natural logs).

This study further developed a vector error correction model (VECM) as follows:

$$\Delta M_t = \chi + \underset{t}{\delta} + \eta M_{t-1} + \sum_{i=1}^{k-i} \beta_t \Delta Y_{t-i} + \sum_{i=1}^{k-i} \beta_t \Delta X_{t-i} + e_t \quad \text{..... (2)}$$

Where Δ is the first difference operator for short run coefficients. The long-run slope coefficients are η.

The slope coefficients $\underset{t}{\eta}$ and β_t are expected to be positive and negative both, i.e. $\underset{t}{\eta}$ and $\beta_t \geq 0$ or ≤ 0 as in Edwards (1992, 1998), Wacziarg (2001), Clemens and Wlliamson (2001),Yanikkaya (2003), Sarkar (2005, 2008), Mamoon & Murshed (2006), Femi Saibu (2012) and Chatterji, Mohan & Dastidar (2013). This study utilized the autoregressive distributed lag (ARDL) framework by Pesaran *et al*. (2001) in Case III, that is, unrestricted intercepts and no trends. An ARDL representation of growth equation for trade openness model is given below for the above given equation 2.

Model (1)[6]

$$\Delta(GRY)_t = \Psi_0 + \sum_{i=1}^{p} \Psi_1 \Delta(GRY)_{t-i} + \sum_{i=0}^{q} \Psi_2 \Delta(OP)_{t-i} + \sum_{i=0}^{r} \Psi_3 \Delta(I)_{t-i} + \sum_{i=0}^{s} \Psi_4 \Delta(YS)_{t-i} + \sigma_1 (GRY)_{t-1} + \sigma_2 (OP)_{t-1} +$$

$$\sigma_3 (I)_{t-1} + \sigma_4 (YS)_{t-1} + \underset{t}{u} \text{.....(3)}$$

In the above equation the term Ψ_i with the summation signs represent the error correction dynamics whereas Δ is the difference operator while the second part [terms with σ_i in equation 3 and 4] correspond to the long run relationship and $\underset{t}{u}$ is a white-noise disturbance term.

Equation (3) also can be viewed as an ARDL of order (p, *q*, *r*). Equation (3) indicates that economic growth tends to be influenced and explained by its past values. The structural lags are established by using minimum Akaike's information criteria (AIC) and Schwarz information criteria (SIC).

After estimation of Equation (3), the Wald test (*F*-statistic) is computed to differentiate the long-run relationship between the concerned variables. The Wald test can be carry out by imposing restrictions on the estimated long-run coefficients of economic growth, trade openness, investment and years of schooling. The null and alternative hypotheses are as follows:

$H_0 = \sigma_1 = \sigma_2 = \sigma_3 = \sigma_4 = 0$ (no long-run relationship)

Against the alternative hypothesis

$\underset{a}{H} \neq \sigma_1 \neq \sigma_2 \neq \sigma_3 \neq \sigma_4 \neq 0$ (long-run relationship exists)

The computed *F*-statistic value will be evaluated with the critical values tabulated in Table CI (iii) of Pesaran *et al.* (2001).

After finding the evidence of long run relationship in the model then in order to estimate the long run coefficients, the following long run model is estimated.

$$(GRY)_t = \sigma_0 + \sum_{i=0}^{r} \sigma_1 (GRY)_{t-i} + \sum_{i=0}^{r} \sigma_2 (OP)_{t-i} + \sum_{i=0}^{r} \sigma_3 (I)_{t-i} + \sum_{i=0}^{r} \sigma_4 (YS)_{t-i} + \underset{t}{u} \text{.....(4)}$$

In the 3rd step this study utilizes the following equation to estimate the short run coefficients:

[6] This study presents trade openness or trade volume, investment and years of schooling as independent variables in model 1.

$$\Delta(GRY)_t = \Psi_0 + \sum_{i=0}^{r} \Psi_1 \Delta(GRY)_{t-i} + \sum_{i=0}^{r} \Psi_2 \Delta(OP)_{t-i} + \sum_{i=0}^{r} \Psi_3 \Delta(I)_{t-i} + \sum_{i=0}^{r} \Psi_4 \Delta(YS)_{t-i} . + \lambda ec_{t-1} + \varepsilon_t \quad \text{.....(5)}$$

λ is the error correction term in the model indicates the pace of adjustment reverse to long run equilibrium following a short run shock, and ec_{t-1} is the residuals that are obtained from the estimated co-integration model of equation (3).

An ARDL representation of growth equation for trade tax model is given below for the above given equation 2.

Model(2)[7]

$$\Delta(GRY)_t = \Omega_0 + \sum_{i=1}^{p} \Omega_1 \Delta(GRY)_{t-i} + \sum_{i=0}^{q} \Omega_2 \Delta(TAXTR)_{t-i} + \sum_{i=0}^{r} \Omega_3 \Delta(I)_{t-i} + \sum_{i=0}^{r} \Omega_4 \Delta(YS)_{t-i} + \gamma_1 (GRY)_{t-1}$$

$$+ \gamma_2 (TAXTR)_{t-1} + \gamma_3 (I)_{t-1} + \gamma_4 (YS)_{t-1} + \psi_t \quad \text{.....(6)}$$

In equation 6 the terms with summation signs show the error correction dynamics, while the second part **(**containing) correspond to the long run relationship. The existence of a long run relationship is tested by the use of *F*-tests. When a long run relationship exists, the F-test indicates that the variable should be normalized and long run and short run coefficients are estimated.

$$\Delta(GRY)_t = \Omega_0 + \sum_{i=0}^{r} \Omega_1 \Delta(GRY)_{t-i} + \sum_{i=0}^{r} \Omega_2 \Delta(TAXTR)_{t-i} + \sum_{i=0}^{r} \Omega_3 \Delta(I)_{t-i} + \sum_{i=0}^{r} \Omega_4 \Delta(YS)_{t-i} . + \lambda ec_{t-1} + \xi_t \quad \text{.....(7)}$$

$$(GRY)_t = \gamma_0 + \sum_{i=0}^{r} \gamma_1 (GRY)_{t-i} + \sum_{i=0}^{r} \gamma_2 (TAXTR)_{t-i} + \sum_{i=0}^{r} \gamma_3 (I)_{t-i} + \sum_{i=0}^{r} \gamma_4 (YS)_{t-i} + \psi_t \quad \text{.....(8)}$$

An ARDL representation of growth equation for tariff model is given below for the above given equation 2.

Model (3)[8]

$$\Delta(GRY)_t = \omega_0 + \sum_{i=1}^{p} \omega_1 \Delta(GRY)_{t-i} + \sum_{i=0}^{q} \omega_2 \Delta(TARIFF)_{t-i} + \sum_{i=0}^{r} \omega_3 \Delta(I)_{t-i} + \sum_{i=0}^{r} \omega_4 \Delta(YS)_{t-i} + \mu_1 (GRY)_{t-1}$$

$$+ \mu_2 (TARIFF)_{t-1} + \mu_3 (I)_{t-1} + \mu_4 (YS)_{t-1} + e_t \quad \text{.....(9)}$$

Where ω_0 is the drift component; e_t is the white noise; the terms with summation signs represent the error correction; dynamics with ω_i for example represents the short run effects; while the second part of the equations with μ_i corresponds to the long run relationship. After finding the evidence of long run relationship in the model then in order to estimate the long run coefficients, the following long run model is estimated.

$$(GRY)_t = \mu_0 + \sum_{i=0}^{r} \mu_1 (GRY)_{t-i} + \sum_{i=0}^{r} \mu_2 (TARIFF)_{t-i} + \sum_{i=0}^{r} \mu_3 (I)_{t-i} + \sum_{i=0}^{r} \mu_4 (YS)_{t-i} + e_t \quad \text{.....(10)}$$

If the long run relationship exists among the variables, the following error correction model is estimated.

$$\Delta(GRY)_t = \omega_0 + \sum_{i=0}^{r} \omega_1 \Delta(GRY)_{t-i} + \sum_{i=0}^{r} \omega_2 \Delta(TARIFF)_{t-i} + \sum_{i=0}^{r} \omega_3 \Delta(I)_{t-i} + \sum_{i=0}^{r} \omega_4 \Delta(YS)_{t-i} . + \pi ec_{t-1} + \upsilon_t \quad \text{.....(11)}$$

The πec_{t-1} is the error correction term and the coefficient π measures the speed of adjustment towards the long-run equilibrium. Since the study is country specific, the usual problem of data comparability, measurement issue and consistency do not arise in this case.

[7] In model 2 study taken trade tax, investment and years of schooling as independent variables.

[8] Model 3 of this study presents average tariff rate, investment and years of schooling as explanatory variables. GDP growth rate use as dependent variable in 1st, 2nd and 3rd model.

5. Empirical Results and Discussions

The results are reported in table 2 based on the ADF test statistic. The empirical results show that almost all variable stationary at level in both constant and constant plus trend. The underling variables such as GDP growth, tax on international trade, trade openness and years of schooling are stationary at level. The first difference of results of ADF demonstrates that all series are stationary at 1% significance level: I(1). It is obviously from results reported in table 2, study finds mix results i.e., the mixture of both I(0) and I(1) variables. Under this condition, applying the ARDL bounds approach is most suitable technique in determining the long-run relationships among the underling variables.

Table 2: Unit Root Test

Variables	LEVEL		FIRST DIFFERENCE	
	Constant	Constant and trend	Constant	Constant and trend
LNGRY	-5.321*** (0)	-5.325*** (1)	-6.146*** (1)	-6.230*** (1)
LNTARIFF	-0.0079 (0)	-1.586 (1)	-7.269*** (0)	-8.288*** (0)
LNTAXTR	-4.245*** (1)	-4.595*** (0)	-7.262*** (1)	-6.990*** (1)
LNOPEN	-2.768* (2)	-2.827 (1)	-7.956*** (0)	-7.945*** (1)
LNI	-2.034 (0)	-2.815 (1)	-5.478*** (1)	-5.243*** (1)
LNYS	-3.336* (1)	-3.335* (1)	-5.261*** (1)	-5.336*** (1)

Note: ***, **, * denotes significance at 1%, 5% and 10% respectively. The null hypothesis is that the series is non-stationary, or contains a unit root and the rejection of the null hypothesis is based on MacKinnon (1996) critical values. The standard Augmented Dickey-Fuller (ADF) unit root test was exercised to check the order of integration of these variables. The lag length is selected based on SIC criteria, this ranges from lag zero to lag two.

The Co-integration test in the bounds' framework involves the comparison of the *F*-statistics against the critical values. The bounds test for Model (1) to Model (3) is presented in table 3. Using the critical value computed by Pesaran *et al*. (2001), study find that *F* test statistics are significant at the 1% level for model (1), (2) and (3). These results reject the null hypothesis of no co-integration, regardless of whether the variables are *I*(1) or *I*(0) or a mixture of both. The test also indicates the presence of valid long run relationships between the independent variables and the dependent variable except international trade tax variable (LNTRT) at the calculated *F*-statistic of 25.01, 18.9 and 6.04 which exceed the upper critical value. Results also show goodness of fit of the specification that is, *R*-squared and adjusted *R*-squared, is 0.59 and 0.45 for model 1, 0.96 and 0.89 for model 2 & 0.62 and 0.47 for model 3 respectively.

Table 3: Estimated Over all Models 1, 2 and 3 Based on Equation (3), (6) and (9) [(Economic Growth with Trade openness, Trade tax and Tariff rate)]

Variable		**Variable**		**Variable**	
C	-0.694(0.781)	C	-3.149(0.174)	C	1.816(0.508)
DLNGRY(-1)	0.192(0.1001)***	DLNGRY(-1)	0.377(0.000)*	DLNGRY(-1)	-0.029(0.090)**
DLNOP	1.42(0.1000)***	DLNTRT	-0.129(0.03)**	DLNTARIFF	-0.988(0.100)***
DLNOP(-1)	0.752(0.380)	DLNTRT(-1)	-0.03(0.021)**	DLNTARIFF(-	-0.645(0.080)***
DLNI	1.665(0.008)*	DLNI	0.494(0.035)**	DLNI	0.338(0.072)**
DLNI(-1)	2.792(0.08)**	DLNI(-1)	2.042(0.02)*	DLNI(-1)	0.463(0.040)**
DLNYS	0.475(0.037)*	DLNYS	0.871(0.027)*	DLNYS	0.022(0.0933)***
DLNYS(-1)	0.403(0.074)**	DLNYS(-1)	0.33(0.060)**	DLNYS(-1)	0.109(0.052)**
LNGRY(-1)	-0.866(0.000)*	LNGRY(-1)	0.63(0.02)**	LNGRY(-1)	0.781(0.004)*
LNOP(-1)	1.348(0.001)*	LNI(-1)	1.97(0.007)*	LNTARIFF(-1)	-0.142(0.056)**
LNI(-1)	2.635(0.006)*	LNTRT(-1)	-0.049(0.81)	LNI(-1)	0.364(0.077)**
LNYS(-1)	0.619(0.056)**	LNYS(-1)	0.504(0.050)**	LNYS(-1)	0.024(0.040)**
R-Squared	**0.5903**	**R-Squared**	**0.9605**	**R-Squared**	**0.62778**
R-Bar-Squared	**0.4556**	**R-Bar-Squared**	**0.898**	**R-Bar-**	**0.476**
F-stat[P-value]	**25.01[0.0068]***	**F-stat[P-value]**	**18.83 [0.000]***	**F-stat[P-value]**	**6.0498[0.0011]***
DW-statistic	**2.1175**	**DW-statistic**	**1.8288**	**DW-statistic**	**1.9588**

Note: 1.*, ** and *** indicate significance at 1%, 5% and 10% level respectively. () refer to p-values.
2. The relevant critical value bounds are obtained from Table C1.iii (with an unrestricted intercept and no trend; with three regressors k=3) in Pesaran et al. (2001). They are 2.72 - 3.77 at 90%, 3.23 - 4.35 at 95%, and 4.29 – 5.61 at 99%.
3. * denotes that the F-statistic falls above the 99% upper bound.

The coefficients of trade openness[9], investment[10] and years of schooling[11] are positive and significantly related to economic growth. While trade restrictions measures are inversely and significantly related to economic growth. The result suggests that *trade openness* acts as a lubricant in the economy creating more employment opportunities. Trade openness explores the opportunities for the domestic resources to make their way into the international market. People can import the consumable products to upgrade their living standard, while the firms and industries can import technology and capital products.

[9] Mankiw (2004) explained that trade openness affects economic growth positively due to technology diffusion which increases productivity. Herath (2008) study founds a significant positive relationship between trade liberalization and economic growth in Sri Lanka. Acemoglu & Zilibotti (1997) explained that the trade openness i.e. trade volumes have positive impact on economic growth in the long-run because opening up capital markets for resource movement from capital abundant markets creates divergence.

[10] Kormendi & Meguire (1985), Barro (1991), Levine & Renalt (1992) reported positive relationship between the investment (capital formation) and economic growth in their study. Khan and Reinhart (2008) described that investment has a larger direct effect on growth. Nejat and Sanli (1999) findings also confirm that physical capital and human capital have significant impact on explaining GDP growth for sample of developed countries.

[11] Barro, Robert J., Sala-i-Martin, and Xavier. (1995), Mankiw, Romer, and Weil (1992) have also found Positive effects of years of schooling on economic growth in USA. While Pritchett (1997), Islam (1995), Caselli, Esquivel, and Lefort (1996) found insignificant effects of years of schooling on economic growth in the long run. Lucas, Robert. (1993) corroborated that the main engine of growth is the accumulation of human capital or knowledge and the main source of differences in living standards among nations is a difference in human capital. Physical capital plays an essential but decidedly subsidiary role.

Table 4: Diagnostic Checking for ARDL

	Model 1 ARDL (0, 0, 0, 1)	**Model 2 ARDL (0, 0, 2, 1)**	**Model 3 ARDL (2, 2, 0, 0)**
Jarque-Bera	29.465[0.000]	5.156[0.0749]	5.937[0.054]
LM Test	1.960 [0.154]	0.122 [0.734]	0.018 [0.891]
ARCH Test	0.463 [0.333]	0.511 [0.489]	0.001 [0.967];
White Heteroskedasticity	0.027 [0.303]	0.324 [0.959]	0.642 [0.816]
Ramsey Reset Test	0.611 [0.463]	0.075 [0.783]	0.991 [0.327]

Notes: Jarque-Bera is the normality test which is based on a test of skewness and kurtosis of residuals, Breusch-Godfrey Serial Correlation LM used to test for the presence of serial Autocorrelation. ARCH test, Based on the regression of squared residuals on squared fitted values (Engle 1982). White test is use for heteroskedasticity. Ramsey's RESET test use for the omitted variables/functional or the square of the fiited values

The robustness and goodness of the ARDL model has been examined by several diagnostic tests such as Jarque-Bera, Breusch- Godfrey serial correlation LM test, ARCH test, White Heteroskedasticity and Ramsey RESET specification test.

Table 4 shows that model 1, 2 and 3 generally pass the several diagnostic tests such as Jarque-Bera, Breusch-Godfrey serial correlation LM test, ARCH test, White Heteroskedasticity and Ramsey RESET specification test. These tests reveal that the models have achieved desire econometric properties, that is there is no evidence of autocorrelation, it has a correct functional form, error is normally distributed and homoskedastic. These models show that these models have the best goodness of fit of the ARDL model and valid for reliable interpretation.

Finally, when analyzing the stability of the long–run coefficients together with the short-run dynamic model, the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residual (CUSUMSQ) are applied. According to Pesaran and Pesaran (2001), the stability of the estimated coefficients of the models should be empirically investigated. A graphical representation of CUSUM and CUSUMSQ statistics are shown in Appendix (graphs 4 to 9). The CUSUM and CUSUMSQ plotted against the 5% significance level. It is clear from the graphs that the plots of both the CUSUM and the CUSUMSQ are within the boundaries of model 2 and 3 which proves stability over time but model 1 show some instability; hence these statistics confirm the stability of the long-run coefficients of ARDL models.

Long-Run and Short-run Estimations (Based on Equations 4, 5, 7, 8, 10 and 11)

Under the analysis of ARDL, the existence of the long run coefficients of Equation 3 to Equation 11 [or model (1) to model (3)] are estimated and the results are reported in table 5. In order to select the best performing ARDL-model, the significance of the resulting ARDL-VECM parameters, the Schwarz information and Akaike information Criterion is used in the study. The Schwarz information and Akaike information Criterion lag specifications for model (1) to model (3) are shown in table 4. For these three models, the optimal numbers of lags for each of the variables are ARDL (0, 0, 0, 1), ARDL (0, 0, 2, 1) and ARDL (2, 2, 0, 0) respectively.

Table 5: ARDL Model Long-run Results

Regressor	Model 1 ARDL (0, 0, 0, 1)	Regressor	Model 2 ARDL (0, 0, 2, 1)	Regressor	Model 3 ARDL (2, 2, 0, 0)
C	-0.185(0.931)	C	0.920(0.806)	C	2.785(0.03)**
LNOP	1.278(0.007)*	LNTRT	-0.189(0.096)***	LNGRY(-1)	0.640(0.090)***
LNI	0.751(0.009)*	LNI	0.914(0.09)**	LNGRY(-2)	0.895(0.030)**
LNYS	2.009(0.100)***	LNI(-1)	2.080(0.193)	LNTARIFF	-1.112(0.0214)**
LNYS(-1)	1.927(0.001)*	LNI(-2)	2.499(0.101)***	LNTARIFF(-1)	-0.318(0.0627)***
		LNYS	1.493(0.089)***	LNTARIFF(-2)	-0.577(0.028)**
		LNYS(-1)	1.0132(0.100)***	LNI	0.310(0.064)***
				LNYS	0.037(0.085)***

Note: *, ** and *** indicate significance at 1%, 5% and 10% level respectively, () refer to p-values

The long run results show that the estimated coefficients are expected to be significant in model 1; it shows the long-run relationship exists among real GDP growth rate, trade openness, investment and years of schooling. If there is one percent increase in trade openness, investment and years of schooling so economic growth increases by 1.27, 0.75, 2.009 and 1.9 percent respectively.

This analysis demonstrates that in the long-run trade openness, investment activities and years of schooling[12] have positive and significant effects on economic growth of Pakistan. This may imply that trade openness policies enhance the trade flows in Pakistan.

The long run model (2) in table 5 shows that international trade tax[13] coefficient is negative and statistically significant, while investment (LNI) and second lag of investment (LNI (-2)) are positive and statistically significant. Years of schooling (LNYS) and first lag of years of schooling (LYS (-1)) coefficient have positive and statistically significant impact on economic growth. These results highlight the importance of education and domestic investment in the growth process of Pakistan. The negative and significant effect of international trade tax in the long run model corroborates that the trade tax creates hurdle in the growth rate of Pakistan. This suggests that trade tax should be removed in order to enhance growth.

According to empirical results of model 3, average tariff rate has a negative and statistically significant impact on economic growth. First and second lag of economic growth, investment and years of schooling has a positive and statistically significant impact on economic growth. This indicates that the one percent increase in the first lag (LNGRY (-1), second lag of GDP growth (LNGRY (-2), investment (LNI) and years of schooling (LNYS) in Pakistan leads to 0.64, 0.89, 0.3 and 0.03 percent current GDP growth.

[12] Abdullah, Mustafa and Habibiullah (2009) reported that trade openness, education expenditure and physical capital (investment) affects economic growth positively both in long run and in short run in Malaysia. Their study suggests that growth impact of trade openness is beneficial when economy faces more competition and thus stimulates productivity. See Krueger (1998) 'Why Trade Liberalization is good for economic growth' article for further information.

[13] Chattergi, Mohan and Dastidar (2012) use also international trade tax as a measure of trade barriers in their study of India and found insignificant results due to non availability of the data. See Rodriguez and Rodrik (2001) also for critiques and weaknesses of trade barriers measures.

Table 6: ARDL Model Short-run Error Correction Model (ECM-ARDL) Results

Regressor		**Regressor**		**Regressor**	
C	0.010(0.11)	C	0.0293(0.25)	C	0.097(1.18)
DLNOP	0.698(0.31)	D(LTRT)	-0.319(-2.38)*	DLNGRY(-1)	0.057(0.28)
DLNI	0.266(1.71)***	D(LINV)	1.038(1.40)	DLNGRY(-2)	0.108(0.588)
DLNYS	0.304(1.77)***	DLINV(-1)	0.651(2.16)**	DLNTARIFF	-0.962(-2.060)**
DLNYS(1)	0.604(3.14)*	DLINV(-2)	1.717(0.95)	DLNTARIFF(-1)	-0.518(-1.05)
Ecm(-1)	-0.765(-5.11)*	D(LYS)	0.561(2.86)*	DLNTARIFF(-2)	-0.699(-1.53)
		DLYS(-1)	0.891(1.40)	DLNI	0.129(0.185)
		Ecm(-1)	-1.012(-2.85)*	DLNYS	0.022(0.131)
				Ecm(-1)	-0.672(-2.62)*

Note: *, ** and *** indicate significance at 1%, 5% and 10% level respectively, () refer to t-values

Table 6 reports the short run dynamics of the second part of the MacKinnon-Shaw hypothesis. The dynamic short-run results reveals that the coefficient of Ecm (-1) is -0.765512, which is highly statistically significant. It implies that the disequilibrium occurring due to a shock is totally corrected in next year at a rate of about 76%. The results suggests that investment and years of schooling have statistically positive and significant effect on economic growth in short run while trade openness measures have insignificant impact on economic growth in short run

Model (2) reports that the error correction terms are negative and statistically significant as expected. The error correction terms coefficient Ecm (-1) are reasonably high i.e. 1.01% which indicates a high speed of readjustment to long run equilibrium from short run disturbance to the model. The international trade tax coefficient is negative and statistically significant similarly coefficient of change in lag investment i.e. DLINV (-1) and change in years of schooling i.e. DLYS are 0.65 and 0.56 which is positive and statistically significant. It suggests that in short run an increase of 1% in change in lag of investment and change in years of schooling is associated with an increase in 65 and 56 percent in economic growth. This short run result therefore suggests that lag in investment and years of schooling have significant positive effects on economic growth in the short run. So lags of investment and years of schooling in the short run could be growth enhancing.

Model (3) demonstrates that the coefficient of lags of economic growth (DLNGRY (-1), DLNGRY (-2)), lags of tariff rate (DLNTARIFF (-1), DLNTARIFF (-2)), change in investment (DLNI) and change in years of schooling (DLNYS) are not significant in the short run. Coefficient of DLNTARIFF reveals that an increase in the 1% in the average tariff rate is related with 0.96 percent decline in economic growth. The coefficient of error correction terms is (-0.67) which is negative and statistically significant, indicating that 67 percent discrepancy in the short span is adjusted in the long run every year. Change in lags of economic growth, change in investment and change in years of schooling is not significantly related to economic growth in the short run. So in the short run economic growth cannot enhance by increasing investment activity, years of schooling and lags of economic growth. So finally the validity of the long run and short run results are confirmed by both the diagnostic test results and cumulative sum (CUSUM) and the cumulative sum of square (CUSUMSQ) (see Appendix figures 4 to 9).

6. Conclusion and Policy Implications

The objective of this present study is to examine the impact of trade openness on economic growth both in the long and short run in Pakistan by using the bounds testing approach to co-integration .The findings suggest that trade liberalization policies play key role to enhance economic growth in Pakistan. This is consistent with the prediction of most international trade theories that trade openness is an important engine for economic growth. The effect of trade volume on growth became significant from 1980 onwards when Pakistan gradually moves towards new tariff reform policy for industrial sector growth. Pakistani industries started importing raw materials and intermediate goods after tariffs reduction which increased labor productivity and consequently led to faster economic growth (see Ashfaque Hasan 2000). Moreover, study also finds that an increase in physical capital and human capital leads to an increase in GDP growth rate of Pakistan. Government should take action to enhance physical and human capital in order to promote economic growth of the country.

The rapid rate of skilled labor emigration, mainly due to unstable law and order situation, is having a deleterious effect on Pakistan's human resources. The stable political and economic environment encourages domestic investment as well as foreign investment in Pakistan. Another significant finding is that trade restrictions measures had adverse effects on growth in long run; this indicates that Pakistan's economic growth was partially the result of the government's open policies.[14] However, the insignificant coefficient of openness trade polices might indicate that openness trade policies may not necessarily generate economic growth in the short-run. The policy implications about sustainable and protracted openness policy are desirable for countries to get the benefits of openness. Therefore, developing countries like Pakistan need to consider trade open policy as a long term plan of the country. Considering the findings of the study, the policy direction of Pakistan should emphasize on more liberal policies, with emphasis on how and when openness is actually important.

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Appendix

Plot of CUSUM and CUSUMQ (stability test)

Model 1: Economic Growth with Trade Openness (Equation 3)

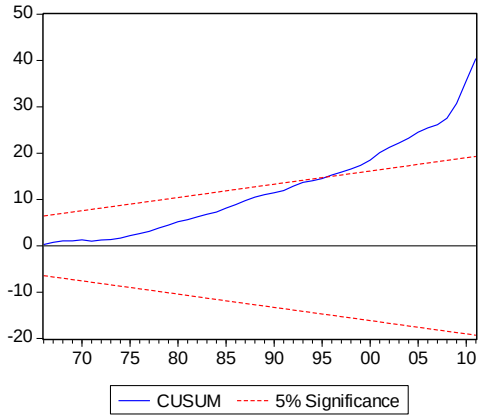


Figure 4: The Straight Lines Represent Critical Bounds At 5% Significance Level

Plot of cumulative sum of squares of recursive residuals

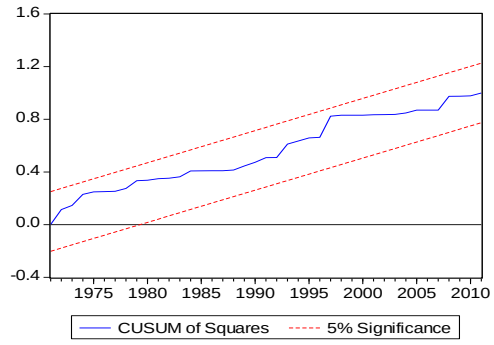


Figure 5: The Straight Lines Represent Critical Bounds At 5% Significance Level

Model 2: Economic Growth with International Trade Tax (Equation 6)

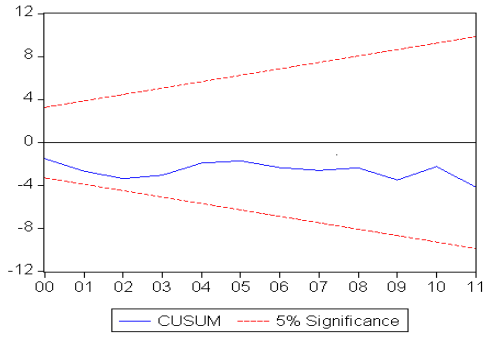


Figure 6: The Straight Lines Represent Critical Bounds At 5% Significance Level

Plot of cumulative sum of squares of recursive residuals

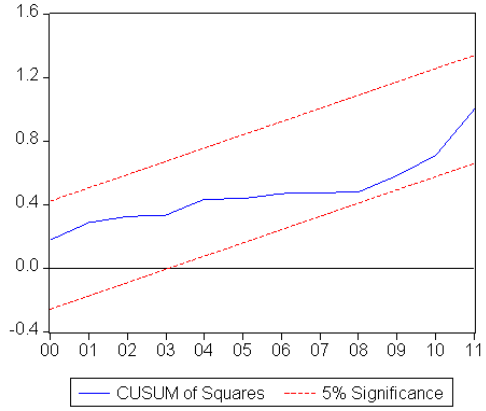


Figure 7: The Straight Lines Represent Critical Bounds At 5% Significance Leve

Model 3: Economic Growth with Tariff rate (Equation 9)

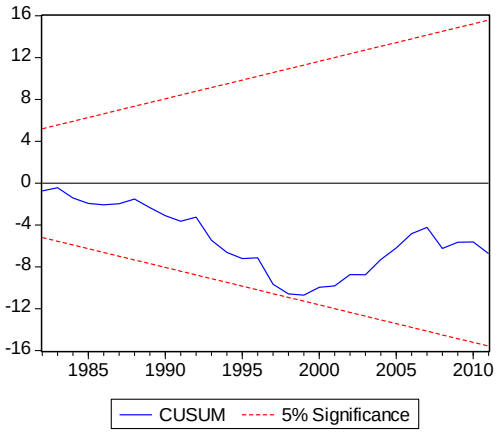


Figure 8: The Straight Lines Represent Critical Bounds At 5% Significance Level

Plot of cumulative sum of squares of recursive residuals

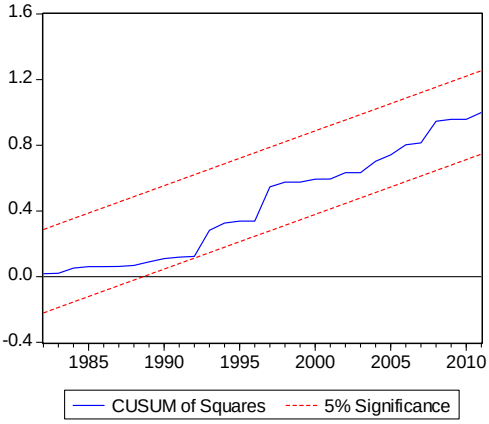
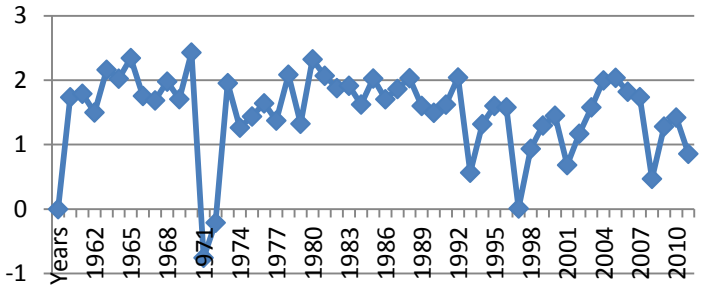


Figure 9: The Straight Lines Represent Critical Bounds At 5% Significance Level

Figure 10 Log of GDP Growth Rate



Source: Author's own calculations based on data obtained from WDI.