

The Role of Fdi in Promoting Economic Growth Across Vietnamese Provinces: Evidence from Spatial Panel Models

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Abstract. This study aims to evaluate the impact of foreign direct investment (FDI) on Vietnamese provinces' economic growth using spatial econometric models together with the data collected from statistical departures during the year 2010- 2020. The result shows that FDI has a positive impact with the economic growth of provinces. However, modeling the spillover effects of FDI from one province to another is relatively challenging due to the complexity of quantifying variables and the inability to fully describe the transmission channels based on the unique characteristics of data from each province. For example, when an FDI enterprise decides to invest in a province, they not only utilize labor within that province but also draw upon labor from other provinces. Therefore, the negative indirect spillover effect of the model also partially explains the input (specifically labor) migration from provinces without FDI investment to those with FDI investment in Viet Nam. The study also finds that other factors, such as public investment, private investment and provincial competitiveness play important roles in promoting economic growth. The article discusses the policy implications of these finding for FDI attraction and allocation strategies in Vietnam. However, the limitations of the paper are recognized, particularly in modeling the complex spillover channels through which FDI affect growth across provinces. The study contributed to the literature by providing new evidence on the spatial dimensions of FDI and economic growth in a developing context.

Keywords: Foreign Direct Investment, Provinces' Economic Growth, Spatial Econometric Model

1. Introduction

Foreign Direct Investment (FDI) had been considered as vital resources of technologies and know-how for the development of each country, as well as cities and provinces within the country. In fact, FDI transfers the production procedure but also management skills and this is how to distinguish investment types, including capital investment and financial packages. FDI may push economic growth by creating jobs, closing the gap between saving and investment together with knowledge sharing, management skills through connection (Frankel et al, 2012). Furthermore, the presence of foreign owned companies will force domestic companies to invest in human resources or technologies to fairly compete.

Wang and Blomstrom (1992) and Ram and Zhang (2002) suggested that FDI will push the economic in: (1) proper financial resources; (2) technologies transformation from developed countries to developing countries; (3) incremental of domestic competition; (4) reserved foreign currency; (5) necessary for better management practices; (6) reduced the imported activities by using export strategies (7) FDI acts as catalyst of domestic saving and investment.

Dondeti and Mohanty (2007) suggested that FDI will help countries and provinces access international markets and enable globalization. Even though FDI is seen as a factor that accelerates economic growth, it can only be done if managed properly (Bezuidenhout, 2009), the extent that FDI can be use for economic development depends on the facilitation of the economics, political and related policies.

Therefore, FDI has an important role in socio-economic development of the nation, as well as provinces. However, due to the nature of geographic and natural resources of each province are differences from one to another, so the FDI investment in the provinces is also relatively different and create a distinctive impact on economic growth.

Vietnam has more than 30 years of implementing policies to attract foreign investment and has achieved many remarkable achievements. The economic sector with foreign direct investment has developed radically and effectively, becoming an important part of the economy, making positive contributions to socio-economic development at the national and international level. In the yearbook “30 years of attracting foreign investment in Vietnam: Visions and opportunities in a new era” (2018), a comprehensive assessment and analysis of both policy and economy of FID in Vietnam in recent years. FDI in a province not only has an impact on economic growth in that province but also affects the growth of other provinces. For instance, when an FDI enterprise enters a province, in addition to employing workers in that province, there will be a spillover effect to increase income from the other province, promoting the growth of another province.

The results of attracting FDI over 30 years show that FDI was and is currently one of the active industries and contributes to socio-economic development. Currently, Vietnam applies similar policies to attract FDI in most of the provinces leading to many shortcomings for FDI attractiveness.

When Vietnam used the Doi Moi policies, the Government determined as foreign direct investment is one of the resources of the economy and important for economic growth purposes and poverty reduction. In 1987, foreign investment act was promulgated as a legal framework for the business activities of foreign partners in Vietnam. Since then, the Law has been revised four times (1990, 1992, 1996, 2001) and in 2006, the Law was applied uniformly to all types of investment including foreign investment. These changes are aimed at creating a more favorable and equal environment for both domestic and foreign enterprises operating in Vietnam.

According to the statistics of Foreign Investment Agency, in 2020, total FDI registered in Vietnam reached 28.5 billion USD, a reduction of 25 per cent compared to 2019 due to the COVID 19. Realized capital was 19.9 billion USD, led by Ho Chi Minh city during the year 2020 with 4.4 billion USD. Second is Bac Lieu with 4 billion USD, the largest FDI project in Bac Lieu is the Liquefied natural gas (LNG) power plant and belongs to LNG Thermal Power Center (Singapore) with and investment capital of 4 billion USD. The other provinces and cities that attract the FDI 1 billion USD include Hanoi (3.6

Billion USD), Ba Ria – Vung Tau (2.2 Billion USD), Binh Duong (1.9 billion USD), Hai Phong (1.5 billion USD), the remaining 4 province in the top 10 leading provinces in FDI include Dong Nai (928 million USD), Bac Ninh (901 million USD), Bac Giang (894 million USD), Long An (810 million USD), Meanwhile, according the General Statistics Office in 2020, there are 3 provinces with growth rates of 10 per cent, which are Bac Giang (13.02 per cent), Hai Phong (11.2 per cent), Quang Ninh (10.05 per cent). In addition, Ninh Thuan achieved an impressive growth of 9.58 per cent. This is also the top 4 provinces have highest GRDP, the other provinces and cities are below 8 per cent. Nevertheless, the other provinces that achieved negative growth rate including Khanh Hoa (-10.52 per cent), Da Nang (-9.77 per cent) Quang Nam (-9.96 per cent), Ba ria Vung ta (-9.77 per cent) and Quang Ngai (-1.02 per cent)

In Viet Nam, there are lots of studies about the impact as well as the roles of FDI in economic growth in provinces, hence most of the research is a collective of theoretical, descriptive statistics without any empirical research about the spatial effects of FDI on economic growth. Accordingly, in respect of spatial impact, the FDI in one province might influence the other provinces' economic growth. In reality, it's challenging to quantify the spillover effects of FDI from one province to another, but research endeavors to clarify this impact among provinces in Vietnam through indirect effects.

The study aims to give an overall and objective status about the FDI in Vietnam's provinces by assessing the spatial impact of FDI on economic growth of the provinces. The result obtained on the quantification of the impact; the studies can be able to suggest solutions to improve the efficiency of the use of FDI in promoting economic growth. In addition, the result can be useful information for policy makers in having a comprehensive view of the roles and impact of FDI in terms of spatial impacts, hence providing policy solutions to attract and allocate FDI in a more reasonable direction in Vietnam's economic context.

2. Literature Review

There were lots of studies about the impact of FDI in economic growth at national level or regional and provinces. Besides that, assessing the FDI under the microscopic aspects based on the organizational survey information, but the assessment of the impact of FDI on the economic growth by using spatial econometric models are relatively few, especially in Vietnam.

The relationship between FDI and economic growth topics attracts researchers quite late compared to other studies. Mody and Murshid (2004) viewed the relationship between FDI, and domestic investment as a uniqueness of developing countries where the marginal return is higher than the average interest rate, which benefits domestic investment.

FDI has an impact and created economic growth through accumulated capital, improvement of technologies and creating jobs (Delali, 2003). Roy and Berg (2006) suggested that FDI has important roles in technologies transferred from developed countries to developing countries. Udo and Obiora (2006) shared the same ideas with Roy and Berg (2006), authors also pointed out the reason of FDI capital movement because of production factors such as capital and labor costs. This means FDI will shift from high-cost countries to cheaper countries.

In research of 140 countries, Ghatak and Halicioglu (2006) found out that FDI has a positive impact on GDP per capita. Thus, by using the simultaneous equation model, Roy and Berg (2006) also found out the positive impact evidence between FDI, GDP ratio on economic growth in the US. On the other hands, Uno and Obiora (2006) did not find any relationship between FDI and economic growth by assessing the West African Monetary Zone and prove that there is a unilateral relationship where FDI is attracted into high GDP per capita countries. Another one-way relationship and unique to the above study are pointed out by Mehanna (2005), who demonstrated that investment precedes growth on a dataset of 80 developing countries.

Chadee and Schlichting (1997) discussed certain aspects of foreign investment in Asia- Pacific countries and concluded that FDI has strongly contributed to all the countries within the area.

Borensztein et al (1998) confirmed that developing countries have benefits from FDI if those countries can enable the developed technologies. According to the world investment report UNCTAD (1999) had suggested econometric models to define the impact of FDI to growth. Zhang (2001) provided the evidence that FDI pushed the economic growth of free-trade countries by analyzing the information from 11 East Asia and Latin America countries. According to Ram and Zhang (2002), FDI helped the international markets and enabled linkage for countries that joined into globalization. Using cointegration and error-correcting models to examine the link between FDI and economic growth in India, Chakraborty and Basu (2002) suggested that GDP in India was not a Granger-caused result and smoother causality from GDP to FDI.

Hsiao and Shen (2003) suggested that there are two-way relationships between FDI, growth and interaction support between FDI and GDP. Using a mixed data from 84 countries between 1970 to 1999, Li and Liu (2005) have pointed out there are incremental interrelationships between FDI and growth, especially during the mid-1980s.

Baharumshah and Thanoon (2006) has used the mixed model and described the positive contribution of FDI in the growth process of East Asia's economics. However, Herzer and et al (2007) argued that there is no relationship between long-term or short-term impact of FDI on growth by using the data from 28 developing countries. In fact, there is not a single country where a positive-unidirectional effect from FDI to GDP is found.

Whally and Xin (2009) analyzed the contribution of FDI in economic growth of Chinese during two growth phases and suggested that the balancing of exporting and economic growth is questionable if the capital flow of FDI is stable (without significant growth) in the future. Karimi and Yusop (2009) based on the linear regression model, researched about the FDI growth in Malaysia. According to those authors, there is a gap of factors to ensure the FDI will persuade or restrict the economic growth. Moreover, there was research by Wijeweera and partners (2010) with the mixed study of 45 countries during 1997 to 2004 that capital flow of FDI has a positive impact on economic growth when and only when there is an existence of skilled laborers.

Agrawal and Khan (2011) observed the impact of FDI on economic growth in Asia countries which are from China, Japan, India, Korea and Indonesia. During the time of 1993 to 2003 to account for structural changes of GDP. Their study used mixed data regression (categories) to find out the impact of FDI to economic growth of those markets. Furthermore, the study also included the impact of the financial crisis in Asia in 1997 and global financial crisis in 2007 toward those countries and comparing them.

There are a lot of studies related to spatial impact of economic variables between cities and regions. Auselin (1988) suggested there is a spatial correlation between economic variables and regions. Coughlin and Segev (2002) have pointed out the spatial impact of FDI on the economic growth of China during 1983-1998. Shan-Li Wang, Feng-wen Chen, Bing Liao and Cuiju Zhang (2020) have used the economic spatial model that the FDI has an impact on Chinese development during 1997-2007 was influenced by the spatial factor which mean that FDI is not only impact on one province but also impact on the other provinces in China.

There are many studies related to the impact of FDI but most of the studies about the impact of FDI to economic growth are limited.

Nguyen Phuong Hoa (2002) used data from 51 provinces in Vietnam to analyze the impact of FDI in economic growth by using the table estimation with which economic growth was influenced with FDI, public investment, labor capital, labor growth and other variable factors. The result showed that the FDI did pushed the economic growth during the year 1996-2000 and there is a correlation between the FDI and labor capital.

Nguyen Thi Tue Anh et al (2006) observed the impact of FDI to economic growth during 1988-2005, Phan and Ramstetter (2006) use internal growth model to evaluate the impact of FDI to economic regions in Vietnam during the year of 1995-2003 and concluded that there is a positive impact of FDI

to economic growth. Le Quoc Hoi (2006) had used an internal growth estimation model based on the study of Borensztein et al (1998) with the data of 59 regions in Vietnam during 1996-2003 and the result also showed the positive impact of FDI to economic growth. Vu (2008) has used the internal growth model to estimate the impact of FDI with the data from 1990-2002 and showed that there was a positive impact of FDI to labor and GDP. Sajid Anwar and Nguyen Phi Lan (2010).

Therefore, there are studies about the FDI to the economic growth on the level of regions in Vietnam but the quantitative studies about the impact of FDI to economic growth and TFP convergence and limitation in regional data and mainly old studies, they are no longer suitable with today situation in Vietnam, especially in integrated economic with pandemic and uncertainty.

The relationship between FDI and economic growth is shown by the positive impact of FDI to economic growth and vice versa, when there is an improvement of economic growth will attract more FDI. Besides that, apart from the geographic condition, natural resources then other factors such as policies will have an impact on economic growth and attract FDI. Therefore, the study tries to clarify the spatial impact of FDI toward economic growth and TFP convergence in Vietnam by using spatial econometric models with provinces panel data.

3. Research methodology

3.1. Spatial econometric model analyzes the impact of FDI on economic growth of Vietnamese's provinces

In this study, we focus solely on the basic Cobb-Douglas production function without considering the impact of changes in technology and human capital on growth. Instead, we use the traditional Cobb-Douglas framework to examine how investment influences economic growth. This approach allows for a straightforward analysis of the relationship between investment and growth while abstracting from other factors that may affect output. Suppose the simple Cobb-Douglas production function for a province has the following form:

$$Y_{it} = A_{it} K_{it}^{\alpha} L_{it}^{\beta} \quad (2)$$

Which,

+ t and i are province i^{th} and year t.

+ Y is output. This study y is taken a Gross regional domestic product of Vietnam's provinces.

+ K is Capital and L is Labor

Because Capital K is built from public investment (I_g), private investment (I_p) and Foreign Direct investment (FDI)

Taking Log of both side from the formula (2) and replace K by the capital factors, the formula will be:

$$\ln Y_{it} = A_{it} + \alpha_1 \ln I_{g_{it}} + \alpha_2 \ln I_{p_{it}} + \alpha_3 \ln fdi_{it} + \alpha_1 \ln L_{it} + u_{it} \quad (3)$$

With the Ln as Log of variables and u is a error term of the model

Institutions play a crucial role in the economic growth of provinces. Therefore, this study also considers the provinces competitiveness index (PCI) as an indicator that affects the output. Therefore, model (3) is rewritten as follows.

$$\ln Y_{it} = A_{it} + \alpha_1 \ln I_{g_{it}} + \alpha_2 \ln I_{p_{it}} + \alpha_3 \ln fdi_{it} + \alpha_1 \ln L_{it} + u_{it} \quad (4)$$

Simplify the formula (4)

$$y_{it} = c + \beta x_{it} + u_{it} \quad (5)$$

y and x is the logarithmic symbol of Y and X, respectively. x is a set of independent variables, including I_g , I_p , fdi, L and PCI.

The spatial influence among variables has been mentioned since the late 1970s, notably in the research of Paelinck & Klaassen (1979). Subsequent studies have expanded the application of this method in economic analysis. Building upon the research by Belotti F. and et al. (2017) on developing a method to estimate spatial econometric models using STATA software, the authors propose a basic spatial econometric model with panel data as follows:

$$y_{it} = \alpha + \rho \sum_{j=1}^n w_{ij} y_{jt} + \sum_{k=1}^n x_{it} \beta_k + \sum_{k=1}^n \sum_{j=1}^n w_{ij} x_{jtk} \theta_k + \mu_i + \gamma_t + \vartheta_{it} \quad (1)$$

$$\vartheta_t = \lambda \sum_{j=1}^n m_{ij} \vartheta_t + u_t \quad (1')$$

$$\mu \sim (0, \sigma_\mu^2) \quad (1'')$$

which:

+ y and x are defined as above.

+ w_{ij} and m_{ij} are elements of the two matrixes of spatial weights W and M, respectively. M is a matrix of spatial weights that may or may not be equal to W (Belotti F. and et al., 2016)

+ t is time, i and j are province i^{th} and j^{th} , respectively.

+ a is constant, β is coefficient effect of x on y

+ ρ and θ are spatial autoregressive coefficient and spatial coefficient effect of x on y

+ λ is spatial autoregressive coefficient

+ u is a vector of error term.

3.1.1. Model selection for spatial econometric models

After performing tests for model (1), the values of parameters ρ , θ and λ suitable for each type of spatial econometric model will be obtained as follows:

- 1) If $\theta = 0$ the model becomes spatial autoregressive combined model (SAC)
- 2) If $\lambda = 0$ the model becomes Spatial Durbin model (SDM)
- 3) If $\theta = 0$ và $\lambda = 0$ model becomes Spatial Autoregressive model (SAR)
- 4) If $\rho = 0$ và $\theta = 0$ model becomes Spatial error model (SEM)
- 5) If $\rho = 0$, $\theta = 0$ và $\mu_i = \psi \sum_{j=1}^n w_{ij} \mu_j + \zeta_i$ model becomes Generalized Spatial Panel Random Effects model (GSPRE).

3.1.2. The spatial weights matrix

The common measurement about the spatial correlation is Morn's I index according to the Moran test in 1950. If the positive result means that the provinces close to each other will have positive spatial correlation and vice versa. In this study, the spatial weights matrix builds the Contiguous first order matrix with contiguous scale (MW1) for 63 provinces in Vietnam. This is a common spatial matrix that has been used in most of the studies. For instance, the hypothesis of province i is next to 2 other provinces, the value in the matrix is calculated on average for each province is $\frac{1}{2}$. In this study, the spatial weights matrix for Vietnamese provinces is generated in GeoDa software then imported into Stata using the spmat commands.

3.1.3. Testing the spatial dependence and spatial lag

To check the spatial impact and spatial lag in the panel data model by using the hypothesis of $H_0 : \rho = 0$ (there is no existence of spatial dependence) and $H_0 : \theta = 0$ (there is no existence of spatial lag impact) of each model. The Lagrange model is used to test when estimating the hypothesis to eliminate the complexity of maximum likelihood. In which, the test of the spatial effect and for error component of the model are based on the studies of Anselin (1988); Baltagi et al (2003, 2006, 2007)

3.1.4. The advantages and disadvantages of using spatial econometric model

Usually, the FE and RE techniques are commonly used for panel data. However, the issue is the spatial effect that FE and RE models cannot measure. For instance, the economic growth of a province might have an impact on neighboring provinces. This is not fully concluded if FE and RE models are used. Therefore, the study uses the spatial econometric model to justify the impact variances when observing the spatial factors.

Spatial econometric model with panel table has been used recently and accepted that the estimation technique is more accurate by explaining both spatial and time elements when there is a spatial dependence of observants (Anselin et al, 2004; Ellorst and Vega, 2013). Spatial panel data is a special case of panel data analysis. In fact, the spatial panel regression is more superior comparing to the cross panel data or time series, with the elements as:

Previous studies about the economic growth, poverty, or income inequality between provinces in a nation or nations that share the similarity of geographic condition usually use normalized regression panel databases. The normal database is also considered the distinctive elements of the nations but left-out the spatial relationship. Peracchi and Meliciani (2001) have argued that there is a strong correlation between economic growth between provinces as well as neighboring countries. The other study of Anderson and Van Wincoop (2001) has also argued that the provinces between countries had a strong connection with each other due to the same policies and regulations. Neighboring provinces will have advantages of geographic distance compared to other provinces that did not share the boundaries. According to Le Gallo et al (2003), if measuring the economic relationship but eliminating the spatial correlation then the result might not be accurate and unreliable. This is also an autocorrelation in spatiality that has been found in the study of Paraguas and Kami (2005) or Higazi et al (2013). There are multiple elements of the province but are not being observed or controlled in the model that change simultaneously. Besides that, the regional regulations applied for one province might have the similar effect to another province which share the same geographic conditions and climate.

The biggest disadvantage of spatial econometric model is about the spatial matrix, the relativity of the spatial matrix in the models. Besides that, the spillover effect between cities, provinces and countries is complicated and this model cannot analyze and calculate all those spillover channels. In addition, because of the complexity of constructing the spatial matrix create the consequences in choosing the correct model for analyzing. The questionable in most of the studies is that by using different spatial matrix model might result differently. To overcome the weakness, studies had used different spatial matrix to consider the changes of factors. In the case that factors have greater changes then the model must reevaluate or else meet the criteria of robustness.

3.2. Data

Data related to economic growth, capital (public investment, private investment and FDI) and labor are collected from Vietnam’s Provincial statistical yearbook in period of 2010-2020.

The data Province Competitiveness Index (PCI) is collected from The Chamber of Commerce and Industry of Vietnam (VCCI) in period of 2010-2020. This is a index to consider the Vietnam’s provincial business environment based on an annual business survey, assessment and ranking of the economic governance quality of provincial authorities in creating a favorable business environment for development of the private sector.

Table 1: Data description

Variable	Obs	Mean	Standard deviation	Smallest value	Largest value
Gross regional domestic product at constant 2010 prices (Bill. Dongs)	63	55447	102336	4403	712925

Public investment at constant 2010 prices (Bill. Dongs)	63	7242	12364	1520	77719
Private investment at constant 2010 prices (Bill. Dongs)	63	8589	12593	1594	88003
Foreign Direct Investment (FDI) at constant 2010 prices (Bill. Dongs)	63	5139	9399	0	48163
Province Competitiveness Index (PCI)	63	63	2	58	70
Labor (Thous. persons)	63	884	709	234	4436

4. Analyzing the impact of foreign direct investment to economic growth in the provinces

FDI has attracted and became one of the most important capital of provinces' economic growth, with the contribution of FDI, it adds a large capital to provinces as well as creating jobs and improving the income of citizens. However, with a significant difference in investment of FDI, the impact of economic growth between provinces are also different. Yearly data shows that with a large economies of scale such as Ho Chi Minh, Ha Noi, Binh Duong, Dong Nai have a potential to attract more FDI.

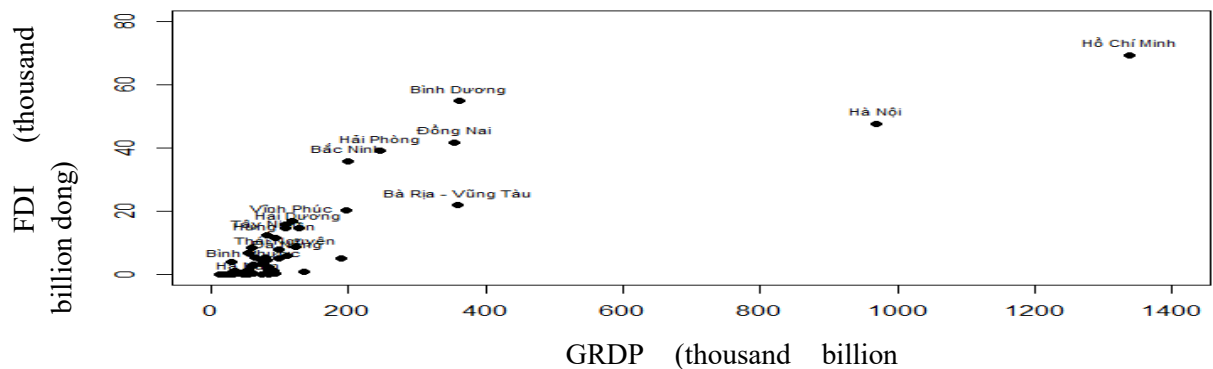


Figure 1: correlation between FDI and GRDP of provinces in 2019

The study uses the spatial econometric model with Quasi – Maximum likelihood estimation to evaluate the impact of FDI to economic growth:

Table 2: result of spatial econometric model in SDM

VARIABLES	(1) SDM - RE
Public Investment	0.06*** (0.00)
Private investment	0.62*** (0.09)
FDI	0.01* (0.00)

Labor	0.49*** (0.10)
PCI	0.14* (0.08)
rho	0.20** (0.09)
lgt_theta	-2.59*** (0.25)
sigma2_e	0.00*** (0.00)
Constant	1.56*** (0.60)
Observations	567
R-squared	0.88
Number of mun	63

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

(Sources: authors' calculation)

Table 2 discusses the estimation of the model in SDM excluding the effect of a province specific fixed effects model (Lesage and Pace, 2009). The result shows that FDI has a positive impact on the provinces' GRDP growth. Meanwhile, the coefficients of the variables of public investment are positive, showing that the public investment has a positive impact on economic growth at the provincial level. Besides that, the coefficient of the PCI variable is positive which has statistically significant, and explains that the higher the PCI, the better contribution to economic growth. Furthermore, the result of the model given that the variables are constant, the 1 per cent incremental increase in public investment, private investment, FDI, PCI and labor can increase the growth of GRDP of provinces by 0.06 per cent; 0.62 per cent; 0.01 per cent; 0.14 per cent and 0.49 per cent respectively.

When testing the spatial $\rho = 0.2$, which is positive and has statistically significant results, the spatial impact between provinces will have positive spillovers to other provinces. However, the $\text{lgt_theta} = - 2.59$ means that the negative impact of growth (including public investment, private investment, FDI, labor and PCI) will cause negative impact and a reduction of input of a province if there is an increase from another province. This is true when input resources are limited and it is necessary to have policies and solutions to balance and optimize input resources of provinces, hence maximize growth.

4.1. Direct, indirect, and total marginal impact

A spatial econometric model allows complexity structure of dependent variable with explanatory variable and the changing to variances may affect themselves, directly and indirectly with other variables. Therefore, in the spatial econometric model, there will be an existence of direct, indirect and total effect between variables.

LeSage and Pace (2009) showed that direct impact exists in a spatial regression econometric model and is being used to measure the effect of changing independent variables to dependent variables at provincial level. Followed by the direct impact mechanism from the principal component and its neighbors. Meanwhile, the indirect affect is crossed- spatial impact to measure the changes of independent variable in one province to dependent variable of other provinces. Belotti F. and et al.,

(2016) based on Elhorst (2014) show the SDM static model only has long-term direct and indirect effects with the following specific calculation formula:

$$Direct\ effect = \{(1 - \rho W)^{-1}(\beta_k I - \theta_k W)\}^{\bar{d}}$$

$$Indirect\ effect = \{(1 - \rho W)^{-1}(\beta_k I - \theta_k W)\}^{\overline{rsum}}$$

In which, \bar{d} is the mean diagonal element of a matrix and \overline{rsum} is the mean row sum of the nondiagonal elements.

Total impact is a combination of direct and indirect impact, detailed as shown:

Table 3: direct, indirect, and total marginal impact

LR_Direct	
Public investment	0.0569***
Private investment	0.5220***
FDI	0.0060***
labor	0.2857***
PCI	0.1382***
LR_Indirect	
Public investment	-0.0191***
Private investment	-0.0344
FDI	-0.0168***
labor	1.0015***
PCI	0.3848
LR_Total	
Public investment	0.0378***
Private investment	0.4876***
FDI	0.0108***
labor	1.2872***
PCI	0.5230***

*** p<0.01

(Source: based on author calculation)

Table 3 shows the estimation of direct, indirect, and total impact of the spatial econometric model of FDI to economic growth. The results estimated in all three scenarios meet the expectation of the model. This means when variables are chosen does have the existence of direct, indirect and total when the spatial factor is considered. Therefore, in the spatial econometric model, there is not only a direct influence of the independent variable on economic growth but also an indirect influence on other provinces. However, some coefficients are not statistically significant in both models exhibiting marginal effects.

The spillovers result of FDI on economic growth from one province to another are limited in this study. Especially when FDI enters a province, it can use labor from any provinces and create income as well as the money transfer to the family. However, due to the statistical characteristics of Vietnam, most of the GRDP at provinces are calculated based on production, so there is not fully accounted for the income sent back by workers. Besides that, the separation of information on the income of labor in the FDI enterprises have not been statistically or incompletely, leading to the limitation of the study.

4.2. Robustness test

To test the robustness test, the study uses a different spatial matrix to consider the changing of coefficients in the model. In addition to the Contiguous first order matrix with contiguous scale used above, 04 matrices are used for testing as follows:

- First order contiguous matrix (MW2): this is a simple matrix with only a value of 0 and 1 and considers whether it is contiguous or not.

- Marginal contiguous matrix (MW3): this matrix is built based on the contiguous border distance between provinces. The value in the matrix is the contiguous value (in kilometers or miles) of two contiguous provinces and vice versa will equal to 0.

- Distance matrix to 3 central provinces (MW4): this matrix is built based on the 3 central provinces: Ha Noi, Da Nang and Ho Chi Minh City. The value in the matrix is measured by distance between provinces to central provinces and taking the smallest value of a province to 3 central provinces above.

- Coordinate space matrix (MW5): this matrix is built based on the coordinates of a province according to Google including Longitude and Latitude.

Table 4: robustness test of the model

Parameter	MW1	MW2	MW3	MW4	MW5
Public investment	0.0621	0.0632	0.0639	0.0689	0.0625
Private investment	0.6210	0.6100	0.6174	0.6246	0.6123
FDI	0.0103	0.0115	0.0129	0.0153	0.0125
Labor	0.4907	0.4941	0.5013	0.5021	0.4957
PCI	0.1438	0.1381	0.1380	0.1450	0.1243
Spatial					
rho	0.6012	0.6022	0.6131	0.6824	0.6032
Variance					
sigma2_e	0.0045	0.0046	0.0050	0.0053	0.0051

(Sources: authors' calculation)

The above table discusses the SAC spatial econometric model with 5 spatial weights matrixes to test the robustness. The result shows that there are no differences between the MW1 and MW2 which means that choosing the contiguous first order matrix with contiguous scale and first order contiguous matrix does not affect the study's result. There is also not significant effect with the other 3 cases, for example the rho is from 0.6 to 0.68 and Sigma2_e is from 0.0045 to 0.053 between the models, also the sign of the variances and statistically significant do not change. Therefore, the result of the model meets the criteria of robustness test and can be used to analyze the impact of the FDI to economic growth.

5. Conclusion and implication

With the improvement of the current situation of FDI and economic growth in 2010-2020, especially 2013-2019 and 2020 when the COVID 19 has huge impact on the economy. However, the total result of economic growth during the recent years show there are an improvement of provinces and the roles of FDI is important in economic growth.

The model's result shows the spatial impact of FDI to economic growth. FDI not only has a positive impact on the economic growth of the provinces but also pushes the other provinces' growth. However, due to the nature of Vietnam's statistics, most of the GRDP provinces are calculated by the production and the incremental income of the labor in the FDI enterprises are not fully accounted for. For example, when an FDI enters a province by using the labor there, the enterprise can be using the labor from the other provinces and these laborers can send the income to their family from other provinces. Besides that, the limitation of the model is relative to the spatial matrix, and it is difficult to

determine the appropriate model. In addition, modeling FDI spillover channels from one province to another is relatively difficult due to the complexity in quantifying variables and the inability to fully describe these spillover channels.

The findings have important implication for policy makers in Vietnam. First of all, the result indicates the FDI attracted can be used to promote economic growth at provincial level, particularly in less developed regions. However, policymakers should also consider the potential spatial spillover of GDI and design policies to encourage investment in areas that can generate positive externalities for neighboring provinces, thus the policymakers can focus on enhancing infrastructure, human capital and institution quality to create more favorable investment climate.

The limitation of the article should be acknowledged. First, the data methods used in analysis may not fully capture the complex channels through which FDI affect economic growth across provinces. Second, the study focuses only on the quantity of FDI, without considering the quality or composition of investment, Therefore, Future research could use more disaggregated data and advanced spatial models to better understand these spillover mechanisms and examine how different types such as sector, country of origin may have differential impact on growth. Despite the limitations, the study makes an important contribution to the literature by providing new evidence on the spatial dimensions of FDI and economic growth in a developing country context, and offers valuable insights for policymakers in Vietnam.

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