THE IMPACT OF SOCIAL, PHYSICAL, AND FINANCIAL INFRASTRUCTURE ON ECONOMIC GROWTH: A PANEL DATA ANALYSIS OF DEVELOPED AND DEVELOPING COUNTRIES

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Abstract

From last few decades, both developed and developing countries have been paying more attention to the development and improvement of infrastructure. Yet, the term infrastructure remains ambiguous since the literature so far has picked selective indicators to represent infrastructure. However, the major types of infrastructure include: physical infrastructure, social infrastructure and financial infrastructure. All these types of infrastructure exert a twofold impact on economic growth: 1) On the demand side, it affects economic growth through technological progress; 2) On the supply side, it affects economic growth through the provision of better services to people. The prime objective of the present study is to measure the impact of social, physical and financial infrastructure on economic growth in a compact way. For empirical analysis, a panel of 32 developed and 51 developing countries is used over the time period 1996 to 2015. Estimation is based on linear regression analysis that is used unbalanced data set. To check heterogeneity in the data, we have used fixed effect model (FEM) and random effect model (REM) using balanced and unbalanced panel. After that, we have conducted threshold analysis. Results reveal that the infrastructure exerts a significant impact on economic growth.

Keywords: Infrastructure, Economic Growth, Panel Data Regressions

1. Introduction

Infrastructure is an essential ingredient of productivity and growth. It is defined as a structure or an underlying establishment on which sustained development of a society depends. Buhr (2003) diversified infrastructure into three major types: 1) Physical/hard infrastructure, that contributes to the production of goods and services through a diverse combination of facilities such as transportation, energy, agriculture and telecommunication sector; 2) Social/soft infrastructure, which includes facilities related to health and education sector; 3) financial infrastructure, that represents the entire functioning of financial institutes and intermediaries. Investment in all these types of infrastructure are fundamental to economic growth. Moreover, the relationship between infrastructure and growth is bi-causal i.e. infrastructure significantly affects economic growth and vice-versa. According to Shewart (2010), infrastructure is an amalgamation of different physical structures such as schools, hospitals, financial infrastructure, energy, transport, water and telecommunication which are utilized by numerous production units to assist production processes. According to World Development Report (1994), infrastructure

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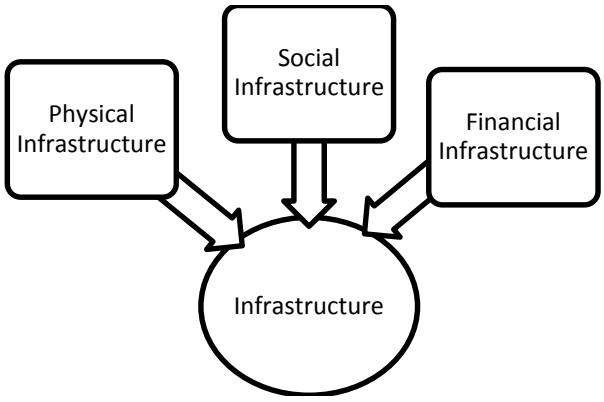
facilitates all those economic activities that lead an economy to achieve economies of scale, innovative production and capital formation. Moreover, increased employment leads to increase per capita income and household consumption.

Figure 1: Types of Infrastructure



Source: Buhr (2003)

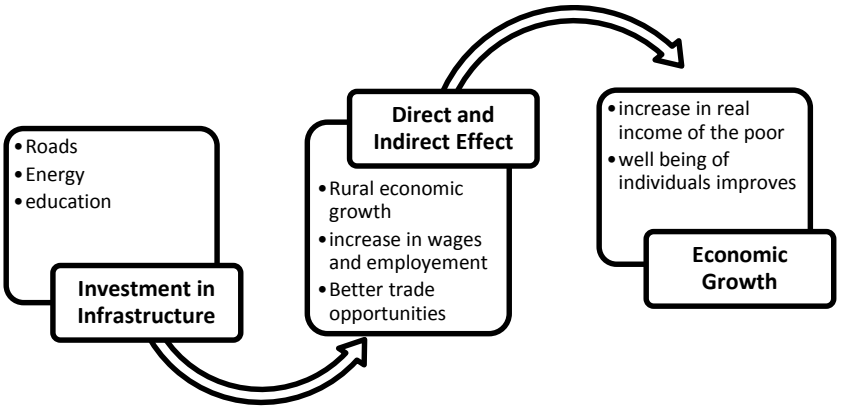
The effects of development in infrastructure are not only confined to macro-level outcomes but improvements in consumption pattern and living standard of people at household level is also observed. Investment in public infrastructure improves productivity of an economy and triggers private sector development through the provision of basic services such as water, sanitation, transportation, energy and communication to the economy. Moreover, the effect of infrastructure on economic growth can be diversified into two categories: demand side effects of infrastructure and supply side effects.

Demand side effects optimize economic growth by improving the living standard and income level of households, access to local and global markets and by improving the facilities in overall society. Supply side effect of infrastructure on economic growth is further categorized in two channels: direct and indirect. Through direct channel, higher investment in infrastructure is translated into higher growth as social, physical and financial infrastructures increase labor productivity on one hand and reduce cost of production on the other hand. Through indirect channel infrastructure enhances easy access to health and education facilities which uplifts the standard of living of people and also their income level. Investment in its types of infrastructure promotes growth by reducing transaction cost, increasing the access to goods and services, availability of transportation and improving communication facilities. It is important to note that non-accessibility of these facilities triggers poverty.

According to the predictions of *Capital Project and Infrastructure Spending Outlook,* infrastructure costs are expected to rise from $4 trillion in 2012 to more than to $9 trillion by 2025 and will result in massive economic development. As per the estimates of *World Economic Forum*, every dollar spent on a capital projects (utilities, energy, transport, water and sanitation system) create an economic return ranging between 5% to 25%. Moreover, an additional 1% increase in transport and communication investments increase GDP per capita growth by 0.6%. In the light of these estimates, developing countries of Asia especially Pakistan and India have increased investment in infrastructure from 10% in 2006 to 12% in 2017. However, infrastructure spending in Western Europe has been reduced from 20 % in 2006 to 12% in 2017 and it is expected to decrease more than 10% by 2025.Similarly, China and Pakistan have also

decided to construct one belt road Project: *China Pakistan Economic Corridor (CPEC)* which will link Kashgar North Western China to Pakistan's Gawadar port on Arabian Sea by constructing a road of 2000 kilometers. The estimated cost of the project is $62 billion. The main objective of CPEC is to increase economic development, improve trade, regional connectivity and infrastructure within the region and to reduce the severity of energy crisis in Pakistan.

Figure 2: Stages of infrastructure development



The previous studies in literature have not considered all the dimensions of infrastructure while estimating its impact on economic growth. Therefore, the main objective of this study is to estimate index of infrastructure to demonstrate the progress in its social, physical and financial dimensions and its relationship with economic growth. It will also help analysts to understand various threshold levels between different categories of infrastructure for developed and developing economies. The study will test following hypothesis:

H_0: Social, financial and physical infrastructure has no impact on economic growth.

2. Review of Literature

Literature has also demonstrated that infrastructure development has a positive impact on education and health (Bryceson and Howe, 1993). Provision to infrastructure decreases unemployment in an economy which in turns extends markets (Gachassin *et al*., 2010). Infrastructure such as roads, water, irrigation facilities and energy sector give advantages to small and intermediate markets by enhancing productivity of land and labor, by increasing access to health and education services and by improving communication and banking services (Kirubi *et al.*, 2009; Lokshin and Yemtsov, 2005: Khandker *et al*., 2009). According to World Bank (1994), improvement in all these factors leads to economic growth and play role as contributing factor to human development. World Bank estimates of year 2004 show that the gains from infrastructure services are more in under developed nations as compared to the developed ones as they have more potential to grow.

Infrastructure is the foundation of every economy which helps to achieve the goal of high and sustainable growth through industrialization and improvement in welfare (Nurkse, 1953; Eckstein, 1957; Rostow, 1959). Infrastructure enhances economic growth mainly by reducing unemployment and by enhancing living standard of people (Looney and Fredericksen, 1981, Munnell (1990, 1992), Eberts (1986, 1991), Easterly and Rebelo, 1993, Canning and Pedroni (1999, 2004), Esfahani and Ramirez, 2003, Majumdar, 2012). Aschauer (1989) has briefly highlighted the importance of infrastructure for enhancing growth of an economy. He explained

that the decline in productivity is the outcome of less attention given to infrastructure improvement. Infrastructure exerts a significant positive impact on economic growth by decreasing cost of production, improving economic conditions for production processes, increasing employment level and by improving national and international investments. (Fan et.al, 2004, Macdonald, 2008, Sahoo et.al, 2010).

Martin and Rogers (1995) made an attempt to model public infrastructure and its effect on industrial area on welfare and trade. Results revealed that subsequent to trade integration, the environment for industrial growth is favorable in countries that have improved domestic infrastructure facilities to reach a desirable level of economic growth. Public capital also showed a positive effect on industrial area, trade and economic growth. Among all the types of infrastructure, the magnitude of the effect of physical infrastructure on economic growth is highest. (Canning and Fay, 1993; Fernald, 1999; Hulten, 2004; Mehmood and Siddiqui, 2013).

Moreover, social infrastructure (Hall and Jones, 1999, Onisanwa, 2014, Gnade *et al.*, 2017) and financial infrastructure (Benabdesselam, 2013) also exerts a positive impact on growth of an economy. Summarization of literature gives a clear idea of how amalgamation of these variables with infrastructure can effect economic development. However, none of the study in literature has incorporated all these types of infrastructure simultaneously in a single model. The contribution of this study is to show the combined effect of all types of infrastructure on economic growth by constructing an index and then the impact of that index on economic growth is estimated. Moreover, this paper calculates an optimal threshold level of infrastructure for developed and developing countries.

3. Data

Considering availability of data as limitation, a panel of 83 countries has been made over the time period 1996 to 2015. The data comprises of 32 developed and 51 developing countries. The sources of data include: World Development indicators (WDI) and World Bank Economic Data (WED) series. The core variables of the analysis are infrastructure and economic growth whereas, tax to GDP ratio, total labor force, foreign direct investment, capital in infrastructure, human capital and Governance indicator are treated as controlled variable. Infrastructure is further divided into three types: 1) physical infrastructure; 2) social infrastructure and 3) financial infrastructure. Physical infrastructure includes length of railways, rail passenger, freight transport, air passenger carried, electricity production and consumption, agriculture irrigated land, sanitation facilities and water facilities. Social infrastructure includes enrollment in secondary education, enrollment in primary education, number of hospital beds, life expectancy and fixed telephone subscription. Financial infrastructure includes Bank Z's score, number of commercial banks, listed domestic companies, stock traded turnover ratio and stock price volatility. Although the main goal of our study is to find the nexus between infrastructure and economic growth but as there doesn't exist any solitary variable that gives a clear representation of infrastructure, we have made index of infrastructure by computing averages of all the three types of infrastructures. The construction of index involves three steps.

- Assortment of relevant infrastructure variables
- Normalization of variables
- Weighted average and Aggregation of variables.

Data on capital in infrastructure is calculated by applying perpetual inventory method on gross fixed capital formation (Benabdesselam, 2013). Total labor force is the working population which contributes to production process either directly or indirectly. Tax to GDP ratio is defined

as revenue generated from tax collection. Foreign direct investment has also been incorporated due to its significant contribution towards economic growth. Moreover, the countries having weak institutions, poor governance, and weak policies show a negative impact on economic growth. To incorporate this affect, we have added governance indicator in our model. Human capital is also added as productivity depends on it.

4. Methodology

Infrastructure can be incorporated into the model in two ways: one way is to treat it as a flow variable and second way to treat it as a stock variable. Barro (1990) has incorporated infrastructure as government expenses which is flow variable. In this form, it exerts direct effect on production function whereas, Futagami *et al*. (1993) argued that if state services are relative to public capital, then economic policy remains suitable only in steady state equilibrium, not in transition phase. Therefore, he suggested to add infrastructure in model as a stock variable. However, we have used a generalized approach following the methodology of Esfahani and Ramirez (2003). The model explains the relationship between economic growth as a function of various elements that spur economic growth and living standard of people.

$$Y = f(INF, K, L, GOVI, FDI, TG, HK) \quad (1)$$

Where Y represents output growth in an economy, INF represents infrastructure, K represents capital, L represents labor, HK is human capital, GOVI is the abbreviation used for governance indicator and TG is tax to GDP ratio. Estimation is based on two types of regression analysis: linear regression that is used for the analysis of unbalanced data set and nonlinear regression analysis that is used for balanced data set. To check heterogeneity in the data, we have used fixed effect model (FEM) and random effect model (REM) using balanced panel.

4.1. Trends of Infrastructure

In this modern world, faster infrastructure growth is required for faster economic development. Therefore, this section includes trends of infrastructure for overall data, for developed countries, for developing countries and the trends for different types of infrastructure in Pakistan. Figure 3 shows distribution of infrastructure index for the years 2000 and 2015. For the year 2015, the country Germany shows a dramatic increase in infrastructure. The country has better transportation sector, communication and energy sectors. After Germany, Hungry exhibits remarkable improvement in infrastructure as compared to 2000.

Figure 4 shows the impact of infrastructure on developing economies for the year 2000 and 2015. For the year 2000, Ukraine shows the behavior of an emerging economy with highest infrastructure as compared to other countries whereas, in 2015, Hungary shows an unexpected increase in infrastructure because of increase in investment and tax friendly surroundings that have triggered public spending to increase infrastructure development. For the year 2015, Germany gives evidence of the existence of best infrastructure as compared to rest countries of the world Apart from Germany, Oman also shows dramatic increase in infrastructure development as compared to the year 2000 as she earned huge the profit from oil exports which in turn increased her spending on infrastructure development.

Figure 6 and 7 shows that in case of Pakistan, infrastructure has been tremendously developed from 1996 to 2015 and is still developing. In 1996, infrastructure development of Pakistan was less than 2% which rose to approximate 35% in 2015 increasing the contribution of infrastructure to economic growth by 35%. However, the infrastructure development fell in 2014 as compared to year 2013 due to floods and natural calamities that the economy endured.

Figure 3: Comparison of infrastructure index between 2000 and 2015

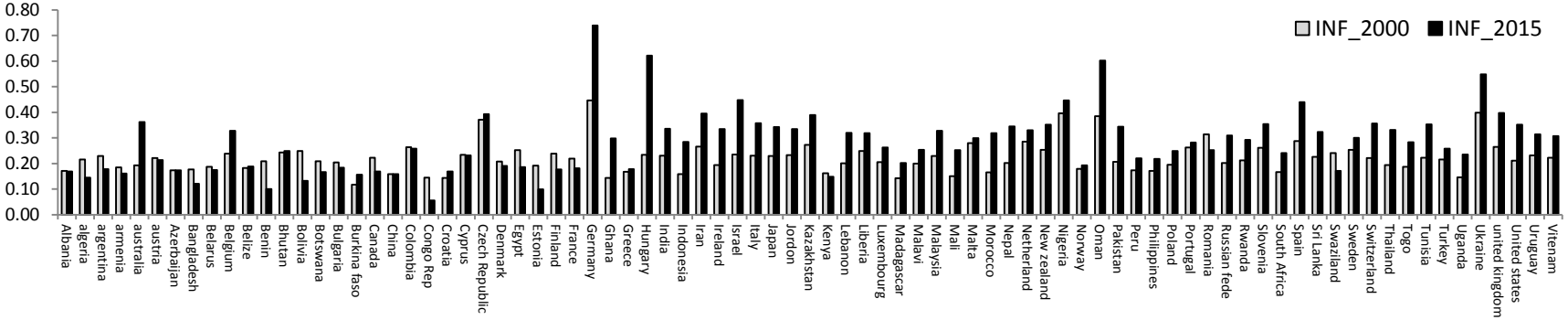


Figure 4: Comparison of Infrastructure Index between 2000 and 2015 for Developing countries

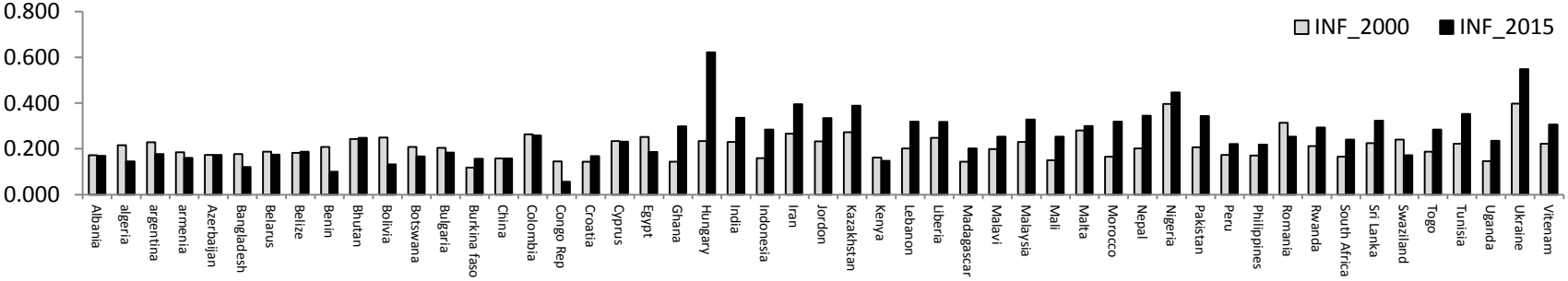
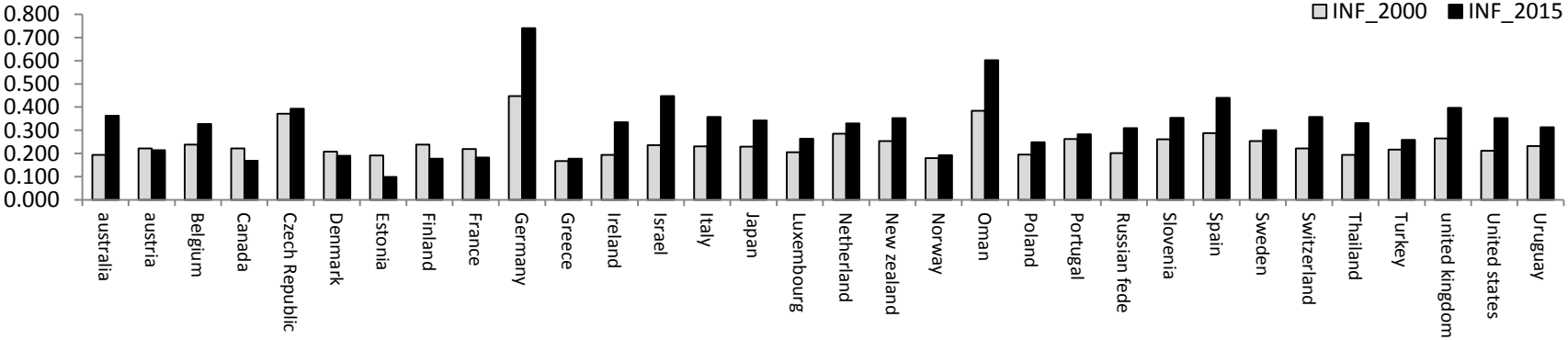
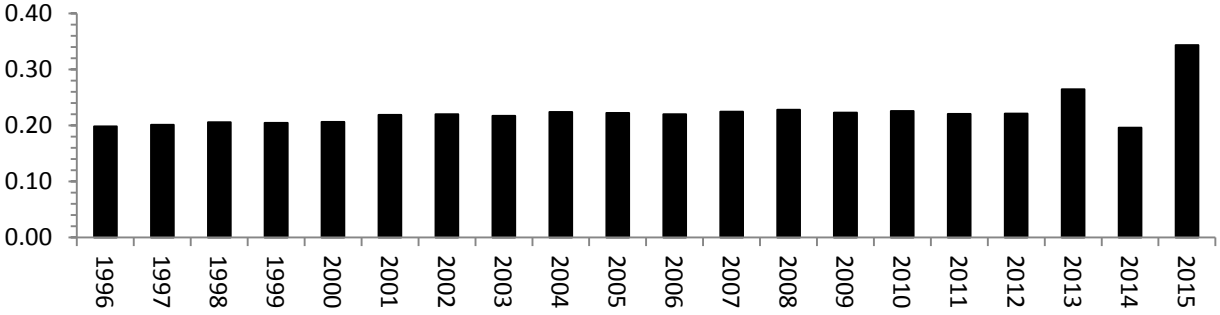


Figure 5: Comparison of Infrastructure Index between 2000 and 2015 for Developed countries:



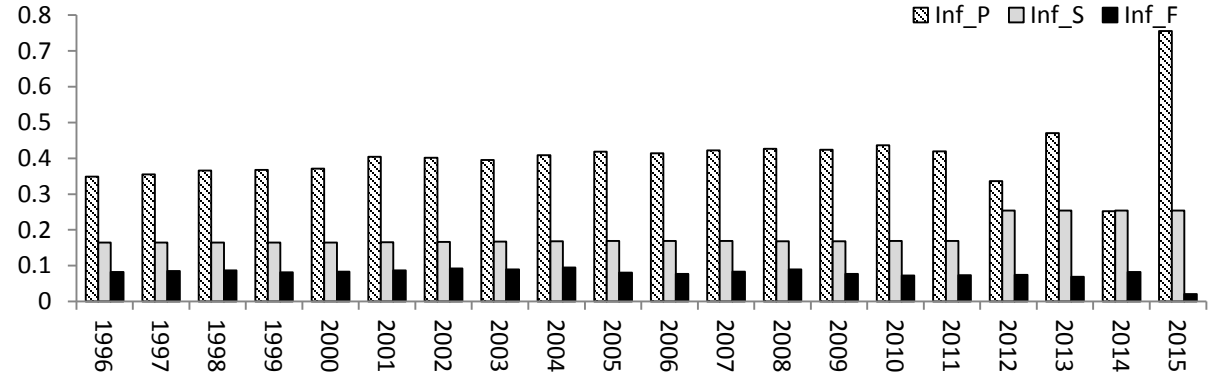
Source: Author's own work

Figure 6: Infrastructure Developments in Pakistan



Source: Author's own work

Figure 7: Physical, Social and Financial Infrastructure in Pakistan



Source: Author's own work

Figure 6 and 7 show that from 1996 to 2015 infrastructure development is following an increasing trend each year. In 2015, financial infrastructure showed a declining behavior due to huge burdens of external debt. From all the three categories of infrastructure, physical infrastructure has developed more in Pakistan as compared to social and financial infrastructure due to CPEC related projects. The basic objective of CPEC is to improve the communication sector and trade among these two countries. Investments have also been made to construct new roads, to improve the condition of railway track and to make Gwadar the hub of economic activity. Moreover, different nuclear energy projects have also been initiated across Pakistan especially in Karachi.

4.2. Pooled OLS Model

Pooled regression is used when we assume that the groups being pooled are homogenous. It works on the principle of "Ordinary Least Square technique" in which every single observation of each group of data is subtracted from the average value of that group. The model is written as follows:

$$L(Y_{it}) = \alpha + \beta_1 L(K_{it}) + \beta_2 L(TLF_{it}) + \beta_3 (INF\_O_{it}) + \beta_4 L(TGDP_{it}) + \beta_5 \mathrm{L}(FDI_{it}) + \beta_6 \mathrm{L}(HK_{it}) + + \beta_7 (GOVI_{it}) + U_{it} \quad (2)$$

Where Y_{it} shows output of a country (i) in time period (t), K_{it} represents capital stock of a country (i) in time period (t), INF_O_{it} represents overall infrastructure of a ,L_{it} is the total labor, TG_{it} is the tax to GDP ratio, $GOVI_{it}$ represents governance indicator. In order to scale

down highly large values of some variables, the variables are expressed in log form. In our analysis, equation 2 is estimated in three different ways: first with physical infrastructure, second with social infrastructure, third with financial infrastructure.

$$LY_{it} = \alpha + \beta_1 L(K_{it}) + \beta_2 L(TLF_{it}) + \beta_3 (INF\_P_{it}) + \beta_4 L(TGDP_{it}) + \beta_5 \mathrm{L}(FDI_{it}) + \beta_6 \mathrm{L}(HK_{it}) + + \beta_7 (GOVI_{it}) + U_{it} \quad (3)$$

$$L(Y_{it}) = \alpha + \beta_1 L(K_{it}) + \beta_2 L(TLF_{it}) + \beta_3 (INF\_S_{it}) + \beta_4 L(TGDP_{it}) + \beta_5 \mathrm{L}(FDI_{it}) + \beta_6 \mathrm{L}(HK_{it}) + + \beta_7 ((GOVI_{it}) + U_{it} \quad (4)$$

$$L(Y_{it}) = \alpha + \beta_1 L(K_{it}) + \beta_2 ln(TLF_{it}) + \beta_3 (INF\_F_{it}) + \beta_4 L(TGDP_{it}) + \beta_5 \mathrm{L}(FDI_{it}) + \beta_6 \mathrm{L}(HK_{it}) + + \beta_7 (GOVI_{it}) + U_{it} \quad (5)$$

Pooled regression is criticized because of some of its deficiencies such as it fails to observe heterogeneity in information which may results in the omission of variables or may give biased results. To cater this issue, we have also employed Fixed Effect Model (FEM) and Random Effect Model (REM). To check which of these two model reaps superior results, we have used Hausman (1978) text with null hypothesis that random effect model is appropriate as compared to fixed effect model.

4.2.1. Results based on Panel Regression Models

The outcome of four regressions of table 1 based on pooled regression, time specific fixed effect model and time specific random effect model postulates the evidence of significant positive relationship between infrastructure and economic growth for overall data. The results of time specific fixed effect model show that all the variables have positive impact on the economic growth while foreign direct investment and primary school enrollment demonstrate a negative relationship with economic growth. Results of random effect model show that foreign direct investment and primary school enrollment are negatively related with economic growth. Hausman test declares time specific fixed effect to be a better model in case of overall data. Inclusion of governance indicator improves the overall significance of the model. The value of R^2 is also high which is an indication of better performance of the model. The results of fixed effect model for infrastructure, physical infrastructure, social infrastructure and financial infrastructure indicate significant and positive relationship among FDI whereas, primary school enrollment shows negative association with economic development.

The justifications of the variables with negative impact on economic growth is that an increase in tax to GDP ratio leads to high tax rates which decrease investments rates and slows down development in capital supply. In such economic condition, decline in growth is the ultimatum (Lee and Gordon, 2005). Fixed effect model shows that the coefficient of financial infrastructure is significantly large as compared to social and physical infrastructure. Time specific fixed effect model also exhibits a positive and significant relationship with dependent variable. Pooled regression shows that foreign direct investment and tax to GDP ratio exert a negative effect on economic growth. However, physical infrastructure, social infrastructure, financial infrastructure, governance indicator, human capital, capital and total labor force cast a positive and significant impact on economic growth whereas, primary school enrollment and foreign direct investment impact economic growth negatively. In case of developed economies, Hausman test declares that fixed effect model is better than random effect model.

Table 1: Impact of Overall, Physical, Social and Financial infrastructure on economic growth (Overall Data)

	Pooled Regression Model				Time Specific Random Effect				Time Specific Fixed Effect			
VARIABLES	**Reg-1**	**Reg-2**	**Reg-3**	**Reg-4**	**Reg-1**	**Reg-2**	**Reg-3**	**Reg-4**	**Reg-1**	**Reg-2**	**Reg-3**	**Reg-4**
LK	0.577***	0.577***	0.578***	0.571***	0.306***	0.303***	0.305***	0.306***	0.152***	0.150***	0.150***	0.152***
	(0.010)	(0.010)	(0.010)	(0.011)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)
LTLF	0.428***	0.428***	0.429***	0.448***	0.581***	0.583***	0.584***	0.575***	0.495***	0.485***	0.502***	0.480***
	(0.027)	(0.027)	(0.027)	(0.027)	(0.041)	(0.041)	(0.041)	(0.041)	(0.067)	(0.067)	(0.067)	(0.068)
LTGDP	-0.035**	-0.041**	-0.043***	-0.014	0.094***	0.093***	0.092***	0.093***	0.045**	0.044**	0.044**	0.042**
	(0.017)	(0.016)	(0.016)	(0.017)	(0.019)	(0.019)	(0.019)	(0.019)	(0.018)	(0.018)	(0.018)	(0.018)
LFDI	-0.109***	-0.110***	-0.110***	-0.111***	-0.073***	-0.073***	-0.0733***	-0.072***	-0.052***	-0.052***	-0.053***	-0.051***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.005)	(0.006)	(0.006)	(0.00590)	(0.005)	(0.005)	(0.005)	(0.005)
LPSE	-0.204***	-0.204***	-0.206***	-0.224***	-0.0815***	-0.0816***	-0.0802***	-0.0826***	-0.0182	-0.0193	-0.0178	-0.0226
	(0.022)	(0.023)	(0.022)	(0.022)	(0.027)	(0.027)	(0.027)	(0.027)	(0.025)	(0.025)	(0.025)	(0.02)
GOVI	0.086***	0.088***	0.089***	0.092***	0.036***	0.037***	0.038***	0.036***	0.026***	0.026***	0.027***	0.025***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
INF_O	0.122*				0.078				0.025			
	(0.073)				(0.075)				(0.069)			
INF_P		0.021				0.063				0.046		
		(0.042)				(0.043)				(0.041)		
INF_S			0.0179				0.0402				0.053*	
			(0.045)				(0.035)				(0.031)	
INF_F				0.154**				0.115*				0.115**
				(0.073)				(0.062)				(0.056)
Constant	1.626***	1.647***	1.647***	1.631***	3.099***	3.118***	3.112***	3.159***	5.285***	5.372***	5.265***	5.405***
	(0.060)	(0.059)	(0.059)	(0.062)	(0.194)	(0.194)	(0.194)	(0.198)	(0.436)	(0.443)	(0.433)	(0.439)
Obs.	1,660	1,660	1,660	1,620	1,660	1,660	1,660	1,620	1,660	1,660	1,660	1,620
R-squared	0.951	0.951	0.951	0.950					0.581	0.581	0.582	0.577
Number of countries					83	83	83	81	83	83	83	81
Hausman tests									700.46	697.20	707.02	719.00
p- value									0.0000	0.0000	0.0000	0.0000

Source: Authors own calculations. Standard errors are in parentheses, whereas, ***, **,* indicates significance at 1%, 5% & 10%level of significance, respectively

Table 2: Impact of Overall, Physical, Social and Financial infrastructure on economic growth (developed countries)

	Pooled Regression Model				Time Specific Random Effect				Time Specific Fixed Effect			
VARIABLES	**Reg-1**	**Reg-2**	**Reg-3**	**Reg-4**	**Reg-1**	**Reg-2**	**Reg-3**	**Reg-4**	**Reg-1**	**Reg-2**	**Reg-3**	**Reg-4**
LK	0.546***	0.543***	0.537***	0.586***	0.092	0.084	0.095	0.080	0.301***	0.299***	0.302***	0.316***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.063)	(0.063)	(0.063)	(0.064)	(0.049)	(0.049)	(0.049)	(0.050)
LTLF	0.025	0.039	0.061	0.034	0.160	0.243	0.171	0.348*	0.352***	0.363***	0.353***	0.354***
	(0.071)	(0.070)	(0.070)	(0.072)	(0.205)	(0.205)	(0.206)	(0.207)	(0.119)	(0.119)	(0.119)	(0.121)
LTGDP	-0.046**	-0.046**	-0.044*	-0.022	-0.021	-0.017	-0.017	-0.026	0.023	0.023	0.023	0.021
	(0.023)	(0.023)	(0.0232)	(0.023)	(0.031)	(0.031)	(0.031)	(0.031)	(0.029)	(0.029)	(0.029)	(0.029)
LFDI	-0.039***	-0.041***	-0.043***	-0.035***	-0.018***	-0.018***	-0.018***	-0.017***	-0.021***	-0.022***	-0.022***	-0.019***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.00541)	(0.005)	(0.005)
LPSE	0.367***	0.354***	0.337***	0.384***	-0.104	-0.080	-0.087	-0.106	0.230**	0.229**	0.233**	0.219**
	(0.057)	(0.057)	(0.057)	(0.058)	(0.118)	(0.119)	(0.118)	(0.120)	(0.098)	(0.099)	(0.099)	(0.100)
GOVI	0.092***	0.092***	0.094***	0.061***	0.018	0.026	0.022	0.010	0.056**	0.063***	0.061**	0.048**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.026)	(0.026)	(0.026)	(0.026)	(0.024)	(0.024)	(0.024)	(0.024)
INF_O	0.209**				0.457***				0.316**			
	(0.101)				(0.156)				(0.150)			
INF_P		0.100				0.0038				0.032		
		(0.062)				(0.081)				(0.079)		
INF_S			0.128*				0.146**				0.085	
			(0.068)				(0.068)				(0.069)	
INF_F				0.642***				0.589***				0.568***
				(0.12)				(0.162)				(0.157)
Constant	2.138***	2.145***	2.212***	1.978***	9.656***	9.126***	9.509***	8.570***	3.771***	3.797***	3.786***	3.682***
	(0.142)	(0.143)	(0.139)	(0.15)	(1.22)	(1.23)	(1.22)	(1.24)	(0.36)	(0.35)	(0.35)	(0.37)
Observations	640	640	640	620	640	640	640	620	640	640	640	620
R-squared	0.918	0.917	0.917	0.917	0.220	0.208	0.214	0.226				
Number of countries					32	32	32	31	32	32	32	31
Hausman test									112.94	72.09	96.08	67.94
P-value									0.0000	0.0000	0.0000	0.0000

Source: Authors own calculations. Standard errors are in parentheses, whereas, ***, **,* indicates significance at 1%, 5% & 10%level of significance, respectively

Table 3: Impact of Overall, Physical, Social and Financial infrastructure on economic growth (Data of 51 developing countries)

	Pooled Regression Model				Time Specific Random Effect				Time Specific Fixed Effect			
VARIABLES	**Reg-1**	**Reg-2**	**Reg-3**	**Reg-4**	**Reg-1**	**Reg-2**	**Reg-3**	**Reg-4**	**Reg-1**	**Reg-2**	**Reg-3**	**Reg-4**
LK	0.568***	0.574***	0.572***	0.567***	0.169***	0.169***	0.170***	0.172***	0.122***	0.121***	0.121***	0.123***
	(0.012)	(0.012)	(0.011)	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)
LTLF	0.484***	0.490***	0.483***	0.469***	0.417***	0.419***	0.416***	0.426***	0.747***	0.757***	0.752***	0.770***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.035)	(0.035)	(0.034)	(0.035)	(0.049)	(0.049)	(0.049)	(0.049)
LTGDP	0.054**	0.029	0.054**	0.098***	0.127***	0.128***	0.123***	0.139***	0.093***	0.093***	0.087***	0.098***
	(0.025)	(0.023)	(0.025)	(0.025)	(0.021)	(0.021)	(0.021)	(0.022)	(0.019)	(0.019)	(0.019)	(0.020)
LFDI	-0.051***	-0.053***	-0.055***	-0.049***	-0.023***	-0.023***	-0.023***	-0.021***	-0.015***	-0.015***	-0.015***	-0.013***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
LPSE	-0.245***	-0.247***	-0.255***	-0.259***	-0.049***	-0.049***	-0.049***	-0.054***	-0.025	-0.026*	-0.024	-0.028*
	(0.024)	(0.025)	(0.024)	(0.024)	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)	(0.016)	(0.015)	(0.015)
GOVI	0.065***	0.066***	0.065***	0.068***	0.026***	0.026***	0.025***	0.026***	0.028***	0.029***	0.028***	0.029***
	(0.001)	(0.011)	(0.0116)	(0.0114)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
INF_O	0.284***				0.058				0.028			
	(0.100)				(0.056)				(0.051)			
INF_P		0.032				0.012				0.027		
		(0.054)				(0.039)				(0.036)		
INF_S			0.174***				0.0681***				0.074***	
			(0.058)				(0.025)				(0.023)	
INF_F				0.152*				0.0730*				0.102***
				(0.089)				(0.041)				(0.037)
Constant	1.785***	1.823***	1.783***	1.836***	4.608***	4.624***	4.603***	4.654***	7.289***	7.359***	7.344***	7.442***
	(0.073)	(0.072)	(0.073)	(0.071)	(0.223)	(0.223)	(0.212)	(0.212)	(0.337)	(0.341)	(0.333)	(0.331)
Observations	1,020	1,020	1,020	1,000	1,020	1,020	1,020	1,000	1,020	1,020	1,020	1,000
R-squared	0.944	0.943	0.944	0.945	0.870	0.870	0.871	0.872				
Number of countries					51	51	51	50	51	51	51	50
Hausman test									18.42	15.45	24.71	32.51
P-value									0.0000	0.0000	0.0000	0.0000

Source: Authors own calculations. Standard errors are in parentheses, whereas, ***, **,* indicates significance at 1%, 5% & 10%level of significance, respective

The results of present study are in line with the result of (Ogun, 2010) that in case of fixed effect model from all the three categories of infrastructure, the coefficient of social infrastructure has greater impact on economic growth as compared to financial and physical infrastructure. This is because of the fact that social infrastructure has tendency to eliminate poverty which triggers economic growth. In case of developing economies, the coefficient of financial infrastructure reveals larger impact on economic growth.

5. Conclusion

Infrastructure and economic growth are interrelated variables. A number of studies in literature verify the existence of relationship between infrastructure and economic growth but none of the study has investigated the relationship between all the three types of infrastructure with economic growth in a single model. However, present study has removed this hindrance. Our results based on fixed effect model reveal that overall infrastructure contributes positively towards economic growth not only in case of overall data but also in case of developing and developed countries. Capital and labor exert a positive impact on economic growth. Three dimension of infrastructure also appear to be showing a positive association with economic growth in case of overall data and the data of developed and developing economies.

Based on the empirical outcome of this study, the implications are as follows:

- Comprehensive growth policy should be devised to achieve sustainable economic development through increased investment in physical, social and financial infrastructure.
- The governments should invest in those areas where marginal return is high. In the light of this finding, developing countries can reap more profit by investing in infrastructure.
- Investment in infrastructure should be made up to the optimum level where increase in infrastructure increases long run growth because right after that point, increase in infrastructure reduces long run economic growth. If a country has already achieved that point, she should try to innovate new technology in order to vacate room for further investment and to save the marginal benefit from turning negative.
- Furthermore, developed countries after investing maximum in infrastructure, if face the problem of negative marginal benefit, then like China, they should start investing in nearby countries so that they may also develop and reap highest level of efficiency. CPEC will not only benefit Pakistan but the profits of investor will also increase in the form of extended markets.

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