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Infrastructure Development and Economic Growth: A Comparative Study of Developing and Emerging Economies of Asia

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Contents

Abstract: The present study attempts to test our prime hypothesis—whether infrastructure development is a discernible factor responsible for the recent advancement in the Asian region—by making a group comparison of South Asian (India, Pakistan, Bangladesh and Sri Lanka) South East Asian countries (Malaysia, Indonesia, Thailand and South Korea), in order to study the development paradigm of growing Asia via the infrastructure development. We have taken into account three profound factors for infrastructure development: transportation, telecommunication and energy development, and constructed an Infrastructure Development Index (IDI) based on these factors. Using panel data ranging from 1980 to 2017, we have employed different econometric techniques to probe the influence of physical infrastructure on economic growth in selected Asian countries. Our findings showed that besides a number of confounding factors, the development in physical infrastructure substantially explain the economic growth in selected Asian countries. Our findings suggest that the selected Asian Countries particularly the South Asian countries should emphasize on the physical infrastructure for sustainable long run economic growth.

Key Words: Infrastructure Development, Economic Growth, Panel Co-integration; South Asia, East Asia

JEL Classification: O4; E6; H4; H5

Introduction

Economic Growth continues to be a theme of debate in economic theory since the 1950s. There is still no general consensus on the factors accountable for sustainable long run economic growth. However, the growth theory is augmentative. For instance, the preliminary neo-classical growth model developed in the classic work of Solow and Swan in the 1950s stresses that capital accumulation and technical change are the major forces behind economic growth. However, according to this theory, a growth rate tied with labor productivity is the long run outcome in the absence of technical change which is assumed as exogenous (Solow, 1956; 1957; Swan, 1956). In contrast, the endogenous growth theories developed in the 1980s claim that capital accumulation and technical change are endogenous and results from the profit maximization motive of

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economic agents (Lucas, 1988; Romer; 1986; Romer, 1990). Since the recent developments in growth theory, increasing recognition is being given to infrastructure as one of the determinants of output and competitiveness.

The fundamental question arises that how the physical infrastructural development affects the long run growth path, is of vital importance and encompasses different transmission channels First, the increase in the efficiency of customary factors i.e., labor and capital, is the primary channel through which infrastructural development affect growth (Barro,1990; Gibbons et al.,2019. Second, some researchers proclaimed that investment on physical infrastructure enhances the durability of private investment and hence affect economic growth positively (Gupta, et al., 2014; Agenor, 2009). Third, better infrastructure facilities private businesses by reducing the maintenance cost of capital and thus allocating additional funds to productive investment which, in turn, generate an additional growth effect (Dreger & Reimers, 2016; Su & Bui, 2017; Brox & Fader, 2005; Fedderke & Bogetić, 2009). Fourth, existing literature has documented the linkages between the FDI and economic growth (Balasubramanyam, Salisu, & Sapsford, 1999; Iamsiraroj, 2016 Alvarado, Iniguez, Ponce, 2017). The quality of Physical infrastructure also attracts foreign direct investment and hence indirectly contributes to economic growth especially in the capital deficient developing countries Asiedu, 2002; Demirhan & Masca, 2008; Ang, 2008). (Palei, 2015).

It has been observed in a number of research findings that the developed infrastructure enhances the competitiveness of exports and minimizes transportation cost. Consequently, the lager volume of trade minimizes the cost of transportation among different regions, integrating the markets globally, thus connecting the nations to international markets at low cost Conrad & Seitz, 1994; Romp & De Haan, 2007; Deng, 2013; Palei, 2015). Infrastructure development is an important ingredient of competitiveness; however, policy makers must incorporate the environmental and sustainable development aspects in their development policy (Balkyte & Tvaronavičiene, 2010). In contrast, some studies argued that public investment on academia, knowledge creation and technological infrastructure along with trade openness is important for innovation and hence sustainable, human centered long-run economic growth Ginevičius & Korsakiene, 2005; Haq & Luqman, 2014; Kaur &Singh, 2016).

The empirical evidence document that the marginal contribution of public infrastructure to economic growth is very high in the United States (Aschauer, 1989). Besides, many cross-country studies supported the claim that there is high output elasticity of public expenditure on physical infrastructure (Calderón, Moral-Benito, & Servén, 2015; Canning, 1998). However, these finding were challenged by many studies on the methodological ground such as the problems of endogeneity, and spurious regression. Many studies after controlling for the problems of endogeneity and spurious regression, found that infrastructure amplify the economic growth process (Palei, 2015; Chakraborty, & Nandi, 2011). In developing countries, there is a weak institutional structure and the state apparatus favor the rent seeking segment of the society. As a result, public expenditure on physical infrastructure is mismanaged and rent seekers take an undue share of public expenditure. In this context, existing literature emphasizes on the role of institutional quality and governance in infrastructure growth nexuses. These studies find the considerable contribution of infrastructure to economic growth after taking into account the quality of institutions (Esfahani &Ramírez, 2003; Dabla-Norris et al., 2012). Similarly, a series of country-specific studies also found a positive role of infrastructure in the economic growth process which includes Pakistan (Mohmand, Wang, &Saeed, 2017; Ayub, Rasheed, Ahmad, & Bashir, 2021; Javid, 2019), India (Unnikrishnan & Kattookaran, 2020; Pradhan & Bagchi, 2013; Sahoo & Dash, 2009), China (Banerjee, Duflo, & Qian, 2020), South Africa (Fedderke, Perkins, & Luiz, 2006) , and Turkey (Özer, Canbay, & Kırca, 2020). Some provincial level studies also substantiate the fact that physical infrastructure plays an important role in economic growth and reduces the regional disparities within the country (Démurger, 2001). Similarly, in a regional context, some studies document the positive influence of physical infrastructure on economic growth in the South Asian region (Rashid et al., 2021; Khan et al., 2020). More recently, some studies find evidence for the decreasing return on physical infrastructure especially in advance industrialized countries (Jong-A-Pin & De Haan, 2008; Välilä, 2020). Similarly, some studies argue that the marginal social benefit of Physical infrastructure is higher in the less developed region (Nijkamp, 1986; Canaleta, Arzoz & Gárate, 2002; Shenggen & Zhang, 2004). These narratives of literature make us available with a conclusion that the country level findings substantiate the fact that physical infrastructure plays a vital role in the growth of a country. Further, cross-country panel studies have provided strong support of the positive contribution of the physical infrastructure to economic growth, indicating that marginal contribution are higher in the underdeveloped regions. Given these alternative arguments, the prime objective of the study is to investigate by making a group comparison of South Asian and South East Asian countries, whether the output elasticity of physical infrastructure is higher in the less developed region.

The contribution of the study to the existing literature is as follows. First, according to the best of our knowledge there is no study that make a group comparison of South Asian and South East Asian countries in infrastructure growth nexuses. Second, the existing literature on infrastructure growth nexuses are criticized on the ground that most of the studies used large panel of heterogeneous countries. We address the problem of heterogeneity and estimated the two separate regressions i.e., first for the South Asian countries and second for the South East Asian countries. Third, existing literature used a single component of infrastructure or used public expenditure as a proxy of physical infrastructure. However, in developing countries due to weak institutional structure and inefficient state apparatus, public expenditure cannot reflect the true picture. Hence, to avoid measurement error, we have constructed a composite index of infrastructure development (IDI) based upon three pillars of physical infrastructure: transportation, telecommunication and energy. Fourth, most of the existing studies are criticized on the grounds of methodological weaknesses such as the problems of endogenity, and spurious regression due to weaknesses in estimation techniques. To overcome these problems, the study has used FMOLS, and DOLS methods, based on panel co-integration that is an efficient way to address the problems of endogeneity.

After a comprehensive introduction in the first section, the remaining paper is organized in the following sections: Section 2 entails a comparative analysis of infrastructure development and growth in the region of Asia. Section 3 provides the details about the model specification, describes data and methodology. Section 4 presents the results of the study, while section 5 concludes the study.

Infrastructure Development and Growth in Asia

A Comparative Analysis

The selected Asian countries in this study comprise four South Asian and four South East Asian countries. In this section, we provide some comparison of these countries in terms of economic indicators and their other characteristics relevant to the transport and communication sector. The countries in each region that we selected for this study are more or less similar in terms of their basic economic, and transport and communication indicators. However, the cross-region comparison reflects that the countries in the South East Asian region are better than their counterparts in South Asia in terms of both economic indicators and transport and communication.

In terms of economic performance, India is dominating the South Asian region due to its higher economic growth in the last decade. The other South Asian economies are growing more or less at the same rate. In terms of openness, Sri Lank is dominating throughout history. Due to its relatively open economy, Sri Lank has attracted a handsome amount of Foreign Direct Investment (FDI). This higher amount of inflow of FDI places Sri Lank in a dominant position in terms of growth in investment. However, as is evident from appendix A, in terms of the indicators of transport and communication, almost all of the South Asian countries are Similar.

In the South East Asian region, South Korea, being one of the Asian tiger, is dominating in terms of growth performance. South Korea is followed by the recently emerging economy of Malaysia. The remaining two countries in the region i.e. Indonesia and Thailand are not much different in terms of economic performance. In terms of international openness, Malaysia is taking the lead, followed by Thailand. Again, due its relatively higher openness of the economy and trade liberalization policies, Malaysia has experienced a whopping trend in attracting considerable amount of FDI. However, in terms of the overall investment growth, South Korea is competing with Malaysia.

This implies that the lower amount of FDI into South Korea is compensated by its higher level of the mobilization of domestic resources. Indonesia is the most closed economy, and also its overall investment growth rate is lower than other countries in the region. In terms of the energy consumption, South Korea is dominating, followed by Malaysia and then Thailand. Again, Indonesia is the lowest in terms of the energy consumption. Roads are relatively better in South Korea and Malaysia, and also, the communication facilities in these two are relatively better as compared with the other two South East Asian countries.

The region wise comparison shows that South East Asian region is relatively better than the South Asian region, not only the economic performance, but also high energy consumption and communication facilities are observed. This better position places the South East Asian region better than the South Asian region in terms of infrastructure and business indicators.

Model, Data and Methodology

The Model

In line with the literature on growth (Mankiw, Romer & Weil, 1992), we extend the human capital augmented neoclassical model by incorporating the physical infrastructure as an additional explanatory variable.

$$LnGDP_{it} = \beta_{io} + \beta_{1i}LnX_{it} + \beta_{2i}LnIndex_{it} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where; GDP_{it}= Real Gross Domestic Product, $Index_{it}$ =The Index of Physical infrastructure, X_{it}= The vector of Control Variables includes, employed labor force denoted by *LF*, Gross fixed capital formation denoted by *GFCF*, human capital denoted by *EXPHE* and trade openness denoted by *TTRADE*, ε = Error term.

Data and Variables Description

The present study uses real GDP, Physical capital, labor force, human capital, trade openness and Physical Infrastructure. We use gross fixed capital formation as proxy for physical capital while human capital is captured through the expenditure on health and education. Trade openness is measured by using ratio of total trade volume to GDP.

Data ranges from 1980 to 2017, is taken from WDI. The variable of our interest is physical infrastructure. We construct the index of physical infrastructure development (IDI) by using three different components of infrastructure i.e. transportation, telecommunication and energy.

The study uses principal component analysis in order to construct composite index.

$$Index_i = Z_1X_{11} + Z_2X_{12} + Z_3X_{13} + \cdots \ldots\ldots\ldots\ldots.. Z_nX_{1n}$$

or

$$Index_i = \sum Z_jX_{ij}$$

Here, Index$_i$ is the composite index, Z_j stands for a weight given to jth indicator, and x_{ij} is the observation value. In order to make the index unit free, and to convert the different variables - measured in different units - in a comparable same unit, we have used the following formula;

$$Z_{ij} = (\frac{Z_{oj} - Z_{mj}}{\sigma_j})$$

Here, Z_{ij} are the observation that are scale free, Z_{oj} show original observations, Z_{mj} denotes the mean of the jth, and indicator and σ_j indicates standard deviation of jth indicator

Empirical Findings

Findings of the study grounded on the following three steps. First, we have determined the order of integration of each variable. Second, based on the results, we test for co-integration with residual Co-integration method Kao, 1999; McCoskey & Kao, 1998). In the third step, we employ the approaches of FMOLS and DOLS.

Unit Root Tests

The study has employed a number of tests to check the stationarity of the data. The results of different panel unit root tests are presented in table 1. The results of these tests indicate that the variables are non-stationary at level form, but become stationary when differenced at first level, except health and education expenditure. So health and education expenditure variables are stationary at level. The results compel us to employ panel Co-integration tests in order to check the long run relationship among the corresponding variables.

Table1. Im, Pesaran and Shin W-stat and Levin, Lin & Chu Panel Unit Root Tests

Null Hypothesis: There exists unit root				
Variables	*Im, Pesaran and Shin W-stat (Intercept and Trend)*		*Levin, Lin & Chu t (Intercept and Trend)*	
	Levels	First Difference	Levels	First Difference
LNGDP	3.11344 (0.9991)	-4.92645*** (0.0000)	0.86215 (0.8057)	-7.5977*** (0.0000)
LNLF	2.62796 (0.9957)	-3.18229*** (0.0007)	3.98271 (0.9999)	-5.90809*** (0.0000)
LNGFCF	0.36879 (0.6439)	-5.3091*** (0.0000)	-0.54108 (0.2942)	-7.10309*** (0.0000)
LNIndex	0.29082 (0.6144)	-7.47057*** (0.0000)	1.23402 (0.8914)	-10.2468*** (0.0000)
LnTTRADE	0.51129 (0.6954)	-5.80857*** (0.0000)	0.83976 (0.7995)	-10.0676*** (0.0000)
LNEXPHE	-4.16614*** (0.0000)	-	-6.57305*** (0.0000)	-

****, **, * shows significance at 1%, 5%, 10% respectively.*

Panel Co-integration Tests

The results of panel co-integration are provided in the Table 2. The results show that five statistics, out of seven, reject the null hypothesis of no co-integration which implies that there exists long run relationship among the variables.

Table 2. Pedroni's and Kao's Test for Panel Co-integration

Pedroni's Test for Panel Co-integration.			Kao Residual Cointegration Test		
	Statistic	Prob.		t-Statistic	Prob.
Panel v-Statistic	9.84581***	0.0000			
Panel rho-Statistic	2.075702	0.9810			
Panel PP-Statistic	1.353484*	0.0880	ADF	3.253053	0.0006
Panel ADF- statistic	1.657633**	0.0487			
	Statistic	Prob.			
Group rho-Statistic	3.076500	0.9990			
Group PP-Statistic	5.698371***	0.0000			
Group ADF-Statistic	2.469388***	0.0068			

****, **, * shows significance at 1%, 5%, 10% respectively.*

FMOLS and DOLS Results

After the establishment of long run relationship, we estimate equation 1 by the methods of FMOLS and DOLS. To avoid the problem of regional heterogeneity, we estimated separate growth equations for South Asian and South East Asian regions. This group comparison helps us to review the results across the regions. The FMOLS and DOLS results for South Asian countries are presented in the Table 3.

Table 3. Estimates of Physical Infrastructure and Economic Growth of South Asian Countries

Variables	*FMOLS*		*DOLS*	
	Parameter	T-Stat.	Parameter	T-Stat
LNLF	0.870882	9.772 (0.0000)	0.291206	2.7570 (0.0082)
LNGFCF	0.181339	5.1074 (0.0000)	0.344508	1.6584 (0.1037)
LNEXPHE	0.035552	2.310457 (0.0127)	0.079220	3.0759 (0.0035)
LNTTRADE	0.309573	12.21306 (0.0000)	0.552949	4.2266 (0.0001)
LNINDEX	0.120248	2.360024 (0.0045)	0.182089	2.3875 (0.0075)
R^2		0.995303	0.999622	
Adjusted R^2		0.994965	0.999032	
S.E		0.093967	0.041272	
Durbin-Watson stat		2.182910	2.137675	

The results reported in table 3 show that confounding factors such as employed labor, physical capital and human capital positively explain the growth process. Our results of the South Asian region show that physical infrastructure is positively associated with the economic growth. Many studies on infrastructure growth nexuses document similar results for the selected south Asian countries (Rashid et al., 2021; Khan et al., 2020;

Mohmand et al., 2020; Baloch, 2018). Alternatively, both the FMOLS and DOLS results show that physical infrastructure is positively contributing to growth of income in South Asian region. However, the magnitudes of the coefficient are different between selected Asian countries. The output elasticity of physical infrastructure estimated by the FMOLS and DOLS are 0.12 and 0.18 respectively which is comparatively higher than South East Asian Countries as reported in table 4. This result is also in line with existing literature which support the claim that output elasticity of physical infrastructure is higher in the less developed region (Eberts, 1986; Shi, Guo, &Sun, 2017).

Table 4. Estimates of Physical Infrastructure and Economic Growth of South East Asian Countries.

Variable	*FMOLS*		*DOLS*	
	Coefficient	t-Statistic	Coefficient	t-Statistic
LNLF	0.350960	7.7056 (0.0000)	0.153005	4.580409 (0.0000)
LNGFCF	0.37208	5.3178 (0.0000)	0.115226	4.682510 (0.0000)
LNEXPHE	0.165991	3.3433 (0.0000)	0.009170	1.935082 (0.0555)
LNTTRADE	0.23253	11.1748 (0.0000)	0.485936	3.34340 (0.0000)
LNINDEX	0.063148	2.41784 (0.0052)	0.110107	2.013800 (0.0039)
R^2	0.961894		0.999943	
Adj. R^2	0.959018		0.999826	
S.E	0.173224		0.011421	
D.W Stat.	1.804800		(--------)	

In the same way, Table 4 summarizes the results of FMOLS and DOLS for South East Asian countries. The estimated results disclose that all the variables are statistically significant along with the expected signs. Physical infrastructure is positively contributing to growth in the South East Asian region. Many studies on infrastructure growth nexuses document similar results (Chia, 2016; Bardal, 2019). Interestingly, the output elasticity of physical infrastructure is lower in this case as compared to that of the South Asian region. The output elasticity or marginal contribution of physical infrastructure for the East Asian countries estimated by FMOLS and DOLS are 0.06 and 0.11 respectively which is lower than South Asian countries. Thus the results substantiate the hypothesis that marginal contribution of physical infrastructure is higher in developing South Asian countries. These results are again in line with the existing literature that claim higher marginal contribution of physical infrastructure in the relatively less developed regions (Nijkamp 1986; Canaleta, Arzoz & Gárate, 2002; Eberts, 1986; Shi, Guo & Sun, 2017).

Conclusions

The study investigates the contribution of physical infrastructure to economic growth of selected Asian countries by employing the panel data ranging from 1980 to 2017. The prime objective of the study is to investigate —by making a group comparison of South Asian and South East Asian countries —whether the output elasticity of physical infrastructure is higher in the less developed region. For this purpose, we have constructed an index of physical infrastructure by taking into account three pillars of infrastructure development— transportation, communication, and energy. Further, we employed different techniques of panel co-integration to verify the co-integrating relationship among the concerned variables.

The findings based on the panel co-integration disclose that there exists long run relationship between the physical infrastructure and economic growth. Further, we have divided our sample into two regions, i.e., South Asian region and South East Asian region, and employed FMOLS and DOLS to estimate the growth equations. Findings of the study, in the both cases, showed that infrastructure plays a vital role in long run growth process. Yet, in regional comparative analysis, South Asian countries have more infrastructure development returns as compared to East Asian countries.

The findings of the study suggest a vigilant massage to economic planners that, along with investment in human capital, the investment in physical infrastructure have a great margin to boost up economic performance in the Asian countries, especially in the South Asian countries —where optimal initialization of the economic resources need well established infrastructure, as the East Asian countries has shown such sort of growth miracles formerly.

There are some limitations of the study. The study used different indicators of the physical infrastructure for the composite index. However, currently ICT is playing major role in the growth and development. Future research can use some indicators of the ICT such as broadband connections to construct the composite index. Similarly, this study is based on the group comparison of selected South Asian countries with East Asian countries. The future research can extend this study by making comparison of larger groups of developed and developing countries. Moreover, south Asian countries are facing the poverty and income inequality and regional disparities. Future research can investigate the influences of physical infrastructure on poverty, income inequalities and regional disparities in South Asian context.

References

Agénor, P. R. (2009). Infrastructure investment and maintenance expenditure: Optimal allocation rules in a growing economy. *Journal of Public Economic Theory*, *11*(2), 233-250. https://doi.org/10.1111/j.1467-9779.2009.01408.x

Agénor, P. R., & Moreno-Dodson, B. (2006). *Public infrastructure and growth: New channels and policy implications* (Vol. 4064). World Bank Publications.

Alvarado, R., Iniguez, M., & Ponce, P. (2017). Foreign direct investment and economic growth in Latin America. *Economic Analysis and Policy*, *56*, 176-187. https://doi.org/10.1016/j.eap.2017.09.006

Ang, J. B. (2008). Determinants of foreign direct investment in Malaysia. *Journal of policy modeling*, *30*(1), 185-189. https://www.jstor.org/stable/23215424

Aschauer, D. A. (1998). 'Is Public Expenditure Productive?', Journal of Monetary Economics, 23 (2), March, 177-200. *International Library Of Comparative Public Policy*, *10*, 650-673.

Asiedu, E. (2002). On the determinants of foreign direct investment to developing countries: is Africa different?. *World development*, *30*(1), 107-119. https://doi.org/10.1016/S0305-750X(01)00100-0

Ayub, M., Rasheed, R., Ahmad, R., & Bashir, F. (2021). Infrastructural Investments and Economic Growth: Evidence from Pakistan. *Journal of Business and Social Review in Emerging Economies*, *7*(3), 591-598. https://doi.org/10.26710/jbsee.v7i3.1845

Balasubramanyam, V. N., Salisu, M., & Sapsford, D. (1999). Foreign direct investment as an engine of growth. *Journal of International Trade & Economic Development*, *8*(1), 27-40. https://doi.org/10.1080/09638199900000003

Balkyte, A., & Tvaronavičiene, M. (2010). Perception of competitiveness in the context of sustainable development: facets of "sustainable competitiveness". *Journal of business economics and management*, *11*(2), 341-365. https://doi.org/10.3846/jbem.2010.17

Baloch, M. A. (2018). Dynamic linkages between road transport energy consumption, economic growth, and environmental quality: evidence from Pakistan. *Environmental Science and Pollution Research*, *25*(8), 7541-7552. https://doi.org/10.1007/s11356-017-1072-1

Banerjee, A., Duflo, E., & Qian, N. (2020). On the road: Access to transportation infrastructure and economic growth in China. *Journal of Development Economics*, *145*, 102442. https://doi.org/10.1016/j.jdeveco.2020.102442

Bardal, A. B. (2019). The potential for integration of the transport complex of the East of Russia into the international market of transport services. *Economic and Social Changes: Facts, Trends, Forecast*, *12*(6), 150-165. https://doi.org/10.15838/esc.2019.6.66.8

Brox, J. A., & Fader, C. A. (2005). Infrastructure investment and Canadian manufacturing productivity. *Applied Economics*, *37*(11), 1247-1256. https://doi.org/10.1080/00036840500118382

Calderón, C., Moral-Benito, E., & Servén, L. (2015). Is infrastructure capital productive? A dynamic heterogeneous approach. *Journal of Applied Econometrics*, *30*(2), 177-198. https://doi.org/10.1002/jae.2373

Canaleta, C. G., Arzoz, P. P., & Gárate, M. R. (2002). Structural change, infrastructure and convergence in the regions of the European Union. *European Urban and Regional Studies*, *9*(2), 115-135. https://doi.org/10.1177/096977640200900202

Canning, D. (1998). A database of world stocks of infrastructure, 1950–95. *The World Bank Economic Review*, *12*(3), 529-547. https://doi.org/10.1596/1813-9450-1929

Chakraborty, C., & Nandi, B. (2011). 'Mainline'telecommunications infrastructure, levels of development and economic growth: evidence from a panel of developing countries. *Telecommunications Policy*, *35*(5), 441-449. https://doi.org/10.1016/j.telpol.2011.03.004

Chia, S. Y. (2016). ASEAN economic integration and physical connectivity. *Asian Economic Papers*, *15*(2), 198-215. https://doi.org/10.1162/ASEP_a_00438

Conrad, K., & Seitz, H. (1994). The economic benefits of public infrastructure. *Applied economics*, *26*(4), 303-311. https://doi.org/10.1080/00036849400000077

Demirhan, E., & Masca, M. (2008). Determinants of foreign direct investment flows to developing countries: a cross-sectional analysis. *Prague economic papers*, *4*(4), 356-369. https://doi.org/10.18267/j.pep.337

Démurger, S. (2001). Infrastructure development and economic growth: an explanation for regional disparities in China?. *Journal of Comparative economics*, *29*(1), 95-117. https://doi.org/10.1006/jcec.2000.1693

Deng, T. (2013). Impacts of transport infrastructure on productivity and economic growth: Recent advances and research challenges. *Transport Reviews*, *33*(6), 686-699. https://doi.org/10.1080/01441647.2013.851745

Dreger, C., & Reimers, H. E. (2016). Does public investment stimulate private investment? Evidence for the euro area. *Economic Modelling*, *58*, 154-158. https://doi.org/10.1016/j.econmod.2016.05.028

Eberts, R. (1986). *Estimating the contribution of urban public infrastructure to regional growth* (No. 86-10).

Esfahani, H. S., & Ramı́rez, M. T. (2003). Institutions, infrastructure, and economic growth. *Journal of development Economics*, *70*(2), 443-477. https://doi.org/10.1016/S0304-3878(02)00105-0

Fan, S., & Zhang, X. (2009). Infrastructure and regional economic development in rural China. In *Regional Inequality in China* (pp. 177-189). Routledge. https://doi.org/10.1016/j.chieco.2004.03.001

Fedderke, J. W., & Bogetić, Ž. (2009). Infrastructure and growth in South Africa: Direct and indirect productivity impacts of 19 infrastructure measures. *World Development*, *37*(9), 1522-1539. https://doi.org/10.1016/j.worlddev.2009.01.008

Fedderke, J. W., Perkins, P., & Luiz, J. M. (2006). Infrastructural investment in long-run economic growth: South Africa 1875–2001. *World development*, *34*(6), 1037-1059. https://doi.org/10.1016/j.worlddev.2005.11.004

Gibbons, S., Lyytikäinen, T., Overman, H. G., & Sanchis-Guarner, R. (2019). New road infrastructure: the effects on firms. *Journal of Urban Economics*, *110*, 35-50. https://doi.org/10.1016/j.jue.2019.01.002

Ginevičius, R., & Korsakiene, R. (2005). Exploration of strategy: objectives, competencies and competitive advantage. *Journal of Business Economics and Management*, *6*(1), 13-22. https://doi.org/10.3846/16111699.2005.9636089

Gupta, S., Kangur, A., Papageorgiou, C., & Wane, A. (2014). Efficiency-adjusted public capital and growth. *World Development*, *57*, 164-178. https://doi.org/10.1016/j.worlddev.2013.11.012

Haq, M., & Luqman, M. (2014). The contribution of international trade to economic growth through human capital accumulation: Evidence from nine Asian countries. *Cogent Economics & Finance*, *2*(1), 947000. https://doi.org/10.1080/23322039.2014.947000

Iamsiraroj, S. (2016). The foreign direct investment–economic growth nexus. *International Review of Economics & Finance*, *42*, 116-133. https://doi.org/10.1016/j.iref.2015.10.044

Javid, M. (2019). Public and private infrastructure investment and economic growth in Pakistan: An aggregate and disaggregate analysis. *Sustainability*, *11*(12), 3359. https://doi.org/10.3390/su11123359

Kao, C. (1999). Spurious regression and residual-based tests for cointegration in panel data. *Journal of econometrics*, *90*(1), 1-44. https://doi.org/10.1016/S0304-4076(98)00023-2

Kaur, M., & Singh, L. (2016). Knowledge in the economic growth of developing economies. *African Journal of Science, Technology, Innovation and Development*, *8*(2), 205-212. https://doi.org/10.1080/20421338.2016.1147207

Khan, H., Khan, U., Jiang, L. J., & Khan, M. A. (2020). Impact of infrastructure on economic growth in South Asia: Evidence from pooled mean group estimation. *The Electricity Journal*, *33*(5), 106735. https://doi.org/10.1016/j.tej.2020.106735

Lucas Jr, R. E. (1988). On the mechanics of economic development. *Journal of monetary economics*, *22*(1), 3-42. https://doi.org/10.1016/0304-3932(88)90168-7

McCoskey, S., & Kao, C. (1998). A residual-based test of the null of cointegration in panel data. *Econometric reviews*, *17*(1), 57-84. https://doi.org/10.1080/07474939808800403

Mohmand, Y. T., Mehmood, F., Mughal, K. S., & Aslam, F. (2021). Investigating the causal relationship between transport infrastructure, economic growth and transport emissions in Pakistan. *Research in Transportation Economics*, *88*, 100972. https://doi.org/10.1016/j.retrec.2020.100972

Mohmand, Y. T., Wang, A., & Saeed, A. (2017). The impact of transportation infrastructure on economic growth: empirical evidence from Pakistan. *Transportation Letters*, *9*(2), 63-69. https://doi.org/10.1080/19427867.2016.1165463

Nijkamp, P. (1986). Infrastructure and regional development: A multidimensional policy analysis. *Empirical economics*, *11*(1), 1-21. https://doi.org/10.1007/BF01978142

Özer, M., Canbay, Ş., & Kırca, M. (2021). The impact of container transport on economic growth in Turkey: An ARDL bounds testing approach. *Research in Transportation Economics*, *88*, 101002. https://doi.org/10.1016/j.retrec.2020.101002

Palei, T. (2015). Assessing the impact of infrastructure on economic growth and global competitiveness. *Procedia Economics and Finance*, *23*, 168-175. https://doi.org/10.1016/S2212-5671(15)00322-6

Pradhan, R. P., & Bagchi, T. P. (2013). Effect of transportation infrastructure on economic growth in India: The VECM approach. *Research in Transportation economics*, *38*(1), 139-148. https://doi.org/10.1016/j.retrec.2012.05.008

Rashid, H. A., Fazal, A., Javaid, Y., & Kausar, N. (2021). Infrastructure and Economic Growth in South Asian Countries. *Journal of Indian Studies*, *7*(1), 81-92. http://dx.doi.org/10.22617/WPS189514-2

Romer, P. M. (1999). Increasing Returns and Long-Run Growth', *Journal of Political Economy, 94* (5), *International Library Of Critical Writings In Economics*, *110*, 470-508. https://www.jstor.org/stable/1833190

Romp, W., & De Haan, J. (2007). Public capital and economic growth: A critical survey. *Perspektiven der wirtschaftspolitik*, *8*(Supplement), 6-52. http://hdl.handle.net/10419/44846

Sahoo, P., & Dash, R. K. (2009). Infrastructure development and economic growth in India. *Journal of the Asia Pacific economy*, *14*(4), 351-365. https://doi.org/10.1080/13547860903169340

Solow, R. M. (1956). A contribution to the theory of economic growth. *The quarterly journal of economics*, *70*(1), 65-94. https://doi.org/10.2307/1884513

Solow, R. M. (1957). Technical change and the aggregate production function. *The* *review of Economics and Statistics*, 312-320. https://doi.org/10.2307/1926047

Unnikrishnan, N., & Kattookaran, T. P. (2020). Impact of public and private infrastructure investment on economic growth: Evidence from India. *Journal of Infrastructure Development*, *12*(2), 119-138. https://doi.org/10.1177/0974930620961477

Välilä, T. (2020). Infrastructure and growth: A survey of macro-econometric research. *Structural Change and Economic Dynamics*, *53*, 39-49. https://doi.org/10.1016/j.strueco.2020.01.007

Appendix A

Table A1. Over the Period Performances of Key Macroeconomic Indicators of South Asian Countries

Country	Period	GDP Growth	GDP Per Capita Growth	Trade (% of GDP)	Inflation (Annual Growth %)	Investment (Annual Growth%)	FDI (% GDP)
Pakistan	1980-1990	6.65	3.19	34.91	7.43	18.98	0.36
	1991-2000	3.96	1.30	35.33	9.25	17.59	0.86
	2001-2010	4.57	2.65	33.63	8.92	15.65	1.86
India	1980-1990	5.68	3.39	13.72	8.84	20.75	0.04
	1991-2000	5.57	3.67	21.45	9.05	22.34	0.45
	2001-2010	7.59	6.04	39.91	6.36	28.48	1.64
Sri Lanka	1980-1990	4.35	2.83	68.00	13.62	28.37	0.73
	1991-2000	5.22	4.01	78.35	9.72	23.61	1.27
	2001-2010	5.20	4.37	69.11	10.73	23.70	1.30
Bangladesh	1980-1990	3.46	0.76	19.27	7.36	14.61	0.01
	1991-2000	4.80	2.63	26.95	5.30	15.68	0.19
	2001-2010	5.82	4.43	40.96	6.40	22.05	0.80

Table A2. Over the Period Performances of Key Macroeconomic Indicators of South East Asian Countries.

Country	Period	GDP Growth	GDP Per Capita Growth	Trade (% of GDP)	Inflation (Annual Growth %)	Investment Annual Growth (% of GDP)	FDI (% of GDP)
Indonesia	1980-1990	6.62	4.43	47.93	9.46	30.36	0.44
	1991-2000	4.43	2.80	59.79	14.14	27.70	0.76
	2001-2010	5.24	3.76	56.93	8.59	19.74	0.92
Malaysia	1980-1990	6.16	3.31	115.18	3.56	35.96	3.37
	1991-2000	7.23	4.57	185.48	3.55	42.18	5.70
	2001-2010	4.62	2.67	191.57	2.21	26.39	2.89
Thailand	1980-1990	7.65	5.73	56.60	5.82	35.28	1.15
	1991-2000	4.63	3.63	91.98	4.53	38.98	2.57
	2001-2010	4.37	3.71	135.02	2.62	27.21	3.59
Korea	1980-1990	7.81	6.52	66.39	8.42	34.54	0.26
	1991-2000	6.19	5.21	62.49	5.10	40.48	0.77
	2001-2010	4.17	3.66	82.12	3.19	36.52	0.50

Source: World Bank (2017), World Development Indicators

Table A3: Over the Period Infrastructure Status of South Asian Countries

Country	Period	Energy use (kg of oil equivalent per capita)	Electric power consumptio n (kWh per capita)	Roads, paved (% of total roads)	Mobile cellular subscription s (per 100 people)	Telephone lines (per 100 people)
Pakistan	1980-1990	346.77	197.62	54.00	0.00	0.52
	1991-2000	421.77	335.14	51.10	0.08	1.62
	2001-2010	476.01	428.67	65.55	23.91	2.94
India	1980-1990	326.46	197.03		0.00	0.42

Country	Period	Energy use (kg of oil equivalent per capita)	Electric power consumptio n (kWh per capita)	Roads, paved (% of total roads)	Mobile cellular subscription s (per 100 people)	Telephone lines (per 100 people)
	1991-2000	404.02	349.31	52.62	0.08	1.56
	2001-2010	496.25	495.92	48.02	18.57	3.57
Sri Lanka	1980-1990	320.31	127.13		0.00	0.53
	1991-2000	360.16	216.07		0.62	1.82
	2001-2010	450.95	373.83	83.42	32.64	9.87
Bangladesh	1980-1990	107.37	33.54		0.00	0.16
	1991-2000	128.82	75.36	8.44	0.04	0.27
	2001-2010	172.86	183.05	9.50	15.92	0.70

Source: *World Bank (2017), World Development Indicators*

Table A4. Over the Period Infrastructure Status of South East Asian Countries

Country	Period	Energy use (kg of oil equivalent per capita)	Electric power consumption (kWh per capita)	Roads, paved (% of total roads)	Mobile cellular subscription s (per 100 people)	Telephone lines (per 100 people)
Indonesia	1980-1990	428.57	91.67	45.10	0.00	0.38
	1991-2000	658.05	283.49	51.23	0.42	1.86
	2001-2010	799.29	513.32	56.87	33.56	8.06
Malaysia	1980-1990	1011.06	860.03	69.98	0.10	5.79
	1991-2000	1712.11	2036.79	74.21	7.23	15.90
	2001-2010	2390.01	3190.34	83.23	73.15	17.23
Thailand	1980-1990	520.89	438.67		0.02	1.36
	1991-2000	1026.29	1210.12	95.15	2.32	6.02
	2001-2010	1497.75	1924.91		58.65	10.28
Korea	1980-1990	1440.10	1472.41	71.50	0.04	17.35
	1991-2000	3212.52	4006.88	76.59	17.06	43.37
	2001-2010	4448.64	7913.55	78.61	84.35	52.85

Source: *World Bank (2017), World Development Indicators*