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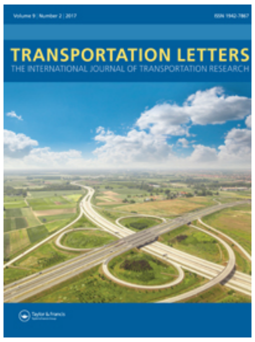

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The impact of transportation infrastructure on economic growth: empirical evidence from Pakistan

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The direct and indirect effects of transportation infrastructure have a positive impact on the economic growth and development of a country. Apart from improving accessibility, infrastructure development brings along trade and investment opportunities to the previously unconnected regions. It also provides access to goods, services, and employment opportunities in these regions through the multiplier effect. In this paper, a panel of data is employed using the unit root, cointegration, and Granger Causality (GC) model to test whether causal linkages between economic growth and transportation infrastructure exist at national and provincial level. The findings suggest that in the short run, there is no causality between the two variables at the national level, however, a unidirectional causality from economic development to infrastructure investment exists in the long run. At the provincial level, bidirectional causality in the rich and much developed provinces exists, whereas a unidirectional GC exists from economic growth to transportation infrastructure in the underdeveloped provinces. The outcomes of the model shed light on the fact that infrastructure investment per se is not sufficient to boost the economic activity in the underdeveloped regions of Pakistan. A cointegrated investment package is needed, targeting not only infrastructure but also the social and technological development, which can help these regions to realize the promotion of economic growth in the long run.

Keywords: Transportation infrastructure, Economic growth, Granger causality, Time series analysis

Introduction

The role of infrastructure in economic growth and social welfare has been studied extensively across the literature over the past years (Sahoo and Dash, 2009; Lakshmanan, 2011; Yu et al., 2012 among others). The contributions of an efficient and effective transportation system to economic growth and stability are numerous, for example, the costs of transportation and production are reduced through timely delivery and enhancing the economies of scale in the production process, integrating markets, creating economic opportunities, and communication links, enhancing the competitive advantage of the production and economy, thereby promoting trade. A competent transportation system also generates a large number of employment opportunities, encourages tourism and foreign investment. These positive outcomes of effective transportation system are more pertinent to developing countries.

Globally transportation and communication are changing every aspect of human life, from trade to manufacturing, education, research, entertainment, culture, and defense. Most emerging economies being aware of the strength of these services are transforming their resources towards knowledge and communications. Recently, however, developing countries are struggling to maintain investment in infrastructure because of the commodity prices and the global financial crisis. Consequently, many new mega projects mainly in the energy and water sectors are closed (Commission, 2011). Many Governments are now turning to alternative modes of financing, such as public private partnership and build-operate-transfer (BOT) models. However, even these modes of financing have proven challenging for most developing countries as they have yet to come up with a legal and regulatory framework for such transactions. Until such a framework exists, infrastructure financing will continue through foreign aid, collecting taxes, and imposing development and user charges.

The discussion on the nexus between infrastructure and economic growth was fueled in the last two decades. Perhaps the first empirical insight into the subject came from Aschauer (1989a, 1989b, 1989c), suggesting investment in infrastructure has a significant positive effect on production and economy. Holtz-Eakin and Schwartz (1995), however, contested the empirical evidences showing the positive relationship between infrastructure and economic growth, and document no evidence of quantitatively important spillovers of state highways on the

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growth of US economy. Later, by employing Mexican data Lachler and Aschauer (1998) instigated an entirely new debate among researcher by suggesting that investments alone are not sufficient for economic growth. Since then, a plethora of empirical studies examined the linkage between infrastructure and economic growth by introducing new variables having plausible impact on economic growth. The existing scholarship embarking on this subject is divided into two strands, one concerned with the output elasticity of infrastructure capital, whereas the other on optimal and effective use of infrastructure for economic growth. As far as the first branch is concerned, many researchers have reported a positive output elasticity of infrastructure investment (Munnell, 1992; Bank, 1994; Holtz-Eakin and Schwartz, 1995; Calderón and Servén, 2004; Canning and Bennathan, 2007, Crafts, 2009; Sahoo and Dash, 2009). Similarly, Fujita and Thisse (2002), Crafts (2009), Chen (2010) and Lakshmanan (2011) shed light on the optimal level of infrastructure for economic growth. Among these, of particular importance is Canning and Pedroni (2008) research as they emphasized 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.

Despite the fact, existing studies provide a useful insight on the impact of infrastructure and economic growth across a range of countries; however, there are no studies examining this relationship in Pakistan which has the unique economic characteristics. Pakistani economy is characterized with the political instability, lack of rule of law, institutional instability, and higher extent of corruption of government officials – all these features somehow negatively influence the relationship between infrastructure and economic growth. In an attempt to fill this literary gap, this paper investigates the GC relationship between Pakistan's national and provincial transportation infrastructure development and economic growth by employing a panel data over the period of 1982–2010. The provincial level analysis will provide a valuable insight into the causality (or lack of causality) between infrastructure and economic growth and will serve to compare the findings at the national level and provincial level. Moreover, such a study will also illustrate the disparity between different provinces of Pakistan in terms of economic growth and infrastructure investment. As far as we know, this is among the first study conducted on the causality between Pakistan's transportation infrastructure and economic growth.

The rest of the paper proceeds as follows. Next section provides a brief literature review of related studies. A discussion on the current situation of infrastructure and economic condition of Pakistan will be followed. Subsequently, the data and methodology will be presented. It is followed by the empirical analysis, whereas the last section concludes the paper.

Literature review

Apart from the above, several classical studies investigated the impact of transportation infrastructure on economic growth. Fogel (1960) reported that the economic rate of return on capital invested on the Union Pacific Railroad was almost 30% during the period 1870–1879. He attributed such high rate of return to the increase in productivity of labor and capital when used on lands opened up for commercial exploitation by the railroad. Later, Aschauer (1989a) examined the impact of the infrastructure investment on output and productivity growth in the US. He showed that low level of capital investment in infrastructure is largely responsible for the private sector's productivity slowdown during 1970s and 1980s. Subsequently, Lynde and Richmond (1993) also studied the causes for the decline in the US productivity and found that 40% of the productivity decline in the US was explained by the fall in public expenditure. Ford and Poret (1991) further investigated this nexus and reported that cross-country differences in productivity growth can be explained partially by the differences in the level of infrastructure investment.

Subsequently, a large number of quantitative studies have attempted to estimate the quantitative relationship between stock of transportation infrastructure and economic growth (see Lakshmanan, 2011 and references therein). These studies generally reveal a strong positive impact of transportation infrastructure and economic output by evaluating the direct and indirect effects of transportation investment. Direct economic effects tend to occur on workers and businesses engaged in the construction and subsequently in utilizing the road which includes transportation costs and time benefits to people and freight. In principle, the value placed on journey time saving is therefore the opportunity cost of the time which is usually measured as gross hourly labor cost. Moreover, for freight movements there can be additional efficiency gains by reducing the amount of time goods are held in transit. These direct impacts also transfer to end-consumers in various ways, including lower prices, increased output, increased corporate profit which may boost corporate investment level and thereby increase the employment opportunities.

On the other hand, in some cases as a result of the incidence chain of effects coming out of direct effect there will be a wide range of indirect effects on the economy (Canning and Bennathan, 2007, Crafts, 2009). Indirect economic effects may occur on supporting industries which supply goods and services to enable the direct investment. Some of these effects cause a redistribution of resources and others may lead firms to enter or exit the market through reducing market imperfections or through affecting the output in imperfect markets. Lastly, increased transfer of knowledge and technology are also the indirect outcomes of infrastructure investment.

Using an integrated approach which includes both direct and indirect effects of infrastructure investment, Banister and Berechman (2001) examined the relationship between transportation investment and growth of the economy and reported a positive association between them. Buurman and Rietveld (1999) analyzed this relationship and concluded that infrastructure investment affects economic growth. Employing the GC test, Fernandes and Pacheco (2010) found a unidirectional causal relationship from economic growth to domestic air transportation in Brazil. In a cross-country study, Bose and Haque (2005) studied the relationship between investment in transportation and economic growth for a group of developing countries and found bilateral causal relationship between them. In a later study of the Indian states, Lall (2007) showed that infrastructure investment is a significant determinant of regional growth. Similarly, taking China as a case study, several researchers have highlighted a causal relationship between

China's transportation infrastructure development and economic growth (Gao, 2005; Zhang, 2008; Zhang and Sun, 2008; Tan and Yang, 2009; Yu et al., 2012).

In contrast to the above, several other researchers have reported the negative relationship between infrastructure investment and economic growth. For example, Devarajan et al. (1996) found a significant negative relationship between economic growth and communication infrastructure and attributed the findings to the possibility of over investment in transportation and communications. Using a panel of countries, Canning and Pedroni (2008) showed that infrastructure does not cause growth in the longer run. Lastly, Straub et al., (2008) failed to find any significant relationship between infrastructure and growth as was the case with Ghana (Nketiah-Amponsah, 2009).

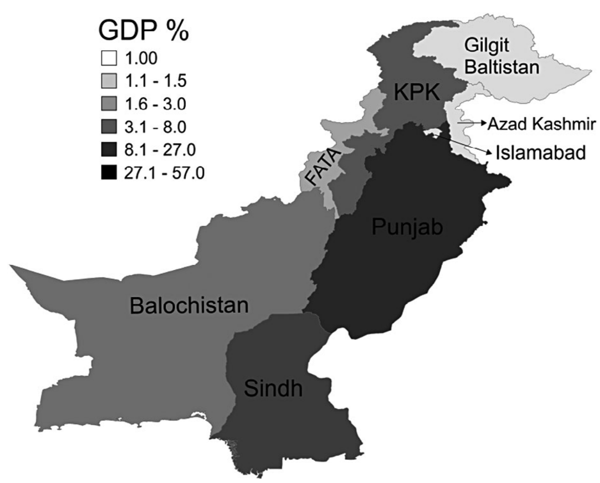
Transportation infrastructure and regional economic growth in Pakistan

Being a developing country, Pakistan is also facing economic and infrastructure issues. Located in South Asia, Pakistani economy has witnessed mixed economic situations like prosperous growth, decline and recovery throughout its 64 years life span (Figure 1). As a developing semi-industrialized economy, more than 80% of the total exports of Pakistan fall in the three categories of SITC 0 (Food & live animals), SITC 6 (Manufactured goods), and SITC 8 (Miscellaneous manufactured articles; Mohmand and Wang, 2013).

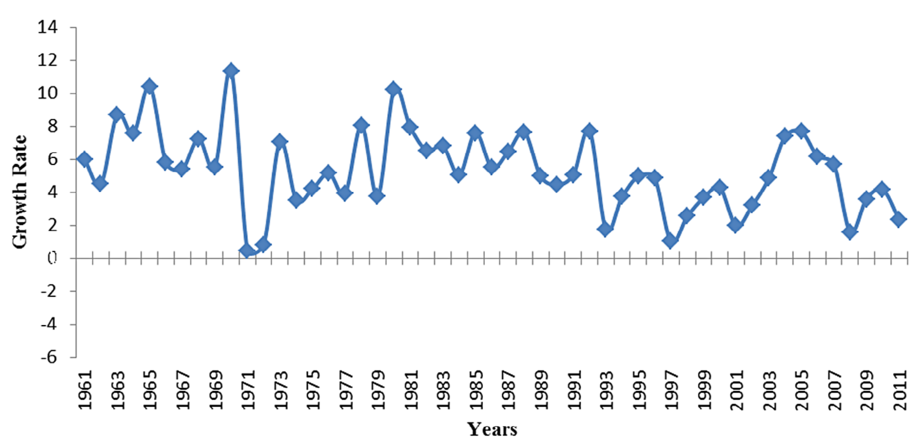
Pakistan's major industries are located in the two provinces Punjab and Sindh, along the Indus River. Punjab, the largest province of Pakistan in terms of population, has the largest and fastest growing economy of the country with 57% share of Pakistan's GDP as of 2010 (Figure 2). Sindh is the second largest province in terms of provincial GDP, however, much of Sindh's GDP is influenced by the economy of Karachi, the financial hub and gateway of Pakistan. The rest of the provinces follow behind as the Government of Pakistan has long pursued a biased development policy with the largest portions of public investments being concentrated in Punjab and Sindh. This trend has left the remaining provinces poor and with inadequate infrastructure. Today, the GDP per capita of Punjab and Sindh is well above $1100 which is a little above $500 from the rest of the provinces.

As far as the road network is concerned, about 40.9% of the total road infrastructure lies in the province of Punjab, followed by 30.9% in Sindh, 16.3 and 11.3% in Khyber Pakhtunkhwa and Baluchistan, respectively. Northern Areas and Azad Kashmir, being mostly hilly areas, constitute a small proportion of just 0.6% of the road network (Table 1).

From this perspective, the disparity in capital expenditure across various regions of Pakistan must be eradicated either through instigating appropriate financial policies or capitalizing and directing the growth spillovers from developed to under developed provinces. Toward this direction, government has started to pay special attention to the poorest province, Baluchistan, which has long suffered from political and economic instability. In addition, this province is also under the spotlight owing to the fact that the port of Gwadar also located in this province which has the ability to generate revenue in millions of dollars annually in terms of port and freight charges – mainly from the outflow of goods from Chinese western provinces and Central Asian states to Indian Ocean. However,



2 Provincial GDP percentages



1 GDP growth rate

Table 1 Estimated length of roads in provinces

Year	Punjab	Sindh	KPK	Baluchistan	Others	Total
2008	104,114	80,863	42,369	29,452	1,552	258,350
2009	105,085	81,618	42,765	29,727	1,565	260,760
2010	105,235	80,625	42,550	29,500	1,535	259,463
2011	106,455	80,960	42,975	29,625	1,580	261,595
2012	107,805	81,385	42,980	29,655	1,590	263,415

Notes: Road length is provided in Kilometers. (Source: Pakistan Economic Survey 2012–13).

reducing the interprovincial disparity between provinces effectively is still a daunting challenge for the government. Law and order, poor adult literacy rates, healthcare issues, inflation, and mounting debt burden have their effects on the performance of the government. In short, *ceteris peribus*, keeping in view the sociopolitical, economical, and geographical differences of these provinces which may certainly have substantial impact on the regional economic disparity, an appropriate transportation infrastructure might prove useful in facilitating communications between provinces and the outside world. Thus, along with others, an improved transportation infrastructure can be a critical factor in the path of more widely spread economic growth and urbanization for the provinces. An appropriate planning of transportation infrastructure investment can affect the growth potential of these regions and also help to reduce the regional disparities to arrive at a more sustainable economic growth path and to maintain social stability.

Methodology and data

In order to investigate our main research question of a significant effect of infrastructure on economic growth, we apply Granger Causality model which is proposed to determine the causality between economic variables using the time-serial data (Granger, 1988). In essence, GC Causality is a statistical concept of antecedence or predictability. The outcomes address the question of whether or not one variable helps in explaining the subsequent time path of another. In basic terms, this methodology can be explained as follows: X is said to cause Y if X contains information in the past terms that helps in the prediction of Y. In the reverse direction, the feedback from Y to X can be said to exist if a prediction of X can be significantly improved by taking into account the past values of Y (Granger, 1988; Yu et al., 2012). Thus, the GC relationship between X and Y can be unilateral or bilateral if the causation is found to be in both the X and Y simultaneously. The data used in this study are a panel data at province level for the period of 1982–2010, so the panel variant of the causal relationship will thus become X_t and Y_t, where t represents the time period. The introduction of panel data structure increases the efficiency of GC test by increasing the degree of freedom.

In our setting, GC model is employed to check the causal relationship between transportation infrastructure and regional economic growth. Technically, it tests that whether the high level of transportation infrastructure causes a rise in GDP, if the time series prediction of GDP from its own past improves when lags of transportation infrastructure are included in the model.

This study uses GDP as a proxy variable for economic growth, whereas the length of the transportation network (kilometers of road network) is taken as a proxy for transportation infrastructure investment. Hence, the empirical model can be represented as follows:

$$\ln \mathrm{GDP}_{it} = \alpha_{0i} + \alpha_{1i} \ln \mathrm{TN}_{it} + \varepsilon_{it} \tag{1}$$

$$\ln \mathrm{TN}_{it} = \beta_{0i} + \beta_{1i} \ln \mathrm{GDP}_{it} + \varepsilon_{it} \tag{2}$$

where GDP is the real GDP, TN is the transportation investment, ε is the error term, ln stands for the log (log is introduced to check for elasticity and to reduce variance and fluctuations in the data), whereas the subscripts i and t denote province and the year, respectively. Data for the model are collected from different official publication of the Economic Survey of Pakistan, the statistical yearbook of Pakistan, provincial statistical bureaus and finally the National Transport Research Center.

Before starting off with the GC, one must make sure that only stationary series involvement as highlighted by Granger (1969). Secondly, there is also the issue of long-run equilibrium relationship between the two variables. To address these issues, two tests namely the panel unit root and panel cointegration test are performed. The first step is to run a panel unit root test to check whether the variables used are stationary. Panel unit root test is a non-parametric test which is performed to investigate the degree of integration between variables. A series is said to be stationary if the mean and variance of the series does not depend on time. The results of the panel unit root are provided in Table 2. These results are estimated using Eviews 7.1 using different tests like the IPS (Im et al., 2003), ADF, etc.

As the empirical findings show, the null hypotheses of a unit root cannot be rejected when we run the panel unit root test on the original value of GDP and transportation investment. However, the null hypotheses can easily be rejected when the first difference of each of the two variables is taken. This concludes that GDP and transportation investment are integrated of order 1 or I (1).

Once the existence of the panel unit root has been confirmed, the second step is to find whether there exists a long-run equilibrium relationship between the two variables. If the variables are cointegrated, it indicates that the variables move together over time in such a way that short-term disturbances will be corrected in the long-term. In contrast, a lack of cointegration represents that such variables have no relationship in long run. To do this, a two-step panel cointegration technique is used (Engle and Granger 1987). Using Equations (1) and (2), a panel regression is performed by estimating the long-run model and the residuals are checked whether or not they are stationary using IPS, ADF-Fisher, and PP-Fisher methods. If the residuals or ε_{ij} are stationary, it means both the variables are cointegrated. The results are reported in Table 3. The table provides strong evidence of integration between these variables as all the statistics significantly reject the null hypotheses of

Table 2 Panel unit root test

Level	Tests	GDP	TN	ΔGDP	ΔTN
National	IPS	–0.4 (0.36)	0.9 (0.82)	–6.4 (0.00)*	–4.2 (0.00)*
	ADF-Fisher	12.2 (0.15)	2.8 (0.94)	51.7 (0.00)*	31.3 (0.00)*
	PP-Fisher	12.3 (0.14)	2.5 (0.96)	55.9 (0.00)*	31.9 (0.00)*
Punjab	IPS	8.8 (1.00)	2.8 (0.99)	–4.2 (0.00)*	–12.3 (0.00)*
	ADF-Fisher	82. 5 (0.99)	24.1 (1.00)	138.9 (0.00)*	265.8 (0.00)*
	PP-Fisher	39.4 (0.99)	21.5 (1.00)	190.4 (0.00)*	271. 7 (0.00)*
Sindh	IPS	–0.07 (0.47)	1.8 (0.97)	–18. (0.00)*	–8.18 (0.00)*
	ADF-Fisher	35.6 (0.22)	10.7 (0.99)	272.3 (0.00)*	117.3 (0.00)*
	PP-Fisher	30.9 (0.42)	9.5 (0.99)	295.5 (0.00)*	119.9 (0.00)*
KPK	IPS	5.8 (1.00)	1.9 (0.98)	–4.2 (0.00)*	–8.7 (0.00)*
	ADF-Fisher	2.9 (1.00)	12.1 (0.99)	63.8 (0.00)*	132.9 (0.00)*
	PP-Fisher	2.8 (1.00)	10.7 (1.00)	189.9 (0.00)*	135.9 (0.00)*
Baluchistan	IPS	0.4 (0.65)	0.7 (0.75)	–4.8 (0.00)*	–2.9 (0.00)*
	ADF-Fisher	1.9 (0.75)	1.4 (0.84)	26.1 (0.00)*	15.6 (0.00)*
	PP-Fisher	1.6 (0.8)	1.3 (0.87)	26.2 (0.00) *	15.9 (0.00)*

Notes: Probability values are given in parentheses. *, **, ***, denotes significance at 1, 5, and 10%, respectively.

Table 3 Cointegration test

Level	Tests	Residual from Equation 1	Residual from Equation 2
National	IPS	–3.9 (0.00)*	–3.3 (0.00)*
	ADF-Fisher	40.4 (0.00)*	36.3 (0.00)*
	PP-Fisher	52.1 (0.00)*	47.9 (0.00)*
Punjab	IPS	–7.36 (0.00)*	–14.04 (0.00)*
	ADF-Fisher	192.99 (0.00)*	305.34 (0.00)*
	PP-Fisher	269.03 (0.00)*	305.68 (0.00)*
Sindh	IPS	–15.51 (0.00)*	–13.76 (0.00)*
	ADF-Fisher	236.98 (0.00)*	204.1 (0.00)*
	PP-Fisher	299.93 (0.00)*	226.1 (0.00)*
KPK	IPS	–16.8 (0.00)*	–11.2 (0.00)*
	ADF-Fisher	268.3 (0.00)*	172.5 (0.00)*
	PP-Fisher	271.7 (0.00)*	172.5 (0.00)*
Baluchistan	IPS	–5.2 (0.03)**	–5.3 (0.01)*
	ADF-Fisher	28.1 (0.00)*	28.4 (0.02)**
	PP-Fisher	28.6 (0.04)**	29.6 (0.02)**

Notes: Probability values are given in parentheses. *, **, ***, denotes significance at 1, 5, and 10%, respectively.

Table 4 Regression results of Granger causality test

Level	Dependent Variable	ΔlnGDP	ΔlnTN	ECM
National	**Δ** In GDP	–	0.55 (0.5)	–0.03 (0.11)
	Δ In TN	0.91 (0.49)	–	–0.02 (0.01)*
Punjab	**Δ** In GDP	–	1.2 (0.18)	–0.41 (0.02)**
	Δ In TN	0.72 (0.24)	–	–0.01 (0.00)*
Sindh	**Δ** In GDP	–	0.22 (0.49)	–0.5 (0.03)**
	Δ In TN	0.31 (0.56)	–	–390.27 (0.01)*
KPK	**Δ** In GDP	–	0.5 (0.33)	–0.62 (0.19)
	Δ In TN	0.86 (0.23)	–	–0.19 (0.04)**
Baluchistan	**Δ** In GDP	–	3.3 (0.19)	0.43 (0.45)
	Δ In TN	0.03 (0.34)	–	–0.27 (0.6)

Notes: Probability values are given in parentheses. *, **, ***, denotes significance at 1, 5, and 10%, respectively.

no cointegration. Thus, it can be stated that GDP and TN has a long-run equilibrium relationship, which means the transportation infrastructure can facilitate Pakistan's economic growth and vice versa.

Given that both prerequisite to the GC tests have confirmed of a causal relationship between the economic growth and transportation network investment, the last step is to estimate the magnitude of this relationship. GDP and investment are cointegrated which means a causal relationship between both variables exists in the long run, however, it is not known whether it is unidirectional or bidirectional (Granger, 1969). In order to identify and quantify the direction of the short-run and long-run causality, a dynamic error correction model, ECM (Kao, 1999; Pedroni, 2004) is used by estimating the following equation:

$$\Delta \ln \mathrm{GDP}_{it} = \alpha_{1i} + \sum_{k=1}^{m} \beta_{1ik} \Delta \ln \mathrm{GDP}_{i,t-k} + \sum_{k=1}^{m} \gamma_{1ik} \Delta \ln \mathrm{TN}_{i,t-k} + \delta_{1i} \mathrm{ECM}_{i,t-1} + \varepsilon_{1it} \quad (3)$$

$$\Delta \ln \mathrm{TN}_{it} = \alpha_{2i} + \sum_{k=1}^{m} \beta_{2ik} \Delta \ln \mathrm{GDP}_{i,t-k} + \sum_{k=1}^{m} \gamma_{2ik} \Delta \ln \mathrm{TN}_{i,t-k} + \delta_{2i} \mathrm{ECM}_{i,t-1} + \varepsilon_{2it} \quad (4)$$

where GDP and TN are the same as previously stated, m is the lag length, Δ denotes the first difference of the variable, and $\mathrm{ECM}_{i,\,t-1}$ denotes the error correction term. If the coefficients of the ΔGDP and ΔTN are significant, it implies that causality between the variables exist in the short run. For the long-run GC to exist, the coefficient of the ECM should be significant. Table 4 reports the results of the panel GC tests for Equations (3) and (4).

Conclusions

The econometric findings, presented in Table 4, show that there is no causality between economic growth and transportation network investment in the short run at either the national or the provincial level. All the first differenced variables are statistically insignificant. In the long run, a causal relationship from economic growth to transportation investment exists at the national level, but not the other way around. The coefficient of the error correction model is significant for economic growth to transportation investment, but insignificant for transportation investment to economic growth. The result of the GC suggests that in the short run, there is no causal relationship between both the variables, whereas in the long run, economic growth is the driving force of transportation network investment and a change in the rate of economic growth does cause a significant change in transportation investment, but increasing transportation infrastructure investment does not lead to a significant rise in economic growth at the national level.

At the provincial levels, the results differ substantially. For the developed provinces of Punjab and Sindh, the coefficients on the error correction term are negative and significant for both GDP and TN, which indicate that bidirectional causality between the two variables exists. The results for these provinces suggest that a change in the rate of economic growth (transportation investment) does cause a significant increase in transportation investment (economic growth). For the less developed province of KPK, there is unidirectional GC from economic growth to transportation infrastructure, a change in the rate of economic growth does cause a significant change in transportation infrastructure investment, but transportation investment does not cause economic growth. Lastly, for the least developed province of Baluchistan, the results imply that neither economic growth has any impact on transportation infrastructure investment nor transportation infrastructure investment is the cause of economic growth.

As far as no causality between economic growth and infrastructure in the short-term analysis is concerned, investment in infrastructure cannot be considered as a public good until the investment become the part of capital stock. Spending on infrastructure has a large multiplier effect and apart from providing accessibility and connectivity, the development of roads can open up previously unconnected regions to trade and investment and step up access to goods, services, and employment opportunities. However, transportation infrastructures do take a considerable time to be built and being functional. It is thus reasonable that a causal relationship between these two variables cannot be established in the short term.

At the national level, the long-term analysis provides sufficient evidence that there is a unidirectional causal relationship from economic growth to transportation investment and that GDP is the Granger cause of transportation infrastructure's development, which means that GDP is indeed a significant cause of development of Pakistan's transportation infrastructure. This result is in line with the commonly accepted notion advocating that economic growth provides necessary financial and technical support for transportation infrastructure investment and improvement (see Aschauer, 1989a, and references therein).

On the other hand, there is no evidence found that transportation investment is the cause of economic growth. The results vary across provinces, where bidirectional causality exists between the variables in the developed provinces and unidirectional causality in the under developed provinces. Although an improvement of the infrastructure can bring about some positive changes, transportation infrastructure alone is not sufficient to bring change in the underdeveloped regions of Pakistan. Hence, efforts should be made not only to upgrade the infrastructure but also to focus on the improvement of the social, technological, and educational levels of the under developed regions.

Taken together, our results suggest that in the short run, there is no GC between economic growth and infrastructure investment. In the long run, a unilateral causality does exist between economic development and transportation infrastructure investment at the national level. At the provincial level, however, there is bidirectional GC between economic growth and infrastructure investment in the developed regions of Pakistan. As far as the least developed province of Baluchistan is concerned, the results imply that economic growth has not impacted on transportation infrastructure and vice versa.

One should bear in mind that our results do not discourage those who believe that investment in transportation infrastructure promotes economic development. Instead, our results suggest the importance of other factors as well in thinking of the effects of infrastructure on economic development. Although the basic logic behind the positive association between economic growth and investment in transportation infrastructure is straightforward – economic development leads to a high demand of adequate transportation facilities and the government meets this demand by investing in infrastructure projects, and this notion is supported by many researchers by documenting that an improved and efficient infrastructure can facilitate a country's economic growth. Nevertheless, we emphasize that in Pakistan, transportation infrastructure investment is not the only determinant of economic growth. The policy implication here is, of course, that, taking future growth implications into account, there is a stronger case now for also considering other causes for economic growth such as education, geography, technological development, sociopolitical situation, human capital, and resource endowments. The results suggest a shift in policy toward the poor provinces. The current infrastructure development projects carried out by the government in Baluchistan and KPK are not sufficient. There is urgent need that the government should focus on efforts to overcome other barriers to regional economic growth in conjunction to transportation infrastructure investment, as an integrated package of investment in these poor regions of Pakistan.

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