
**DOES TRANSPORT INFRASTRUCTURE FOSTERS THE ECONOMIC GROWTH:
AN ASEAN PERSPECTIVE**

Phatthanan Hiranrithikorn¹, Chayongkan Pamornmast^{2*}

¹*Faculty of Management Science, Suan Sunandha Rajabhat University, Bangkok, Thailand*

²*Faculty of Business Administration, Mahanakorn University of Technology, Bangkok, Thailand*

E-mails: ¹phatthanan.hi@ssru.ac.th; ²chayongkanp@hotmail.com (Corresponding author)

Received 15 January 2019; accepted 23 October 2019; published 30 December 2019

Abstract. The prime objective of the current study is to examine the influence of infrastructure of transportation on economic growth for various countries in ASEAN. This influence differs in terms of administrative status and quality of infrastructure across the counties. GDP has been used as an economic growth measure in terms of per worker along with various kinds of infrastructure of transportation for years 2002-2017. Therefore, a short model has been incorporated with capital stock of railways and roads. Two variables have been incorporated to differentiate roads with different covering and quality. In the next step, the administrative status of roads has been distinguished. The results have revealed difficulty in interpretation because of the problem of endogeneity and reverse causality. Therefore, the research model was modified by including the lag values of variables of infrastructure of transportation for getting robust estimates. The unit root test has been performed and first differences in model are used to obtain stationary time series. It was found that GRP per worker is greatly influenced by overall roads stock. This is because of the use of such roads for large traffic load. The regional growth of economy is greatly influenced by the light covering roads rather than national roads of similar quality/covering. The influence of local government's quality was controlled on development of economy. The turnout of voters was used as proxy variable for the local government's quality. It was found that the influence of infrastructure of transportation stock in the areas (where government is of better quality) has not much influence on GRP per worker. Different kinds of infrastructure of transportation have been shown by this research being the drivers of growth of economy in. The administrative status and quality of covering roads creates an influence on the growth of economy. Based on the findings of study, the following recommendations have been made. There is need to develop national roads to improve the economic performance. Further, there is need to improve the quality of countries. However, the influence of infrastructure transportation is high where the government has low quality and overall capital stock influence is high where the government is of good quality (Crescenzi, Cataldo, & Rodríguez, 2016). In future, researches can be conducted by focusing on the influences of other variables of infrastructure including electricity lines, supply of water and for long time periods. The future studies can work on investigating the network effect of transportation infrastructure in ASEAN.

Keywords: Transportation infrastructure; Economic growth; ASEAN

Reference to this paper should be made as follows: Somjai, S., Vasuvanich, S., Meechaiwong, A., Joemsittiprasert, W. 2019. Sustainable development facets: does sovereign debt accelerate the economic growth, *Journal of Security and Sustainability Issues* 9(2): 689-699. [http://doi.org/10.9770/jssi.2019.9.2\(25\)](http://doi.org/10.9770/jssi.2019.9.2(25))

JEL Classifications: O1, R1, R4

1. Background

It has been revealed by a number of studies that improvement of general infrastructure and transportation infrastructure creates a positive influence on development of regions and economic growth (Lietuvnikė et al., 2018, Haseeb, Kot, Hussain, & Jermisittiprasert, 2019; Tvaronavičienė, 2018; Yunus et al., 2019). The influence of railways and road transportation has been analyzed on ASEAN's economic growth in this research. Therefore, it is linked with liberalization of trade. A key role is played by the infrastructure of transportation in this framework. It is not possible to achieve economic growth from trade liberalization without developing

the infrastructure of transportation. Most of the services in transportation are carried out by railway and road systems in ASEAN (Ismail & Mahyideen, 2015; Fernando, 2019). In 2010, the transport of 14% goods was carried out by railways and 74% by roads.

The findings of this study can give important insights and implications regarding the development policies for infrastructure of transportation. In EU, the country lies in the centre of transportation infrastructure. There is need for developments in the region, as it is in the way to implement “Intermodal transport strategy in ASEAN 2020”. The findings of the study will be helpful for the strategy actualization. The study is not specified to ASEAN. Rather, it determines the influence of various types of infrastructure of transportation along with estimation of influence of paved roads having different covering quality (Khandker & Samad, 2018). Further, the research determines the influence of roads (county and national) with various geographical an administrative status on the development of economy in ASEAN. The road infrastructure in developing ASEAN countries is fairly well developed as evident from the figure 1 that the ranking of top growing ASEAN economies is higher than other except Brunei Darussalam.

Country	Rank	Score
1 Singapore	2	6.5
2 Malaysia	11	5.7
3 Indonesia	36	4.5
4 Thailand	37	4.5
5 Vietnam	63	3.8
6 Brunei Darussalam	70	3.5
7 Philippines	90	3.2
8 Cambodia	102	2.9
9 Laos	110	2.8

Figure 1. Transportation infrastructure: a country wise comparison of ASEAN

Source: World economic forum

The total length of paved roads in ASEAN is more than one million KM and Vietnam and Malaysia are leading with 0.35 million km of paved roads.

To analyze the influence of transportation infrastructure on real GDP of the region, the technique of Lan (2016) has been used. The study has added the production function of Cobb Douglas with a number of variables explaining various types of infrastructure. Panel data has been used for counties of ASEAN (municipality of Bucharest) over the years 1995-2010. The data was accessed from RNCMNR.

2. Literature review

Extensive literature is available on the chosen topic. Various types of infrastructure development in transportation can be taken as endogenous variable to define the changes in real GDP. Another way is to use TFP (Total Factor Productivity) that is a key economic rive as per the model of Solow Growth (Fernald, 2014). In general, two alternatives exist, which include the use of investment (private and public) as endogenous variable and using the real stock of relevant infrastructure.

Three alternatives are there to have real infrastructure stock. The length of channels of transportation including railways, water, and roads can be used in terms of per capita (Qin, 2016). Another way is to option for spatial density, which refers to the infrastructure stock divided by the area of country/region. Articles are also part a distinct part of literature that provides solutions about the endogeneity caused by the reverse causality. In the

research models, these issues may arise in defining the influence of economic growth by capital stock (Calderón & Servén, 2014). However, it is not evident about the causes for increase. Alternatively, the productivity or output may increase by increase in infrastructure stock. More resources are required to be allocated when there is high output level for accumulation of various kinds of infrastructure (Zia, Hassan, & Khan, 2017). The estimation of the government quality is another distinct part of literature review. In this research, the influence of government quality on the relation of infrastructure transportation and growth of economy has been estimated.

3. Real GDP, total factor productivity (TFP), and alternative approaches

Both methods were used by Elburz, Nijkamp, and Pels (2017) to find the influence of aggregated stock of infrastructure transportation. Further, the researchers analyzed the influence of four different kinds of infrastructure i.e. airport, roads, railways and ports for Spain. The researchers incorporated the variables of transportation in the production function of Cobb-Douglas and determined the influence of these variables on real GDP. Moreover, they determined the TFP values to elaborate through variables of infrastructure (Johansen & Hansen, 2016). Using the fixed regression effects, the following outcomes were found: When there is 10% increase in aggregated infrastructure of transportation, this causes almost 0.42% rise in the output level and 0.38% in TFP.

It was shown by the regressions using various kinds of infrastructure that TFP and GDP, both are greatly influenced by infrastructure of roads. Another interesting finding by Elburz et al. (2017) was a positive network influence of infrastructure of transportation. The similar regressions were conducted to estimate it and they added infrastructure stocks from different regions (geographically close) to one observation rather than data of region. The hypothesis that current infrastructure stocks in a region have positive effects on the regions in neighborhood was tested by the researchers. The coefficients values were high using the aggregate data rather than regional. The overall infrastructure of transportation had increased by 10% that caused an increase of 0.62% in real GDP (Apergis & Danuletiu, 2014). Previously this increase was of 0.04%. The increase in TFP came 0.61%, which was previously 0.38%. Network effect on infrastructure of transportation prevailed in Spain as reflected by the both coefficients.

The network effect of stocks of motorway in terms of workers was found by Na and Yoon (2016). The data of almost 19 OECD countries was used over the years 1990-2006. The researchers found the influence of motorway stock on total factor productivity. Several models were used that comprised of controlled variables. These can be the drivers of TFP. Kasu and Chi (2018) also found the prevalence of network effect by considering the level of utilization of infrastructure transportation to be a key factor for economic development. The influence of transportation was divided into three groups including the direct groups, indirect and related impacts (Chitnis, Sorrell, & Jackson, 2014). The benefits of access to the resources in markets, cost, and time saving, and output increase were included in the direct group. In the indirect impacts, the benefits of r transportation infrastructure in relation with other economic sectors were involved (He, Huang, & Wang, 2014). The development of a highway road can increase the level of employment. Moreover, it involves the purchase of materials and related products causing an impact on economic performance. The related impacts include the advantages generated from the relation of quality of transportation and economic performance.

The World Bank (2011) mentioned another influence of transportation infrastructure that signifies its contribution to economic growth and development. The goods can be distributed with low cost through development of railway or road infrastructure, which improves the productivity and access to various resources. Moreover, by infrastructure development of transportation, the reliability of traffic increases resulting in decrease of accidents (Alam, Ferreira, & Fonseca, 2016). The changes in GDP accounted by different kinds of infrastructure such as infrastructure of transportation and roads has been explained by the researchers as below. Some significant results were obtained by Ebu, Ezike, and Haruna (2019) for countries of Africa. The augmented Solow model was used by the researchers to determine the influence of various infrastructures including water supply, roads, telecommunications, sanitation, and supply of electricity on GDP. The economic growth is significantly influenced by all the sub sectors of infrastructure except the sanitation system. Further, the GDP growth of Africa is contributed by the significant types of infrastructure (Ebu et al., 2019).

The relation between infrastructure stock and economic development was estimated by Luo and Xu (2018) based on the approach of Ebu et al. (2019). It was found that the increase in economic growth is linked with high stocks of infrastructure. The study involved data of 16 countries in Asia over the time of 20 years. The dependent variable was the real GDP and the explanatory variables included water supply, electricity supply, roads, sanitation infrastructure, and telecommunications. In the last part of this section, different alternative approaches signifying infrastructure for development of economy have been mentioned. The focus of Mohanty and Bhanumurthy (2018) was on the development and maintenance of infrastructure and its influence on the development of economy and government quality. The findings revealed that infrastructure benefits are greater than its costs. A key driver of infrastructure is the governance quality, rather than infrastructure. The study was based on 75 economies over time of 30 years (Ansar, Flyvbjerg, & Lunn, 2016).

It was shown by Yu (2017) that infrastructure and quality of road is importance for trade in the region of Central Asia and Eastern Europe. A simulation of development of road network in these regions was developed by the researchers. The findings of the simulations revealed that the combined influence of the improvement network quality of road and facilitation of trade lead to gains in both cases. These gains can be expected from reduced tariffs.

Investments and Real Infrastructure Stock

Two data sets were used by Yoon, Hastak, and Cho (2017). The first data set involved almost 57 countries over the period of 15 years. The second data set involved 19 countries over period of 12 years. Similarly, two different approaches were used by the researchers. Initially, they determined the influence created by infrastructure on growth of economy by using infrastructure spending as endogenous variable. The coefficients for the first dataset based on 57 countries were negative and statistically insignificant. Using the same approach on the second dataset, the coefficients were positive and significant. However, the values of coefficients were small. However, by using physical infrastructure units as explanatory variables with similar sample, the influence on economic development came out statistically significant and positive (Rokicki & Stepniak, 2018). The second approach based on infrastructure stock reflected in physical units can be compared easily between the countries across the globe. The normalization issue arises in using real stock. As mentioned earlier, three ways exists. The first involves infrastructure stock capital divided by total number of workers. Another alternative involves the use of infrastructure stock divided by corresponding country or regional area.

Two regression types were used by Emoh, Edemodu, and Oparaugo (2017). The data set was based on 98 countries and GDP per capital was taken as endogenous variable. In case 1, the independent variable was roads length per inhabitant. In second case, spatial road density was used as independent variable. The most significant results were in case 22, which shows the value of R^2 equal to 0.76. The correlation coefficient for the relation of GDP per capital and length of paved roads in terms of per capital were estimated in the first case. Therefore, when there is one-millimeter increase in length of paved roads, the GDP per capita increases by \$1.39 and the value of coefficient of determination came out as 0.5. The results of both approaches were significant statistically. The finding of the study shows 1.39 value of coefficient. This helps in explaining the stock of paved roads in the country. The value of coefficient above 1.39 reflects that there is scarcity of roads and improvements are required in the system. The value of coefficient 1.39 shows that such countries have high stock of paved roads and need to improve the maintenance of the current system.

The relation between GNP per capital and paved roads density measured in km per inhabitants (1000) was analyzed by Emoh et al. (2017) based on data of US. OLS technique was used to estimate the intercept and contribution of roads to the growth of economy. There is no clear interpretation for the negative intercept. When the equation goes through origin, the coefficients of roads length per 1000 inhabitants were significant. This shows that a significant influence is created by road length on GDP per capital in the economy. A good possibility is provided by the equation and data to determine the lag of time between infrastructure of roads and its influence on GNP per capita (Maparu & Mazumder, 2017). It was found that there is high correlation between roads length per 1000 inhabitants in the last four years. It shows that GNP is influenced by paved roads. How-

ever, there is four-year lag between the time of construction and its effect (Emoh et al., 2017). Different kinds of infrastructure were used by Lan (2016) such as transportation infrastructure stock in terms of per worker. The researcher used panel data with cross-country analysis for years 1960-1990 to determine the influence of infrastructure stock (telephones in number, generated capacity of electricity, length of railways and roads). It was found that real GDP is influenced by capital stocks of transportation and electricity. A common econometric issue is Reverse causality for most of the research models, which have been previously discussed. Several approaches can be used to get reliable and robust estimation for reverse causality. The co-integration method was used by Lan (2016) and Chotia and Rao (2017) to find the robust estimates to reverse causality. Another method is to use instrumental variables of lag terms. Therefore, lagged values of infrastructure stocks were used. For determining the relation between voter turnover and local government's quality, data was used for almost 18 countries of EU and 174 regions. The data was taken from European Election Database (Christmann & Torcal, 2017). The regions of ASEAN were included in the dataset. The model based on multi-level was used, which showed that voter turnover has a positive association with local government's quality determined by European Quality of Government Index. Specifically, 20% citizens more than usual are active in the regions, where governance is good.

4. Model

To determine the influence of infrastructure on the growth of economy, the approach proposed by Canning (1999) was followed in this research. The production function of Cobb-Douglass was used.

$$GDP_{it} = AGFP_{it} + RSA_{it}^{\alpha} + INFS_{it}^{\beta} + Lab_{it}^{1-\alpha-\beta} + U_{it} \dots \dots \dots (1)$$

In the above equation, Y reflects GDP of the region in (t) year. The aggregate productivity is reflected by *AGFP* and real assets stock is represented by *RSA*. The infrastructure assets stock is represented by *INFS*, labor is represented by *Lab* and error term is shown by *U*. the country index is represented by *I* and time index by *t*. It is crucial to incorporate assumptions for research mode. The constant returns to scale are introduced in the model. The second introduction is the $\log AGFP_{it} = a_t + b_t$ which the fixed effect of region is reflected by *ai* and the overall productivity of country is represented by *bt* in t year. By taking logs of equation 1, the following equation has been derived.

$$\log (GDP_{it}) = a_t + b_t + \alpha \log RSA_{it} + \beta \log INFS_{it} + U_{it} \dots \dots (2)$$

The variables of infrastructure have been separated into four parts. These include the road lengths in t year, available road lengths after improvements in t year, railways length in t year. It is crucial to incorporate the assumption of no difference of quality in the railways and roads of ASEAN. Therefore, the following models will be estimated. The estimation will be started with short research model that reflects the evidence of influence created by infrastructure of road on economic growth of ASEAN.

$$\log (GDP_{it}) = a_t + b_t + \alpha \log RSA_{it} + \beta_1 \log Road_{it} + \beta_2 \log Railways_{it+} + U_{it} \dots \dots (3)$$

An interesting problem is related with the roads quality and the influence created on growth of economy. Two quality types have been used in research because of limitations of data. The roads length modernized in t period and i country and light covering roads are the two forms. These are linked with low quality in the regions, where traffic density is low.

$$\log (GDP_{it}) = a_t + b_t + \alpha \log RSA_{it} + \beta_1 \log Road_{it} + \beta_2 \log L - Road_{it} + \beta_3 \log M - Road_{it} + \beta_4 \log Railways_{it+} + U_{it} \dots \dots \dots (4)$$

One more issue will be tested by using this model. A lag exists between the available road infrastructure stock and its influence on GRP. GRP can be run on the explanatory variables in equation (3) by using various lags

of time. Time lags of 1-4 will be used, as the data did not allow for long lags. In this way, the results obtained will be robust for endogeneity, which occurs through reverse causality. The variables of light and modernized roads will be classified into two groups. In this way, the administrative status of roads will make them differentiated.

The roads, which connect different cities and units of administration in different counties, are regarded as national roads (n-roads). The roads, which connect cities and units of administration located in the similar county, are regarded as county roads (c-road).

$$\begin{aligned} \text{Log}(\text{GDP}_{it}) = & a_t + b_t + a \log \text{RSA}_{it} + \beta_1 \log n - \text{Road}_{it} + \beta_2 \log L - n - \text{Road}_{it} + \beta_3 \log M - \\ & n - \text{Road}_{it} + \beta_4 \log c - \text{Road}_{it} + \beta_5 \log L - c - \text{Road}_{it} + \beta_6 \log M - c - \text{Road}_{it} + \\ & \beta_7 \log \text{Railways}_{it} + U_{it} \end{aligned} \quad \dots (5)$$

Another problem of investigation is to find the influence of local government's quality on the relation of stock of infrastructure of different transportation with growth of economy. The turnout of voter has been used as a proxy variable for local government's quality. It was shown by Sundström and Stockemer (2013) that a positive influence is created by the quality of local authorities on participation of voters in elections. Therefore, the sample will be divided into three groups as per the voters' average turnout during the 2008 and 2012 elections of Senate, shows the structure of classified groups. The dummy variable of ASEAN has been incorporated that is equal to 1 when EU was joined by ASEAN during years 2000-2010 and it is zero in other case. It is expected that the utilization of resources utilization and capital stocks is better when the government is of good quality. For fitting the models, the following data has been used. GRP has been used as endogenous variable in terms of per capita for countries in ASEAN (at 2000 million-dollar constant prices). The method of perpetual inventories has been used for calculating regional capital stock. Following is the capital's law of motion.

$$\text{RSA}_{t+1} = (1 - \emptyset) * \text{RSA}_t + \text{fcf}_t \dots (6)$$

In the above equation, the fixed capital formation (\$) is represented by fcf, capital stock is represented by RSA in t time. The depreciation is represented by \emptyset . The calculation of depreciation has been done as below:

$$\emptyset = \left(\frac{1}{t_2 - t_1 + 1} \right) * \sum_{t=t_1}^{t_2} \frac{\text{cf}_t}{\text{GDP}_T} \dots (7)$$

Where, "cf" consumption of fixed capital in \$ in real terms. The GDP in the initial time of 1991 equals 1/3 of the RSA's first value. The data has been taken from World Bank to determine stock of capital.

5. Estimation

The parameters of true population have been estimated through method of pooled OLS from the sample. The time series and cross section nature of data are neglected in this. To observe the influence of explanatory variables on inflows of FDI (endogenous variable) has been observed through use of pooled OLS. The homogeneity is assumed in terms of cross-country observations in pooled OLS.

The individual countries between WACs are allowed to have time invariant and separate intercepts in FEM. The effects of every country are held constant for a certain time. Moreover, the relation between endogenous and explanatory variables is examined through FEM in every country. In this process, the influence created on the dependent variable is controlled. F-test is done before determining the FEM validity in pooled OLS, which is a common constant method. It is assumed in null hypothesis that a common constant exists for all WACs with a suitable pooled OLS. It is confirmed after rejecting Ho that FEM is consistent and appropriate.

Another way of model estimate is through REM, in which it is assumed that there is uncontrolled and random variation across the countries used in model (Afonso & Arana, 2018). REM can be used, when some influ-

ence is created by countries on the endogenous variable. However, the intercept term is known as random variable having common mean value for the countries (β_0) for the economies (Rehman, Khurshid, & Saleem, 2019).

The variables with high correlation value are excluded from analysis, when there is issue of multicollinearity. The issue of serial correlation, heteroscedasticity, and autocorrelation is tested through use of suitable methods of estimation. Wald test and F-test are conducted for Fem and LM is conducted for REM in order to determine the suitable model. For FEM, a Hausman test is conducted as compared with REM. It is determined by Hausman test about the suitable choice for analysis i.e. REM or FEM. Error terms of regression are correlation when there are significant results of test. Therefore, FEM is preferred.

6. Results

Correlation analysis is used to determine the direction and strength of the relationship between latent variables. As illustrated in Table 1, the results show that all variables, have a positive relationship with ECN.

Table 1. Correlation Analysis

	1	2	3	4	5	6	7	8	9
RGDP	1.00								
	--								
Road	0.15	1.00							
	(0.41)	--							
Railways	0.20	0.13	1.00						
	(0.27)	(0.48)	--						
L-Road	0.26	-0.13	0.41	1.00					
	(0.15)	(0.46)	(0.02)	--					
M-Road	0.03	-0.12	0.43	0.03	1.00				
	(0.87)	(0.52)	(0.01)	(0.88)	--				
L-n-Road	0.311	0.03	0.23	0.31	0.13	1.00			
	(0.01)	(0.87)	(0.52)	(0.01)	(0.88)	--			
M-n-Road	0.411	0.543	0.762	0.052	0.362	0.234	1.00		
	(0.01)	(0.627)	(0.52)	(0.01)	(0.88)	(0.62)	--		
L-c-Road	0.271	0.103	0.223	0.231	0.123	0.237	0.291	1.00	
	(0.01)	(0.87)	(0.52)	(0.01)	(0.88)	(0.231)	0.160	--	
M-c-Road	0.411	0.543	0.162	0.352	0.722	0.234	0.231	0.331	1.00
	(0.01)	(0.627)	(0.52)	(0.301)	(0.188)	(0.62)	(0.021)	(0.121)	--

It has been revealed by Hausman test that the value of chi2 is 259.64 and value of p is zero. These results have been estimated through use of fixed effect regression. There is insignificant influence of the overall roads stock. However, the light and modernized roads create a positive and significant influence as indicated by the coefficients. Further, the influence of modernized or improved roads is four times greater than the light covering roads. The magnitude of influence of both types of roads is large, which is unrealistic (Van Bommel, 2014). Therefore, when there is 10% increase in light covering roads, this causes GRP to increase by 6.8%. There is doubt on this result. During the estimation exercise, we conducted a number of tests that included the Redundant Fixed Effects test and Hausman test. For instance, the Redundant Fixed Effects test was conducted to test the hypothesis that time-specific effects are present in the time series and cross section data (Abu, Karim, & Aziz, 2014). This test enables us to determine if the pooled Ordinary Least Squares (OLS) estimation is appropriate or not and whether one should use the FE/RE estimation. Similarly, the Hausman test was performed to determine if the RE estimates are correct and preferred to the FE and GMM estimates (see Table 2).

Table 2. Regression results of fixed effect estimates (equation 2-5)

Dependent Variable: <i>GDP</i>	Model 2	Model 4	Model 5
RSA	0.177***	0.135**	0.213***
Road	0.198**	0.154**	0.239**
Railway	0.254**	0.0238**	0.321*
L-road		0.313*	0.244*
M-Road		0.0488*	0.293*
L-n-Road			0.219**
M-n-Road			0.231**
L-C-Road			0.234*
M-C-Road			0.816**
<i>R</i>²	0.740	0.518	0.821

To run the research model as shown in equation (4) by using different sub-samples is another issue. ASEAN was categorized into 7 development regions. There was no administrative or official status of these regions. These regions were formed to facilitate the reforms before joining European Union. Almost 5-7 countries were included in each of these regions. According to the results of Hausman test conducted for every development region, it was revealed that fixed effect method is suitable rather than Random effect. Table A1 represented the results. In every region, the influence of overall capital stock is statistically significant and positive. In all the development regions, the roads with improvements and light covering create a significant and positive influence. A positive and significant influence of stock of railways has been found in the Sud-est and Nord-est regions. However, the influence of overall roads stock in all the regions is insignificant. In South development region, the influence of light and modernized roads is greater.

The results after examining the influence of local government’s quality have been shown in the next table. The roads with distinct covering quality are differentiated by this model along with various administrative statuses. The county and national roads have been considered separately. The influence of county and national roads on growth of economy must differ because of use of road systems in ASEAN for national and international transportation. It is expected that the influence of county roads is low but significantly positive. The transportation in the country is based on the network of country roads.

Conclusion

The influence of infrastructure of transportation on economic growth for various countries in ASEAN has been estimated in this research. This influence differs in terms of administrative status and quality across the counties. GRP has been used as an economic growth measure in terms of per worker along with various kinds of infrastructure of transportation for years 1995-2010. Therefore, a short model has been incorporated with capital stock of railways and roads. Two variables have been incorporated to differentiate rods with different covering and quality. In the next step, the administrative status of roads has been distinguished. The results have revealed difficulty in interpretation because of the problem of endogeneity and reverse causality. Therefore, the research model was modified by including the lag values of variables of infrastructure of transportation for getting robust estimates (Arbués, Baños, & Mayor, 2015). The unit root test has been performed and first differences in model ere used to obtain stationary time series. It was found that GRP per worker is greatly influenced by overall roads stock. This is because of the use of such roads for large traffic load (Sobrinho & Monzon, 2014). The regional growth of economy is greatly influenced by the light covering roads rather than national roads of similar quality/covering. The influence of local government’s quality was controlled on development of economy (Rodríguez-Pose & Garcilazo, 2015). The turnout of voters was used as proxy variable for the local government’s quality. It was found that the influence of infrastructure of transportation stock in the areas (where government is of better quality) has not much influence on GRP per worker. Different kinds of infrastructure of transportation have been shown by this research being the drivers of growth of economy in ASEAN (Chia, 2014). The administrative status and quality of covering roads creates an influence on the growth of economy.

Articles are also part a distinct part of literature that provides solutions about the endogeneity caused by the reverse causality. In the research models, these issues may arise in defining the influence of economic growth by capital stock (Agbloyor, Abor, & Yawson, 2014). However, it is not evident about the causes for increase. Alternatively, the productivity or output may increase by increase in infrastructure stock. More resources are required to be allocated when there is high output level for accumulation of various kinds of infrastructure (Zia et al., 2017). The estimation of the government quality is another distinct part of literature review. Based on the findings of study, the following recommendations have been made. There is need to develop national roads to improve the economic performance. Further, there is need to improve the quality of countries. However, the influence of infrastructure transportation is high where the government has low quality and overall capital stock influence is high where the government is of good quality (Crescenzi, Cataldo, & Rodríguez, 2016). In future, researches can be conducted by focusing on the influences of other variables of infrastructure including electricity lines, supply of water and for long time periods. The future studies can work on investigating the network effect of transportation infrastructure in ASEAN.

References

- Abu, N., Karim, M. Z. A., & Aziz, M. (2014). Low savings rates in the Economic Community of West African States (ECOWAS): The role of the political instability-income interaction. *South East European Journal of Economics and Business*, 8(2), 53-63. <http://doi.org/10.2478/jeb-2013-0010>
- Afonso, A., & Arana, C. (2018). Financial development and economic growth: a study for OECD countries in the context of crisis. REM Working Paper, 046-2018. <https://dx.doi.org/10.2139/ssrn.3224317>
- Agbloyor, E. K., Abor, J. Y., & Yawson, A. (2014). Private capital flows and economic growth in Africa: The role of domestic financial markets. *Journal of International Financial Markets, Institutions and Money*, 30, 137-152. <https://doi.org/10.1016/j.intfin.2014.02.003>
- Alam, M., Ferreira, J., & Fonseca, J. (2016). Introduction to intelligent transportation systems. Paper presented at the Intelligent Transportation Systems. http://dx.doi.org/10.1007/978-3-319-28183-4_1
- Ansar, A., Flyvbjerg, B., & Lunn, D. (2016). Does infrastructure investment lead to economic growth or economic fragility? Evidence from China. *Oxford Review of Economic Policy*, 32(3), 360-390. <http://dx.doi.org/10.1093/oxrep/grw022>
- Apergis, N., & Danuletiu, D. C. (2014). Renewable energy and economic growth: Evidence from the sign of panel long-run causality. *International Journal of Energy Economics and Policy*, 4(4), 578-587.
- Arbués, P., Baños, J. F., & Mayor, M. (2015). The spatial productivity of transportation infrastructure. *Transportation research part A: policy and practice*, 75, 166-177. <https://doi.org/10.1016/j.tra.2015.03.010>
- Calderón, C., & Servén, L. (2014). Infrastructure, growth, and inequality: an overview: The World Bank. <https://doi.org/10.1596/1813-9450-7034>
- Canning, D. (1999). Infrastructure's contribution to aggregate output: The World Bank. <https://doi.org/10.1596/1813-9450-2246>
- Chia, S. Y. (2014). 10. The ASEAN Economic Community: progress, challenges, and prospects. *A World Trade Organization for the 21st Century*, 269. <http://dx.doi.org/10.2139/ssrn.2346058>
- Chitnis, M., Sorrell, S., & Jackson, T. (2014). Who rebounds most? Estimating direct and indirect rebound effects for different UK socioeconomic groups. *Ecological Economics*, 106, 12-32. <https://doi.org/10.1016/j.ecolecon.2014.07.003>
- Chotia, V., & Rao, N. (2017). Investigating the interlinkages between infrastructure development, poverty and rural–urban income inequality: Evidence from BRICS nations. *Studies in Economics and Finance*, 34(4), 466-484. <https://doi.org/10.1108/SEF-07-2016-0159>
- Christmann, P., & Torcal, M. (2017). The political and economic causes of satisfaction with democracy in Spain—a twofold panel study. *West european politics*, 40(6), 1241-1266. <https://doi.org/10.1080/01402382.2017.1302178>
- Crescenzi, R., Cataldo, M., & Rodríguez, A. (2016). Government quality and the economic returns of transport infrastructure investment in European regions. *Journal of Regional Science*, 56(4), 555-582. <http://dx.doi.org/10.1111/jors.12264>
- Ebuh, G. U., Ezike, I. B., & Haruna, T. M. (2019). The Infrastructure–Growth Nexus in Nigeria: A Reassessment. *Journal of Infrastructure Development*, 0974930619872096. <https://doi.org/10.1177/0974930619872096>

- Elburz, Z., Nijkamp, P., & Pels, E. (2017). Public infrastructure and regional growth: Lessons from meta-analysis. *Journal of transport geography*, 58, 1-8. <https://doi.org/10.1016/j.jtrangeo.2016.10.013>
- Emoh, F. I., Edemodu, C. A., & Oparaugo, K. O. (2017). Public-Private Funding and Road Infrastructural Development in Nigeria. *Tropical Built Environment Journal*, 1(6).
- Fernald, J. (2014). A quarterly, utilization-adjusted series on total factor productivity. <https://doi.org/10.24148/wp2012-19>
- Fernando, A.T.Z. (2019). Logistics management practices in road freight transport companies. *International Journal of Entrepreneurship*, 23(3), 1-16
- Haseeb, M., Kot, S., Hussain, H., & Jermittiparsert, K. (2019). Impact of Economic Growth, Environmental Pollution, and Energy Consumption on Health Expenditure and R and D Expenditure of ASEAN Countries. *Energies* 12(19), 3598. <https://doi.org/10.3390/en12193598>
- He, C., Huang, Z., & Wang, R. (2014). Land use change and economic growth in urban China: A structural equation analysis. *Urban Studies*, 51(13), 2880-2898. <https://doi.org/10.1177/02F0042098013513649>
- Ismail, N. W., & Mahyideen, J. M. (2015). The Impact of infrastructure on trade and economic growth in selected economies in Asia. <https://dx.doi.org/10.2139/ssrn.2709294>
- Johansen, B. G., & Hansen, W. (2016). Predicting market allocations, user benefits and wider economic impacts of large infrastructure investments for freight transportation. *Transportation Research Procedia*, 16, 146-157. <https://doi.org/10.1016/j.trpro.2016.11.015>
- Kasu, B. B., & Chi, G. (2018). The Evolving and Complementary Impacts of Transportation Infrastructures on Population and Employment Change in the United States, 1970–2010. *Population Research and Policy Review*, 37(6), 1003-1029. <https://doi.org/10.1007/s11113-018-9491-3>
- Khandker, S. R., & Samad, H. A. (2018). Bangladesh's Structural Transformation: The Role of Infrastructure Economic and Social Development of Bangladesh (pp. 71-92): Springer. http://dx.doi.org/10.1007/978-3-319-63838-6_4
- Lan, X. M. (2016). The infrastructure development in the Republic of Guinea. <http://dx.doi.org/10.30958/ajbe.2-3-3>
- Lietuvnikė, M. M., Vasilis Vasiliauskas, A., Vasilienė-Vasiliauskienė, V., Sabaitytė, J. (2018). Peculiarities of illegal immigrant's intrusions into road freight transport units in the France - UK corridor. *Entrepreneurship and Sustainability Issues*, 5(3), 634-647. [http://doi.org/10.9770/jesi.2018.5.3\(16\)](http://doi.org/10.9770/jesi.2018.5.3(16))
- Luo, X., & Xu, X. (2018). Infrastructure, value chains, and economic upgrades: The World Bank. <https://doi.org/10.1596/1813-9450-8547>
- Maparu, T. S., & Mazumder, T. N. (2017). Transport infrastructure, economic development and urbanization in India (1990–2011): Is there any causal relationship? *Transportation research part A: policy and practice*, 100, 319-336. <https://doi.org/10.1016/j.tra.2017.04.033>
- Mohanty, R. K., & Bhanumurthy, N. (2018). Analyzing the Dynamic Relationship between Physical Infrastructure, Financial Development and Economic Growth in India.
- Na, K.-Y., & Yoon, C.-H. (2016). ICT and Transport Infrastructure Development. <https://doi.org/10.1080/00036846.2019.1640860>
- Qin, Y. (2016). China's transport infrastructure investment: Past, present, and future. *Asian Economic Policy Review*, 11(2), 199-217. <https://doi.org/10.1111/aepr.12135>
- Rehman, N., Khurshid, M. K., & Saleem, A. (2019). FINANCIAL AND ECONOMIC INDICATORS OF ECONOMIC ADVANCEMENT: EVIDENCE FROM ASIAN COUNTRIES. <https://doi.org/10.14456/ITJEMAST.2019.140>
- Rodríguez-Pose, A., & Garcilazo, E. (2015). Quality of government and the returns of investment: Examining the impact of cohesion expenditure in European regions. *Regional Studies*, 49(8), 1274-1290. <https://doi.org/10.1080/00343404.2015.1007933>
- Rokicki, B., & Stępiak, M. (2018). Major transport infrastructure investment and regional economic development—An accessibility-based approach. *Journal of transport geography*, 72, 36-49. <https://doi.org/10.1016/j.jtrangeo.2018.08.010>
- Sobrino, N., & Monzon, A. (2014). The impact of the economic crisis and policy actions on GHG emissions from road transport in Spain. *Energy Policy*, 74, 486-498. <http://dx.doi.org/10.1016/j.enpol.2014.07.020>
- Sundström, A., & Stockemer, D. (2013). Quality of government affect voter turnout in the European regions. *QoG Working Paper Series*, 2013(6), 6.

Tvaronavičienė, M. (2018). Towards sustainable and secure development: energy efficiency peculiarities in transport sector. *Journal of Security and Sustainability Issues*, 7(4), 719-725. [https://doi.org/10.9770/jssi.2018.7.4\(9\)](https://doi.org/10.9770/jssi.2018.7.4(9))

Van Bommel, W. (2014). *Road lighting: Fundamentals, technology and application*: Springer. <http://dx.doi.org/10.1007/978-3-319-11466-8>

Yoon, Y., Hastak, M., & Cho, K. (2017). Preference clustering-based mediating group decision-making (PCM-GDM) method for infrastructure asset management. *Expert Systems with Applications*, 83, 206-214. <https://doi.org/10.1016/j.eswa.2017.04.047>

Yu, H. (2017). Motivation behind China's 'One Belt, One Road' initiatives and establishment of the Asian infrastructure investment bank. *Journal of Contemporary China*, 26(105), 353-368. <https://doi.org/10.1080/10670564.2016.1245894>

Yunus, E., Susilo, D., Riyadi, S., Indrasari, M., Putranto, T.D. (2019). The effectiveness marketing strategy for ride-sharing transportation: intersecting social media, technology, and innovation. *Entrepreneurship and Sustainability Issues*, 7(2), 1424-1434. [http://doi.org/10.9770/jesi.2019.7.2\(44\)](http://doi.org/10.9770/jesi.2019.7.2(44))

Zia, Q., Hassan, S., & Khan, G. M. (2017). Adaptive resource utilization prediction system for infrastructure as a service cloud. *Computational intelligence and neuroscience*, 2017. <https://doi.org/10.1155/2017/4873459>

Phatthanan HIRANRITHIKORN is Ph.D. candidate in International Business at Silpakorn University, Thailand. She is also an Assistant Professor in Business Administration of Suan Sunandha Rajabhat University, Thailand. Her interested academic areas are International Business, Marketing, and Logistic and Supply Chain.

Chayongkan PAMORNMAST holds Ph.D. in Banking and Finance from University of New South Wales, Australia. He currently is a Head of Banking and Finance Department, Faculty of Business Administration, Mahanakorn University of Technology, Thailand.