Infrastructure Development (Non-Physical), Economic Growth andPolicy Choices: A Cross-Country Analysis

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Abstract

The relationship between the non-physical infrastructure and development has always been an eye catching issue. The following study inspects the influence of non-physical infrastructure on economic growth of Asian countries. Countries from where data is selected for examination are China, India, Bangladesh, Iran and Sri Lanka. The data of has been regressed from 1970 to 2019. Unit test technique has been employed and ARDL mechanism was chosen for long term and short-term analysis. The findings explain the substantial relationship between non-physical side of infrastructure development and economic growth. Social infrastructure variables i.e education and health showed positive significant relationship with economic growth. Policy has been recommended for economic growth is based on weightage approach to derive the quantitative value of the variables and then prioritize the sectors in which the government should invest according to the significance of variable.

Keywords: Economic growth, Infrastructure development, Non-Physical Infrastructure.

Introduction

The role of infrastructure for economic development has been well documented in the literature (Aschauer, 1989; Calderon & Serven, 2003; Estache, 2006; Munnell, 1990; Sahoo & Dash, 2008, 2009; World Bank, 1994). Infrastructure development, both economic and social, is one of the major determinants of economic growth, particularly in developing countries There is a heated debate regarding the relationship between the economic growth verses infrastructure development and its policy implications. Multipurpose studies regarding these issues were conducted since the late 90's. The role of infrastructure is very much important in economic growth over long run. There are two types of infrastructure defined by the researchers Physical Infrastructure and Non-Physical Infrastructure.

In Pakistan insignificant studies have conducted in this saga, due to transitory / weak governance regimes and their policies i.e., transitions from nationalization to privatization, war against terrorism, short run decision makings. The loss Pakistan encountered along the imposed war against terrorism in terms of, loss of financial paucity, deteriorating law and order situations affecting country's basic infrastructure and subsequently impeding economic growth. The studies conducted are less focus on non-physical infrastructure and its implications on economic growth.

Research Problem

Infrastructure investment in Pakistan is less diverted towards non-physical infrastructure i.e. education and health sector. According of previous studies the impact of investment on non-physical infrastructure is more significant with long lasting impact. In the light of this the research problem will look into the factors which are more inclined

towards investment in non-physical infrastructure. So, this have been further operationalized into following research questions.

Research Questions

The previous studies demonstrated the a rather positive relation between the public investment in infrastructure and economic growth. In the light of this there are following research questions.

- Does non-physical infrastructure play significant role in the economic growth?
- What will be the impact of non-physical infrastructure on economic growth in short and long run?

Research Significance:

According to the studies there is a significant role of non -physical infrastructure in economic development. The biggest example of that is China where there is huge government spending in social infrastructure development. The paper published by (Nannan & Jianing, 2012) shows that the non-physical side has its own share when it comes to have an effect on economic growth. The paper has established that non-physical side of infrastructure has more effect on economic growth than that of physical side.

My study will guide the policies regarding non-physical side of infrastructure that may help achieve infrastructural development in future in Pakistan and should be given more weightage when it comes for government to spend for development or how should government focus on the non-physical infrastructure development.

Literature Review

The observed research on effect and the role infrastructure plays in economic growth started after the foundational work by (Aschauer, 1989) where Aschauer reasoned that public spending is reasonably productive, and the decrease in the U.S productivity was in direct relevance to decline in the public infrastructure. Subsequently Munnell (1990), Garcia-Mila and McGuire (1992), Uchimura and Gao (1993), found high output elasticity of public infrastructure investment though comparatively lower than Aschauer.

Further, it has been found that social infrastructure such as education, health, and housing are essential to promote better utilization of physical infrastructure and human resources, thereby leading to higher economic growth and improving quality of life (Hall & Jones, 1999). Another focus in the literature is on optimal and efficient use of infrastructure for economic growth.

Criticizing these earlier studies Hulten (1997) and Canning and Pedroni (2004) emphasize that there is an optimal level of infrastructure maximizing the growth rate and anything above would divert investment from more productive resources, thereby reducing overall growth.

Investment in education also create expansion in the health expenditure. The investment in education leads to the well trained and well-equipped labor force that leads to economic growth (Awais, Kiani, Thas Thaker, Raza, & Qaim, 2021; Nasir, Awais, & Syed, 2017). With that keeping in mind the health sector also effect the labor force in a way that the productivity doesn't get effected so that leads to more work hence increase in the economic growth (Pravesh, n.d.) The paper discussed the previous results and tried to redefine the linkage between the education expenditure and economic growth in the Indian economy. The time series data has been taken of 28 years i.e from 1980 till 2008 for the estimation purpose, econometric modeling has been used. The long-run results show that there is a significant relation present between the education expenditure of government and economic growth. But the ECM technique showed that the impact of the education expenditure per labor has a lesser effect on the economic growth than that of the physical capital per labor. The results depicted that there is 0.28% increase in the GDP of India with an increase of 1% in physical labor per labor. On the other hand there is o.11% increase in the GDP with an increase in 1% in government expenditure on the education per labor (Saiful Islam, Abdul Wadud Qamarullah Bin Tariq Islam, Abdul Wadud, & Bin Tariq Islam, n.d.), if we discussing about Asian countries we cannot ignore the Bangladesh. As it has the greater GDP among the SARC nation. The citied paper examined the casual relationship between the education and GDP (income). Multivariate approach has been used for estimation of the data that has been chosen from 1976-2003. (Zhang, Zhang, & Lee, 2001) the paper captured

the result of mortality in terms of fertility and what will be the effect of that on the child education investment. There are child policies in China, which helped contain the population of China. The paper showed that there was positive relationship between the mortality decline and economic growth in such a way that mortality decline effect the investment of parents on a child more that help the economy in the future thus cause the economic growth. Islam, (2014) shows the Bangladesh health system heavily relay on government spending for health facilities supply and financing for health sector infrastructure. Health sector receive a little attention from the total resources of Bangladesh economy that means a lot of stubborn issues relating health sector. Only 3% of total GDP of Bangladesh is invested in health sector (WHO). In that investment 34% is financed by the government and 66% from foreign debts that cause inequity. That causes a serious issue in health sector. The assessment of data that is secondary, the paper tried to capture the health issues in the Bangladeshi economy. The result shows that there is high complexity in the health sector of Bangladesh and inefficient labor force. Also, the political instability and inefficient allocation of funds to health sector damaged the health sector. Bangladesh economy has showing positive impact towards achieving MGD4 and MGD5, the health related MDGs. The private sector is growing on small territorial levels providing basic health services. Bangladesh after showing that much progress still lack a descriptive policy regarding primary health sector. The challenges faced by the Bangladesh economy is the lack of leadership and political stability. Only the strong leadership can bring upon the change in the health system and health investment. The policies and the framework that will work more efficiently for the betterment of health and betterment in health facilities for the Bangladeshi population. Likewise, in Iran the studies shows the impact of infrastructure on the economic growth (Review, Sojoodi, Zonuzi, Mehin, & Nia, 2012). The drawback in infrastructure amount in Iran, that became a major issue in less economic growth in developing low income country like Iran. In recent years. There is a raise in infrastructure investment in Iran afterwards. The paper captures the effect of from 1985 to 2008 of infrastructure on economic growth of Iran. ARDL framework has been used for estimation. Infrastructure capital is used as input function into aggregate production function.

In context of Pakistan there is no such study that compromises of the comparison between which should we choose and why would we choose that side of infrastructure. In china a study is made what should we choose physical or non-physical infrastructure (Nannan & Jianing, 2012).

Research Gap

The literature above gives a thorough image of studies that are conducted in different parts of the globe regarding infrastructure development and economic growth. From developed economies to the developing economies. The literature mainly comprises of Physical infrastructure development and its effect whether its long run or short run. There is not much debate whether there physical or non-physical infrastructure should be a priority for a government while making policies. What weightage should be giving according to the effect it having on a particular economy.

The research gap that has identified is that there isn't enough research present that has shown that either infrastructure investment/development can be used as a tool to maintain or increase the rate of economic development and also which side of infrastructure either physical or nonphysical infrastructure should be used in a long run for better economic growth.

Hypothesis

Hypothesis 1

H° = There is significant relationship between non- physical infrastructure and other variables defined in study. Also, it can be used in long run for economic development.

H^{1} = No significant relationship between non- physical infrastructure and other variables defined in study. Also. It cannot be used in long run for economic development.

Model, Data and Methodology

Research Design

Direction, technique and research design depends upon the types of inquiry in qualitative, quantitative and mix-method approach (Creswell, 2014). This research is directed towards quantitative methods to look at the elements of infrastructure development, economic growth and policy choices by analyzing the indicators in physical and non-physical infrastructure. Researcher has selected descriptive research design for this research because data required for this research is external, secondary taken from World Bank statistics. As this research is based on quantitative research methods with descriptive design; data has been produced and results have been described in tabular form. Data and result have been produced in order to meet the objective of research.

Econometric Model

ARDL model was introduced by Pesaran et al. (2001) in order to incorporate I(0) and I(1) variables in same estimation. The autoregressive model is used for decades to model the economic relationships between economic variables in a single equation. ARDL approach is used for forecasting and to disentangle long run relationship from short run dynamics. Its popularity stems from the fact that cointegration of non-stationary is equivalent to error correction process also there is no need to determine the order of integration amongst the variable in advance. All other approaches require that the variables should have same order of integration. In addition it is statistically much more significant approach for the determination of cointegration relationship in small samples while allowing different optimal lag of variables.

The model for the estimation is ARLD Model. ARLD was used by (Y.Shin, M. Hashem, n.d.) (Richard J. Smith, n.d.) (Z. Khan, Rabbi, Ahmad, & Siqun, 2019).

$$\Delta Y_{GDP(it)} = \alpha_1 Mot_{it} + \alpha_2 Beds_{it} + \alpha_3 Phys_{it} + \alpha_4 School(P)_{it} + \alpha_5 School(S)_{it} + \mu_{it} \quad \text{..... Eq 1}$$

It's a Log-Linear model as the values of GDP Per Capita changed to log values to change it to percentage values. The independent variables are Mortality as Mot, Beds as Beds Per Hospital Per (1000), Physicians (Per 1000) as Phys School Enrollment (Primary) Gross% as School(P), School Enrollment (Secondary) Gross% as School (S). Whereas (i) is cross section and (t) is time from 1970-2019. $\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5$ and λ_6 are coefficient and μ_{it} is the error term.

$$\Delta Y_{GDP(it)} = \lambda Mot_{it} + \lambda_2 Beds_{it} + \lambda_3 Phys_{it} + \lambda_4 School(P)_{it} + \lambda_5 School(S)_{it} + \mu_{it} \quad \text{..... Eq2}$$

Data

The data will be used, is panel data of last 50 years and 6 countries Pakistan, India, China, Bangladesh, Iran and Sri Lanka. The data source is World Bank.

Results and Interpretation

Table 1.1:

Unit Root Test:

Results of Panel Unit Root Tests		
Levin-Lin-Chu (2002) (LLC)		
Variables	I(0)	I(1)
GDP	0.64672 (0.741)	8.44175 (0.000)
Mortality	-0.71905 (0.2361)	-1.793 (0.428)

Beds per hospital	-1.64734 (0.0497)	-14.0748 (0.000)
Physicians	0.06721 (0.5268)	-9.34557 (0.000)
School enrollment (Primary)	-1.76905 (0.0384)	-8.09466 (0.000)
School enrolment (secondary)	0.50954 (0.6948)	-3.8801 (0.00001)

The results of Table 1.0 illuminate that the variables are integrated at *I*(1). The results support us to use ARDL Bound Test approach for cointegration.

Table 1.2:

Long Run Analysis:

Long Run Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Hospital Beds Per 1000	-0.728308	0.268222	-2.715315	0.0073
Mortality	0.004659	0.001533	3.038937	0.0027
Physicians	0.10085	0.036449	2.766879	0.0063
School Enrollment (Primary)	0.016039	0.007665	2.092606	0.0378
School Enrollment (Secondary)	0.034064	0.010482	3.249924	0.0014

Table 1.1 shows the results for the long run. 1% change in Mortality changes the GDP by 0.004 % as the Mortality is decreasing variable, due to health expenditures and also the research advancements in the medicine and treatments the mortality rate is decreasing in adults that's a booster for the labor power and onwards to the economic growth and productivity. 1% change in Physicians changes the GDP by 0.1008%, physicians work for the economic growth in two ways first, the act as rent seekers that means more the number of physicians more benefit for the economic activity and also more number of physicians means less time of labor force out of work during illness that means less productivity loss so that has direct effect on GDP (Reilly, 2012). 1 % change in School Enrollment (Primary) and School Enrollment (Secondary) effect the GDP 0.016 & 0.031% respectively, increase in school enrollment directly affect the GDP the higher the level of education higher the effect as explained before by the (Afzal et al., 2011). Lastly Beds per Hospital, 1% change in beds per hospital decreases the GDP 0.72 %, as a matter of fact the government spending's on health is stagnant that means ever low number of beds available according to the population increase in the country, also the government hospitals are overcrowded and private hospitals are unaffordable by the public. As developing country, the most population is either middle class or lower middle that means low affordability of private health services and that means overcrowding in government provided facilities leading to unproductivity.

Table 1.3:

Short Run Analysis

Short Run Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Λ	-0.097585	0.037756	-2.584657	0.0105
D(GDP(-1))	-0.044608	0.114935	-0.388116	0.6984
D(MORTALITY(-1))	0.010116	0.009106	1.110955	0.2681
D(PHYSICIANS(-1))	1.320096	1.272394	1.03749	0.3009
D(SCHOOLP(-1))	-0.001722	0.002282	-0.754502	0.4515
D(SCHOOLS(-1))	-0.004351	0.003335	-1.304458	0.1938
C	0.321247	0.160305	2.003968	0.0466

Mean dependent var	0.111017	S.D. dependent var	1.064845
S.E. of regression	1.257494	Akaike info criterion	-1.431262
Sum squared resid	281.47	Schwarz criterion	0.074943
Log likelihood	336.6893	Hannan-Quinn criter.	-0.828477

Table 1.2 reports the short run findings, major portion of variables show insignificant relationship with the GDP, school enrollment (primary & secondary), physicians, mortality, industry (construction), electricity consumption and energy consumption (oil). The significant variable beds per hospital. λ denotes the speed of adjustment towards the equilibrium or the convergence towards the long-run equilibrium, at every year 9.7% adjustment takes place. Most of the variables shows the negative impact on economic growth, in long-run these variables showed the positive impact on the economic growth. That means sudden boom in the education, health and physical infrastructure don't show any positive impact on economic growth. But in long-term these investment does bear the fruit of economic growth. That means government shouldn't stop investment in education, health, construction industry and energy infrastructure sector.

Conclusion and Policy Recommendations

Conclusion

Infrastructure development plays crucial role in economic growth most importantly non-physical infrastructure. ARDL approach was used to capture the effect of non-physical of infrastructure in long and short term. The results show the significance of both sides of infrastructure. Non-physical variables have positive and significant effect on economic growth in long run except Beds per hospital. Which somehow contradict with the existing studies (Chaudhry et al., 2013), specifically Beds per Hospital. The health expenditure is stagnant for past decade resulting in less investment in the health sector which made the results show negative relation between the variable and the economic growth. Other variable does show the significance and the movement towards the long run equilibrium.

Education sector shows the level wise greater impact on the economic growth and has high response effect towards the government expenditure. Hospital beds show negative effect on economic growth that is arguably opposing the previous findings. Policy Shift is required in health department. The physicians showed the higher impact on growth, as it contains both the health side and the educational side. More physicians mean less time for labor force out of work and basic health services available at the nearest point. from educational point of view that means more research towards cures and health related techniques. Likewise, in China, the growth is

infrastructure lead, according to studies yearly 1500 km roads are added to road infrastructure. If you see the most recent infrastructural development you can see the efficiency on institutional level in infrastructural development, the hospital development in China was remarkable they have taken only days to establish the hospital for the corona cure and many other cure centers. If we can see that example as a benchmark for the Chinese economy and their intuitional values. After the revolution in 1949, the china changed their constitution and move towards communalism. The government started investments in infrastructural development. The investment in infrastructure and the in-education infrastructure has grown greatly. the main example for the educational growth is that all the CEO's around the world in leading software industries are Indians. Also, the multi-national are investing in huge amount in Indian economy. That means high investment in infrastructure. Also, Indian policy according multi-national companies are that you have to share the technology after a decade of the plantation of the industry. India is leading in car industry. Whereas in Pakistan we don't have one car producing domestic company with international recognition. With having highest share of middle class, India has larger share of poverty-stricken population. They need a lot investment in health infrastructure like we do. In contrast to that there is a lot of Indian physicians capturing the international physician's market Hence, India should reconsider its policies to ensure better health infrastructure for its people. As of Bangladesh, the country has been through many ups and downs. From the very start country is been through much loss in political manner.

Policy Recommendations

From the policy perspective the study suggests that investment in non-physical infrastructure contributes positively towards growth. Governments should invest in the sectors like education and health to have a maintained economic growth.

The School enrollment shows that the higher level of education gives the highest growth, so the government spending should be greater towards the higher education. The public health of residents always play a vital role in the development and progress of society The stagnant spending on hospital infrastructure is having negative effect on the economy demanding a drastic change in policy by increasing the spending on Public health investment which will have a positive impact in promoting the development of national health and medical and health undertakings, improving the overall health quality of citizens and promoting the harmonious development of society.

Overall the results suggest that it is necessary to design an economic policy that improves the human capital formation by heavily investing in education sector.

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