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IMPACT OF INFRASTRUCTURE AND INSTITUTIONAL QUALITY ON INDUSTRIAL SECTOR OF PAKISTAN

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ABSTRACT

The purpose of this study is to analyze the impact of infrastructure and institutional quality on industrial growth of Pakistan. The study covers the time span of 1984 – 2012. The ARDL (Auto Regressive Distributive Lag) is employed to see the combine and individual impact of infrastructure and institutional quality on industrial growth of Pakistan. Both infrastructure and institutional quality are measured through two distinct proxies. Infrastructure and institutional quality is found to be positively related to industrial growth. Based on the results of present study it is beneficial to make the institutions strong and invest more on infrastructure development.

Key words: **I**nfrastructure, institutions, industrial sector

JEL Classification: G32, G34

1. INTRODUCTION

Infrastructure is an important determinant to handle the universal development challenges of modern world: social stability, urbanization, climate change mitigation and adaptation, and natural hazards. Unless and until countries build an inclusive growth based infrastructure, they will find it harder to cope with the challenges. Countries are required to focus on private as well as public sector infrastructure along with improving institutional quality

Society comprises of different individuals, their goal is not only to maximize individual's welfare but of society as a whole. Welfare level can be calculated through analyzing the quality of life an individual possess (Aschauer, 1990). Aspirations of economic development are major reason behind the expansion of infrastructure, as it ensures better quality of life. Without an infrastructure that scales up growth, countries will find it harder to meet unmet basic needs. Apart, they struggle to improve competitiveness (Aschauer and Greenwood, 1985).[2] Providing infrastructure without the sound institutional framework will pose a threat to sustainable economic growth. Institutions are made by government, to shape the incentives for key economic actors of the society. Economies facing institutional bottlenecks fail to compete as in all its forms and shapes, it assists in shaping the performances of economic agents to attain sustainable economic growth. While the availability of infrastructure speeds up specialization process. In contemporary

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[2]Telecommunication, transportation, utilities, waste removal, education and health care.

times, the institutional deficiencies and loopholes are the main reasons behind less growth promoting investments. To accelerate growth, overall or sectoral, the imperative need is to provide access to markets. Hence, both institutional quality and infrastructure have significant impact on industrial growth (Valeriani and Peluso, 2011).

Many studies have been conducted in order to analyze the linear relationship between infrastructure and institutional quality [Sunday and Okon (2013), Esfahani and Ramirez (2002) and Mamatzakis (1999)]. Whereas, the perspective of combine impact of infrastructure and institutional quality on industrial growth is yet unexplored. Since last two decades, Pakistan is facing the deteriorating conditions of infrastructure. Imran and Niazi (2011) called the low quality of infrastructure a hindrance in achieving the sustainable growth of production sector in Pakistan. This low industrial growth slowed down the economic growth of Pakistan (Power, 1963). Keeping in view the importance of industrial sector, solution for these problems is a necessary condition for taking Pakistan to a self-sustaining economy.

There is a set of theories, who affirmed the role of institutions in shaping the pattern of economic development. They grounded and based their analysis on the development of industrial sector (Seidman and Seidman, 1994). Since institutions play pivotal role in paving or restraining the way of economic growth; they may help the economy in fostering growth or proves to be a friction in the implementation of industrial policies. Keeping in view the importance of institutions and infrastructure, the present study will evaluate their combined impact on industrial growth. The hypothesis of the study is "*The combine effect of infrastructure and institutional quality on industrial growth is positive*".

Present study adapted the framework of Okoh and Ebiok (2013) to evaluate the long run combined impact of institutional quality and infrastructure on industrial growth of Pakistan. Based on the findings, few policy recommendations are stated.

The rest of the study is organized as follows. Section 2 makes a comprehensive theoretical and empirical appraisal of the existing literature. Section 3 contains the data description and methodology that explains the estimation technique. Section 4 presents the results and discussion while section 5 concludes the study.

2. LITERATURE REVIEW

Following section contains comprehensive theoretical and empirical appraisal of the existing literature, to analyze the impact infrastructure and institutional quality on industrial growth of Pakistan.

2.1. Infrastructure and Industrial Growth

D. Biehl's theory assumes that communication and transportation is an important part of infrastructure (Biehl 1986). Kosempel (2004) presented the *Theory of Long Run Development, explaining the association between infrastructural development and long run growth of the economy. Also* the *Development Theory of*

Transportation showed a positive association between infrastructural development and overall development of country with special focus on underdeveloped countries (Njoh 2009).

The individual, as well as combine effect of infrastructure investment and institutional quality on economic growth have been examined by Okoh and Ebi (2013). The study ultimately presents three results. Increase in infrastructure investment is found to have positive relation with economic growth. Lower institutional quality renders economic growth. While, the combine effect of infrastructure investment and institutional quality on economic growth turned out to be insignificant. The above mentioned study made it clear that the positive affect of infrastructure investment is dependent on institutional quality. The individual impact of infrastructure and institution on growth are examined in many studies, including Rodrik *et.al.* (2004), and Chong and Calderon (2000).

Esfahani and Ramirez (2002) contributed to literature by evaluating contribution of institutions and infrastructure to GDP in a cross-country analysis. The study employed simultaneous equation model to avoid simultaneity problem. The study incorporated data of 75 countries for the time-period of 1965-1995. Telephone lines were used as proxy for infrastructure. The result showed that the contribution of infrastructure to GDP is substantial and the contribution overweighs the cost of provision of these services. The results suggested that apart from other factors, infrastructure is of vital importance for development.

Mamatzakis (1999) while examining the impact of public infrastructure on Greek manufacturing sectors, found that improvement in infrastructure reduce the cost of production hence positive impact on productivity. It is clear from the study that cost elasticity is negative with respect to public infrastructure for most of the industries.[3] High investment in public infrastructure, decreases the cost of production and increases efficiency and growth of industrial sector of Pakistan. There exist the evidences of both negative and positive relationship between infrastructure and industrial growth rate. Shah (1992) conducted a study for 26 Mexican manufacturing industries over the time span of 1970-1987. Gauss-Newton's method is used to evaluate the impact of investment in public sector infrastructure on performance of industrial sector. They imposed price homogeneity condition, which led to system of equation non-linear in parameters. Therefore, an estimation technique, which is useful to remove heteroskedasticity, was employed. The reported study found out that public infrastructure is having very small and positive impact on industrial profitability. They also found private sector responded more positively to direct/voluntary investment in public infrastructure as compare to involuntary/indirect investment.

[3]Cost of production has negative relation with availability of infrastructure. Investment in public infrastructure facilitates industrial transactions. Therefore, investment in public infrastructure will reduce cost of production in industries.

Demurger (2001) analyzed the relationship of infrastructure and growth for china. The researcher analyzed 24 provinces of China for the period of 1985-1998. According to development strategies, investment should be made considering the importance of that particular sector. From year 1960 onwards, there was stress on heavy industry development and provisional self-sufficiency since infrastructure improvement played pivotal role in market development. Therefore, by making it imperative to determine that, underdeveloped infrastructure networks led to growing regional disequilibrium in China. Simple growth model revealed different geographical location, infrastructure investment, and telecommunication facilities matter a lot for better performance of provinces.

Arnold *et.al.*, (2014) examined Indian manufacturing growth for the time span of 1993-2005 by using time series model. This study employed Ordinary Least Square (OLS) to test Cobb Douglas Production function. The study analyzed both policy changes and its implementations. Along with finding positive relationship between private sector participation and services in manufacture sector, the study found, development of infrastructure led to industrial growth. However, they analyzed just the impact of infrastructure on industrial growth regardless of institutions.

2.2. Institutions and Industrial Growth

Opponent to very famous *Greece the Wheel Hypothesis,* there exists *Sand the Wheel Hypothesis.* Meon and Sekkat (2005) presented several evidences supporting the concept of Sand the Wheel Hypothesis. The paper concluded that inefficient institutions worsen the impact of corruption of economy. Further it was found that corruption not only hinder the growth through reduced investment rather it also affect the quality of infrastructure provision.

Meyer & Sinani (2009) argued that institutional framework creates incentives and business practices, which in turn affect the nature of competition. Both foreign and domestic firms are encouraged to compete in an environment protected by market rules. Heckelman and Powell (2008) contributed to the existing literature presented previously by Leff (1964) and Huntington (1968). Leff (1964) and Huntington (1968) believed that corruption has positive impact on economic growth. They state that government's failure to implement pure and good rules provoke corruption, which in turn help economies to grow. However, Heckerman and Powell (2010) empirically test this hypothesis. The reported study analyzes the relationship for 83 countries. Countries have different categories were categorized based on their economic freedom. Democracy is associated with the overall economic freedom index. Using independent variables including log initial GDP, investment, democracy, corruption, and a set of regional dummies. Following the footsteps of Clarke (1995) and Folster and Henrekson (1999) this study employed Weighted Least Square (WLS) due to the problem of heteroscedasticity. This study gives the results that benefit of corruption for growth increases with increasing level of democracy. Therefore, conclusion of the study is that positive or negative impacts of corruption depend on quality of institutions. The study suggested that when government fails to operate under laws and regulation, then corruption is best way to increase growth.

While examining the impact of institutional quality on industrial growth Grogorian and Martinz (2000) hypothesized that the marginal effect of institutional improvements on industrial growth will be stronger in transition economies. Redek and Susjan, (2005) tested this hypothesis later on and concluded there exist a strong negative relation between institutions and economic growth, in case of transitional economies. The institutional theory, recommended by North (1990) suggests that institutions set market rules, ensure interactions among economic actors confirmed that economic actions are bounded by these rules.

3. METHODOLOGY AND DATA

To examine the relationship between industrial growth, infrastructure and institutional quality this study will employ ARDL bound testing approach to co integration proposed by Pesaran *et.al.* (2001). It involves investigating the conditional error correction version of ARDL model. The ARDL approach is beneficial for unbiased and efficient results. Firstly, it is appropriate for small sample size (Pesaran *et.al.*, 2001). According to Ilyas *et.al.* (2010), it is better to use ARDL for small sample, as integration at same order is not a compulsion.

Secondly, it estimates simultaneously short and long run components of the model, it removes the problems associated with omitted variables and autocorrelation and, lastly, this model can distinguish between dependent and independent variables (Narayan, 2004).

Prior to all estimation unit root test will be applied, to determine the stationarity of the variables. The estimation started with conducting the bound test for the null hypothesis of no co-integration. The rejection and acceptance of null hypothesis was decided by the value of F statistic (Perasan *et.al.*, 2001).[4] Following that criteria the estimation proceeded towards short run and long run estimations. Estimation will be preceded using proxies for infrastructure and institutional growth as follow.

$$IG_t = INF_t + INF_t^2 + GCF_t + TO_t + LREER_t + \mu_t \qquad \text{(A)}$$
$$IG_t = INF_t + INF_t^2 + GCF_t + TO_t + LREER_t + INST_t + \mu_t \qquad \text{(B)}$$
$$IG_t = INF_t + INF_t^2 + GCF_t + TO_t + LREER_t + INFINST_t + \mu_t \qquad \text{(C)}$$

Where,
't' denotes the time period, IG is Industrial growth, INF is the Infrastructure (Length of Roads and Telephone Lines), INST is the Institutional quality (Corruption and CIM), TO is the Trade openness, GCF stands for Gross capital formation (% of GDP), REER is the Real Effective Exchange Rate and μ_t *is the error terms*

[4]If the F-statistics will be higher than the upper critical value, the null hypothesis of no long-run relationship will be rejected regardless of whether the underplaying order of integration of the variables is zero or one.

After estimation of long run results, CUSUM (cumulative sum) test will be applied to check the stability of the model. To check the heteroskedasticity, Breusch-Pagan-Godfrey Test will be applied. Depending on probability value of BG test, the presence or absence of heteroscedasticity will be determined. To check normality of data, Jarque-Bera test will apply. Probability value of JB test is expected to be higher than 10% so, null hypothesis of no skewness will be accepted.

3.1. Data

For empirical investigation of macro-economic variables, the data has been retrieved from secondary sources. The present study retrieved data from *World Development Indicator (WDI), International Country Risk Guide (ICRG),* and *Economic Survey of Pakistan.* The time series data is employed over time span of 1984- 2012. Non-availability of data for corruption, limits the time-period to 28 years.

The dependent variable of the study is industrial growth and is measured by Industrial share to GDP. It was previously used by Kemal, (2006). The very basic definition of industrial value added is annual contribution of industrial sector to overall GDP [5]. Data for above-mentioned variable is retrieved from World Development Indicators (WDI).

However, length of roads and telephone lines are used as proxies for infrastructure. Length of roads is measured in kilometers, which is being used for transportation. While, telephone lines are defined as sum of active number of analogue fixed telephone lines (WDI).These variables were previously used as proxy for infrastructure by Loayza and Wada, (2012). Data for length of roads is retrieved from Economic Survey of Pakistan; whereas, the data for telephone lines is retrieved from World Development Indicator (WDI).

To analyze impact of institutional quality on industrial sector of Pakistan, two proxies are used in the present study. First, Corruption and second is Contract Intensive Money Index (CIM). Corruption is defined as fraudulent behavior inside the institutions while CIM is a measure of enforceability of contracts and security of property rights. Previously these two indicators were used as proxy for institutional quality by Sunday and Okon (2013) for Nigeria. Data for corruption is retrieved from International Country Risk Guide (ICRG). Contract intensive money index is calculated through following formula. The calculation of CIM is based on mathematical formula provided by Okoh and Ebi (2013).

$CIM = \frac{M_2 - C_\circ}{M_2}$ *(M_2 is the money and quasi money and $C_\circ$ is the currency in circulation)*

The study used CIM as proxy of institutional quality that measures or gauges the enforceability and security of property rights. Other than institutional quality and infrastructure, there are some other variables as well, which determine industrial

[5] World Development Indicator; retrieved on 2/08/2015.

growth. So the study will use trade openness, gross capital formation, and real effective exchange rate as control variables.

4. RESULTS AND DISCUSSIONS

Prior to analysis, the study investigates the order of integration for each variable included in estimation, through Augmented Dickey Fuller (ADF) test. Results showed that there exist the (Pesaran *et.al.*, 2001) criteria.[6] Therefore, the estimation can be proceeds further. The second step for ARDL approach is to find appropriate lag length depending on which short run and long run relationship among the variables will be checked. In the next step the bound test is applied on each equation of the four models, with two proxies of infrastructure and institutional quality (refer to Table 1).

Table 1: Bound Tests

Equation	F- Statistics	Significance	Critical Bounds	
			0 Bound	1 Bound
1. Lrds	3.74**	5 %	3.15	4.43
2. Lrds + corr	12.00***	1 %	2.96	4.26
3. Lrds + lcords	9.55***	1 %	2.96	4.26
4. Lrds +cim	3.55**	5 %	2.96	4.26
5. Lrds + lcmrd	3.54**	5 %	2.96	4.26
6. Ltelp	3.56*	10%	3.15	4.43
7. Ltelp +corr	6.26***	1%	2.96	4.26
8. Ltelp +lcotelp	4.61***	1%	2.96	4.26
9. Ltelp + cim	15.66***	5%	2.96	4.26
10. Ltelp + lcmtelp	14.36***	1%	2.96	4.26

4.1 Diagnostic Tests

Prior to long run results some diagnostic tests were applied (results given in Table 2 below). Serial correlation LM test is applied to check the correlation of variables with its past values. Breusch-Pagan-Godfrey test is applied to check the heteroscedasticity of the data. Stability of the model is assured by CUSUM (cumulative sum test), CUSUM square test and histogram normality test is applied to ascertain that the normality assumptions are satisfied. In reference to Table 4, depending on the p-value the null hypothesis of no hetero is accepted. It means that the data is homoscedastic. Histogram normality test show that normality assumptions are truly satisfied. The null hypothesis of no skew in the data is accepted.

Table 2: Diagnostic Tests

Variables	Normality Test	Serial Correlation	Test for Heteroscedasticity
Equation. 1	0.386 (0.82)	2.99 (0.087)	1.34 (0.29)
Equation. 2	0.50 (0.77)	1.74 (0.314)	1.23 (0.44)

Continued on next page

[6]co-integration level of all variables must be a combination of level and first difference.

(Continued) Table 2: Diagnostic Tests

Variables	Normality Test	Serial Correlation	Test for Heteroscedasticity
Equation. 3	2.49 (0.28)	2.76 (0.17)	0.81 (0.66)
Equation. 4	0.74 (0.68)	3.51 (0.08)	2.03 (0.098)
Equation. 5	0.70 (0.70)	4.57 (0.122)	1.67 (0.29)
Equation. 6	0.58 (0.74)	4.22 (0.03)	2.95 (0.02)
Equation. 7	0.13 (0.93)	3.6 (0.10)	1.61 (0.26)
Equation. 8	3.23 (0.19)	10.4 (0.04)	1.11 (0.49)
Equation. 9	0.18 (0.91)	7.00 (0.07)	0.67 (0.76)
Equation. 10	0.039 (0.98)	11.04 (0.04)	0.62 (0.79)

CUSUM recursive residual test and CUSUM square test is applied to check the stability of the model. It is clear that both the models are stable at 5% significance.

4.2. Results of Long Run

The results show that all the variables are significantly effecting industrial growth except contract intensive money index and trade openness. In reference to Table 3.a length of roads is positively associated with industrial growth and it is having a significant impact on industrial growth of Pakistan.

It is estimated that 1% increase in length of roads will improve the industrial growth by 11%.The result support the findings of Bottaso and Conti (2010), who claimed that investment in transport infrastructure, will promote industrial efficiency. In the next equation, a proxy for institutional quality (corruption) is added. It is shown that in presence of corruption, 1% increase in length of roads will increase industrial growth by 5%. Comparing the results with the previous equation, it is clear that the impact of change in length of roads is minor. The industrial growth of Pakistan is associated negatively to quality of institutions. According to corruption index, provided by Thompson and Shah (2005), the higher value of corruption index refers to clean institutions. Hence, the results can be interpreted as 1 unit increase in corruption index will increase the industrial growth by 0.04%.The results can be justified based on the findings of Leff (1964) and Huntington (1968).

In the next step the estimation was carried with CIM. The results show that CIM is associated positively with industrial growth. While, the coefficient of length of roads can be interpreted as, in presence of low contract enforceability, 1% change in length of roads will increase the industrial growth by almost 15%. Furthermore, the result shows that the coefficient of combine impact of length of roads and corruption is negatively related to industrial growth. The result can be interpreted as 1% combine increase in length of roads and corruption index (reduction in corruption) will reduce the industrial growth by 0.13%. The results are coherent with findings of Okoh and Ebi (2013).

Table 3a: Impact of Infrastructure (length of roads) and Institutional Quality on Industrial Sector

Variables	Equation 1	Equation 2	Equation 3	Equation 4	Equation 5
Lrds	11.59** (2.01)	13.1*** (4.17)	19.71*** (3.36)	15.85* (1.79)	15.91* (1.79)
$Lrds^2$	-0.49** (-2.05)	-0.54*** (-4.27)	-0.82*** (-3.41)	0.66* (-1.81)	0.67* (-1.81)
To	-0.00 (-1.14)	-0.00** (-2.22)	0.003 (0.66)	0.004 (-1.25)	0.004 (-1.25)
Gcf	-0.02* (-1.78)	-0.01** (-2.49)	-0.04*** (-3.15)	-0.02** (-2.01)	-0.02* (-1.64)
log(reer)	-1.25** (-2.24)	-0.26 (-1.14)	-1.20** (-2.49)	-1.25** (-2.01)	-1.25** (-2.00)
M2	0.008*** (2.75)	0.00*** (4.87)	0.005*** (3.74)	0.008*** (2.54)	0.008** (2.52)
Corr	–	-0.06*** (-3.16)	–	–	–
Cim	–	–	–	0.030 (0.471)	–
Lcords	–	–	-0.13* (1.89)	–	–
Lcmrd	–	–	–	–	0.002 (0.48)

*Note: The *,**,*** represents level of significance at 10%, 5% and 1% respectively.*

Table 3(b) shows that the coefficient of telephone lines is related positively to industrial growth. However, the isolated impact of telephone lines on industrial growth is insignificant. In second equation, in presence of corruption, the coefficient of telephone line is associated positively to industrial growth.

The result of the present study can be explained as in presence of corruption in the economy, 1% increase in telephone line will improve performance of industries by 0.8%. The results are supported by arguments of Shapiro (1976).The third equation result shows that combine impact of telephone lines and corruption is negatively associated to industrial growth. The coefficient can be interpreted as 1 unit combine change will affect industrial growth by 0.1%, inversely. Furthermore, the estimation is preceded by using an alternative proxy of institutional quality that is CIM. Results can be interpreted as, in presence of low contract enforceability, 1% increase telephone lines will improve industrial growth by 0.6%. The coefficient of CIM shows that CIM is not effecting industrial growth significantly. The interaction term of CIM and telephone is also not significant. The results are in coherence to Okoh and Ebi (2013).

Table 3b: Impact of Infrastructure (telephone lines) and Institutional Quality on Industrial Sector

Variables	Equation 6	Equation 7	Equation 8	Equation 9	Equation 10
Ltelp	0.27 (1.11)	0.83*** (3.24)	1.84*** (15.38)	0.81*** (4.02)	0.60** (2.31)
$ltelp^2$	0.01 (-1.42)	-0.030*** (-3.52)	-0.08*** (-15.06)	-0.02*** (-4.4)	-0.02** (-2.50)
To	0.001 (0.90)	0.008** (2.37)	0.63*** (4.28)	-0.03 (-0.36)	-0.002 (-1.57)
Gcf	0.016*** (-3.30)	-0.027*** (-4.41)	-0.03*** (-14.0)	-0.02** (-2.65)	-0.03*** (-4.69)
log(reer)	-0.46** (-2.89)	-0.29** (-1.41)	-0.06 (-0.89)	-0.12 (-0.55)	-0.45** (-2.91)
M2	0.005*** (4.03)	0.004*** (5.32)	0.005*** (8.14)	0.008*** (8.75)	0.008*** (7.63)
Corr	-	-0.05*** (-3.12)	-	-	-
Cim	-	-	-	-0.002 (1.35)	-
Lcotelp	-	-	-0.49*** (-3.48)	-	-
Lcmtelp	-	-	-	-	0.001 (0.32)

*Note: The *,**,*** represents level of significance at 10%, 5% and 1% respectively.*

The study has used a quadratic term of both proxies of infrastructure to show the rate at which infrastructure is effecting industrial growth. The results show that similar to findings of Okoh and Ebi (2013), infrastructure is effecting the industrial growth positively. Industrial growth will increase but at a decreasing rate.

5. CONCLUSION AND POLICY RECOMMENDATION

The objective of the study is not only to scrutinize the impact of infrastructure and institutional quality, individually on industrial growth of Pakistan but also the combine impact of infrastructure and institutional quality on industrial growth of Pakistan. For this purpose, two different proxies for infrastructure and institutional quality are used in every equation. The results of the present study reject the stated hypothesis. The results show that the combine impact of infrastructure and institutional quality on industrial growth of Pakistan is negative. The infrastructure is related positively to industrial growth. However the quadratic term of infrastructure show that in relation to infrastructure, industrial growth is increasing but at a decreasing rate. However the weak institutional quality affects the industrial growth positively. A country with weak institutions can face a negative impact of capital formation.

Summarizing the whole study, it can be concluded that better infrastructure and weak institutions affect the industrial growth positively. However, the combine impact of infrastructure and institutional quality on industrial growth is negative.

Keeping in view results of the present study, to achieve considerable and long run industrial growth, following policy recommendations are suggested. Since infrastructure is effecting industrial growth positively, investment should be made to infrastructure. However, investment in infrastructure should not be at cost of current expenditures. As compensation on current expenditures can deteriorate the industrial growth.

On one hand weak institutions are promoting industrial growth. On the other hand, presence of corruption hindered the positive impact of gross capital formation. Hence, institutions should be made strong so that pure transactions could be insured. Anti-corruption laws should be applied strongly, so that illegal industrial activities could be removed. In case of violation of laws, punishment should be same for all.

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