# Advance Journal of Econometrics and Finance
## Vol-4, Issue-1, 2026

**Advance Journal of Econometrics and Finance**

Online ISSN
2959-8990
Print ISSN
2959-8982
https://ajeaf.com/index.php/Journal/About

Name of Publisher: SCHOLAR CRAFT EDUCATION & RESEARCH HUB

Review Type: Double Blind Peer Review

Journal Frequency: Quarterly Research Journal


# Impact Of Electricity Infrastructure on Trade Openness: A Case Study of Pakistan


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**Abstract**

The aim of this study is to analyse the impact of Electricity Infrastructure on Trade Openness in Pakistan over the period of 1991-2024. The estimation technique used for this purpose is Auto Regressive Distributive Lag (ARDL). A proxy is used for the measurement of infrastructure such as electricity consumption, along with other determinants of trade openness. Infrastructure variables, population growth, and financial development are found to be positively associated to trade openness. Thus validates the hypothesis that is; electricity infrastructure facilitates trade openness in Pakistan. Real effective exchange rate has a negative impact on trade openness in Pakistan. In the light of results, it is suggested that, government should build more dams and power generation units in order to enhance more electricity generation to boost trade.



**Keywords:** Trade openness, Electricity Infrastructure, ARDL, Financial development

Advance Journal of Econometrics and Finance
Vol-4, Issue-1, 2026

## Introduction

In today's fast-growing world, every country is striving hard to achieve the best possible growth to compete other countries. A well-developed infrastructure (INFRA) is an important factor that derives the growth of any economy [Arnold *et al*., (2008)]. Infrastructure is defined as; the investment made by the government and firms to run all the economic activities smoothly. It is comprised of transportation and telecommunication facilities etc. Infrastructure is considered an essential feature for progress of any country. Electricity Infrastructure paves way for developing economies to attain sustainable economic growth [State Bank of Pakistan, (2013)].

Apart from electricity infrastructure, trade is among those factors that boost economic performance [Sulieman and Albiman (2014)]. No nation can survive alone in the world because the world is rapidly transforming into a global village. In all the process of this transformation, the contribution of trade is very significant as compare to any other factor. Trade creates wider opportunities for the nation to introduce and gear up for better economic system in their countries [Ramazan et al., (2013)].

Moreover, according to the Solow model, trade openness creates inflow of capital goods and technology, which enlarge the industrial activity and trade in manufactured products. The result would be the increase in economic growth [Harrison, (1994)].

Trade liberalization started after third wave of globalization. Pakistan has liberalized and deregulated its trading sector in late 1980's. Number of studies affirmed the enhanced trade owing to improved infrastructure not only reduced the cost of trade but also boosted the competition among trading partners [Fedderke and Garlick (2008)]. A broad literature on infrastructure and trade highlights the importance of infrastructure for trade. The condition of highways plays considerably important role for enhancing the efficiency of transport sector [Nordas et al., (2004)].

The present study will incorporate the trade openness (TO), and economic growth along with other macroeconomic variables to determine the impact of electricity infrastructure on openness to trade. Present study adopted the framework from the study of Suleiman and Albiman (2014) to see the impact of electricity infrastructure on trade openness for Pakistan. The period of 1991-2024 is taken in this study. The estimation technique used in present study is Autoregressive Distributive Lag (ARDL). The existing studies and literature on the association between Electricity INFRA and TO is not very clear for the case of Pakistan; therefore, it needs a detailed empirical analysis.

## Objective of study

i. To examine the effect of electricity infrastructure on trade openness in Pakistan.
ii. To analyse influence of population growth, the real exchange rate and financial development on trade openness in Pakistan.

## Research Questions

i. How does electricity consumption as a measure of infrastructure affects trade openness in Pakistan?
ii. How does population growth, the real exchange rate and financial development influence trade openness in Pakistan?

## Hypothesis of the study

**$H_O$:** Improvement in Electricity Infrastructure does not facilitates trade openness.

**$H_1$:** Improvement in Electricity Infrastructure facilitates trade openness.

## Significance of study:

The link between infrastructure and trade is well-known whereas the specific impact of electricity infrastructure in the Pakistani context is unclear (Mirza et al., 2022). This research directly offers a unique perspective by addressing that gap. The results are design to help Pakistani policymakers with clear evidence-based guidance to make investments for infrastructure betterment which will result in improved trade competitiveness. This study provides a clear understanding of how infrastructure actually affects trade flows in a real-world developing economy, moving beyond broad theories to workable insights. Eventually, this work aims to help Pakistan make smarter investment decisions to fuel its economic growth and integration into the global market.

Remaining study is organized as follows; second chapter is comprised of the existing theoretical and empirical literature to analyze the impact of infrastructure on trade openness of Pakistan. Chapter 3 is consists of theoretical framework and chapter 4 is about data and methodology. Whereas, chapter 5 presents the detailed discussion of the results. Lastly, chapter 6 concludes the whole study.

## Literature Review

### Introduction

Electricity Infrastructure development is very important factor for sustainable growth of an economy. All type of infrastructure has its own importance, but physical infrastructure plays significantly important role. It has the ability to enhance economic performance by providing those facilities to the common people, which are fundamental for economic growth of every developed and developing nation Haider, (2012). Economists have been putting their efforts to establish a link between infrastructure development and trade liberalization. A broad literature on infrastructure and trade is available which highlights the importance of infrastructure trade openness.

This literature will reveal the relationship between infrastructure and trade openness. It builds the theoretical and empirical base for understanding the link between infrastructure variable and trade openness in case of Pakistan.

In a world where countries aim for sustainable development, international trade is crucial for their growth. Therefore, a country needs powerful infrastructure such as roads, ports and communication networks to work well because it is considered backbone of a country. Better infrastructure makes it convenient, cost-effective and faster to move goods which in turn uplift both imports and exports. As a result of increased trade, people receive the fruits such as more job opportunities, high wages which highlights the vital role of infrastructure in nations' prosperity (The world Bank, 2020b; World Trade Organization, 2018; Donaldson, 2018).

Technology is an important component of basic infrastructure in this fast-growing world; closely assist by telecommunication and internet system. Telecommunication infrastructure investment is also important for economic growth [Clark and Gray (2014)]. Investment in telecommunication infrastructure leads to economic growth as it increases the demand for goods and services like products cable, switches etc. Higher economic returns to telecommunication infrastructure investment boost economic performance of a country.

**Improvement in telephone system reduces the cost of doing business.**

Infrastructure played a vital role in economic development. Therefore, a well-developed infrastructure reduces the distance between regions and integrates national and international markets at low costs. It is widely accepted that infrastructure, like roads and power lines is a key to country's economic growth. As the World Economic Forum (2014) points out that good infrastructure brings countries together cheaply and efficiently. However, many Asian economies have focused on building a large quantity of these tasks without ensuring the quality.

This has created a problem where the infrastructure is noy fully supportive for the economy. Calderons and Serven (2004), confirms that the quality of infrastructure is vital for long term growth. Therefore, the focus is now to correctly build more things that are highly efficient and well-maintained.

According to Hansen (1965), infrastructure contributes to economic development through specifically enhancing efficiency and generally by giving facilities making lives better overall. The non-existence of these facilities in any country can reduce the capability of the population to produce efficiently. Many studies proclaimed that infrastructure contributes in growth, employment, output, income, and quality of life and give rise to output of firms in individual sectors of the economy [Hardy (1980)]. Feltenstein and Jiming (1995) consider three types of infrastructures, electricity, communication and transport. According to them out of these three infrastructures, electricity and communication plays vital role in reducing sectoral cost of production. However, transport cost effect is opposite on sectoral cost of production.

Bougheasa (1999) defines the role of infrastructure in trade and transport costs. Transport costs indirectly depend on infrastructure. He further added, the countries having optimal levelof infrastructure have an edge over other states in face of trade volume and economic growth; as, infrastructure tends to decrease transport cost with all its trading partners. Limao and Venables (2001) give the same argument that transport costs depend heavily on infrastructure. They highlight that access to sea and distances to markets have strong influence on shipping cost. This will directly affect manufactured exports and consequently economic growth of the developing countries.

Anderson and Shimokawa (2006) argue that for the achievement of potential benefits from international trade liberalization insufficient domestic rural infrastructure was a major blockage. They argued that poor INFRA is one of the big obstacles in way of achieving potential benefits from trade liberalization. Fedderke and Bogeti (2006) explain that infrastructure investments are vital for the development of economic growth. It has direct influence on economic growth through capital accumulation and indirect by means of total factor productivity gains. Infrastructure investments encourage private investment due to low costs of production. However, emerging markets in return provide new opportunities to produce more for trade. Ports lower down the trade and transaction costs and roads decreases transport cost. Both factors provide great opportunity for local firms to access international markets.

Prabir De (2006) explains that several local trading blocs for example EU have followed aa global trade policy in order to increase their intra-regional transport networking. It is assumed that Improvement in transportation facilities help to decrease transaction costs and it will also create higher intraregional trade. Moreover, it will provide access to international market. Prabir De (2006) further explains that Neo classical classified different factors into only labor and capital and highlighted the performance of infrastructure in local areas development. In the point view of Hirschman and Myrdal (1958), who were the pioneers of development economics, social overhead capital plays crucial role to develop infrastructure in helping productive activities. Infrastructure network is crucial for the economy because it plays significant role in decreasing the natural inequality between different regions within a country [Prabir De (2006)]. Present study also explains that infrastructure quality is very important determinant of bilateral trade performance. He is of the view that transport costs have strong influence on trade flows. There are different views regarding infrastructure investments, as these are considered as countries endogenous choices.

Weiss (2008) provides a framework about the role of infrastructure in regional cooperation. Infrastructure investments and interventions reduce trade costs and encourage close intraregional and interregional trading linkages. The study suggests that reduced trade costs and barriers are important for the development of infrastructure. Furthermore, Fedderke and Garlick (2008), associate infrastructure and growth through different ways. Sometimes itacts as an input in the process of production. According to Fedderke and Garlick (2008), improvements in infrastructure reduce the cost of production. It encourages factor accumulation by providing facilities to human capital development.

Infrastructure contributes in economic growth during its fiscal stimulus effects. Infrastructure also plays significant role into growth of regions through the services it provides, which can be use as inputs to other economic activities. Its indirect contribution to economic growth is through externalities that mainly improve productivity. The facilitating characteristics of infrastructure tend to decrease cost and distribution margins in an economy by promoting domestic and international trade and market integration [Brooks (2011)]. Development of local ports can increase the potential of the whole region. On one side, it represents longer distance partners like China, Russia and India, on the other end; it represents Middle East and Europe. The development in local port capacity with better trade facilitation strategies leads to increase continental trade. The development of foreign trade greatly contributes to national economic growth and it puts heavy responsibility on the ports and shipping services [Anwar (2011)].

Infrastructure and trade openness has close link with each other. As mentioned above, improvement in infrastructure leads to increase trade among trading regions, which has direct influence on economic growth. Infrastructure in its all aspects can prove as engine to drive the economy of regions and major source to improve life standard of poor nations.

**Empirical Studies**

Relationship between infrastructure and trade liberalization is explain in many empirical studies as Sulieman and Albiman (2014) analyze the existence of dynamic relationship between infrastructure trade and GDP growth in Malaysia. They used data from the period of 19992010 and the variables of interest are; total trade, GDP, infrastructure along with the proxy for telephone line and total internal visitor arrival. The study uses co-integration/ARDL to evaluate the link between the variables. Statistical result shows that there exist causal relationships between infrastructure, trade, tourism, and economic growth.

Sajoodi et al., (2012) analyze the role of infrastructure on growth and development of Iran over the period of 1985-2008 by employing autoregressive distributive lag (ARDL). Infrastructure and real GDP are main variables. Proxies' uses for infrastructure in this study are railway, roadway, electricity, transportation, and telecommunication. Results reveal that telecommunication and transportation infrastructure significantly and positively affect economic growth of Iran. Results also indicate that impact of electricity production capacity on per capita output growth is not significant.

Babatunde (2011) finds the relationship between infrastructure, trade openness FDI and GDP. He employs OLS estimation technique to analyze the panel data of 42 Sub Saharan Africa countries over the time of 1980-2003. The study employs proxy of telephones lines for infrastructure; other variables include trade, GDP, inflation and FDI are the variables use in this study. Empirical results show that infrastructure development, TO and FDI has a significantly positive linked. Another study by Czernichet al., (2011) analyzes the association between broadband infrastructures on GDP growth. The estimation technique used for this purpose was OLS. They took the data from 1996-2007. Telecommunication, computers, cable T.V, GDP, population, and trade openness are the variables use in this study. Broadband diffusion has significantly enhanced economic growth of OECD countries. Results of the study show that there is positive relationship between broadband infrastructure and economic growth.

Lean and Smyth (2010) analyzed link between GDP growth, infrastructure and export prices. The author uses electricity generation as a proxy to infrastructure. The study consists of annual time series data from the time of 1970-2008 for country like Malaysia. The variables employed are electricity generation, real GDP and CPI. Estimation technique use in this study is ARDL (autoregressive distributive lag). Bound test was applied to examine the presence of a longterm equilibrium relationship between electricity

generation, real GDP, exports, and the CPI. All variables show an increasing trend especially after the era of 1990 except exports, which show a significant decline in 2000. Findings of the study also show that there is unidirectional Granger causality between GDP and electricity. Rehman et al, (2011) have studied the relationship between infrastructure availability and FDI inflows for Pakistan. They employ ARDL estimation technique by taking the data for the period of 1975- 2008. The literature shows that there is positive relationship between good infrastructure and foreign direct investment. They state that in order to attract foreign direct investment in host country availability of good quality infrastructure play a significant role.

Shepherd and Wilson (2006) present record of minimum distance road routes, which are connect different countries across Europe and Central Asia. Shepherd and Wilson (2006) took yearly data from the period of 1984-2004. Variables use in this study are expenditures of country, exports, imports, tariff rate and road distance. Study shows that good highways network quality is robustly related with higher trade flows. Gravity model use in present study suggests that improved road infrastructure could increase trade by 50% over baseline. Result demonstrates that cross-country overflows because of overland travel are vital. Also, add up to combination exchange could go up to 30% by overhauling streets and roads in only three nations like Albania, Hungary and Romania.

The effects of infrastructure, quality of regulation and changes in the competition regimes on air transport costs analyzed by Micco and Serebrisky (2004). The data use for cross-countries is from the period of 1990-2001. Variables use in this study includes real GDP, transport cost, trade that is sum of exports and imports. Along with these variables, population, corruption, distance, number of airports, telephone lines, weight and quality and government efficiency is also included. They use standard reduce form approach to estimate the significance of each of the factor that explain air transport cost. Results show that the share of air transport in US imports is significant, as it has increased from 24% in 1990 to 35% in 2000. They find that improvement in airport infrastructure and quality of regulation reduces transport costs as a result trade flows also increases.

**Summary and Gap Analysis**

The impact of infrastructure on trade and other macroeconomic variables has been study in recent years. Most of the studies show positive relationship of infrastructure with different variables. However, the literature on the relationship among electricity infrastructure and trade openness is not very clear for the case of Pakistan; therefore, it needs a detailed empirical analysis. Present study distinguished in that it will incorporate this important aspect. It relates to the several strands of the literature focused on different macroeconomic aspects of infrastructure along with trade liberalization. Present study conducted using an updated time series data set of electricity infrastructure indicators. Hence, the present study will explore this important dimension that is not yet studied for the case of Pakistan.

**Theoretical Framework**

**Endogenous Growth Theory**

This study is based on the Endogenous Growth Theory, developed by Romer (1990). The theory explained that long-run economic growth and trade performance are driven by internal factors of an economy rather than external forces. Unlike traditional growth models that treat technological progress as exogenous, Endogenous Growth Theory emphasized the role of deliberate investment in productive systems. Past studies based on this theory highlight that infrastructure development, innovation, and efficient use of resources improve productivity, lower transaction costs, and support sustained economic and trade growth over time.

**Relevance to the study**

The Endogenous Growth framework is particularly relevant for examining the relationship between electricity infrastructure and trade openness in Pakistan. Electricity infrastructure is a key input for production, industrial activity, and trade-related operations. Adequate and reliable electricity reduces production delays, lowers costs, and enhances export competitiveness, while shortages restrict trade performance. Within this framework, trade openness is also influenced by domestic financial development, exchange rate competitiveness, and population dynamics. Therefore, the model provides a suitable theoretical basis to analyses how improvements in electricity infrastructure and other internal factors like population growth along financial development affects Pakistan’s trade openness.

**Implication of the Theory**

According to Endogenous Growth Theory, strengthening electricity infrastructure can generate long-term benefits for trade and economic growth. The theory implies that sustained investment in electricity supply increases productivity and encourages greater participation in international trade. In accordance to the present study, expanding and stabilizing electricity infrastructure, alongside supportive financial and macroeconomic policies, can enhance trade openness and promote sustainable economic growth in the long run.

**Data and Methodology**

The betterment in infrastructure base is a pre-requisite for supporting and quickening monetary development and social advancement in a nation [Bhatia, (1999)]. It has a great impact on the trade performance of the regions. The development in hard and soft infrastructure has largely facilitated the trade expansion between regions [Brooks and Hummels, (2008)]. This chapter contains methodology, data, and estimation technique in order to analyse the relationship between electricity infrastructure and trade openness. The latest software EViews 12 will be used for estimation because it has the property of selecting best model itself.

The organization of this chapter is as follows: The section 4.2 consists of model specification, whereas; section 4.3.is comprised of justification of the variables. The section 4.3.1 includes the data sources. Finally, the estimation techniques are explained in section 4.4.

**Model Specification**

In order to investigate the impact of electricity infrastructure on trade openness of Pakistan it is necessary to specify and estimate a model linking them together. ARDL model can be formulated by using following equations:

$$TO_t = \beta_0 + \beta_0 EC_t + \beta_1 REER_t + + \beta_2 POP_t + \beta_3 FD_t + \mu_t$$

Whereas;

't' in subscript denotes the time period from 1991-2024.

TO = Trade openness (trade as % of GDP)

POP = Population growth (annual %)

REER = Real effective exchange rate index (2010=100)

FD = Financial development (proxy used is m2 as percentage of GDP)

EC = Electric power consumption (kWh per capita)

$\mu_t$= Error term

Trade openness (trade as percentage of GDP) is dependent variable that is obtained by summing up imports and exports. It is important to introduce the other determinants of trade openness. Alesina and Wacziarg (1998) and Nordas et al., (2004) previously analyze these determinants. Electricity Infrastructure is main focused variable. In previous studies, different proxies for infrastructure have been used like roads, railways, and electricity to measure infrastructure [Brooks (2008)]. Therefore, present study is also using electricity consumption as a proxy. For FD the proxy used in this study is M2.

**Variables Justification**

Trade openness referred to the phenomenon of making efforts to transfer of goods and services, information, labour, capital and thoughts across the borders [Shahbaz, (2012)].

Infrastructure and trade are inter-linked with each other. It has a direct impact on trade [Sulieman and Albiman, (2014)]. Francios and Machim (2007) argued that good infrastructure helps to reduce the cost of transportation, which in turn have the positive impact on trade. Moreover, according to Shahbaz and Lean (2012) electricity consumption is also considered an important infrastructural variable. Castaneda et al., (2000) conducted the research and concluded that infrastructure highways and electricity have significantly positive impact on manufacturing, which will in turn lead to increase the trade performance of the country [Zhang & Graham (2020)].

Real effective exchange rate is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs (WDI, 2024). REER is one of the important policy variables in an open economy [Khan et al., (2012)]. REER is helpful to infer the direction of trade flow between two countries [Zakaria and Ghauri, (2012)]. According to the economists and policy makers, at the point when a nation expands conversion standard, the price of domestic products falls as compare to its trading partner. This results into an increase in global interest of exports and decline in imports [Khan et al., (2012)]. Data of REER is taken from WDI from 1991-2024.

Population growth is a demographic variable. Population growth was an important indicator in the process of structural change. The role of population growth rose in the relative price of the forming and in manufacturing employment share Prati et al, (2011) explained the importance of population for the developing countries, which are more dependent on imports. He argued that with increase in population the demand of import would increase significantly. Moreover, they have found that it is positively related with trade.

**Variables Data Source**

Data for all the variables is retrieved from world development indicators (WDI) from the period of 1991-2024.

**Estimation Techniques**

The decision about estimation technique will be made after checking the order of integration of the variables. The order of integration will decide that which estimation technique to be employed. If the order of integration is one then cointegration will be used and if it is mixture of one and zero then ARDL will be employed. The autoregressive distributive lag (ARDL) method was first introduced by Pesaran and Shin (1999), and later it was extended by Pesaran et al., (2001). The ARDL technique has advantage over other estimation techniques of not requiring a specific identification of the order of the underlying data. According to Pearson and Shin (1999), the problem of serial correlation and endogeneity can be addressed by establishing a correct selection of lags in ARDL model. This method differentiates dependent from independent variables [Suleiman and Albiman, (2014)]. It is suitable for small sample size. The application of ARDL consists of following three steps.

The first step will be to check for the stationary of the variables. The test will be of the augmented dickey-fuller. Next step will be the ARDL bound test that allows the mixture of Integrated of order (1) and (0) variables. Therefore, if all the variables are integrated of order one and zero then it can be employed [Pearson et al., (2001)].

The ARDL bounds testing approach to co-integration depends upon critical values by Pesaron et al. (2001) to take decision about co integration among variables. There exists co integration among variables if calculated value of F-statistic is more than upper critical bound. If lower critical bound is more than computed F-statistic than computed F-statistics then hypothesis of no cointegration may be accepted [Shahbaz and Fridun, (2011)]. If the computed F-statistic value falls between the critical values, no conclusive decision can be made regarding long run co integration [Suleiman and Albiman, (2014)]. The next stage will be to test long run and short run coefficients of ARDL. Along with long run results of the variables in the model, there is an error correction term, which indicates the speed of adjustment back to long run equilibrium after a shock. If the error correction term is significant, it means that the variables have a tendency to attain long run equilibrium.

In addition, to determine the stability of the ARDL bounds testing approach to co-integration, stability tests namely cumulative sum (CUSUM) and cumulative sum of square (CUSUMSQ) will be applied [Shahbaz and Lean, (2012)]. The next step will be the implication of diagnostic tests. First diagnostic test will be of heteroscedasticity. The null hypothesis of this test is no heteroscedasticity. The criteria of selection or rejection of null hypothesis is to check the Pvalue. If it is greater than 0.1%, then null hypothesis will be accepted, otherwise it will be rejected. Serial correlation LM test will used after it. The criteria of null hypothesis acceptance or rejections will remain same. Finally, normality test will be employed. This test statistic can be used to test a null hypothesis whether variables are considered to have a normal distribution. The test uses the assumption that error term is normally distributed and the coefficients are asymptotically normally distributed. If p-value exceeds from 0.1, then null hypothesis will be accepted which will show that normality assumptions are satisfies.

**Results and Discussion**

Effect of electricity infrastructure on trade openness of Pakistan is analysed in the present study. Infrastructure is a settled capital venture by government and firm that makes conceivable all its monetary exercises. It incorporates general classifications, for example, telecom, transportation, utilities, waste evacuation, instruction, medicinal services, innovative work, and preparing offices. Besides, transportation incorporates streets, ports, railroads and plane and utilities incorporates power and water. Furthermore, transportation includes roads, ports, railways and airplane and utilities includes electricity and water [Sulieman and Albiman (2014)].

Infrastructure is an important determinant for the development of any economy. In every single creating country, infrastructure advancement is the most basic step in putting the economy destined for success. Pakistan needs roads and railroads to transport goods and services from one spot to other and afterward ports and air terminals to send out our industrial products to foreign trading partners [State Bank of Pakistan, (2013)].

Apart from infrastructure, trade is among those factors that increase economic activities [Sulieman and Albiman (2014)]. Pakistan has liberalized its trade since late 1980s.Numerous studies illustrate that infrastructure promote trade by decreasing trade costs and increasing competition between trading fellows [Fedderke and Garlick (2008)].

In order to assess the impact of electricity infrastructure on trade openness, ARDL bound testing techniques that was proposed by Pesaron et al., (2001) was employed. As the sample size of present study is small and ARDL estimation technique deals well with the small sample size. This chapter is organized as follows: Section 5.2 consists of the empirical results. This section is further divided into four sub sections. Section 5.3 contains diagnostic and stability tests.

Section 5.4 and 5.5 includes the short run and long run results.

**Empirical Results**

The present study used a proxy of infrastructure namely electricity consumption to run the regression. The estimation is done in order to analyze the influence of infrastructure on trade openness. Estimation results are given below:

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**Unit-Root Test**

In case of time series study, it is essential to examine the stationarity of the variables in order to identify the order of integration [Ali et al., (2015)]. For this purpose, the Standard ADF unit root test was used [Atif etal., (2010)]. The results obtained are listed in the table 4.1.

The unit root test results show that TO and FD(M2) are stationary at first difference, (integrated of order is one). Whereas, POP, REER, and EC are stationary at level that shows that they are integrated of order zero. This implies that in order to check the long run relationship between the variables, ARDL bound testing procedure is applicable [Ali et al., (2015)]. While optimum lag lengths are chosen by utilizing Schwarz information criteria.

**Table 1: Unit-Root Test**

| Variables | Level | | 1st Difference | | Result | Order of integration |
|---|---|---|---|---|---|---|
| | t- values | P-Value | t- values | P-Value | | |
| TO | -2.20 | 0.03 | -5.76 | 0.00 | Stationary at 1st difference | I (1) |
| M2 | -2.30 | 0.42 | -4.45 | 0.00 | Stationary at 1st difference | I (1) |
| REER | -5.18 | 0.00 | -2.71 | 0.18 | Stationary at level | I (0) |
| POP | -2.75 | 0.01 | -4.19 | 0.002 | Stationary at level | I (0) |
| EC | -2.92 | 0.04 | -3.85 | 0.05 | Stationary level at | I (1) |
| Critical Value at at 1% is -3.69, 5% is -2.97, and at 10 % is -2.62. | | | | | | |

**The Bound Testing Approach**

The bound test is applied to check the long run relationship between the variables. The results obtained from bound test reveals that long run relationship in the variables exists as shown below in the table 4.2, the calculated F-statistic is larger than the upper critical values for all the significance level. Therefore, null hypothesis stating no long run relationship exists was rejected. We accepted the alternative hypothesis of $H_1$ of long run relationship.

**Table 2: Bound test result**

| Equation | F-statistics | Significance level % | Critical bound | |
|---|---|---|---|---|
| | | | F-statistics | |
| | | | I (0) | I (1) |
| EQ | 15.77 | 1% | 5.14 | 6.61 |

After checking the pre requisite of bound testing approach, we can proceed to the long run and short run results including the results of Error correction model. The subsequent paragraphs are reporting and discussing the results of both long and short run relationships.

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**Diagnostic Tests and Stability Test**

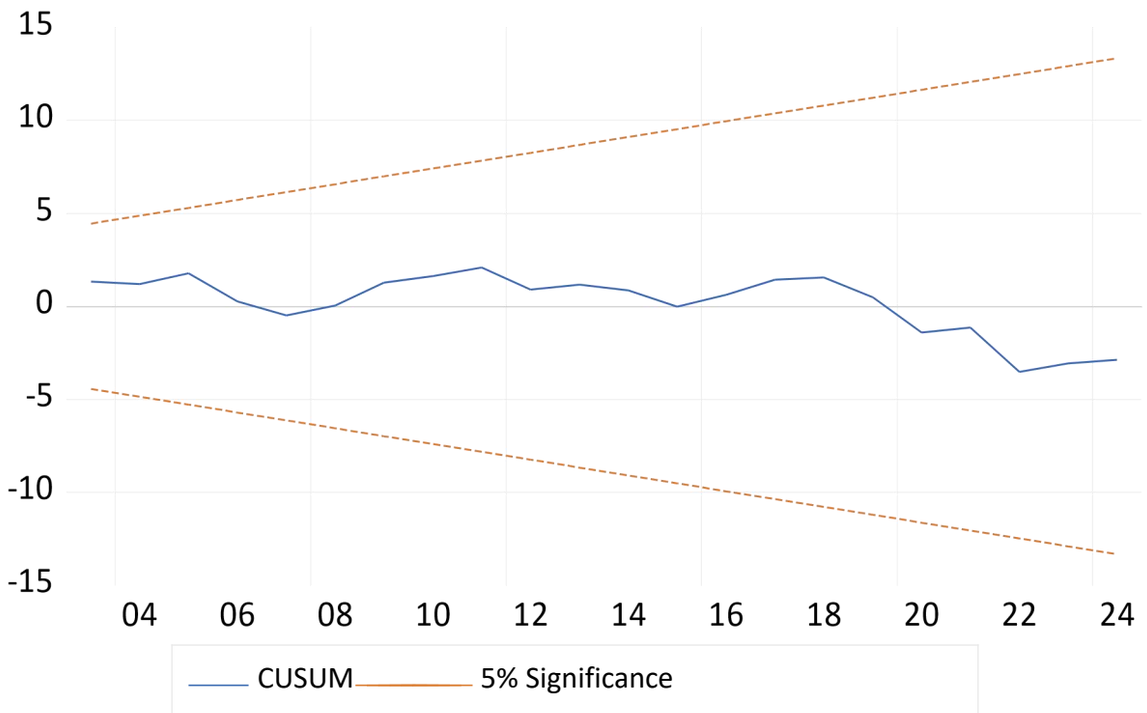
The present study used a series of diagnostic tests and CUSUM test to check the stability of the ARDL model for Pakistan. These tests were applied later after long run results, but reported before as they are required. These results confirm the authenticity of the long run results. The results of diagnostic test are given below in table 5.3. Whereas, the results of stability test are shown in the graphs plotted below.

**These are the diagnostic tests results:**

**Table: 3 Diagnostic Tests**

| Post estimation Test | Prob. Value |
|---|---|
| Heteroskedasticity Test | 0.20 |
| Breuch-Godfrey Serial Correlation LM Test | 0.70 |
| Normality Test | 0.92 |
| *P > 0.1, then reject null hypothesis. | |

Result shows that there is no autocorrelation in residuals. Moreover, result reveals that there is no evidence of heteroscedasticity effect. The normality test indicate that the coefficients of error term are normally distributed. Lastly, the stability test indicates that the CUSUM and CUSUM SQ are used within the defined critical bounds. This shows that the coefficients are in the ARDL model are stable at 5 percent for Pakistan. This means that model is stable. The results are showing that the data used in this study is normal and whole model is stable.



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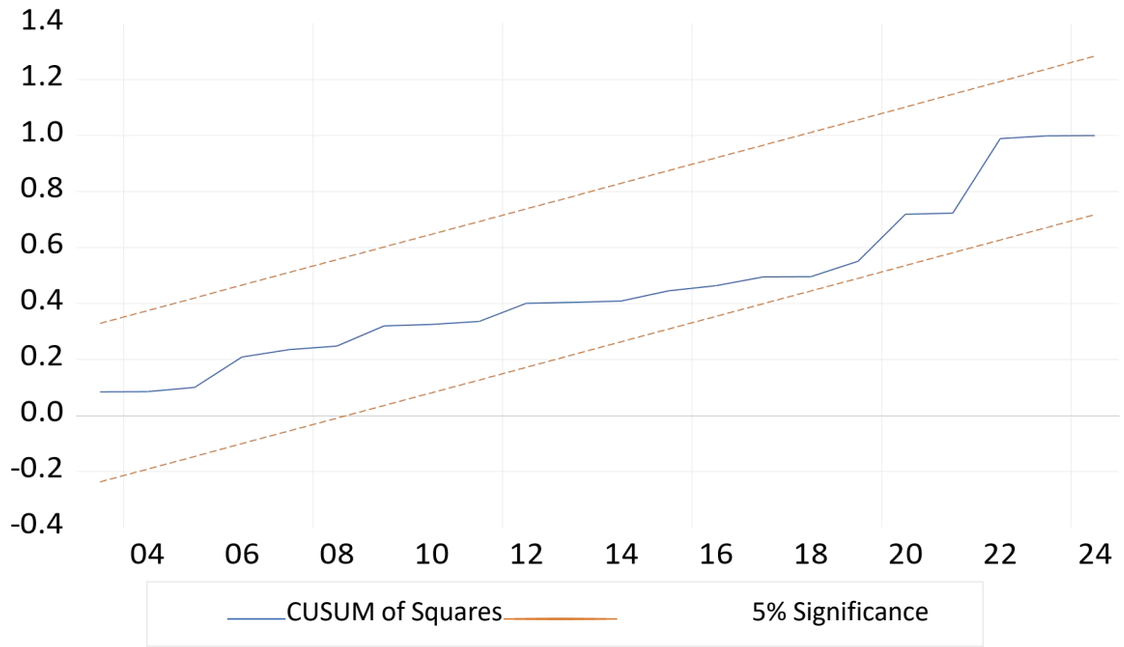


**Short Run Results**

Before explaining long run results, it is also important to report short run results. The short run results of equation are given below in the table 5.5. Short run results indicate that electricity consumption is positively affecting the trade openness in the short run. With one percent increase in electricity, consumption will cause the trade openness to increase by 0.24 percent in the short run. Whereas, with one percent increase in REER, trade openness will decrease by 0.19 percent in short run. Population growth affect for trade openness is found to be negative and significant in short run. One percent rise in population growth, will decrease TO by 11.20 percent.

The derivation of error correction model from ARDL can be done by using simple linear transformation Banejee et al., (1993). The ECM for short run relationship is attained that describes how the model converges to the equilibrium path. In addition, it has the ability to integrate short run adjustment with long run equilibrium without losing the long run information. The results of ECM indicate that the co-integrated coefficient of electricity consumption is significant at 0.72 %. The results indicate that electricity consumption have restored its equilibrium after bearing short run shock faster than another variable.

**Short Run Results**

| Variables | Coefficient t-value |
|---|---|
| D(EC) | 3.39<br>(0.24) |
| D(REER) | -0.19<br>(-2.46) |
| D(POP) | -11.20<br>(-4.52) *** |
| D(M2) | 0.60<br>(8.07) |
| ECT | -0.72<br>(-10.76) * |
| ***=1 %, **=5%, *=10% | |

Advance Journal of Econometrics and Finance
Vol-4, Issue-1, 2026

**The Long Run Results**

Long run results of all the variables of interest are given below:

| Regressors | Coefficient<br>(t-value) |
|---|---|
| C | -110.8<br>(-4.18) |
| M2 | 0.60<br>(8.70) *** |
| EC (-1) | 58.3<br>(4.86) |
| POP | 8.17<br>(3.20) * |
| REER | -0.19<br>(-2.46) *- |
| ***= 1%, **=5%, *=10% | |

**Results and Discussions**

The purpose of this study was to analyse the effect of electricity infrastructure on trade openness of Pakistan. The long run results of all the variables are presented in table 5.5. Electricity Infrastructure is major focused variable. It has positive significant impact on trade openness of Pakistan. It is positively related with trade of country. To analyse the impact of infrastructure on trade openness, the present study incorporated proxy of infrastructure like electricity consumption.

Electricity consumption has positive relation with trade openness. It is significant not only in short run but also in long run. Long run results presented in table 5.5 show that with one percent increase in electricity consumption cause the trade openness by 58 percent. There is huge literature available, which supports the results. The studies of (Limao & Venebles,2001; Fedderke & Garlick 2008; Sulieman and Albiman,2014) support the positive relationship of infrastructure and trade openness. Infrastructure such as electricity is important for manufacturing process. If industries are getting nonstop supply of electricity, then their production will increase. As a result, they will produce surplus and eventually that surplus goods will become the exports of nation. Hence, infrastructure has a positive impact on trade openness.

The short and long run results show the significant negative influence of REER on trade openness. The literature of Akhtar and Hilton (1984) and Bailey et al., (1987) support the results. They have provided the evidence that one-unit increase in exchange rate has negative impact in the long run over total exports of industrial goods Akhtar and Hilton (1984). One percent increases in REER means the appreciation of currency that means exports are expensive and imports are cheaper. Since, Pakistan import expensive products like fuel that has negative impact on trade. As our exports are expensive, that will result in retaliation [Akhtar and Hilton (1984)]. The coefficient of real effective exchange rate shows one percent increase in real effective exchange rate will cause the trade openness to reduce by 0.19 percent. According to theory, if the exporters are risk averse, then due to the unexpected change in exchange rate exports decreases. The reason behind this decline in exports is that the expectations of exporters regarding profit reduced Arize, (1997). Kenen and Rodrik (1986) and Pritchett (1991), have found through empirical studies that there is negative association among the trade openness and exchange rate fluctuations.

Proxy of financial development (M2) is one of the most significant and robust variables, showing a stable positive impact in both the short and long run. As with 1% increase in Financial Development (M2) leads to a 0.60% increase in Trade Openness (TO), both immediately and in the sustained equilibrium. The effect of population on trade

liberalization is significantly positive as shown in the table 5.5. The long run results show that with one percent increase in population growth, trade will improve by 8.17 percent respectively. Many studies support the present results including Prati et al., (2011) explained the importance of population for the developing countries that are more dependent on imports. He argued that with increase in population the demand of import would increase significantly; in turn, the volume of trade would increase multiple times. Leukhina and Turnovsky,(2015) also explained the positive role of population for trade openness. Moreover, trade flows change due to the change in size and consumption of import demand along with the increase in working population. For example, in one hand whenever labour force increases, the production level also increases depending upon the efficiency of the labours. The producers will produce surplus output and that surplus will be exported. On the other hand, due to increase in population at large scale, the developing countries can face the problem of shortage in basic food items. So, in order to meet the needs of the nation, country imports from other countries. Hence, in both ways population growth is causing trade to expand (World Trade Report, 2013).

**Conclusion and Policy Recommendations**

**Conclusion**

The present study investigates the impact of infrastructure on trade openness. Infrastructure is very important factor that play vital role in the process of development. Infrastructure, particularly electricity is essential for regional cooperation and integration [Kumar and De (2008)]. Along with electricity infrastructure, trade openness is also very important factor to discuss. Trade openness has played a fundamental role in diffusion of resources from developed to developing countries. Trade factor has always been the top priority of all developing countries, specifically for Pakistan.

The huge literature is available about the importance of infrastructure for trade openness. Francois and Machim, (2007) found the direct impact of infrastructure on trade openness. According to Hansen (1965), infrastructure contributes to economic development through enhancing efficiency and by giving facilities that make the life easy. The non-availability of these facilities in any country can reduce the productive efficiency of the population. In the light of existing literature about the importance of infrastructure for trade openness, the present study used ARDL bound testing method. This technique was employed to checkthe long run relationship between infrastructure and trade openness in case of Pakistan from 1991-2014. Empirical evidence established the existence of long run as well as short run relationship between these two variables for Pakistan. The ECM affirms that the long run equilibrium is attained after a shock. The analysis revealed that trade openness is positively and statistically significantly affected by infrastructure. The present study used the proxy for infrastructure like electricity consumption. The results of ARDL model showed infrastructure have positive long run relation with trade openness. The results of this research are not new. Previously, Suleiman and Albiman, (2014) found the positive relationship between infrastructure and TO. According to the report of State Bank of Pakistan, infrastructure is the fundamental necessity in the working of any nation. In order to strengthen the economy, Pakistan needs a properly functioning infrastructure along with electricity provision. People need electricity to power their homes and industry. If the country has a good electricity infrastructure, then the manufacturing in the industries will increase. This will result in increase in exports. Therefore, in one or other hand, it is affecting the trade performance of a country. Since, the number of existing literatures validates the findings of present study. The results obtained from present study shows that there exists positive relation between both variables. It means that the alternate hypothesis of the present study is accepted that the *"Improvement in Electricity Infrastructure facilitates trade openness."* Likewise, the REER has shown significantly negative impact on openness of trade in case of Pakistan. Kenen and Rodrik (1986) previously translated these results. According to study, the irregular changes in exchange rate reduces the exports by reducing the profit expectations that has the negative impact on trade. The coefficient of financial development is significantly positive according to the results. The results of equation are showing the positive impact of population on trade openness. Prati et al., (2011) explained the importance of population for the developing countries, which are more dependent on imports. He argued that with increase in population the demand of import would increase significantly. Whereas, the impact of infrastructure observed to be highly significant and positive on trade liberalization.

To summarize whole analysis, it is concluded that the trade openness is being negatively affected by REER. Whereas, findings shows that infrastructure and trade are positively related. Electricity consumption has positive impact on trade openness. [Nordas and Piermartini (2004), Suleiman and Albiman (2014).

**Policy Recommendations**

In the light of the results obtained from present study to achieve long run economic growth, and development in the economy, following policy implications are suggested;

According to the historical analysis of infrastructure variables, the present study found that, the infrastructure in Pakistan since last two decades have been growing at low pace (Limao, 2001). Therefore, steps need to be taken for the improvement of electricity infrastructure. Government needs to allocate the concrete share of Budget for the improvement in power generation sector.

Since electricity, consumption and production are closely linked with the imports and exports of country. Investment in electricity generation should be the top priority of the public sector development program. Furthermore, the respective authorities need to control unnecessary and excessive load shedding because it affects the manufacturing sector adversely. As a result, exports will decrease due to low level of production.

**References**

AhMAd, N. A., Ismail, N. W., & Hook, L. S. (2011). The role of ICT infrastructure on Malaysian trade. *Journal of Economics and Management*, *5*(1), 140-148.

Ahmed, H. J. A., Bashar, O. H., & Wadud, I. M. (2012). The transitory and permanent volatility of oil prices: What implications are there for the US industrial production? *Applied Energy*, *92*, 447-455.

Akhtar, M. A., & Hilton, R. S. (1984). *Exchange rate uncertainty and international trade: Some conceptual issues and new estimates for Germany and the United States*. Federal Reserve Bank.

Ali, H. S., Yusop, Z. B., & Hook, L. S. (2015). Financial development and energy consumption nexus in Nigeria: An application of autoregressive distributed lag bound testing approach. *International Journal of Energy Economics and Policy*, *5*(3), 816-821.

Alesina, A., & Wacziarg, R. (1998). Openness, country size and government. *Journal of public Economics*, *69*(3), 305-321.

Anwar, S., & Sun, S. (2011). Financial development, foreign investment and economic growth in Malaysia. *Journal of Asian economics*, *22*(4), 335-342.

Arnold, J. M., Javorcik, B., Lipscomb, M., & Mattoo, A. (2016). Services reform and manufacturing performance: Evidence from India. *The Economic Journal*, *126*(590), 1-39.

Arize, A. C. (1997). Conditional exchange-rate volatility and the volume of foreign trade: Evidence from seven industrialized countries. *Southern Economic Journal*, 235-254.

Babatunde, A. (2011). Trade openness, infrastructure, FDI and growth in Sub-Saharan African countries. *Journal of management policy and practice*, *12*(7), 27.

Bailey, M. J., Tavlas, G. S., & Ulan, M. (1987). The impact of exchange-rate volatility on export growth: some theoretical considerations and empirical results. *Journal of Policy Modeling*, *9*(1), 225-243.

Bougheas, S., Demetriades, P. O., & Morgenroth, E. L. (1999). Infrastructure, transport costs and trade. *Journal of international Economics*, *47*(1), 169-189.

Brooks, D. H. (2010). Regional cooperation, infrastructure and trade costs in Asia. In *Trade facilitation and regional cooperation in Asia*. Edward Elgar Publishing.

Brooks, D. H. (2008). *Linking Asia's trade, logistics, and infrastructure* (No. 128). ADBI Working Paper.

Calderón, C., Easterly, W., & Servén, L. (2003). Latin America's infrastructure in the era of macroeconomic crises. *The Limits of Stabilization: Infrastructure, Public Deficits, and Growth in Latin America. Stanford University Press y Banco Mundial*, 21-94.

Clarke, R. A., & Knake, R. K. (2014). *Cyber war*. Old Saybrook: Tantor Media, Incorporated.

Czernich, N., Falck, O., Kretschmer, T., & Woessmann, L. (2011). Broadband infrastructure and economic growth. *The Economic Journal*, *121*(552), 505-532.

Donaubauer, J., Glas, A., Meyer, B., & Nunnenkamp, P. (2018). Disentangling the impact of infrastructure on trade using a new index of infrastructure. *Review of World Economics*, *154(4), 745-784.*

Feltenstein, A., & Ha, J. (1995). The role of infrastructure in Mexican economic reform. *The World bank economic review*, *9*(2), 287-304.

Fedderke, J. and Bogeti Z. (2006). "Infrastructure and Growth in South Africa: Direct and Indirect Productivity Impacts of 19 Infrastructure Measures", *World Bank Policy Research Working Paper 3989, August 2006.*

Fedderke, J., & Garlick, R. (2008). Infrastructure development and economic growth in South Africa: A review of the accumulated evidence. *Policy paper*, *12*, 1-28.

Francois, J., & Manchin, M. (2013). Institutions, infrastructure, and trade. *World development*, *46*, 165-175.

Haider, A. (2012). *Information systems for engineering and infrastructure asset management*. Springer Science & Business Media.

Harrison, A. (1996). Openness and growth: A time-series, cross-country analysis for developing countries. *Journal of development Economics*, *48*(2), 419-447.

Hansen, N. M. (1965). Unbalanced growth and regional development. *Economic inquiry*,

*4*(1), 3.

Hardy, A. P. (1980). The role of the telephone in economic development. *Telecommunications policy*, *4*(4), 278-286.

Kenen, P. B., & Rodrik, D. (1986). Measuring and analysing the effects of short-term volatility in real exchange rates. *The Review of economics and statistics*, 311-315.

Kumar, N., & De, P. (2008). *East Asian Infrastructure Development in a Comparative Global Perspective: An Analysis of RIS Infrastructure Index*. Research and Information System for the Non-Aligned and Other Developing Countries.

Lean, H. H., & Smyth, R. (2010). Multivariate Granger causality between electricity generation, exports, prices and GDP in Malaysia. *Energy*, *35*(9), 3640-3648.

Limao, N., & Venables, A. J. (2001). Infrastructure, geographical disadvantage, transport costs, and trade. *The world bank economic review*, *15*(3), 451-479.

Mirza, F. M., & Arif, A. (2022). Infrastructure and trade: A review of the literature with a focus on South Asia. *Journal of Economic Surveys, 36*(3), 791–823.

Nordås, H. K., & Piermartini, R. (2004). *Infrastructure and trade* (No. ERSD-2004-04). WTO Staff Working Paper.

Prati, M. A., Ricci, M. L. A., Christiansen, L. E., Tokarick, M. S., & Tressel, M. T.

(2011). *External performance in low-income countries*. International Monetary Fund.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.

Pinstrup-Andersen, P., & Shimokawa, S. (2006). Rural infrastructure and agricultural development. *World Bank*.

Rehman, C. A., Ilyas, M., Alam, H. M., & Akram, M. (2011). The impact of infrastructure on foreign direct investment: The case of Pakistan. *International Journal of Business and Management*, *6*(5), 268.

Romer, P. M. (1990). Endogenous technological change. *Journal of political Economy*, *98*(5, Part 2), S71-S102.

Sahoo, P., Kumar Dash, R., & Nataraj, G. (2010). China's growth story: The role of physical and social infrastructure. *Journal of Economic Development-Seoul, 37(1), 53.*

Shahbaz, M. (2012). Does trade openness affect long run growth? Cointegration, causality and forecast error variance decomposition tests for Pakistan. *Economic Modelling*, *29*(6), 23252339.

Sojoodi, S., Mohseni Zonuzi, F., & Mehin Aslani Nia, N. (2012). The role of infrastructure in promoting economic growth in Iran. *Iranian Economic Review*, *16*(32), 111-132.

Shepherd, B., & Wilson, J. S. (2006). Road infrastructure in Europe and Central Asia: Does network quality affect trade? *World Bank Policy research working paper*, (4104).

Suleiman, N. N., & Albiman, M. M. (2014). Dynamic relationship between tourism, trade, infrastructure and economic growth: Empirical evidence From Malaysia. *Journal of African Studies and Development*, *6*(3), 49.

Weiss, J. (2008). A Framework for Considering Infrastructure for Regional Cooperation.

*Infrastructure and Trade in Asia*, 15-27.

Zakaria, M., & Ghauri, A. B. (2011). Trade Openness and Real Exchange Rate: Some Evidence from Pakistan. *Romanian Economic Journal*, *14*(39). State bank of Pakistan Report, 2013 Accessed on 18th march, 2015:

http://www.sbp.org.pk/reports/annual/arFY12/Vol-2/eng/CompleteReport.pdf

World Trade Report, 2013

Accessed on 15th October, 2015 http://beta.tutor2u.net/economics/reference/terms-of-trade