Determinants of Foreign Direct Investment Distribution in Vietnam: An Inclusion of Spatial Econometrics Element

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Abstract

The study investigates determinants of foreign direct investment (FDI) distribution across 63 Vietnamese provinces. Exploratory Spatial Data Analysis (ESDA) and spatial regressions are employed to analyze cross-sectional data in 2018. Also, a panel data analysis is applied to analyze the data over 2010-2018. The first results show that the spatial distribution of FDI in Vietnam is persistently uneven between 2010 and 2018. While the provinces with a low FDI stock cluster in the Northwest area, the provinces with significantly high accumulative FDI gather in the Southeast region. Secondly, the main results obtained from the spatial analysis for determinants of new-registered FDI in 2018 are as robust as the findings from OLS analysis. However, the role of space is essential to point out the clustering effect of FDI inflows in Vietnamese provinces, helping avoid the estimation bias from the OLS analysis. Thirdly, poverty deters inward FDI from moving into the most underserved areas in Vietnam. The new-registered FDI in 2018 tends to favor the moderate provinces, which do not own a high level of average personal income and a high poverty rate. Fourthly, the results from panel data analysis confirm critical determinants of FDI in Vietnam over the period 2010-2018, including FDI stock, economic agglomeration, market size, income factors, the share of the industrial sector in gross regional domestic products (GRDP), net migration rate, electricity access, and land access index. In addition, new foreign investors pay more attention to the production factors, such as provincial GRDP per capita or labor wage, than the consumption perspective represented by the average personal income. Furthermore, amendment No. 63/2014/QH13 in 2014 in FDI law of Vietnam is found to create an immediate negative impact on new FDI inflows in 2014 but positively support foreign capital inflows into Vietnam for the years after 2014. Regarding policy implications, the study proposes four policy suggestions. Labor mobility and land policy can become practical tools in directing FDI inflows among Vietnamese provinces. Designing FDI policies needs to prioritize the regional development linkage rather than singly promoting FDI inflows into a specific province. It is crucial to develop FDI promotion strategies based on a sub-regional scale by gathering the provinces in each region, especially for the poorest areas in Vietnam. Finally, the government should regularly execute periodic reviews and evaluations on FDI policy to attract more FDI inflows into Vietnam in subsequent periods.

Key words: FDI, determinants, spatial analysis
Category Number: S52. Foreign Direct Investment, trade and local development: drivers and impacts
JEL Classification: C31, R12, R58

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1. Introduction

In Vietnam, the foreign-invested sector has become an important engine for economic development (Freeman, 2004). Since December 1987, one year after the economic reform known as Doimoi, the first law on FDI was enacted, opening the way for economic integration of Vietnam with the regional and the world economy. The IMF (2021) emphasizes the leading role of FDI in the manufacturing industries development of Vietnam: FDI can create a positive contribution to structural transformation and enhance the country's living standards. However, the poverty reduction in Vietnam was more significant in locations with a stronger concentration of Global Value Chains (GVC) firms (mainly FDI firms) over the period 2004-2014 (World Bank Group, 2020). Also, the World Development Report 2020 points out that inequality arising from GVC firms' distribution across regions in Vietnam has a geographical dimension. The study of Hoang et al. (2021) shows that FDI distribution is highly uneven in Vietnam. The top 5 provinces absorbed 74 percent of total inward FDI in Vietnam over 1988-2003 (Leproux and Brooks, 2004). According to the data of GSO Vietnam, this situation had been minorly improved as 71 percent of total registered FDI was still concentrated in the top ten Vietnamese provinces in 2015. By the end of 2019, 42 percent of the entire FDI stock in Vietnam is situated in the Southeast region, in which Ho Chi Minh city is the top 1 percent highest FDI-density destination in the country (GSO Vietnam, 2019). Most foreign investors prefer to locate their activities with other investors already there (Leproux and Brooks, 2004). The ultimate purpose of this study, therefore, is to investigate the factors that determine new FDI inflows in Vietnamese provinces, inducing the highly unequal distribution of FDI in Vietnam. While most studies on investigating FDI determinants in Vietnam are often implemented at the country-level or sub-national level, this study employs data at the provincial level. In addition, it develops a comprehensive approach towards the inclusion of spatial analysis on utilizing cross-sectional data in 2018. The study further investigates the critical determinants of FDI in Vietnam through a panel data analysis over 2010-2018. The paper can contribute to the previous literature through three main points.

- The study is one of the leading analyses using the recent geo-method of Exploratory Spatial Data Analysis to examine the significantly uneven distribution of FDI across 63 Vietnamese provinces between 2010 and 2018.
- Through a spatial dependence approach, the study results suggest the crucial role of space in fingering out the clustering effects of FDI inflows in Vietnamese provinces, helping avoid estimation bias of the OLS analysis.
- The study provides conclusions on the critical determinants of FDI distribution in Vietnamese provinces. From that, the study can recommend adequate policy implications in monitoring FDI inflows among Vietnamese provinces, particularly attracting more additional FDI into the poorest locations in Vietnam.

The paper is organized into six sections. Section 2 summarizes the theoretical and empirical background of the spatial distribution and local determinants of FDI. In section 3, the study examines FDI patterns in Vietnam through a brief grounding of sectoral composition and geographic distribution of FDI across the country. Section

4 describes the models, data, and econometric methodologies. All the findings from the empirical analysis are discussed in Section 5. Finally, Section 6 concludes and provides economic implications for policy designs.

2. Literature review

2.1. FDI distribution and Exploratory Spatial Data Analysis (ESDA)

Exploratory spatial data analysis (ESDA) is the initial step in spatial analysis to examine a given variable's random or non-random distribution among spatial units. Anselin (1995) defines ESDA as a collection of techniques to visualize spatial data, identify spatial outliers, and investigate spatial patterns such as hot spots (high-values clusters) and cold spots (low-value clusters). The results gained from ESDA can offer the conclusion of spatial autocorrelation, the presence or absence of spatial variations in the given variable. The spatial autocorrelation can be either positive or negative. In the case of positive spatial autocorrelation, areas close to each other have similar values (high values are next to high values or low values are next to low values). Meanwhile, the negative spatial autocorrelation presents the different values that neighborhood locations can obtain (high values are next to low values). Since the spatial framework was developed by Anselin (1995), many studies applying ESDA have been conducted on different data levels from national, regional, municipal, to district data. Altay and Çelebioğlu (2012), through ESDA, investigates the trade and production concentration in 135 countries across the world over 1990-2009. By applying quartile maps, box plots, Global Moran's I, and Local indicators Spatial Analysis Statistics (LISA), the study finds severe inequality and heterogeneity in the spatial concentration of trade and production. In detail, the LISA analysis shows that the center of spatial concentration in terms of production and trade of the world belongs to the group of Asia Pacific countries. Using municipal-level datasets, Mendez and Gonzales (2021) study the human capital constraints across 339 municipalities in Bolivia. The study uses spatial clustering methods, including both spatial dependence analysis and regionalization framework. Their findings emphasize the importance of spatial data analysis in designing policies on human development goals.

In Vietnam, Hoang and Goujon (2014) use Philcarto mapping to present the geographic distribution of accumulative FDI over 2001-2006. The study shows that 92 percent of total FDI in Vietnam concentrates in the 19 provinces with two main destinations (Hanoi and Ho Chi Minh city). The remote regions including Northern Mountains, Central Highlands, and Mekong River Delta have the lowest density of accumulative FDI over the mentioned period. Esiyok and Ugur (2015) describe the accumulative FDI in 2009 of Vietnam across provinces by using a quantile map. The provinces with low FDI inflows in Vietnam are found to locate together, including a group of Ha Giang, Cao Bang, and Bac Kan in the North and another group of Dak Nong, Dak Lak, and Gia Lai in the Southwest. The highest FDI inflows come to the provinces in the Southeast area, surrounded by provinces with high FDI inflows. Although those general investigations can present the distribution of FDI across Vietnamese provinces, they are unable to provide the statistical significance of spatial clusters as what Global Moran's I and LISA analysis could detect.

2.2. FDI determinants and spatial dependence

A vast amount of empirical literature has tried to explain the determinants of FDI inflows. Assunção et al. (2011) summarize the theoretical approaches on FDI and point out that the spotlight of the FDI determinants falls on three main approaches: the Eclectic paradigm, the institutional approach, and the "New Theory of Trade." First, the Eclectic paradigm of Dunning (1977, 1979) explains the three motivations why a firm decides to become a multinational one. The first motivation is the benefit of owning productive processes, technology, and management skills that the international firms may hold over the local firms. Second, the advantage of locating in safe markets, favorable tax systems, and low production costs can motivate firms to establish in foreign markets. Third, the internationalization advantage explains that FDI can reduce transaction costs and lowering the risk of copying technology or quality management compared to other methods such as licensing. In terms of the institutional approach (Bellak and Leibrecht, 2009), it explains the determinants of FDI through political variables such as political stability, financial incentives, and tariff and tax treatment (cited in Assunção et al., 2011). For instance, Bellak and Leibrecht (2009) study the relationship between tax rate and FDI attraction and conclude that countries with lower tax rates attract a higher level of FDI. The "New Theory of Trade" emphasizes the importance of opening the economy to attract FDI. The group of variables, including market size, market growth, the openness of the economy, and factor endowments, help explain the FDI determinants.

United Nations Conference on Trade and Development (UNCTAD) (2007) discusses three motives for firms to direct investment in foreign markets: market-seeking, efficiency-seeking, and resources-seeking. The UNCTAD global survey also reports that market-seeking FDI is the most common type with 51 percent of FDIs and usually occurs in middle-income developing economies to look for new customers. The efficiency-seeking FDI that aims at reducing operation and production costs is usually found in the case of lower-income developing countries, including ASEAN. The resources-seeking or accessing key factor inputs FDI targets a country with abundant resources and raw materials. In some situations, the created asset-seeking FDI might be found in the case of developed economies. For instance, the resources-seeking FDI aims at acquiring new technology to improve productivity.

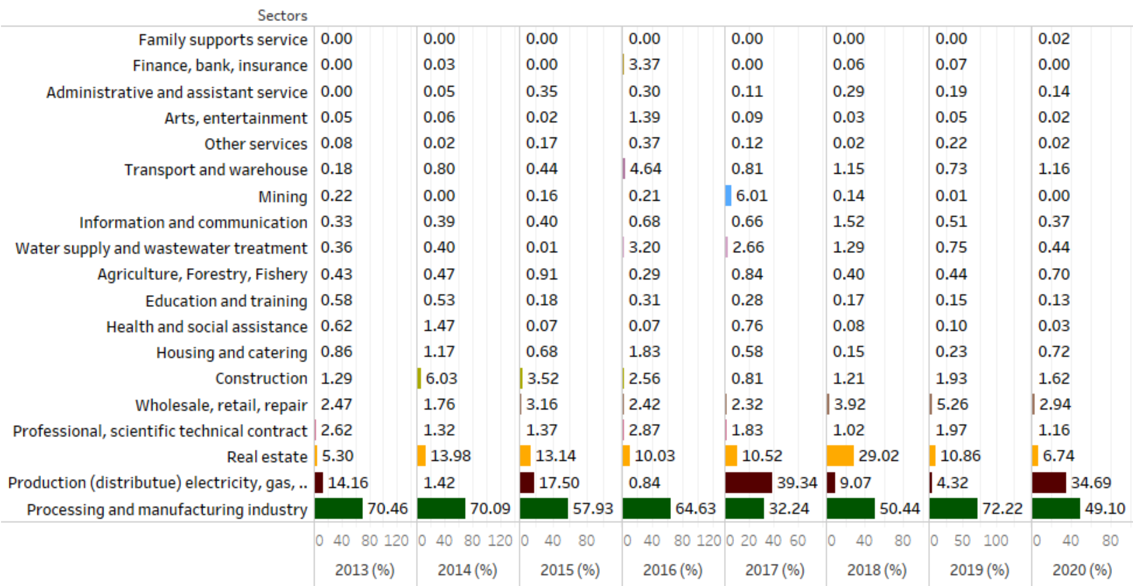
Besides the traditional views on FDI determinants through the two-country relationship (the host and the home market), the other literature on FDI determinants further attempts to consider the spatial interdependence among locations. Baltagi et al. (2007) investigate the impact of spatial dependence on US FDI. This study examines FDI determinants based on the following motives of MNEs: horizontal FDI, vertical FDI, and complex vertical with a regional economic accumulation FDI (cited in Esiyok and Ugur, 2015). The horizontal motive of FDI explains that multinational firms replicate identical goods and services across regions or countries. Those production processes between the home and host markets are very similar. The horizontal FDI aims at the unique market for the identical products and services production of firms. Therefore, there is no spatial interaction between FDI in the host provinces and the neighboring provinces' FDI level or market potential in a spatial perspective. By contrast, vertical FDI occurs when multinational companies geographically fragment their production into various stages to take advantage of the change in relative production costs (Yeaple, 2003). The manufacturing across regions or countries is highly interdependent, and vertical FDI prefers the location with lower production costs. Hence, the higher FDI level of the host location may result in a lower FDI of its neighbors due to a competitive effect. However, in terms of market size, which is usually measured by gross regional domestic products, the neighboring provinces may not affect FDI inflows in the host provinces. Regarding the complex vertical with a regional economic accumulation, the higher regional economic agglomeration may attract more FDI in the neighboring provinces of a country. The argument is that the higher density of supplier networks and FDI firms' presence in a region may lead to a higher level of inward FDI in that region. Thus, the larger market size and higher FDI stock in neighboring provinces may positively contribute to the inward FDI level into the host province (Hoang et al., 2021). Following this approach, Hoang and Goujon (2014) employ spatial econometric models to study the determinants of FDI distribution among Vietnamese provinces over 2001-2010. The study also discusses another type of FDI in a spatial perspective: a regional trade platform. This type of FDI shows that the investment and production in a host province can serve the consumption of both the host province and its neighboring provinces. Therefore, a positive association between the market size of neighboring provinces and the FDI inflows of the host provinces may exist. However, the region may experience a substation effect that cause a higher level of inward FDI in a host province and a lower level of FDI inflows in its neighbors. In addition, the main results of the study indicate that the ordinary OLS method contains an estimation bias as the spatial autocorrelation is found on the error terms of OLS and FDI in Vietnam belongs to a regional trade platform.

3. The brief overview of FDI in Vietnamese provinces

Vietnam has experienced a mounting inward FDI for over 30 years after the economic reform. According to Wee and Amelia (2019), Vietnam was the third-largest recipient of inward FDI in ASEAN, with over USD 15 billion (after Singapore and Indonesia) in 2018. Some principal reasons can explain why Vietnam, an emerging ASEAN country, has become an attractive destination for foreign investors. The first contributor comes from the specific achievements of Vietnamese government with in maintaining a stable macroeconomics status with an average annual growth of 6 to 7 percent. The second contributor is the country's active engagement with the rest of the world through the international Free Trade Agreement (FTAs). Vietnam has successfully set up 16 FTAs with foreign governments, organizations, and territories in the world by November 2021. Thirdly, the central government has developed a strategic investment policy with regular reviews and maintained an enduring annual domestic investment that accounts for around 40 percent of GDP since 1986 (Vu, 2015). To attract investment into the economy, Vietnam put much effort into creating a business-friendly environment. For example, after six years of the first Foreign Direct Investment law (1987), the Ministry of Planning and Investment (MPI) established the first specific policy area called Tan Thuan Export-Processing Zone (EPZ). By offering land rent exemptions, corporate income tax reduction, and other incentives, the establishment of the industrial parks and economic zones receives the great attention of foreign investors and contributes considerably to Vietnam's economic transformation (Morisson, 2015). During the period 2010-2018, the Foreign Direct Investment law amendment approved by the National Assembly of Vietnam on 26 November 2014 and became effective from 1 July 2015, remarks a significant shift in FDI policy. The amendments helped eliminate the confusion that accompanied the Investment Law and Enterprise Law in 2005 and ease the foreign investment process (see Appendix 1). One of the crucial contributions is that foreign investors investing in a Vietnamese company can be treated similarly to a domestic investor. The simplification also offers more opportunities for foreign investors to select appropriate investing structures and target suitable sectors to reduce burdensome investment approval requirements as in the Law 2005 (Allen and Overy, 2014). The fourth contributing factor for the growing FDI inflows in Vietnam may stem from other local characteristics of Vietnam, including the large labor force, the availability of natural resources, and the strategic geographic position of Vietnam in the heart of the Southeast Asia region.

However, the allocation of FDI into sectors and across regions is highly unequal in Vietnam. Over 60 percent of FDI stock currently operates in the processing and manufacturing industry (GSO Vietnam, 2019). By contrast, there is a few amounts of FDI in other sectors. Figure-1 summarizes the new-registered FDI among various sectors in Vietnam over 2013 – 2020. The processing and manufacturing industry has kept the dominant position throughout the period, with an averagely of 58 percent of new-committed FDI each year. Meanwhile, the agriculture sector has received minimal attention from foreign investors. Also, the distribution of FDI among Vietnamese regions is highly unequal across regions. According to data provided by GSO Vietnam, by the end of 2019, 42 percent of the total FDI stock in Vietnam is situated in the Southeast region. The second favorable location for FDI inflows is the Red River Delta region, with 29 percent of the accumulative FDI. In contrast, the Central Highlands, the Northern midlands and mountainous areas, and the Mekong Delta region have become the least attractive locations with a modest share in the accumulative FDI. Another obstacle of FDI in Vietnam is the lack of a strong linkage between FDI and domestic firms in Vietnam. FDI firms are the critical component in the global supply chain, helping connect local enterprises with the rest of the world through the channel of international business. However, when coming to the host countries, FDIs also require a certain level of absorptive capacities such as the quality of human capital, infrastructure development, or the strength of supporting industries (Nunnenkamp, 2004). The supporting industries of Vietnam remain weak in facilitating industrial upgrading of the country. Domestic enterprises face obstacles to engage themselves in the higher value chain stage or even into the supply chain with FDI firms (JICA, 2016).

Figure-1: The percentage of new-registered FDI in sectors in Vietnam (2013-2020)



Note: The raw data of new-registered capita FDI is measured in million USD, then author converted the raw data into percentage.
https://public.tableau.com/app/profile/chung.trinh/viz/NewRegisteredFDIbySectorsinVietnam2013-2020/Sheet1

Source: Author's summary from data of Ministry of Planning and Investment, Vietnam

4. Methodology and Data Description

4.1. Spatial Weight Matrix and Exploratory Spatial Data Analysis

4.1.1. Spatial Weight Matrix

In the spatial analysis framework, the fundamental component of spatial autocorrelation is the spatial weight matrix. First, the spatial weight matrix imposes a structure telling what the neighbors for each location are. Second, given the assumption of the existing interaction of different geographics, the spatial weight matrix indicates the intensity of connectivity level among pairs of spatial units. The spatial weight matrix can be either symmetric or unsymmetric (Pace et al., 2012). In the first case, for M spatial objects, the degree of spatial relationship among them is denoted by an M x M matrix which is called W. In which the spatial interaction between the pair of spatial units i and j is depicted by each element (i, j) of W, W_{ij}. By convention, the diagonal elements get a result of 0. The two most applicable weight matrices are contiguity-based and distance-based (Miranti, 2021). In recent spatial dependence research, a growing number of studies use row-standardization for the spatial weight matrixes (LeSage and Pace, 2009; Sarrias, 2020). The row-standardization process helps ensure that all weights are between 0 and 1, and it can facilitate the meaning of operation with the weight matrix as an averaging of the neighboring values (Anselin et al., 2005). Notably, W^{std} or row-standardized spatial weight matrix is established as below:

$$w_{ij}^{std} = \frac{w_{ij}}{\sum_{j=1}^{N} w_{ij}}$$

The previous studies of Hoang and Goujon (2014) and Hoang et al. (2021) suggest that the weight matrix used for country-level should be distance-based while the border-based weight matrix should be applied for sub-national level. Based on the geographic characteristics of Vietnam, the study follows this suggestion to employ the border-based weight matrix, specifically the queen contiguity spatial weight matrix with order level one.

4.1.2. Global Spatial Autocorrelation

Global spatial autocorrelation measures the overall clustering patterns of spatial objects. Sarrias (2020) clarified the primary goal of these indices to indicate the degree to which similar observations are more likely to like near each other. The most common measure is using Moran's I statistics which reflects the overall clustering of observations. Moran's I statistic is the correlation coefficient for the interaction of a given variable and its neighboring values. According to Anselin (1995), Moran's I statistics at a point of time t can be derived from the formula as follows:

$$I = \frac{N}{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}} \left[\frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}(X_i - \bar{X})(X_j - \bar{X})}{\sum_{i=1}^{n} (X_i - \bar{X})^2} \right]$$

Where, N is number of provinces (N=63), i and j are spatial units (provinces), Wij is the binary element of spatial weight W, X_i is the value of variable X at location i. X_j is the value of variable X in location j. $\bar{X}$ is the cross-sectional mean value of data. The hypothesis for the randomness distribution of accumulative FDI in Vietnam is set as below:

- H_0: The distribution of accumulative FDI in Vietnam is random.
- H_1: The distribution of accumulative FDI in Vietnam is not random but has a spatial autocorrelation.

Based on the p-value of Moran's I statistics, the significance of Moran's index can be investigated. The Moran's I index can get a value from -1 to 1. If Moran's I index is close to 0, it reflects the spatial randomness distribution of the dataset, we accept the hypothesis H_0. In contrast, we reject the hypothesis H_0 and accept H_1 if Moran's I index is far from 0. It could be either positive or negative Moran's I. A positive spatial autocorrelation (Moran's I index is positive) indicates that observations are clustering and have similar values. By contrast, a negative autocorrelation is dispersed when Moran's I is negative.

4.1.3. Local Indicators of Spatial Association (LISA)

As the assessment of clustering provided by Global Autocorrelation does not indicate the location of the location of clusters, Anselin (1995) clarified the significances of spatial clusters for each region through the Local Indicator of Spatial Association (LISA). Also, LISA can establish a proportional interaction among the sum of local statistics and a corresponding global statistic. The hot-spots clusters indicate the significant spatial clusters with relatively high-value regions rounded by the relatively high-value regions. Meanwhile, the cold- spots are the significant spatial clusters with relatively low-value regions surrounded by the relatively low-value regions. Pointing out spatial clusters also helps clarify spatial outliers, which are the significant-high (low) value clusters surrounded by the low (high) clusters (Miranti, 2021). The LISA formula for year t and region k has the formula as follows:

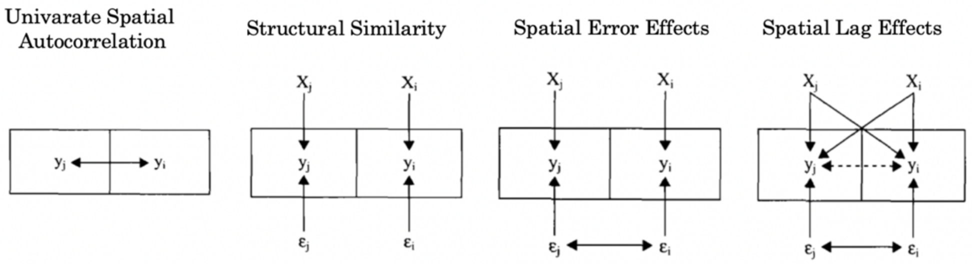
$$I_{it} = \left(\frac{X_i - \bar{X}}{m_o}\right)\sum_{j=1}^{n} w_{ij}\left(X_j - \bar{X}\right) \text{ with } m_o = \sum_{i=1}^{n} \frac{(X_i - \bar{X})^2}{n}$$

Where, I_{it} is local Moran's I, wij is an element of a spatial weights matrix (W) that defines the neighborhood structure between each pair of provinces, X_i is value of variable X at location i. X_j is value of variable X in location j. $\bar{X}$ is the cross-sectional mean value of data.

4.2. Cross-sectional Data Analysis with Spatial Dependence

After examining the spatial distribution of the dataset, if there is a spatial autocorrelation existing, the next step is to investigate the mechanism inside. Baller et al. (2001) refer to spatial autocorrelation as a situation in which values on a variable of interest are systematically related to geographic location. The spatial processes are represented in **Figure-2**, which depicts the spatial approach for investigating FDI determinants across provinces. First, in the univariate spatial autocorrelation, the two-headed arrow reflects the simultaneity inherent in spatial autocorrelation of FDI in provinces. In this case, the connection between FDI levels is represented regardless of the influent factors of FDI in each location. Second, the OLS model (see equation (1)) with the inclusion of a spatial weight matrix is presented as a structural similarity. The mechanism of this structure is that different influent elements in a location may impact the FDI of its location but not significantly impact the FDI of its neighbors. In other words, the spatial relationship between $y_i$and y_i will become nonsignificant even the model includes exogenous variables.

Figure-2: Spatial processes



Source: Baller et al. (2001)

In practice, the assessment of structural similarity can be conducted as the test for spatial autocorrelation of the least square's residuals. As Anselin (1988) referred, the causes might stem from spatial dependence or spatial heterogeneity. The first term mentions a spatial lag effect or a spatial error effect, while the latter presents a situation where coefficients or error patterns can be systematically different across spatial units. As the focus of this study is put on spatial dependence, the study concentrates on the contrast between a spatial lag model (see equations (3) and (4)) and a spatial error model (see equation (2)).

As depicted in **Figure-2,** the spatial error effects indicate that the unmeasured independent variables can impact the dependent variable of its own location and influence the dependent variable of the surrounding locations through the spatial interaction of error terms. Therefore, the Spatial Error Model (SEM) can reflect the spatial influence of unmeasured influencing factors on the FDI level of the host and neighboring provinces. On the other hand, the spatial lag effects illustrate that the impact of random shocks occurring in error term and the interaction between the independent and dependent variables across locations contribute to the interdependence of provinces. For Spatial Error Model (SEM), the spatial lag lambda (λ) is put in the error term (equation (2)). In the Spatial Autoregression Model, the spatial lag rho (ρ) is added to the dependent variable (equation (3)). Meanwhile, when the spatial lag (γ) is put on the independent variable matrix (X), it is presented as the Spatial lag-X Model (SLX) in equation (4) (Vega and Elhorst, 2015). Lastly, the Spatial Autoregressive Model and Spatial Lag-X Model combination can be presented as equation (5), called Spatial Durbin Model (SDM).

Ordinary Least Squares Model (OLS):

$$y = X\beta + \varepsilon \tag{1}$$

Spatial Error Model (SEM):

$$y = X\beta + u, \quad u = \lambda W u + \varepsilon \tag{2}$$

Spatial Autoregression Model (SAR):

$$y = \rho W y + X\beta + \varepsilon \tag{3}$$

Spatial Lag-X Model (SLX):

$$y = X\beta + WX\gamma + \varepsilon \tag{4}$$

Spatial Durbin Model (SDM):

$$y = \rho Wy + X\beta + WX\gamma + \varepsilon \tag{5}$$

Where, X represents the matrix of independent variables from M spatial objectives as in **Table-1**. W stands for the spatial structure made from spatial weight matrix.

4.3. Panel Data Analysis

Besides the cross-sectional analysis, the study further investigates the determinants of FDI distribution in Vietnamese provinces by employing panel data for every 2-year from 2010-2018. The following function illustrates various independent variables explaining the logarithm of new-registered FDI per capita:

$$\mathbf{Ln_{NFDIpc}} = \mathbf{F(FDI\ stock\ per\ capital\ , Labor\ quality, Electricity\ access, Netmigration, Trade\ openess,}$$
$$\mathbf{Land\ access, Industrial\ share, Income\ factors, Economic\ agglomeration, Market\ size)} \tag{6}$$

To investigate the impact of the FDI law amendment No.67/2014/QH13, which became effective from 1 July 2015 in Vietnam, the study includes a dummy variable for the year 2014 (equation (7)) and the period after 2014 (equation (8)).

$$LnNFDIpc_{(t+1)} = \alpha + \beta_1 LnAFDIpc_t + \beta_2 Trained_t + \beta_3 Electricity_t + \beta_4 Netmigration_t + \beta_5 Trade_t + \beta_6 Land\_index_t + \beta_7 Share\_Indus_t + \beta_8 Income\_factor_t + \beta_9 LnGAD_t + \beta_{10} LnGRDP_t + \beta_{11} Dum_{in2014} + \mu + \epsilon \tag{7}$$

$$LnNFDIpc_{(t+1)} = \alpha + \beta_1 LnAFDIpc_t + \beta_2 Trained_t + \beta_3 Electricity_t + \beta_4 Netmigration_t + \beta_5 Trade_t + \beta_6 Land\_Index_t + \beta_7 Share\_Indus_t + \beta_8 Income\_factor_t + \beta_9 LnGAD_t + \beta_{10} LnGRDP_t + \beta_{11} Dum_{after2014} + \mu + \epsilon \tag{8}$$

Where, $LnNFDIpc_{(t+1)}$ is the logarithm of new inward FDI per capita in the next year, representing the dependent variable. μ is provincial fixed effect term (in case of random effect, $\mu = 0$ and for fixed effect $\mu \# 0$). ϵ stands for the error term. All independent variables are in year (t) and described as in **Table-2**. Regarding models' selection between random-effect and fixed-effect models, the study uses the Hausman test. Before the Hausman test, an F-test is also applied to evaluate between the random effect, fix-effect, and pool panel analysis. The results from F-test and Hausman test suggest the random effect for estimations in equations (7) and (8).

Table-1: Variables description for cross-sectional data analysis

Variable	Definition	Explanation	Theory Background	Expected Sign
Dependent variables				
Ln_NFDIpc_2018	The logarithm of new FDI per capita in 2018			
Independent variables				
Ln_income2018	The logarithm of average personal income in 2018	The personal income level of five income groups is frequently measured by GSO Vietnam every 2-year in each province. The study uses the average personal income of five income groups, and take natural logarithm of it.	Resources-seeking	-
Trained2018	The percentage of trained employees in enterprises in 2018	This variable stands for level of labor quality in each province	Resources-seeking	+
Ln_AFDIpc_2017	The logarithm of accumulative FDI per capita in 2017	To avoid the overlap of FDI stock in 2018 and new-registered FDI in the that year, the study employs accumulative FDI per capita in the previous year (2017)	Efficiency-seeking	+
Ln_dominpc2018	The logarithm of domestic investment per capita in 2018	The domestic investment per capita is expected to have a positive relationship with new FDI (Vu, 2015).	Efficiency-seeking	+
Pov2018	Poverty rate in 2018	Poverty is a proxy for the overall development level of each province. The multidimensional poverty indicator is measured by GSO Vietnam from 2016. According to Gnangnon (2020) foreign investors usually prefer a location with sustainable supporting conditions, so the relationship between inward FDI and the poverty rate of province is expected to be negative.	Efficiency-seeking	-
GAD2018	Gravity adjusted demand in 2018	The variable represents the economic agglomeration, the study follows previous research of Fukao and Tei (1997) and Someya (1997) to establish formula of the GAD index for 63 Vietnamese provinces.	Efficiency-seeking, Market-seeking	+
Intrade2018	The ratio between sum of exports and imports value per GRDP in 2018	To evaluate the impact of trade openness on new FDI, the study employs the variable of trade which is measured by the ratio between sum of exports and imports value and GRDP of province.	Efficiency-seeking, Market-seeking	+/-
Time_access	Time access to cities (in minutes)	Estimated travel time to cities in each provinces, the data are available on the website of GeoQuery.	Efficiency-seeking	+/-
Infrastructure Variable				
Inzone2018	Number of industrial zones in 2018	The study uses the number of industrial zones as an indicator for infrastructure development.	Efficiency-seeking	+
Control Variables				
Agri	Share of agriculture sector in GRDP in 2018	The share of agriculture in GRDP reflects the contribution of agriculture sector share in GRDP of a province.	Efficiency-seeking	+/-
Indus	Share of industrial sector in GRDP in 2018	The share of industrial sector in GRDP reflects the contribution of industrial sector share in GRDP of a province.	Efficiency-seeking	+/-
Ser	Share of service sector in GRDP in 2018	The share of service sector in GRDP reflects the contribution of service sector share in GRDP of a province.	Efficiency-seeking	+/-

Note: For GAD: Gravity Adjusted Demand formula[1]

[1] For 63 provinces in Vietnam, a formula of the GAD index can be depicted below

$$GAD_j = \sum_{k}^{62} \frac{GRDP_k}{\mathrm{dist}_{jk}} + \frac{GRDP_j}{r_j^2} k = 1, \ldots .62. k \neq j$$

Where, GAD_j indicates the gravity adjusted demand for the economy of province j. $GRDP_k$ stands for the GRDP of neighboring province k of province j. $dist_{jk}$ is the distance between two provinces measured by a straight line (km). Given the assumption that all the provinces have round shapes, $r_j{}^2$ indicate the square of the

Source: Author's summary

Table-2: Variables description for panel data analysis

Variable	Definition	Explanation	Theory Background	Expected Sign
Dependent variable				
LnNFDIpc_t+1	The logarithm of new FDI per capita in the following year t+1	To avoid the overlap of FDI stock and new-registered FDI in the same year, the study employsthe FDI stock per capita in the next year (t+1) as a dependent variable.		
Independent variables				
LnAFDIpc_t	The logarithm of accumulative FDI per capita in year t	The higher level of FDI stock in the current year may induce a higher level of new FDI in the following year.	Efficiency-seeking	+
Trained_t	The percentage of trained employees in enterprises in year t	The variable stands for labor quality. The better labor quality a province has, the higher level of new FDI may come to that province.	Efficiency-seeking	+
Electricity_t	The percentage of households having access to electricity in year t	The variable stands for the level of infrastructure development in a province.	Efficiency-seeking	+
Trade _t	Share of import values in GRDP in year t	A province with a higher level of import share in GRDP may have a higher level of trade openness.	Efficiency-seeking, Market-seeking	+/-
LnGAD_t	Gravity adjusted demand in 2018	The variable represents the economic agglomeration, the study follows previous research of Fukao and Tei (1997) and Someya (1997) to establish formula of the GAD index for 63 Vietnamese provinces.	Efficiency-seeking, Market-seeking	+
Land_index_t	The land access index in year t	The study uses land access index published by VCCI Vietnam (https://pcivietnam.vn/en). The access to land is measured by two dimensions, including how easy it is to access land and the security of tenure once land is acquired.	Efficiency-seeking	+/-
Indus_share_t	Share of industrial sector in GRDP in year t	The share of industrial sector in GRDP reflects the contribution of industrial sector share in GRDP of a province.	Efficiency-seeking	+/-
LnGRDP_t	The logarithm of GRDP in year t	The study uses logarithm of GRDPvariable as a measure for market-size.	Market-seeking	+/-
Netmigration_t	The ratio between (In migration – Out migration) per total population of province, multiplies with 1000 in year t	Net migration can represent the labor mobility among provinces in Vietnam.	Market-seeking	+/-
LnGRDP_t	The logarithm of GRDP per capita in year t	Logarithm of GRDP per capita variable is one of income factors employed in this study. GRDP per capita is connected to production cost perspective.	Market-seeking	-
Ln_Wage_t	The logarithm of monthly compensation of an employee in enterprises in year t	Logarithm of monthly compensation of an employee is one of income factors employed in this study. This variable is also related to production cost perspective.	Efficiency-seeking	-
Ln_Income_t	The logarithm of average personal income in year t	Logarithm of average personal income is one of income factors employed in this study. This variable is more related to consumption perspective.	Efficiency-seeking	+/-
Dummy Variables				
Dum_in2014	If year is not 2014, get value 0	To estimate the impact of the law ammendment in 2014 on the new FDI in that year.	Policy Evaluation	+/-
Dum_after2014	If year is either 2016 or 2018, gets value 1	To estimate the impact of the law ammendment in 2014 on the new FDI in the years after 2014.	Policy Evaluation	+/-

Source: Author's summary

radius of province j. $GRDP_j$ stands for the GRDP of province j. A positive coefficient of GAD is expected in the study to present the efficiency of economic agglomeration in attracting new FDI.

4.4. Data Source and Statistics Description

Table-3: Data Sources

Variables	Data Source	Access
GRDP of province over the period 2010-2016	General Statistic Office Library	52 Nguyen Chi Thanh, Hanoi, Vietnam
Time access to cities (in minutes)	GeoQuery	http://geo.aiddata.org
Number of industrial zones	Japan ASEAN Center	https://www.asean.or.jp
Distance between two provinces (Km)	Distance.org	https://distance.org
Land access index	VCCI Vietnam	https://pcivietnam.vn/en
Other provincial data for 2018	Ministry of Planning and Investment in Vietnam: The Socio-Economic Statistical Data of 63 provinces.	https://www.gso.gov.vn/en/data-and-statistics/2020/05/socio-economic-statistical-data-of-63-provinces-and-cities/

Source: Author's Summary

Table-4: Statistics Description for Cross-Sectional Data

Variable	Explanation	Obs	Mean	Std. Dev.	Min	Max
ln NFDIpc2018	Log of new FDI per capita 2018	63	-4.363	7.512	-32.614	.726
ln AFDIpc2017	Log of accumulative FDI per capita 2017	63	-.224	1.981	-5.259	3.183
ln income2018	Log of average personal income in 2018	63	8.067	.344	7.298	8.828
ln gad2018	Log of gravity adjusted demand in 2018	63	7.3	1.069	5.398	10.491
trained2018	Rate of trained employees in 2018	63	19.392	7.151	8.2	42.6
pov2018	Rate of multidimensional poverty 2018	63	9.825	10.121	.1	44.5
inzone2018	Number of industrial zones in 2018	63	7.429	6.941	0	33
electric2018	Rate of households having electricity	63	98.611	2.858	85.5	100
access	Time access to cities in each province	63	65.811	52.262	4.741	217.871
intrade2018	International Trade Openness	63	1.548	2.035	.003	11.971
agri2018	Share of agriculture sector in GRDP	63	20.542	11.366	.67	43.82
indus2018	Share of industry sector in GRDP	63	34.44	14.911	13.83	78.47
ser2018	Share of service sector in GRDP	63	38.845	10.289	11.68	64.03

Source: Author's summary

The new-registered FDI in Vietnam is measured in millions USD, and its smallest value is 0. Therefore, all the zero values of FDI per capita are replaced by 0.00001 before taking the natural logarithm. For the time access to cities, the unit is minute. The average time for traveling to the city of the province is 65.8 minutes (**Table-4**). For international trade openness, the indicator is calculated by sum of exports and imports value in GRDP of province. The data for exports and imports is in USD currency, so they are multiplied with the exchange rate (USD/VND) provided by the World Bank every year before dividing to GRDP (VND) in each province[2]. Notably, the poverty rate used in this study refers to multidimensional poverty rather than the head-count poverty ($1.9 per day)[3]. Since 2016, GSO Vietnam has started publishing multidimensional poverty on its website.

Table-5: Statistics Description for Panel Data

Variable	Explanation	Obs	Mean	Std. Dev.	Min	Max
nfdipc_next	New FDI per capita in the next year	315	.234	.458	0	3.238
acfdipc_same	Stock FDI per capita in current year	315	2.438	4.575	0	41.482
grdp	GRDP of province	315	58535.27	107373.96	4.120.227	907059
pop	Average population of province	315	1440722.2	1258070.5	296500	8598700
grdppc	GRDP per capita in province	315	33.881	32.87	10.44	270.064
indus	Share of industrial sector in GRDP	315	32.259	14.747	8.556	84.27
intrade	International trade openness	315	1.104	1.655	.003	12.849
trained	Rate of trained employees	315	16.295	6.974	5.1	44.9
netmig	Net migration in each province	315	-1.524	10.168	-27.3	74.6
wage	Average monthly wage of employee	315	4.992.848	1.692.778	1890	10330
gad	Gravity adjusted demand	315	2167.88	4.111.713	96.455	35986
income	Average personal income	315	2.256.321	1109.29	567	6823
electric	Rate of electricity access	315	97.08	5.701	55.8	100
land	Land access index in province	315	6.148	.87	3.037	8.839

Source: Author's summary

The study uses a balanced panel every 2-year data 2010-2018. Regrading land access index, it is one of criteria in the calculation of PCI (provincial competitive index) in Vietnam. The study uses land access index published by VCCI Vietnam (https://pcivietnam.vn/en). The access to land is measured by two dimensions, including how easy it is to access land and the security of tenure once land is acquired. When checking the correlation matrix among variable, it is noted that the gravity adjusted demand and the GRDP of provinces have high correlation at 0.93 **(see Appendix 2).** Therefore, the study controls for GAD and GRDP separately in panel regressions.

[2] Exchange rate USD/VND from the World Bank Data: https://data.worldbank.org/indicator/PA.NUS.FCRF?end=2020&locations=VN&start=2010

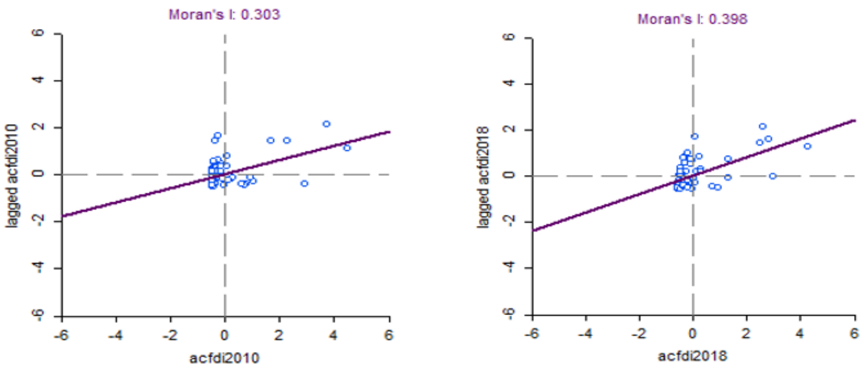
[3] See more detail for the multidimensional poverty in Vietnam at: https://www.gso.gov.vn/wp-content/uploads/2021/03/Thong-cao-bao-chi-MDP_MPI_English.pdf

5. Empirical results

5.1. The uneven distribution of FDI in Vietnamese province

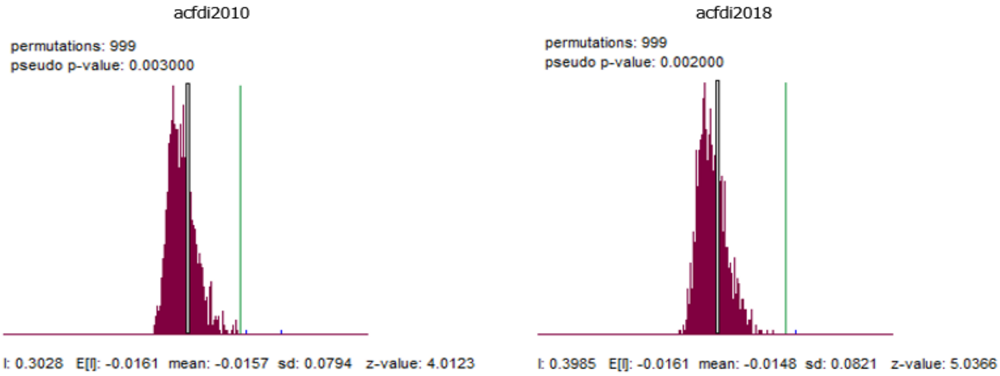
The focus of this part is to investigate the spatial distribution of accumulative FDI across 63 Vietnamese provinces. First, the queen contiguity spatial weight matrix with order level 1 is employed. The lowest number of neighbors a province can get is 2, and the highest number of neighbors a province can have is 9. **Appendix 3** also demonstrates the connectivity map for 63 provinces in Vietnam calculated based on queen contiguity spatial weight matrix.

Figure-3: Global Moran's I scatter plot of accumulated FDI in Vietnam between 2010 and 2018



Source: Author's calculation from GeoDa software

Figure-4: Global Moran's I statistics of accumulated FDI in Vietnam between 2010 and 2018

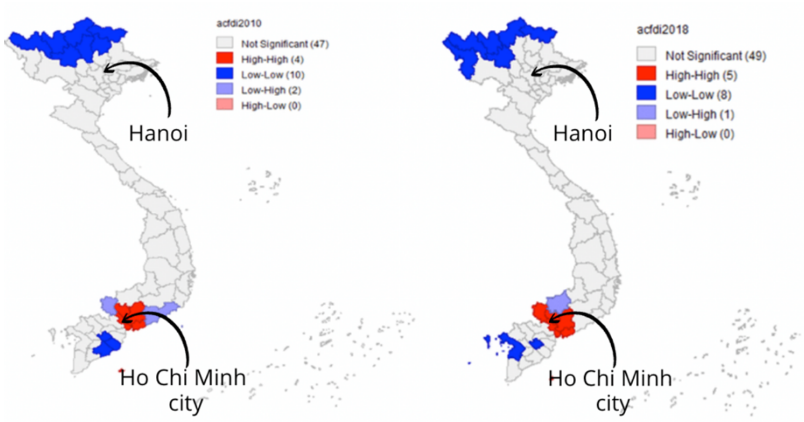


Source: Author's Calculation from GeoDa software

The study applies the queen contiguity spatial weight matrix with order level 1. From the result of Global Moran's I analysis, the Global Moran's I index has positive values for both 2010 and 2018 at 0.303 and 0.398, respectively (**Figure-3**). Also, the Global Moran's I index in both cases is significant at 0.5 percent (**Figure-4**). The results suggest that the distribution of accumulative FDI in Vietnam is not random but has a positive spatial autocorrelation (similar values gather). When using the same level of permutation, the statistical significance level of Global Moran's I index in 2018 (at p = 0.002) is higher than that in 2010 (at p = 0.003) (**Figure-4**). Furthermore, the magnitude of Global Moran's I index in 2018 is larger than in 2010, as in **Figure-3**. This outcome indicates that the uneven distribution of FDI stock in Vietnamese provinces has become more severe over 2010-2018.

Thirdly, the LISA analysis is employed to investigate the distribution of clusters (hot spots and cold spots) of the accumulative FDI across 63 Vietnamese provinces in more detail. The result from LISA analysis identifies clustering patterns of accumulative FDI in Vietnam. **Figure-5** shows that the provinces with significantly low accumulative FDI gather in the Northwest region in 2010 and 2018. Those provinces include Cao Bang, Lao Cai, Lai Chau, Dien Bien, Ha Giang, and Yen Bai. Meanwhile, the only hot spot that absorbs a significantly high level of accumulative FDI is persistently located in the Southeast region between 2010 and 2018, which includes Ho Chi Minh City, Dong Nai, Ba Ria-Vung Tau, and Binh Duong. Ho Chi Minh city becomes the center of this hot spot when the city stays at the top attracting destination of FDI in Vietnam. In addition, another cold spot was found in the Mekong Delta region in 2010, including provinces such as Vinh Long, Soc Trang, and Tra Vinh. Although the statistic significance of this group of provinces turned into insignificant in 2018, another cold spot occurred in the region of Mekong Delta in that year.

Figure-5: LISA analysis of hot spots and cold spots of accumulative FDI between 2010 and 2018 in Vietnam



Source: Author's calculation from GeoDa software

In summary, the result of the LISA analysis illustrates that the distribution of accumulative FDI across Vietnamese provinces is highly uneven between 2010 and 2018. While the cold cluster of provinces with significantly low FDI stock occurs persistently in the Northwest area, the hot cluster of provinces absorbing a significantly high amount of FDI stock remains in the Southeast region in Vietnam.

5.2. The local determinants of FDI distribution in Vietnamese province: A spatial approach

The estimation of FDI determinants is widely conducted through the traditional research method such as OLS analysis. Anselin (1988) points out the possibility of estimation bias from the OLS analysis as this method neglects the inclusion of spatial information into models. Following (Baller et al. 2001), the approach to address this issue can start with testing residual's randomness distribution of OLS models before considering of spatial regression. Hence, the study begins with OLS estimation for the investigation of FDI determinants in Vietnam. **Table-6** represents the results from four OLS estimations, in which we control for the share of the agriculture sector, industry sector, and service sector in the model (1), (2), (3), respectively.

Table-6: Local determinants of new-registered FDI in Vietnam based on OLS method

Log of new-registered FDI inflows in 2018	(1) OLS1	(2) OLS2	(3) OLS3
Log of average personal income 2018	-19.50***	-19.76***	-17.97***
	(6.339)	(6.539)	(6.538)
Rate of trained employees in 2018	0.265**	0.0629	0.00914
	(0.121)	(0.132)	(0.164)
Log of accumulative FDI per capita 2017	1.424*	1.472*	1.300*
	(0.768)	(0.761)	(0.763)
Log of domestic investment per capita 2018	0.475	1.081	0.607
	(2.449)	(2.400)	(2.712)
Log of gravity adjusted demand 2018	1.044	0.802	0.305
	(1.602)	(1.588)	(1.607)
Poverty rate in 2018	-0.736***	-0.771***	-0.794***
	(0.210)	(0.206)	(0.217)
Number of industrial zones in 2018	0.193**	0.214**	0.162*
	(0.0825)	(0.0972)	(0.0948)
Trade openness 2018	0.147	0.355	0.126
	(0.187)	(0.262)	(0.226)
Time access to cities	-0.0136	-0.0138	-0.0141
	(0.0194)	(0.0189)	(0.0204)
Share of agricultural sector in GDP 2018	0.206**		
	(0.0997)		
Share of industrial sector in GDP 2018		-0.137*	
		(0.0699)	
Share of service sector in GDP 2018			0.102
			(0.0923)
Constant	145.4***	165.6***	145.3***
	(43.65)	(48.13)	(46.39)
N	63	63	63
R^2	0.676	0.681	0.663
AIC	382.9	381.8	385.3
BIC	406.5	405.4	408.9
Log lik.	-180.5	-179.9	-181.7
Moran's I statistics p-value	0.0752	0.044	0.06

Note: Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's estimation

The typical results of three OLS models show that the critical determinants of new-registered FDI across 63 Vietnamese provinces in 2018 include the stock FDI in the previous year (2017), poverty rate, average personal income, number of industrial zones, and the share of the industrial sector in GRDP. Specifically, new-registered

FDI in 2018 tends to locate in provinces that already absorbed the high level of accumulative FDI in the previous year. This finding is in line with the conclusion of Leproux and Brooks (2004). Also, a province with a high level of average personal income can receive a lower level of new-registered FDI in 2018. One of the explanations can stem from the positive correlation between personal wage and personal income, and new FDI may prefer a location with lower labor wages. Besides, if the province has a high level of poverty rate, it may lower its chance of receiving new-registered FDI in 2018 because the coefficient of poverty variable is negative and significant at 1 percent in all models of **Table-6**. This finding provides supports to the conclusion of the World Development Report 2020: poverty reduction in Vietnam works better in locations with a high density of GVC firms (also FDI firms). On another angle, the higher poverty rate reflects a lower social development of a province in overall because the multidimensional poverty index is measured by five dimensions in Vietnam: education, health, housing, living condition, and accessing ICT rather than the absolute headcount poverty. In summary, FDIs tends target locations with the better overall development conditions in Vietnam. In other words, new-registered FDI in 2018 is found to favor the moderate provinces that may not have a too high level of average personal income and poverty rate. This finding explains why more FDI have recently started moving out of major cities (Hanoi, Ho Chi Minh) to locate in adjacent provinces such as Bac Ninh, Vinh Phuc in the North, and Dong Nai or Vung Tau in the South.

Furthermore, the industrial zone variable has a positive coefficient which becomes significant at 5 percent in all models of Table-6. This result indicates that new foreign investors in 2018 pay much attention to the existing industrial zones numbers of provinces in that year. The finding is aligned with the previous study of Tien et al, (2020) when the author investigates the role of Special Economic Zones (SEZs) in attracting FDI at regional level and concludes that the districts with a larger number 24 of SEZs attract more FDI capital stocks. In addition, by controlling for three sectors, the study also obtains additional significant coefficients for the following variables, including the share of industrial sector and the agriculture sector in GRDP. Specifically, the share of the industrial sector per GDP in 2017 is higher, lowering new-registered FDI in 2018. The reason is that when checking for the structure of new-registered FDI by sectors in 2018, the study finds some big FDI projects coming in the Real Estates sector rather than Industrial Sector in that year (See **Figure-1**). Also, in 2018 Vietnam receives more investment in agriculture in that year, accounting for 1.9 percent of total FDI projects in Vietnam (MPI, 2018).

In addition, when controlling for the agricultureu sector share in GRDP, the coefficient of trained employees rate variable turns into significant at 10 percent significance in model (1), while this variable is insignificant in models (2) and (3). When the agriculture sector share variable is eliminated from model (1), the trained employee variable becomes insignificant (**Appendix 4**). This finding indicates that new-registered FDI in the agriculture sector share in 2018 may target the high-value agriculture segment that often requires skilled workers rather than ordinary employees. In Vietnam, the agriculture sector in Vietnam is currently led by large domestic corporations such as the Pan group or the Trung Nguyen group. There is only a limited amount of FDI operating in the agriculture sector. However, the foreign investors in 2018 who invest in the agriculture sector may target the high-value-added agriculture segment in that year. The study of Sakata (2019) shows that there were 35 high-tech agricultural zones established across Vietnam by June 2018. The total credit amount granted to high-tech agricultural projects went up to to nearly VND 40,000 billion by that time.

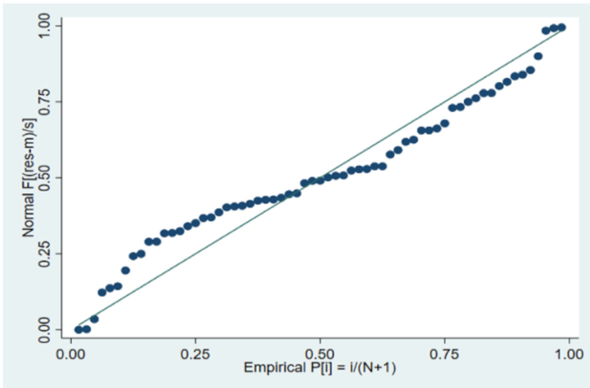
Despite the specific findings obtained by OLS analysis, the study further checks if there is a spatial autocorrelation in residual distribution of OLS models. When noticing Moran's I statistics results for spatial dependence of residual terms in all three models, the Moran's I index gets significant at 10 percent, especially at 5 percent (p-value = 0.044) for model (2). This outcome illustrates that spatial autocorrelation occurs in the residual distribution of all OLS models. Following the previous study of Silveira-Neto and Azzoni's (2006), when the significance level of the Moran's I test is within 10 percent, it is essential to include the role of space to avoid the bias estimation.

Figure-6: The Moran test for spatial dependence, Vector Inflation Factor test for multicollinearity, and Residual distribution of OLS2 model (2)

Moran test for spatial dependence
H0: Error terms are i.i.d.
Errorlags: Wqueen2018
chi2(1) = 4.20
Prob > chi2 = 0.0404

Variance inflation factor

	VIF	1/VIF
ln income2018	12.906	.077
pov2018	8.19	.122
ln gad2018	6.926	.144
ln AFDIpc2017	4.614	.217
inzone2018	2.834	.353
indus2018	2.647	.378
trained2018	2.415	.414
ln dominpc2018	2.153	.464
access	2.095	.477
intrade2018	2.054	.487
Mean VIF	4.683	



Source:Author's estimation

Also, the study reexamines the non-randomness allocation of error terms by visualizing the distribution of error terms of OLS Model (2) which has the highest statistics significant Moran's I index. **Figure-6** shows that the residuals of model (2) are not randomly distributed surrounding the cross line. In conclusion, both Moran's I statistics (significance) and the visualization result explain why spatial regressions are essential in estimating FDI determinants in this study.

Furthermore, it needs to be emphasized that the motivation for including the role of space is not only because of the technical aspect but also to investigate the investment behaviors through spatial dependence. Given that the distribution of the accumulative FDI in Vietnam is highly uneven between 2010 and 2018, as specified in the ESDA section, the study would like to put the concentration on investigating determinants of FDI in Vietnam with the inclusion of the role of space in order to bring about economic implications.

Table-7 represents the results for OLS analysis and spatial regressions. The first finding is that the sign of all significant determinants found in OLS analysis, including the accumulative FDI in 2017, personal income level, poverty rate, industrial zone, and the share of the industrial sector, are robust as in the results of spatial regressions. This finding supports the study result of Hoang and Goujon (2014) when these authors also confirm the robustness between OLS results and spatial regressions. It is also essential to select the best fitted spatial regression among the four models employed. Hoang et al. (2021) and Esiyok and Ugur (2015) suggest using the LM test to select between the spatial lag and spatial error models. Besides, other authors suggest another approach based on Akaike's Information Criteria (AIC) to select the best model as this index can be easily compared between OLS and spatial regression models (Kopczewska, 2020; Miranti, 2021). In addition, the AIC can help compare models which have a different number of parameters. Therefore, following the latter, the model with the lowest AIC shows the best fitness. **Table-7** shows that Spatial Error Model (SEM) gives the lowest AIC at 379.1 among four spatial regressions and the OLS model.

Furthermore, to avoid confusion between the SDM model and the SEM model because the log-likelihood of the SDM is higher than that of the SEM model, but its AIC is not, the Wald test is used to compare the SDM and the SEM model. Wald test results show that the SDM model can be reduced by either the SAR or SEM models (see **Appendix 5**). Then, the LM test is further applied to compare the SAR model and the SEM model. The result from the LM test confirms that the SEM model is better off because its p-value is statistically significant while the SAR model is not (See **Appendix 6**). Therefore, the result analysis mainly focuses on the outcomes generated by the SEM model.

First, the study finds a negative sign with a significance at 1 percent in the spatial term of the SEM model (Spatial Lambda is equal to - 0.566). This outcome indicates that any random shock (such as a pandemic or unavoidable earthquake) impacting the error terms in one province can transfer into the neighboring provinces. The finding is in line with one of the previous studies of Rey (1999) on the US regional economic income convergence from a spatial econometric perspective. The author also finds that shocks originating in one state can spill over into surrounding states, potentially complicating the transitional dynamics of the convergence process. Secondly, although the Spatial Autoregression Model (SAR) is not the best-fitted model, its AIC is the second lowest at 383.5 among four spatial regressions. The spatial term (Rho) of the SAR model also turns out with a negative (-0.283) and 10 percent statistically significant value. This outcome indicates an exciting point: a competitive effect between the host and neighboring provinces in attracting new-registered FDI in 2018. In other words, the local characteristics of the host province that create either a positive or negative impact on the inward FDI of that province can also affect either negatively or positively the new-registered FDI of its neighboring provinces.

Table-7: OLS and Spatial Regression Results for the determinants of FDI in Vietnam

Log of new-registered FDI per capita 2018	(1) OLS2	(2) SAR	(3) SEM	(4) SLX	(5) SDM
main					
Log of average personal income 2018	-19.76***	-19.38***	-19.32***	-24.28***	-25.49***
	(6.539)	(5.441)	(5.096)	(7.166)	(6.377)
Rate of trained employees in 2018	0.0629	0.0531	0.0827	0.216	0.200
	(0.132)	(0.113)	(0.104)	(0.168)	(0.150)
Log of accumulative FDI per capita 2017	1.472*	1.404**	1.788***	1.803***	1.996***
	(0.761)	(0.571)	(0.559)	(0.627)	(0.559)
Log of domestic investment per capita 2018	1.081	1.241	0.419	0.437	0.0482
	(2.400)	(1.826)	(1.794)	(2.072)	(1.844)
Log of gravity adjusted demand 2018	0.802	0.886	0.302	0.413	0.593
	(1.588)	(1.285)	(1.129)	(1.617)	(1.439)
Poverty rate in 2018	-0.771***	-0.845***	-0.711***	-0.757***	-0.753***
	(0.206)	(0.156)	(0.131)	(0.195)	(0.174)
Number of industrial zones in 2018	0.214**	0.211*	0.252**	0.185	0.244*
	(0.0972)	(0.126)	(0.125)	(0.150)	(0.134)
Share of industrial sector in GDP 2018	-0.137*	-0.138**	-0.140***	-0.107	-0.132**
	(0.0699)	(0.0568)	(0.0526)	(0.0673)	(0.0599)
Trade openness 2018	0.355	0.376	0.224	0.408	0.397
	(0.262)	(0.367)	(0.323)	(0.401)	(0.357)
Time access to cities	-0.0138	-0.0147	-0.0228*	-0.0163	-0.0301*
	(0.0189)	(0.0144)	(0.0126)	(0.0194)	(0.0173)
_cons	165.6***	162.7***	161.6***	165.0	300.6**
	(48.13)	(43.15)	(40.51)	(154.3)	(141.0)
Spatial Autocorrelation Parameters					
Wqueen2018					
Spatial Rho (SAR)		-0.253*			
		(0.145)			
Spatial Lambda (SEM)			-0.566***		
			(0.174)		
Spatial Cross-regressive (SDM)					-0.644***
					(0.167)
Log of average personal income 2018				6.013	-10.24
				(15.61)	(14.47)
Rate of trained employees in 2018				-0.0506	0.209
				(0.277)	(0.247)
Log of accumulative FDI per capita 2017				1.693	2.976**
				(1.487)	(1.345)
Log of domestic investment per capita 2018				-2.134	-3.619
				(4.679)	(4.165)

Log of gravity adjusted demand 2018				-3.485	-4.211
				(3.339)	(2.974)
Poverty rate in 2018				0.157	-0.321
				(0.454)	(0.426)
Number of industrial zones in 2018				0.183	0.471
				(0.365)	(0.330)
Share of industrial sector in GDP 2018				-0.00840	-0.105
				(0.121)	(0.111)
Trade openness 2018				-0.690	-0.935
				(0.947)	(0.846)
Time access to cities				-0.0484	-0.0674^{**}
				(0.0321)	(0.0286)
var(e.ln_NFDIpc2018)		16.81^{***}	14.75^{***}	16.48^{***}	13.04^{***}
		(4.809)	(4.291)	(5.452)	(4.079)
N	63	63	63	63	63
R^2	0.681				
Pseudo- R^2		0.6668	0.6775	0.7031	0.6848
AIC	381.8	383.5	379.1	399.3	392.8
BIC	405.4	411.4	406.9	446.5	442.1
Log lik.	-179.9	-178.7	-176.5	-177.7	-173.4
Chi-squared		144.0	269.8	149.2	201.0

Note: Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's estimation

Noticeably, by including the role of space in models SAR, SEM, SLX, and SDM, the accumulative FDI in the previous year variable becomes more significant (at 1 percent) than the result of OLS analysis (at 10 percent). This finding suggests the critical role of space in these estimations. While OLS results only indicate that the province with a high level of accumulative FDI in the previous year tends to induce a higher new-registered FDI in the next year (2018), the spatial regression's results can further reflect the existence of spatial autocorrelation occurring in accumulative FDI distribution. In detail, new-registered FDI in 2018 tends to favor the location where a group of provinces with a significantly high level of accumulated FDI exists. Interestingly, a province with a low stock FDI might still become attractive for new-registered FDI if neighboring provinces have a high accumulative FDI level. At the same time, a province with a low stock FDI located in the position where its surroundings are low accumulative FDI provinces tends to lower its chance of receiving new-registered FDI.

5.3. The determinants of FDI distribution a panel data analysis

Using panel data over 2010-2018, the study also evaluates the impact of the FDI law amendment in 2014 through the dummy variable in and after 2014. While **Table-8** reflects the impact of the law amendment in 2014, **Table-9** focuses on the impact after 2014. First, from **Table-8**, the FDI law amendment in 2014 immediately harmed the FDI inflow in that year. The possible explanation for this significantly negative coefficient of the dummy in the 2014 variable is the postponed behavior of foreign investors. Overall, the FDI law amendment in 2014 is judged to extend foreign investors' support by simplifying investment procedures and treating foreign and domestic investors equally (Allen and Overy, 2014). The amendments were prepared and announced at the beginning 2014, then officially approved on 26th November 2014. However, these amendments became effective from 1st July 2015. Therefore, it is understandable why foreign investors may postpone investment activities until the effective time point to take the advantage of the FDI law amendment of 2014.

Secondly, in **Table-9**, the dummy variable in 2014 is replaced by after 2014. In this panel data set, it means the dummy for both 2016 and 2018. The results from most of the estimations of **Table-9** show that the dummy variable after 2014 turns positive and significant at 5 percent. This result illustrates that the FDI law amendment in 2014 created a positive impact in the following years. From a policy analysis perspective, these outcomes emphasize that the equal treatment between foreign and domestic investors, as specified by the FDI law amendment in 2014, is essential to attract more FDI into Vietnam in the following years.

Table-8: Determinants of FDI over 2010-2018 with dummy in 2014

Log of new-registered FDI per capita	(1) Model_1	(2) Model_2	(3) Model_3	(4) Model_4	(5) Model_5	(6) Model_6
Log of accumulative FDI per capita	0.383**	0.348**	0.346**	0.383**	0.360**	0.364**
	(2.48)	(2.21)	(2.17)	(2.40)	(2.23)	(2.24)
Rate of trained employees in enterprises	0.203**	0.135	0.0917	0.209**	0.166*	0.106
	(2.23)	(1.42)	(0.95)	(2.21)	(1.70)	(1.07)
Rate of households having access to electricity	0.367***	0.370***	0.360***	0.452***	0.440***	0.417***
	(3.50)	(3.44)	(3.23)	(4.33)	(4.17)	(3.78)
Net-migration	-0.0926*	-0.114**	-0.111**	-0.0911*	-0.108**	-0.103**
	(-1.85)	(-2.23)	(-2.16)	(-1.76)	(-2.06)	(-1.97)
Trade openness	-0.000865	-0.000299	-0.00110	0.000699	0.000901	-0.000313
	(-0.26)	(-0.08)	(-0.31)	(0.20)	(0.25)	(-0.09)
Log of land access index	6.571**	5.359*	4.690	6.524**	5.586*	4.598
	(2.06)	(1.67)	(1.43)	(2.01)	(1.72)	(1.39)
Share of industrial sector in GRDP	0.0984**	0.0513	0.0520	0.107**	0.0666	0.0699
	(2.11)	(1.16)	(1.15)	(2.20)	(1.48)	(1.52)
Dummy in 2014	-1.770*	-1.842*	-1.960**	-1.805*	-1.842*	-2.023**
	(-1.84)	(-1.90)	(-2.02)	(-1.87)	(-1.90)	(-2.07)
Log of gravity adjusted demand	3.764***	2.492***	2.295***			
	(4.18)	(3.25)	(2.73)			
Log of GRDP per capita	-4.809**			-4.071**		
	(-2.55)			(-1.96)		
Log of monthly wage of employee		-0.976			-1.093	
		(-0.63)			(-0.69)	
Log of average personal income			0.593			1.153
			(0.41)			(0.78)
Log of GRDP				3.121***	1.911**	1.472
				(2.91)	(2.21)	(1.57)
Constant	-69.56***	-63.98***	-72.43***	-86.95***	-73.85***	-82.21***
	(-6.98)	(-4.41)	(-6.51)	(-7.53)	(-5.02)	(-7.13)
R^2_within	0.103	0.102	0.104	0.0999	0.0990	0.103
R^2_between	0.666	0.633	0.630	0.627	0.607	0.608
R^2_overall	0.404	0.386	0.384	0.381	0.370	0.369
Observations	315	315	315	315	315	315
Year	No	No	No	No	No	No
Province	No	No	No	No	No	No

Note: t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's estimation

Table-9. Determinants of FDI over 2010-2018 with dummy after 2014

Log of new-registered FDI per capita	Model1	Model2	Model3	Model4	Model5	Model6
Log of accumulative FDI per capita	0.419***	0.369**	0.368**	0.415***	0.379**	0.384**
	(2.71)	(2.34)	(2.30)	(2.60)	(2.35)	(2.35)
Rate of trained employees in enterprises	0.175*	0.142	0.106	0.188*	0.173*	0.125
	(1.90)	(1.50)	(1.11)	(1.95)	(1.77)	(1.26)
Rate of households having electricity	0.325***	0.322***	0.366***	0.424***	0.397***	0.428***
	(3.08)	(2.97)	(3.27)	(4.03)	(3.73)	(3.84)
Net-migration	-0.0713	-0.104**	-0.0993*	-0.0735	-0.0985*	-0.0960*
	(-1.40)	(-2.03)	(-1.90)	(-1.39)	(-1.88)	(-1.80)
Trade openness	-0.00230	-0.000228	-0.00110	-0.000426	0.00102	-0.000298
	(-0.68)	(-0.06)	(-0.31)	(-0.12)	(0.29)	(-0.08)
Log of land access index	7.448**	6.503**	6.542**	7.575**	6.795**	6.496**
	(2.40)	(2.09)	(2.06)	(2.40)	(2.16)	(2.02)
Share of industrial sector in GRDP	0.126***	0.0670	0.0488	0.134***	0.0825*	0.0710
	(2.67)	(1.51)	(1.07)	(2.68)	(1.82)	(1.53)
Dummy after year 2014	2.242**	2.855**	1.997*	1.838**	2.712**	1.383
	(2.48)	(2.52)	(1.74)	(2.02)	(2.38)	(1.22)
Log of gravity adjusted demand	4.301***	2.713***	2.893***			
	(4.66)	(3.51)	(3.25)			
Log of GRDP per capita	-6.764***			-5.737***		
	(-3.36)			(-2.60)		
Log of monthly wage of employee		-4.606**			-4.604**	
		(-2.26)			(-2.20)	
Log of average personal income			-2.086			-0.838
			(-1.09)			(-0.44)
Log of GRDP				3.536***	2.134**	1.882*
				(3.24)	(2.45)	(1.94)
Constant	-65.83***	-34.37*	-61.42***	-86.32***	-46.53**	-77.13***
	(-6.48)	(-1.83)	(-4.68)	(-7.43)	(-2.47)	(-6.01)
R^2_within	0.111	0.107	0.100	0.104	0.104	0.0965
R^2_between	0.671	0.644	0.633	0.631	0.617	0.604
R^2_overall	0.410	0.393	0.383	0.382	0.376	0.363
Observations	315	315	315	315	315	315
Year	No	No	No	No	No	No
Province	No	No	No	No	No	No

Note: t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's estimation

Thirdly, the results of both **Table-8** and **Table-9** point out the most significant determinants of FDI inflows over 2010-2018, including stock FDI, electricity access, gravity adjusted demand, and gross regional domestic products as these variables' coefficients are positive and significant at 1 percent. These findings are in line with the results from cross-sectional analysis. The higher stock FDI in the current year of a province may induce a higher new FDI inflows in the following year into that province. The coefficient of electricity access variable is also positive and significant, confirming the keen interests of foreign investors in the level of infrastructure development of provinces. While gravity-adjusted demand reflects the economic agglomeration, the gross regional domestic products variable unfolds size of the provincial economies. In this study, foreign investors tend to favor locations with a higher level of both economic size and agglomeration.

Fourthly, the study also figures out critical determinants of FDI inflows over 2010-2018, including the net migration, land access, share of the industrial sector in GRDP, and rate of trained employees. The higher net migration may lower FDI inflows. Because the tremendous amount of in-migration compared to out-migration can lead to higher population density in provinces. Therefore, new FDI may avoid locations with a high net-migration rate. Besides, the land access variable has a positive coefficient which is significant at 5 percent in all regressions of **Table-9** and most of the estimations of **Table-8**. This outcome indicates that foreign investors prefer provinces with better land security and land access policies. In addition, the larger share of the industrial sector in GRDP attracts more FDI inflows over 2010-2018 as the coefficient of industrial sector share is positive and statistically significant at 5 percent and 10 percent when controlling for GRDP per capita in **Tables-9, Table-8** respectively. This finding from panel analysis is contradictory to the cross-sectional data in 2018. However, it may reflect the fact more correctly over the period 2010-2018 as the processing and manufacturing FDI are currently the most dominant area, accounting for nearly 60 percent of stock FDI in Vietnam. Regarding the rate of trained employees, the variable is also positive and significant at 10 percent in most of estimations of **Table-8** and **Table-9**, showing that new FDI prefers the province with better labor quality.

Furthermore, the study investigates the relationship between new FDI and three income indicators, including GRDP per capita, an average monthly wage, and average personal income. The analysis results show that GRDP per capita and monthly wage have a significant and negative relationship with new FDI in Vietnam. Meanwhile, the average personal income variable is insignificant in **Tables-8** and **Table-9**. The argument is that the GRDP per capita and the monthly wage of employees are factors contributing to the economy's supply side, while the average personal income indicator is inclined to reflect the consumption and demand side of the economy. Therefore, new FDI may concern more the cost of production factors than the consumption aspect, especially most FDI in Vietnam is operating in the processing and manufacturing industry. This finding is consistent with the previous analysis of Hoang et al. (2021), which concludes that investors pay more attention to production factors than consumption.

6. Conclusion and Policy Implications

In conclusion, the first finding demonstrates the highly uneven distribution of FDI in Vietnam between 2010 and 2018. While the provinces with significantly low FDI stock are present in the Northwest area, the significantly high accumulative FDI provinces, including Ho Chi Minh city, gather in the Southeast region. Secondly, the main result obtained from the spatial analysis shows that the determinants of new FDI in 2018 are as robust as the findings of OLS analysis. New FDI in 2018 tends to favor provinces with a higher stock FDI in 2017, a higher number of the industrial zone, or a lower share of the industrial sector in provincial GDP. Interestingly, a province with a higher poverty rate tends to reduce new FDI inflows in 2018**.** Also, new FDI inflows in 2018 target the moderate provinces which does not have a too high average personal income or a too high poverty rate. This finding supports the fact that there is a gradual movement of new FDI from the major cities like Hanoi or Hochiminh into the adjacent provinces. The third finding emphasizes the importance of including spatial analysis in investigating FDI determinants in Vietnam. New

FDI in 2018 tends to go to the location where there is a group of high stock FDI provinces existing there. Interestingly, a province with a low stock FDI might still become attractive to new-registered FDI if its location is close to the provinces with significantly high FDI stock. Fourthly, the finding from panel data analysis shows that new-registered FDI tends to favor provinces which have a higher FDI stock in the previous year, a higher level of economic agglomeration or economic size, a larger share of the industrial sector in provincial GDP, a better access to electricity or land security, or a lower net migration rate. Furthermore, regarding the three income factors applied in this analysis, new foreign investors pay more attention to the factors belonging to production perspective such as provincial GDP per capita or labor wage than the consumption perspective represented by the average personal income. Finally, amendment law **No. 63/2014/QH13** in 2014 in FDI law in Vietnam is found to create the immediate negative impact on new FDI inflows in 2014 but generate the positive impact on new FDI inflows for the years after 2014.

Regarding policy implications, the study suggests four treatments. First, labor mobility represented by net migration rate and land policy illustrated by the land access index can become effective tools in monitoring FDI inflows among provinces in practice. Secondly, the spatial clusters of FDI stock found in this thesis suggest that designing FDI policies needs to prioritize the regional development linkage rather than singly promotes FDI inflows into a specific province. The study suggests that the government can create promotion centers on a sub-regional scale by gathering the group of provinces in each region. Notably, the spatial clusters found in this study suggest that designing FDI policies needs to prioritize the regional development linkage rather than singly promote FDI inflows into a specific province. There are currently three main promoting FDI centers in Vietnam: The North, the Central, and the South. The study suggests that the government can create promotion centers on a lower scale by gathering the group of provinces in each region. Thirdly, without the necessary intervention from the government, FDI inflows may neglect the poorest provinces because the inward FDI is found to favor medium provinces which do not have too high an average personal income or too high a poverty rate. Therefore, the poor areas in Vietnam require further attention from the policymakers. The government is suggested to gather poor provinces into groups. It is crucial to find out the strengths and weaknesses in each group. From that, policymakers can attract FDI into specific sectors in each group. As a result, the poor provinces can acquire more inward FDI. Finally, the FDI law amendment in 2014 fosters more FDI inflows into Vietnam after 2014. One of the crucial contributions of this amendment is to establish the equal treatment between foreign investors and domestic investors in Vietnam. Therefore, the government should have a regular review and evaluation on FDI policy to attract more FDI inflows into Vietnam in subsequent periods.

One of the study's limitations is a lack of discussion on the unique treatment of local authorities, which requires further case studies for investigation. Due to the lack of data for new-registered FDI in sectors, it is unable to investigate the determinants of FDI sectors in Vietnam in panel analysis. Future research can extend the analysis by case studies discussion or using spatial panel analysis for examining the role of space in deciding FDI determinants to extend this study.

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Appendixes

Appendix 1 - FDI Law amendment No. 67/2014/QH13

Article 23 of Decree No 67/2014/QH13 on Foreign Direct Investment issued by the Government on 26th November 2014, effective from 1st July 2015:

1. Economic organizations must satisfy the conditions and carry out investment procedures as prescribed for foreign investors when investing in establishing economic organizations; investment, capital contribution, purchase of shares and capital contributions of economic organizations; investment under a BCC contract in one of the following cases:

a) There is a foreign investor holding 51% or more of the charter capital or the majority of general partners are foreign individuals, for economic organizations being a partnership;

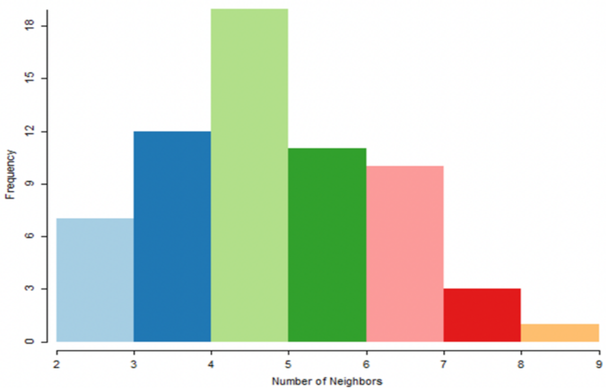
b) Having an economic organization specified at Point a of this Clause holding 51% or more of the charter capital;

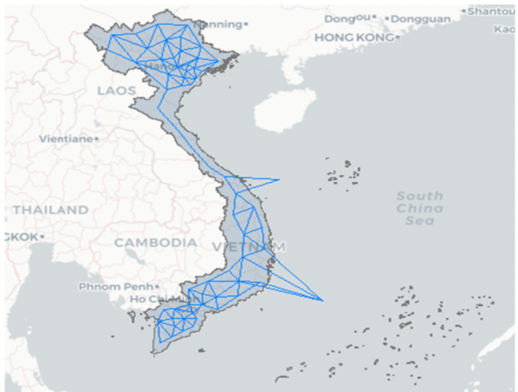
c) There are foreign investors and economic organizations specified at Point a of this Clause holding 51% or more of charter capital.

Appendix 2. Correlation Matrix of Panel Data 2010-2018

	(1)												
	ln_nfdipc	ln_aFDIpc	ln_gad	ln_wage	ln_income	ln_grdppc	ln_grdp	trained	intrade	electric	netmig	indus	ln_land
ln_nfdipc	1.00												
ln_aFDIpc	0.44***	1.00											
ln_gad	0.52***	0.48***	1.00										
ln_wage	0.24***	0.23***	0.49***	1.00									
ln_income	0.44***	0.39***	0.74***	0.82***	1.00								
ln_grdppc	0.38***	0.44***	0.82***	0.69***	0.76***	1.00							
ln_grdp	0.46***	0.46***	**0.93*****	0.52***	0.72***	0.83***	1.00						
trained	0.27***	0.21***	0.50***	0.53***	0.53***	0.58***	0.52***	1.00					
intrade	0.27***	0.29***	0.50***	0.41***	0.45***	0.47***	0.43***	0.28***	1.00				
electric	0.49***	0.49***	0.56***	0.24***	0.56***	0.44***	0.49***	0.20***	0.26***	1.00			
netmig	0.05	0.13*	0.33***	0.19***	0.27***	0.41***	0.33***	0.25***	0.32***	0.07	1.00		
indus	0.32***	0.37***	0.53***	0.37***	0.33***	0.65***	0.49***	0.32***	0.53***	0.23***	0.32***	1.00	
ln_land	0.09	-0.04	-0.05	-0.05	0.07	-0.06	-0.09	-0.33***	-0.06	0.17**	-0.06	-0.16**	1.00

Appendix 3. The number of neighbors and connectivity map for 63 provinces





Appendix 4. Cross-sectional data 2018 OLS

	(1) OLS	(2) OLS1	(3) OLS2	(4) OLS3
ln_AFDIpc2017	1.192	1.424*	1.472*	1.300*
	(1.57)	(1.85)	(1.94)	(1.70)
ln_dominpc2018	-0.230	0.475	1.081	0.607
	(-0.09)	(0.19)	(0.45)	(0.22)
ln_income2018	-16.64**	-19.50***	-19.76***	-17.97***
	(-2.63)	(-3.08)	(-3.02)	(-2.75)
trained2018	0.100	**0.265****	0.0629	0.00914
	(0.69)	(2.18)	(0.48)	(0.06)
ln_gad2018	0.198	1.044	0.802	0.305
	(0.13)	(0.65)	(0.51)	(0.19)
pov2018	-0.766***	-0.736***	-0.771***	-0.794***
	(-3.61)	(-3.50)	(-3.75)	(-3.65)
inzone2018	0.110	0.193**	0.214**	0.162*
	(1.23)	(2.34)	(2.20)	(1.70)
intrade2018	-0.0518	0.147	0.355	0.126
	(-0.30)	(0.79)	(1.36)	(0.56)
access	-0.0148	-0.0136	-0.0138	-0.0141
	(-0.71)	(-0.70)	(-0.73)	(-0.69)
agri2018		**0.206****		
		(2.07)		
indus2018			-0.137*	
			(-1.96)	
ser2018				0.102
				(1.11)
Constant	133.2***	145.4***	165.6***	145.3***
	(3.14)	(3.33)	(3.44)	(3.13)
R^2	0.653	0.676	0.681	0.663
aic	385.1	382.9	381.8	385.3
bic	406.5	406.5	405.4	408.9
Observations	63	63	63	63

Note: t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix 5. Wald test for simplifying SDM model

1. For simplifying SDM Model to SLX Model (Yes if p-value > 0.05, No if p-value < 0.05)

(1) [Wqueen2018]ln_NFDIpc2018 = 0
chi2(1) = 14.95
Prob > chi2 = 0.0001

2. For simplifying SDM Model to SAR Model (Yes if p-value > 0.05, No if p-value < 0.05)

(1) [Wqueen2018]ln_income2018 = 0
(2) [Wqueen2018]trained2018 = 0
(3) [Wqueen2018]ln_AFDIpc2017 = 0
(4) [Wqueen2018]intrade2018 = 0
(5) [Wqueen2018]ln_gad2018 = 0
(6) [Wqueen2018]access = 0
(7) [Wqueen2018]inzone2018 = 0
(8) [Wqueen2018]indus2018 = 0
(9) [Wqueen2018]pov2018 = 0
(10) [Wqueen2018]ln_dominpc2018 = 0
chi2(10) = 14.68
Prob > chi2 = 0.1441

3. For simplifying SDM Model to SEM Model (Yes if p-value > 0.05, No if p-value < 0.05)

(1) [Wqueen2018]ln_AFDIpc2017 = -[Wqueen2018]ln_NFDIpc2018*[ln_NFDIpc2018]ln_AFDIpc2017
(2) [Wqueen2018]ln_income2018 = -[Wqueen2018]ln_NFDIpc2018*[ln_NFDIpc2018]ln_income2018
(3) [Wqueen2018]trained2018 = -[Wqueen2018]ln_NFDIpc2018*[ln_NFDIpc2018]trained2018
(4) [Wqueen2018]ln_gad2018 = -[Wqueen2018]ln_NFDIpc2018*[ln_NFDIpc2018]ln_gad2018
(5) [Wqueen2018]pov2018 = -[Wqueen2018]ln_NFDIpc2018*[ln_NFDIpc2018]pov2018
(6) [Wqueen2018]access = -[Wqueen2018]ln_NFDIpc2018*[ln_NFDIpc2018]access
(7) [Wqueen2018]inzone2018 = -[Wqueen2018]ln_NFDIpc2018*[ln_NFDIpc2018]inzone2018
(8) [Wqueen2018]indus2018 = -[Wqueen2018]ln_NFDIpc2018*[ln_NFDIpc2018]indus2018
(9) [Wqueen2018]intrade2018 = -[Wqueen2018]ln_NFDIpc2018*[ln_NFDIpc2018]intrade2018
(10) [Wqueen2018]ln_dominpc2018 = -[Wqueen2018]ln_NFDIpc2018*[ln_NFDIpc2018]ln_dominpc2018
chi2(10) = 6.74
Prob > chi2 = 0.7494

Appendix 6. LM test and Robust LM test between SAR and SEM Model

```
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHT MATRIX : vnm_admbnda_adm1_gov_20201027
   (row-standardized weights)
TEST                           MI/DF       VALUE          PROB
Moran's I (error)             -0.1844     -1.6008         0.10942
Lagrange Multiplier (lag)        1         1.6684         0.19648
Robust LM (lag)                  1         0.3846         0.53516
Lagrange Multiplier (error)      1         4.2235         0.03987
Robust LM (error)                1         2.9397         0.08643
Lagrange Multiplier (SARMA)      2         4.6081         0.09986
============================ END OF REPORT ==============================
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