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Spillover effects of transportation capital and provincial competitiveness on economic growth in Vietnam

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Abstract

This study uses the spatial econometric model to evaluate the impact of transportation capital and provincial competitiveness on economic growth in Vietnam. Data from 63 provinces and cities in Vietnam were collected between 2010 and 2017. It is found that both direct and indirect effects of transportation capital are positive and statistically significant, and that the spillover effect is strong. The findings confirm the high efficiency of synchronous investments in the transport infrastructure. In addition, the study points to the necessity of improving labor quality, which is closely related to the services provided by the provincial government: general education, vocational training, and employment service growth.

Keywords: Transportation capital, Economic growth, Spillover effect

1. Introduction

It has been over three decades since implementation of the Doi Moi renovation reform. Vietnam has made remarkable progress in reducing poverty and attracting foreign investment. According to the World Intellectual Property Organization (2021), Vietnam is a lower-middle-income country.

Transportation is a sector of great importance to the Vietnamese government during economic development. Along with the deep and broad integration of bilateral and multilateral trade agreements, Vietnam has attracted investment from financial investment organizations for transport development. Investment capital for transportation in Vietnam accounts for about 10% of the total social investment contributing to improving infrastructure quality. According to Schwab (2011; 2019), the quality of Vietnam's transport infrastructure in 2019 ranked 66 out of 141 countries, moved up by 37 places in the period 2010-2019.

Several construction projects have been completed. For example, many segments of the North-South highway construction project have been built, and the international

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passenger terminal 2 (T2) of the Noi Bai airport was inaugurated. In addition, the metro lines projects in Hanoi and Ho Chi Minh City have been implemented, the airport construction projects in Long Thanh in Dong Nai, and other major port construction projects are underway.

Despite improving transport efficiency, such as increasing traffic connectivity, shortening travel time between regions, and satisfying the travel needs of the people, there exist many shortcomings. The transport infrastructure system has not met the development needs to achieve the goal of industrialization and modernization of the country. According to the General Statistics Office (2021), the current situation of railway infrastructure in Vietnam is outdated and prolonged, which causes capital-raising challenges, such as urban railway projects, and some key transport projects are at risk of delay.

Measuring the impact of transport capital is necessary as it provides a more detailed view of investment effectiveness. Recently, Tin (2017) used data from Mekong Delta provinces from 2001 to 2014. Results from the feasible general least square model (FGLS) show that the impact of the ratio of public investment to gross regional domestic product (GRDP) growth is insignificant. Some scholars study the impact of transport on a small area in Vietnam (Minh and Huong, 2016; Tuong *et al.*, 2019). However, there are few quantitative studies on the impact of transport capital in Vietnam, especially research on the impact of provincial competitiveness, similar to the contents of this article.

To exploit the efficiency of investment capital, the quality of management by local governments and their competitiveness are considered essential determinants. In 2019, Vietnam ranked 89 out of 141 countries in institutional status, while in 2010, it ranked 74/139 (Schwab, 2019). Thus, the ranking went down. However, there are no studies to assess the impact of transport capital, including spatial spillover effects among 63 provinces in Vietnam that use spatial econometric models. Hence, this study sheds light on the impact of transport capital and provincial government competitiveness on economic growth in Vietnam, using the spatial econometric model to assess the spillover effects of transport capital.

The remainder of the study is organized as follows. Section 2 presents an overview of the research literature and analytical framework. Section 3 describes the data and analyzes the panel data models, including spatial and non-spatial econometric models, to study the impact of transport capital on provincial competitiveness on GRDP. Section 4 presents the results of the research models. Finally, section 5 presents the conclusion and policy recommendations.

2. Literature review

Classical, neoclassical, and even modern theories observe that capital and labor are important inputs that affect economic growth (Petty, 1900; Wicksell, 1916; Ramsey, 1928; Cobb and Douglas, 1928). Beginning in the 1950s, Mincer (1958), Schultz (1961), and Becker (1962) introduced the concept of human capital to demonstrate its impact on productivity. Human capital is approached from different aspects, such as work skills and experience, education,

and labor training. Smith (1776) also mentioned that labor skills contribute to economic growth. The role of human capital was developed in Romer's research (1990). In many studies, such as those of Hanushek (2013), and Abuzyarova *et al.* (2019), human capital contributes to improving science and technology, thereby improving labor productivity and positively affecting growth in different ways. Human capital can affect economic growth either directly or indirectly. Labor contributes directly to the increase in productivity with their skills and work experience.

Many scholars examine the effects of capital and human capital according to the Cobb-Douglas function. They separate transport capital to consider its impact on economic growth. Munnell and Cook (1990) use data from 48 US states from 1970 to 1986 on the dependent variable in Gross State Domestic Product (GSDP) and show that the elasticity coefficient of highway stock is 0.06. This result is similar to Eisner's (1991) and Baltagi and Pinnoi's (1995) studies. But Finn's (1993) study in the US for the 1950-1989 period shows that the coefficient of vehicle capital is insignificant while the elasticity coefficient of highway capital is significant. Using panel data in the US from 1969 to 1986, Holtz-Eakin and Schwartz (1995) show that the elasticity of roads and highways capital on GSDP is 0.0476. Boopen (2006) studied data from 38 sub-Saharan African countries and a sample of 13 small island developing states from 1980 to 2000. The results from the pooled ordinary least squares (POLS) model and dynamic equilibrium model for groups of 38 countries show the statistical significance of the transport capital effect on economic growth. The elasticity coefficient in the dynamic equilibrium model has a value of 0.22 for transport capital and 0.043 for a 1-year delay of traffic capital. The cross-sectional data model for 13 small island states shows that the impact of that coefficient is positive but not statistically significant. Melo *et al*. (2013) synthesize the method and elasticity coefficient from 33 studies on the impact of transport infrastructure with a collection of 563 observations. The estimations are grouped according to six criteria: country, measure of transport, type of publication, industrial sector, mode of transport, and time frame. The mean of elasticity coefficients for Europe is 0.039 and shows the lowest average output compared to 0.069 for the US and 0.083 for other countries. Monetary measures of transport are associated with lower average output elasticities of transport than physical measures of transport (0.046 and 0.108, respectively). In all studies, on average, an increase of 10% in transport investment contributes to an increase in output by 0.5%.

There are several studies on the spillover impacts of transport capital on economic growth by spatial economics models (Dehgan, 2018; Zou *et al.*, 2008; Yu *et al.*, 2013; Boarnet, 1996; Holtz-Eakin and Schwartz, 1995; Jiang *et al.*, 2015). Boarnet (1996) conducted a study with California-US country data from 1969 to 1988 and confirmed that the elasticity coefficient of their own county street and highway capital was 0.16, but the spillover effect was negative. This spillover effect is similar to the study of Holtz-Eakin and Schwartz (1995). Using data from 29 provinces in China between 1986 and 2012, Jiang *et al.* (2015) show that the spatial

spillover effect of transportation capital is positive and the spillover effect is stronger in provinces of similar economic status.

According to the growth and institutions theories, in addition to the factors of capital and human capital, the important determinants are the quality of state governance and institutions. The role of the state institutional framework began to be recognized as important (Lewis, 1955; Ayres, 1962). Many recent studies indicated the state governance and institutions' effect on economic growth (Acemoglu and Johnson, 2005; Pande, 2009; Adams, 2009; Arshad, 2019). However, Ivankova (2019) shows that there is a significant difference in the annual Global Competitiveness Index among four countries (Slovakia, the Czech Republic, Hungary, and Poland), but there are no significant differences in GDP growth rates between these countries. In Vietnam, Tinh *et al.* (2018) show that local provincial competitiveness has a positive and statistically significant influence on hourly wage income for wage-earning workers.

There is no research on the simultaneous impact of transport investment and competitiveness of provincial governments in 63 provinces/cities in Vietnam. Based on Melo *et al.* (2013), the proposed regression form is as follows:

$$lnY_{it} = f(L_{it}, K_{it}, T_{it}, Z_{z,it})$$

where Y_{it} is the output of form i at period t; L is the number of laborers; T is the transport capital; K is capital in other sectors; Z_z is various competitiveness factors and labor quality.

3. Research methodology and data

Using the Cobb-Douglas production function, the dependent variable GRDP is Gross Regional Domestic Product of 63 provinces/cities in Vietnam from 2010 to 2017. Similar to some previous studies (Jiang *et al.*, 2015; Kamps, 2006), this paper uses the value of fixed assets and long-term investment as an indicator of capital. However, due to data constraints, this paper uses the value of fixed assets and long-term investment by types of economic activity of the General Statistics Office; the value of fixed assets and long-term investment for transportation and storage (*KAT*, unit: billion VND) as an indicator of the transport capital; and the value of fixed assets and long-term investment for other economic activities (*KAO*, unit: billion VND) as an indicator of other sectors capital. Labor quality is represented by the ratio of trained workers over 14 years old (*TLRate (%)*). L is the number of working laborers over 14 years old. This paper obtains data from Provincial Competitiveness Index (PCI) for competitiveness factors. Variables are taken from PCI data. *EntryCosts* stands for the index of entry costs for business start-ups. *LandAccesseasy* is an index of access to land and security of business premises. Transparency represents an index of the transparent business environment and equitable business information. *InCharges* is an index of minimal informal charges. *TimeCosts* represents an index of limited time requirements for bureaucratic procedures and inspections. *ProacLeadership* stands for an index of proactive and creative provincial leadership in solving problems for enterprises. *BSServices* is an index of developed and high-quality business support services. *LTraining_PCI* represents an index of sound labor training

policies. *LeInstitutions* is an index of fair and effective legal procedures for dispute resolution. The prefix "Ln" refers to the natural logarithm of the variable.

As no data is available for Vietnam for 2021 and under the impact of the COVID-19 pandemic, some 2020 data are preliminary. Due to data collection limitations, in the period 2010-2019, we only collected and studied data from 2010 to 2017 without losing the meaning of the results. During the research period, Vietnam's economy was affected by the world economic crisis in 2008-2009, the effects of which lasted until 2012 because the consumer price index (CPI) increased to 122.97% in 2008 - the highest yearly level in several years. The world economic crisis affected Vietnam in the period between 2008-2012. Therefore, the study uses a dummy variable D for 2013-2017 (D = 1 if the year is between 2013 to 2017, D = 0 for other years).

In the first step, all variables of PCI data 2010-2017 are used as control variables with the form of Cobb-Douglas function (Model 1 in Table 2). In step 2, to avoid the multicollinearity problem, the study removes the variables of PCI which are not statistically significant in Model 1. In the final step, since the role of transportation in regional connectivity is important, the study focuses on the spillover effects of transport investment. Following the spatial economics model in previous studies (Holtz-Eakin and Schwartz, 1995; Boarnet, 1996), however, unlike previous studies using the variable in the form of ln(M*KAT) (M is a spatial matrix, KAT is a representative variable of the transport infrastructure) for assessing the spillover effects of transport infrastructure, this study uses the Spatial lag of X model for the variable M*lnKAT to assess the impact of the percentage change of other provinces on the province in question instead of calculating the effect of the total transport capital of other provinces. The final model (Model 3) is presented as follows:

$$LnGRDP = \beta_0 + \beta_1 LnKAO + \beta_2 LnKAT + \alpha M^*LnKAT + \beta_3 LnL + \beta_4 LnTLRate + \sum \beta_z LnZ_z + D + u.$$

This study uses the distance-inverse matrix so that it does not eliminate spillovers between non-bordering provinces. The spillover effect is inversely proportional to distance. In addition, Model 3 shows a spillover effect when each province increases by 1% instead of by 1% for the total of all provinces. The spatial matrix M = $\{m_{ij}\}$ is a square matrix of size 63 x 63, formed from the inverse matrix of the distance between Provincial People's Committee i and Provincial People's Committee j ≠ i. The coefficient on the road diagonal is 0, which is then normalized by a row. $\{Z_z\}$ is the set of PCI at step 2.

PCI data are taken from VCCI website, transport investment data are from the General Statistics Office (GSO) and other data are from the 63 Provincial Statistical Yearbooks of GSO. Descriptive statistics of the variables are given in Table 1.

Coefficients of variation (CV) variables *GRDP*, *KAO*, and *KAT* are over 100%; therefore, in each variable between provinces and years, the differential value is high. CV of the L variable is 80% and the scale is uneven. This is due to the difference between large cities (Ha Noi, Ho Chi Minh, Da Nang…) and small provinces (Bac Kan, Cao Bang, Lai Chau…).

Table 1. Summary statistics of variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
GRDP	504	58312615.482	113450473.596	4120340	906532000
KAO	504	73651709.957	227691281.574	1533690	1758616460
KAT	504	3611682.820	11383131.067	21731	89065725
L	504	826495.198	665143.934	187652	4391660
TLRate	504	16.350	6.967	5.1	45.6
LTraining_PCI	504	5.549	0.847	2.956	8.175
EntryCosts	504	8.057	0.843	5.065	9.598
LandAccesseasy	504	6.205	0.861	3.037	8.839
Transparency	504	5.971	0.602	2.764	7.625
TimeCosts	504	6.413	0.893	3.508	8.690
InCharges	504	5.878	1.099	2.809	8.943
ProacLeadership	504	5.005	1.121	1.387	9.376
BSServices	504	5.205	1.161	1.753	8.755
LeInstitutions	504	5.333	1.084	1.996	7.909

Source: Author's calculation

4. Empirical results

The results in step 1 are shown in Model 1 (Table 2). In step 2, the results are shown in Model 2a (fixed effect – FE) and Model 2b (random effect - RE). In the last step, the study evaluates the spatial spillover effect by spatial lag of X models (SLX), the results are shown in the Model 3a and Model 3b. Combining the Hausman test, the final selected model is fixed effect, which is Model 3b.

Table 2. Estimation results

Variable	Model 1a (FE)	Model 1b (RE)	Model 2a (FE)	Model 2b (RE)	Model 3a (SLX, RE)	Model 3b (SLX, FE)
LnKAO	0.158***	0.172***	0.158***	0.170***	0.127***	0.117***
	(0.020)	(0.024)	(0.021)	(0.023)	(0.010)	(0.010)
LnKAT	0.060***	0.063***	0.063***	0.064***	0.032***	0.030***
	(0.013)	(0.015)	(0.014)	(0.015)	(0.008)	(0.008)
LnL	0.735***	0.889***	0.780***	0.889***	0.765***	0.424***
	(0.167)	(0.092)	(0.175)	(0.092)	(0.079)	(0.103)
LnTLRate	0.191***	0.186***	0.186**	0.181**	0.084**	0.072**
	(0.043)	(0.043)	(0.045)	(0.045)	(0.028)	(0.028)
LnLTraining_PCI	0.187***	0.183***	0.208***	0.201***	0.061*	0.040
	(0.058)	(0.058)	(0.052)	(0.052)	(0.037)	(0.037)

Table 2. Estimation results *(continued)*

Variable	Model 1a (FE)	Model 1b (RE)	Model 2a (FE)	Model 2b (RE)	Model 3a (SLX, RE)	Model 3b (SLX, FE)
LnEntryCosts	0.114***	0.100**	0.145***	0.131***	0.094***	0.114***
	(0.044)	(0.043)	(0.039)	(0.038)	(0.029)	(0.029)
LnTransparency	0.097	0.090				
	(0.066)	(0.070)				
LnLandAccess	0.062*	0.057*	0.062*	0.069**	0.084***	0.092***
	(0.035)	(0.034)	(0.034)	(0.033)	(0.026)	(0.026)
LnTimeCosts	-0.002	-0.007				
	(0.037)	(0.037)				
LnInCharges	-0.025	-0.002				
	(0.029)	(0.028)				
LnProacLeadership	0.032	0.034				
	(0.021)	(0.021)				
LnBSServices	-0.022	-0.022				
	(0.022)	(0.023)				
LnLeInstitutions	-0.008	-0.004				
	(0.018)	(0.019)				
D	0.093***	0.080***	0.089***	0.080***	0.077***	0.096***
	(0.015)	(0.014)	(0.013)	(0.012)	(0.009)	(0.010)
_cons	2.549	0.229	1.954	0.325	0.824	
	(2.117)	(1.038)	(2.187)	(1.036)	(1.002)	
M_ LnKAT					0.211***	0.242***
					(0.018)	(0.018)
Total effect					0.243***	0.272***
					(0.017)	(0.017)
R^2 (within; between; overall)	(0.847; 0.811; 0.810)	(0.845; 0.819; 0.819)	(0.844; 0.819; 0.818)	(0.843; 0.816; 0.816)	0.845	0.830
Obs. /Groups	504/63	504/63	504/63	504/63	504/63	504/63

Notes: The values in parentheses are standard errors. *, **, *** denote statistical significance at 10%, 5%, and 1%, respectively.

Source: Author's calculation

The final results indicate that factors of competitiveness have an insignificant impact on GRDP, such as transparent business environment and equitable business information, minimal informal charges, limited time requirements for bureaucratic procedures and inspections, proactive and creative provincial leadership in solving problems for enterprises, developed and high-quality business support services, fair and effective legal procedures for dispute resolution.

The other variables in the PCI data are statistically significant when considering their impact on economic growth, including "*EntryCosts*" and "*LandAccess*". This shows that the shortening of time, procedures, and application of information technology for registration and registration changes in business activities have contributed to economic growth. This result is explained as the time and procedures are shortened, and enterprises are put into operation as soon as possible; therefore, the economy benefits. The results show that the variables in the PCI "easy access to land and security of business premises" contributes to economic growth. This study indicates that it is necessary to focus on striving to increase this index. Variations of human capital, such as the number of employees, the proportion of trained working employees, are statistically significant. This shows that for economic growth, in addition to increasing the number of employees and the rate of qualified labor, it is important to focus on improving the quality of general education and vocational training.

The impact coefficient of non-transport capital on economic growth is positive in the SLX model. Model 3b results also indicate that transport investment has direct and indirect impacts.

Table 3. The impact coefficients from the two nearest and two farthest provinces to Quang Ninh

Province	Coef.
Hai Phong	0.023
Hai Duong	0.013
Bac Lieu	0.000
Ca Mau	0.000

Source: Author's calculation

The total coefficient of 0.272 is statistically significant; this is implying that investment for transport should be done simultaneously in all provinces and cities because of the spillover effect advantage.

5. Conclusion

The study was conducted to assess the impact of transport capital, human capital, and provincial competitiveness on GRDP of 63 provinces/cities in Vietnam between 2010 and 2017. The results show that the positive impact of investment capital on economic growth has both direct and indirect effects. The indirect impact of transport capital for 62 provinces on the remaining province is huge, which is the main contributing factor to the total impact. This proves the vital role of synchronous development in transport infrastructure. Therefore, it is recommended that the government focuses on investing in transport to enhance connectivity between regions and modes of transport, such as railways, roads, waterways, and airways. To strengthen that goal, it is necessary to have a comprehensive plan for the development of inter-provincial routes, strongly promote the construction of inter-provincial routes, especially high-quality routes, such as highways and high-speed rail, and network of roads in the East-West economic corridor.

In addition, the results reveal that instead of increasing the number of workers, the government needs to focus on improving the quality of labor, from improving the quality of general education and vocational training to increasing funding for labor training and increasing the use of information technology in labor recruitment. The results also show that market entry costs have a positive impact on growth which demonstrates the efficiency and importance of shortening the time, procedures, application of information technology for registration, and registration changes in the business activities of enterprises. Furthermore, improving other provincial competitiveness indexes and increasing land access are especially important, especially in the current context.

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