The Dynamics of Foreign Direct Investment and Exchange Rates: An Interconnection Approach in ASEAN

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Highlights

1. Examine the spatial effects of the exchange rate on FDI inflows among ASEAN countries.
2. Spatial econometrics is employed.
3. The effect of the exchange rate on FDI depends on the source-region.
4. FDI inflows in ASEAN is also influenced by the exchange rates of neighboring countries.

The Dynamics of Foreign Direct Investment and Exchange Rates: An Interconnection Approach in ASEAN

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Abstract

This paper examines the direct and spillover effects of the exchange rate on foreign direct investment (FDI) inflows based on a panel of ASEAN countries for the period 2001 to 2018. We utilize the spatial econometric approach to accommodate the nature of spatial dependence among ASEAN countries. Our results suggest that the effect of the exchange rate depends on the source-region of FDI, implying the existence of spatial heterogeneity in ASEAN's FDI. We also show that FDI inflows in ASEAN is not only influenced by the exchange rate of the country itself but also by those of the neighboring countries.

Keywords: Foreign Direct Investment, Exchange Rates, Macroeconomics, Spatial Models

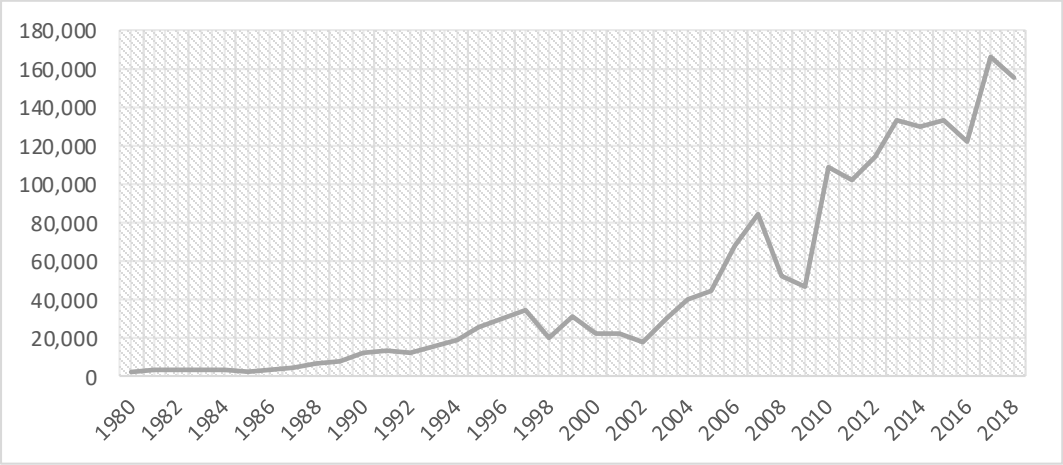
JEL Classifications: F21, F31, F41, R12

I. Background

The extended rallies following the Asian financial crises in the 1990s, the signing of the ASEAN Free Trade Area (AFTA) and the expansion of intra-SEACEN[1] trade of Korea and Taiwan, have all combined to contribute to the increasing intensity of intra-regional Foreign Direct Investment (FDI) among the ASEAN and SEACEN economies (Adhikary, 2001). This is reflective of the tide of internationalization in the ASEAN economies and the consolidation of the ASEAN integration process (Barrell & Pain, 1999; Casi & Resmini, 2011; Mold, 2003). As displayed in Figure 1, FDI inflows into ASEAN had an increasing trend throughout 1980-2018. More specifically, based on the ASEAN FDI Database (2019), the majority of intra-ASEAN FDI inflows were received by Indonesia, followed by Singapore and Vietnam in 2018. Interestingly, Vietnam had never been part of the top three FDI recipients prior to 2016. In addition, the magnitude of extra-ASEAN FDI inflows in 2018 were five times greater than those for intra-ASEAN. The largest percentage of extra-ASEAN FDI inflows was for Singapore, followed by Vietnam and Thailand in 2018.

Figure 1

Total FDI Inflows to ASEAN Economies (Million USD)



Source: International Monetary Fund (IMF)

The dynamics of ASEAN's FDI are also correlated to international factors, such as exchange rates. The U.S. subprime crisis which triggered a global financial crisis (GFC) in 2008, resulted in the massive withdrawals of FDI in almost all parts of the world. In 2008, ASEAN's outward foreign direct investment (OFDI) totaled USD 32 billion, while United Kingdom received USD 44 billion inward FDI (IFDI) and the United States' OFDI totaled USD 5.5 billion. In the aftermath of the GFC's devastating effects on the global economy, the Federal Reserves operated Unprecedented Monetary Policy (UMP) through Large-Scale Asset Purchases (LSAP) which led to highly appreciated exchange rates in emerging market economies (Bhattarai et al., 2018). Ensuing this, the pattern of FDI inflows changed in 2009 with the United Kingdom and the United

[1] The South East Asian Central Banks (SEACEN) has established as a cooperation forum for central banks in the Asia-Pacific region that was legally established in 1982 with 8 members of Central Banks and has grown to 19 members of Central Banks/Monetary Authorities. South Korea and Taiwan officially joined in 1990 and 1992, respectively. See https://www.seacen.org.

States experiencing significant declines in OFDI of USD 239 billion and USD 180 billion respectively, while the OFDI in ASEAN experienced only a decrease of USD 5.2 billion (International Monetary Fund, 2019). Under such challenging circumstances, ASEAN economies still managed to maintain approximately two percent economic growth in 2009, while the global economic growth had slowed down drastically (World Development Indicators, 2019). The rapid recovery and muted impact of the ASEAN countries from the global crisis, has unsurprisingly, drawn the interest of investors to this region.

There is, however, still much on-going debate concerning the impact of changes in exchange rates on the flow of foreign direct investments. There are, at least, four hypotheses that focus on the effect of the real exchange rate on FDI (Kosteletou & Liargovas, 2002). The monetary approach, the balance of payments, and the strategic behavior of international firms have demonstrated that the appreciation in the real exchange rate leads to a current account deficit and induces foreign capital inflows (Boateng et al., 2015; Campa, 1993; Corbo, 1985; Cushman, 1985; Darby et al., 1999; Ffrench-Davis, 1983; Kogut & Chang, 1996). On the contrary, the imperfect-capital-markets theory and the relative-labor-cost theory predict that a real exchange rate depreciation leads to an increase in inward FDI and vice-versa (i.e., Blonigen, 1997; Froot & Stein, 1991; Guo & Trivedi, 2002; Kiyota & Urata, 2004; Klein & Rosengren, 1994). On the other hand, studies by Castro et al. (2013) and Felipe & Llamosas-rosas (2018) had different perspectives where they found no relationship between exchange rates and direct investments for foreign investors in Brazil and Mexican states. Hence, it is crucial to ascertain the relationship of exchange rate movements on FDI inflows as they may have implications for central bank intervention and the forces driving markets.

In view of the above premise, this paper examines the direct and spillover effects of the exchange rates of neighboring countries on foreign direct investment (FDI) inflows among the ASEAN countries. Besides looking at the effects of exchange rates on ASEAN's FDI, we will also incorporate a spatial analysis to provide a broader and more in-depth investigation. As suggested by Fujita et al. (1999), economic integration and cross-border investment would create an agglomeration effect, and thus an analysis on the spatial distribution of neighboring countries is essential as these countries cannot be taken as being homogeneous. This is especially in light of existing bilateral and multilateral agreements that have been established, both with inter and intra countries in the ASEAN region, making the geographical interconnections between ASEAN countries even more relevant and inevitable. A comprehensive investigation on the spatial framework is, therefore, required to specify the role of exchange rate movements on ASEAN's FDI.

Most existing empirical studies on FDI in the ASEAN region frequently utilize a traditional panel and gravity model to explain the determinants of FDI by considering the economic sizes of the countries of origin and destinations and the distances between (e.g., see Blattner, 2006; Camara, 2002; Eichengreen & Tong, 2007; Hattari, Rajan, & Thangavelu, 2014; Hoang, 2012; Hoang & Bui, 2015; Irawan, 2013; Ismail, 2009; Masron & Abdullah, 2010; Mina, 2007; Thangavelu & Narjoko, 2014). Unfortunately, the traditional panel and gravity model is unable to capture the interrelationships or interdependence between countries, especially where the effect of spatial interaction between countries within a particular region is obvious.

The spatial econometric model is able capture and explain the behavior of FDI influenced by third countries, if there is a connection between them via a network. There are voluminous literature that have examined the determinants of FDI using spatial econometric models, such as Baltagi et al. (2007), Blonigen et al. (2007), Ploeg & Poelhekke (2009), Uttama & Peridy (2009), Nwaogu (2012), and Regelink & Paul Elhorst (2015) for U.S. outward FDI, Garretsen & Peeters (2009) for Dutch outward FDI, Ledyaeva (2009) for Russian inward FDI, Chou et al. (2011) for Chinese outward FDI, Marouane (2019) for MENA Region inward FDI, Fischer et al. (2017) for Austrian outward FDI, Felipe & Llamosas-rosas (2018) for Mexican states' inward FDI. In the case of ASEAN, Uttama & Peridy (2009) examined FDI originating from the United States (extra-ASEAN), while Hoang & Goujon (2019) investigated the intra-ASEAN and extra-ASEAN FDI using the Spatial Autoregressive Model (SAR) and Spatial Error Model (SEM) respectively.

In view of their proven proficiency, this paper uses spatial econometrics to address the issues related to inter and intra relationships for FDI and thus follows the works of Hoang & Goujon (2019) and Uttama & Peridy (2009). These research analyses have investigated the determinants for ASEAN inward FDI using spatial econometrics. However, this paper addresses an issue which they have not formally tackled, which is the role of the exchange rate and its spatial dependence effect in determining FDI inflows among ASEAN countries. Moreover, they only used the SAR and SEM, which allow only spatial lag and error analysis of neighboring countries. Whereas in our paper, we have incorporated the Spatial Durbin Model (SDM), which unlike the SAR and SEM, accommodates not only spatial lag analysis but also the spatial effect for independent variables. This model not only allows us to make empirical investigations on the spatial effect of the exchange rate and macroeconomic factors but also simultaneously enable us to study the path of FDI inflows into ASEAN countries. In addition, the SDM also outperforms the SAR and SEM in terms of comparative spatial model specification. Elhorst (2010) and LeSage & Pace (2009) argued that the SDM produces unbiased coefficients, although the data generating process selects SAR or SEM. The rationale is that the cost of ignoring spatial dependence in the dependent variable and the independent variables is relatively high while ignoring spatial dependence in disturbances, if present, will only cause a loss of efficiency.

Using a dataset based on a panel of ASEAN countries from 2001 to 2008, our empirical investigations have unveiled several crucial findings. First, we find the existence of spatial heterogeneity in FDI form in ASEAN, which is shown by the effect of the exchange rate and macroeconomic variables on foreign direct investment inflows that are varied among different forms of FDI based on the source countries. Second, we find that FDI inflows in ASEAN are not only influenced by the macroeconomic factors of the country itself but also by the spatial effect channel transmitted from a third-country to the particular ASEAN country. Third, we find that the results become susceptible when the structure of matrix W is changed. By implementing the inverse distance matrix, the "Export-platform FDI hypothesis" is established. However, when the spatial weight matrix is the first-order binary contiguity, it becomes quite challenging to prove the existence of the geographical interdependence of FDI inflows, which then leads to the "Pure horizontal FDI hypothesis."

This paper is organized as follows: Section II discusses the theoretical considerations. Section III discusses methodological aspects, which comprises data, variables, theoretical insight, and econometric specification. Section IV discusses the estimation results. The last section provides the concluding remarks and policy implications.

II. Theoretical Considerations

The exchange rate is one of the most important determinants of FDI. Theoretically, there are at least four hypotheses that focus on the effect of the real exchange rate on FDI (Kosteletou & Liargovas, 2002). Briefly, the monetary approach, the balance of payments, and the strategic behavior of international firm approach show that an appreciation of the real exchange rate leads to a current account deficit and induces foreign capital inflows. The findings of these various approaches have been supported by voluminous literature such as Ffrench-Davis (1983), Corbo (1985), Boateng et al. (2015), Campa (1993), Darby et al. (1999), and Kogut & Chang (1996). In addition, Cushman (1985) also suggested an expected real exchange rate appreciation adjusted for risk tends to reduce the foreign cost of capital and encourages FDI inflows. On the contrary, the imperfect-capital-markets theory and the relative-labor-cost theory predict that a real exchange rate depreciation leads to an increase in inward FDI and vice-versa (i.e., Blonigen, 1997; Froot & Stein, 1991; Guo & Trivedi, 2002; Kiyota & Urata, 2004; Klein & Rosengren, 1994). On the other hand, studies by Castro et al. (2013) and Felipe & Llamosas-rosas (2018) had different perspectives where they found no relationship between exchange rates and direct foreign investments in Brazil and Mexican states. Hence, the relationship of exchange rate movements on FDI inflows has crucial implications for central bank intervention and market-driving forces.

Moreover, FDIs are also spatially dependent in nature, as portrayed by the relationship between possible forms of FDI on the spatial lag coefficient of FDI and the investment potential of neighboring countries. There are four forms of FDI outlined in the literature as follows: horizontal FDI, vertical FDI, export-platform FDI, and complex vertical FDI. Traditionally, FDI is only differentiated into horizontal FDI and vertical FDI, which assess the interaction between home countries and host countries without considering the FDI in neighboring countries (third countries). In horizontal FDI (market-seeking), the determinants of foreign investments are motivated by the search for better market access in destination countries in terms of trade barriers avoidance, which may be translated in terms of lower transportation costs and import protection arising from protectionist policies in the host countries (Fugazza & Trentini, 2014; J. R. Markusen, 1984).

Vertical FDI (efficiency-seeking) is driven by differences in international factor prices, where multinational companies will invest in host countries that have lower production costs or input factors compared to the country of origin (Helpman 1984, Fugazza and Trentini 2014). In vertical FDI, it is estimated that competition occurs between destination countries and neighboring countries related to FDI withdrawal, causing negative impacts on the destination countries. However, the market potential of a neighboring country is not expected to have a direct effect because investors flow funds into a country only to produce final goods, not as a potential market. According to J. R. Markusen & Venables (1998) and J. Markusen et al. (2000), if the host country has relative endowment factors and low trade costs, then vertical FDI is more dominant. However, if the factor costs and the country size difference between the two countries are relatively small and the trade costs are high enough, then horizontal FDI will be more dominant.

On the other hand, the development of the international trade system has broadened the shape of the FDI model, morphing it from a predominantly bilateral framework into a multilateral framework. This encompasses the FDI relationship between origin and destination countries with the inclusion of the effects of third party countries as investment considerations in destination

countries, i.e., exports-platform FDI and complex vertical FDI. Ekholm, Forslid, and Markusen (2007) and Keller and Yeaple (2009) define export-platform FDI (neighboring market-seeking) as multinational companies investing in destination countries to produce final goods to be sold to third parties, especially when destination countries and third markets are included in zone free trade, for their lower trade barriers.

Baltagi, Egger, and Pfaffermayr (2007) acknowledge the complicated integration of trade between home and host countries and thus introduced a complex vertical FDI model. The premise of this model is that direct investment enters the host country with the motivation of forming production chains in various countries to exploit the comparative advantage, and where the host country exports intermediate goods to third markets for processing before being sent to its final destination. In the complex vertical FDI, it is expected that there is a positive spatial interaction between the host country and third-party countries related to FDI inflows and there is also the expectation that there is a positive spatial relationship between neighboring market potentials and FDI in the destination country.

Table 1
Predicted Signs of the Theoretical Model Explanatory

FDI Types	FDI in neighboring countries (ρ)	Market Potential of neighboring countries (φ)
Horizontal FDI	0	0
Vertical FDI	-	0
Export-platform FDI	-	+
Complex vertical FDI	+	+/0

The theory-based conjecture of the expected impact of spatial interactions in the presence of the four main types of FDI has been synthesized by Blonigen et al. (2007), Ledyaeva (2009), Regelink and Paul Elhorst (2015), Hoang and Goujon (2019), and Fugazza and Trentini (2014), and is summarized in Table 3. Based on the above discussion of the four types of FDI, the spatial interactions are tested for the effect of FDI flows in neighboring countries on FDI in the host country (ρ) and the potential influence of neighboring markets on FDI in the host country (φ).

III. Empirical Strategy

A. Data Sources

This paper analyzes the impact of the exchange rate and macroeconomic variables on FDI inflows in ASEAN, focusing on the spatial dependence of ASEAN foreign direct investment (FDI) inflows and the spatial heterogeneity in FDI forms between 2001 and 2018. The research dataset includes the 10 ASEAN countries of Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. Based on our data source, ASEANstats, the flows of Inward Foreign Direct Investment (FDI) into ASEAN by Source Country is divided into FDI that enters ASEAN from the world/global, from inside ASEAN itself (intra-ASEAN), and from outside ASEAN (extra-ASEAN).

Table 2
Variables

Variables	Description	Unit of Account	Source
Foreign Direct Investment net inflows (FDI)	The value of inward direct investment made by non-resident investors as a share of gross domestic product	Percentage	ASEANstats
Exchange Rate (XR)	Official exchange rate (period average)	LCU per USD	World Bank
Market Size ($MARKET$)	Real Gross Domestic Product (constant 2010 US$)	Millions of USD	World Bank
Trade Openness ($OPENNESS$)	The sum of exports and imports of goods and services measured as a share of gross domestic product	Percentage	IMF and World Bank
Political risk (POL)	Political Stability and Absence of Violence/Terrorism	Index	Worldwide Governance Indicators
Inflation (INF)	Consumer Price Index(CPI)	Index	World Bank
Infrastructural development ($INFRA$)	Total number of airports	Count	ASEAN-JAPAN Transport Partnership

To sidestep negative data values for FDI inflows due to the outflows being greater than the inflows, we have divided the data by GDP, which otherwise would not have been possible using natural logarithms calculation. The various forms of FDI have frequently been used in existing literature to capture the characteristics of FDI activities (Alba et al., 2010; Baltagi et al., 2007; Garretsen & Peeters, 2009; Hattari et al., 2014; Hoang & Goujon, 2019; Uttama & Peridy, 2009). Table (1) displays the set of variables.

Table 3
Descriptive Statistics

		FDI GLOBAL	FDI INTRA-ASEAN	FDI EXTRA-ASEAN	MARKET	OPENNESS	POL	XR	INF	INFRA
Brunei Darussalam	mean	0.067	0.005	0.062	9.511	1.008	1.183	0.380	4.583	1.000
	median	0.037	0.003	0.030	9.514	1.008	1.158	0.336	4.595	1.000
	std. dev	0.110	0.010	0.110	0.037	0.088	0.115	0.127	0.026	0.000
Cambodia	mean	0.082	0.022	0.061	9.294	1.351	-0.283	8.305	4.505	8.000
	median	0.057	0.017	0.038	9.298	1.357	-0.326	8.307	4.589	8.000
	std. dev	0.069	0.018	0.052	0.384	0.191	0.302	0.017	0.281	0.000
Indonesia	mean	0.717	0.375	0.342	13.506	0.491	-1.039	9.246	4.526	215.833
	median	0.761	0.317	0.493	13.504	0.459	-0.812	9.180	4.580	211.500
	Std. dev	0.596	0.318	0.416	0.287	0.097	0.579	0.167	0.347	30.504
Lao PDR	mean	0.037	0.006	0.030	8.835	0.625	-0.071	9.092	4.548	12.556
	median	0.024	0.005	0.017	8.831	0.606	-0.072	9.043	4.576	13.000
	std. dev	0.040	0.006	0.035	0.391	0.093	0.466	0.112	0.288	0.511
Malaysia	mean	0.564	0.097	0.467	12.437	1.677	0.215	1.281	4.595	23.667
	median	0.591	0.115	0.496	12.421	1.610	0.169	1.316	4.597	21.000
	Std. dev	0.216	0.103	0.152	0.261	0.298	0.178	0.104	0.129	5.369
Myanmar	mean	0.111	0.048	0.064	10.675	0.438	-1.132	3.795	4.330	45.056
	median	0.063	0.007	0.051	10.765	0.448	-1.102	1.854	4.568	34.000

	Std. dev	0.096	0.071	0.042	0.490	0.126	0.212	2.619	0.620	14.031
Philippines	mean	0.281	0.017	0.264	12.242	0.655	-1.334	3.875	4.547	85.222
	median	0.204	0.008	0.204	12.212	0.648	-1.384	3.863	4.587	85.000
	Std. dev	0.245	0.024	0.229	0.290	0.089	0.328	0.092	0.210	0.428
Singapore	mean	3.204	0.213	2.991	12.310	3.693	1.261	0.380	4.600	2.000
	median	2.858	0.160	2.672	12.320	3.681	1.221	0.335	4.591	2.000
	Std. dev	1.714	0.177	1.609	0.299	0.365	0.173	0.127	0.117	0.000
Thailand	mean	0.689	0.127	0.561	12.700	1.280	-0.843	3.567	4.576	35.056
	median	0.718	0.125	0.627	12.707	1.277	-0.992	3.534	4.593	35.000
	std. dev	0.258	0.113	0.242	0.199	0.082	0.572	0.121	0.130	0.938
Vietnam	mean	0.555	0.093	0.462	11.620	1.533	0.236	9.815	4.523	19.611
	median	0.515	0.074	0.412	11.630	1.546	0.242	9.788	4.561	20.000
	Std. dev	0.336	0.072	0.273	0.327	0.268	0.125	0.157	0.444	1.461
ASEAN	mean	0.631	0.100	0.530	11.313	1.275	-0.181	4.974	4.533	44.800
	median	0.235	0.034	0.193	11.888	1.105	-0.104	3.825	4.595	20.500
	Std. dev	1.071	0.168	0.998	1.578	0.932	0.943	3.708	0.310	62.866

For the macroeconomic variables, we use the exchange rate, market size, trade openness, political risk, inflation, and infrastructural development. The official exchange rate (L.C.U per the U.S. $, period average) is utilized to represent the exchange rate[2] (Hattari et al., 2014; Hoang, 2012; Hoang & Bui, 2015; Marouane, 2019). We use the real gross domestic product (2010 constant) to measure the market size (Felipe & Llamosas-rosas, 2018; Garretsen & Peeters, 2009; Hoang & Goujon, 2019; Marouane, 2019; Nwaogu, 2012). The consumer price index is utilized to represent inflation (Boateng et al., 2015; Hoang & Bui, 2015; Hoang & Goujon, 2019; Ismail, 2009). We also employ the indicator of Political Stability and Absence of Violence / Terrorism to represent political risk since it is crucial to ascertain the quality of governance (Garretsen & Peeters, 2009; Hoang & Goujon, 2019; Marouane, 2019; Nwaogu, 2012). We use total export and import (as a per cent of GDP) to denote trade openness (e.g., Boateng et al., 2015; Chou et al., 2011; Garretsen & Peeters, 2009; Ismail, 2009; Marouane, 2019). Lastly, we utilize the total number of airports to represent infrastructural development, which is different from Marouane (2019), Nwaogu (2012), Hoang & Goujon (2019) who use telephone lines as a proxy. Our rationale for this is that technological development will render the use of telephone lines obsolete and their usage will thus trend downwards and the airport is one of the infrastructures in the transportation of goods which is considered by investors' costs. The exchange rate, market size and inflation rate are calculated as natural logarithms. Table (2) presents the descriptive statistics of the variables.

B. Spatial Econometric Model

For previous research analyzes, the traditional panel data model is frequently employed to examine the linkage between macroeconomic factors and foreign direct investment (e.g., Camara, 2002; Hoang, 2012; Hoang & Bui, 2015; Irawan, 2013; Masron & Abdullah, 2010; Mina, 2007). However, this model does not include the spatial inter-relation aspect of FDI between regions. Moreover, these researches examined the determinants of FDI using spatial econometric models to the exclusion of the exchange rate as a determinant factor impacting FDI as well as the spatial relationship of the effect of macroeconomic changes in neighboring countries on the host country. As a value add to existing literature, we are extending our investigation to include not only the effect of FDI in the third-country affecting the FDI in the host country, but also the spatial

[2]. We do not use the nominal/real effective exchange rate due to incomplete data for Brunei Darussalam, Cambodia, Lao PDR, and Myanmar.

relationship of the effect of macroeconomic changes in the third-country on FDI in the host country, via the spatial spillover effects.

To achieve these research aims, we utilize the spatial econometric models. In specifying the model, we extend a broader set of spatial econometrics of FDI inflows, developed by Uttama & Peridy (2009) and Hoang & Goujon (2019) to capture the third-country effects of the exchange rate and macroeconomic variables on FDI inflows in the ASEAN region. Our model estimate is thus expressed in the following equation:

$$FDI_{it} = \alpha + \rho \sum_{j=1}^{n} w_{ij} FDI_{jt} + \sum_{k=1}^{K} \beta_k x_{itk} + \sum_{k=1}^{K} \sum_{j=1}^{n} \theta_k w_{ij} x_{jtk} + \varphi \sum_{j=1}^{n} w_{ij} GDP_{jt} + \mu_i + \gamma_t + v_{it}$$

$$v_{it} = \lambda \sum_{j=1}^{n} w_{ij} v_{jt} + \epsilon_{it} \quad (1)$$

where β denotes the direct coefficient of the independent variable, which is indicative of the impact exerted by the macroeconomic variable of the host country on the FDI inflows of the host country (dependent variable). θ denotes the spatial exogenous variable coefficient, which indicates the impact exerted by the macroeconomic variable in the neighboring country on the FDI inflows of the host country. ρ denotes the spatial autoregressive coefficient, which indicates the degree of FDI spatial dependence. v_{it} is vector Nx1 *error-term* for the host country i at t-time. λ acts as a spatial coefficient of autocorrelation to calculate the impact of FDI shocks from the neighboring country j on the host country i. γ_t stands for the time-period fixed effect, μ_i refers to the spatial unit fixed effect. Meanwhile, ϵ_{it} denotes a random error vector, satisfying $\epsilon_{it} \sim N(0, \sigma_{it}^2)$.

C. Robustness Checks

We also perform several robustness checks to ensure that our empirical results are consistent with alternative estimations and empirical variables. Specifically, we conduct two robustness checks as follows: First, we divide the spatial econometric models for three different interaction effects: (i) Spatial Autoregressive (SAR) Model, which contains only the spatial lag term of the dependent variable, where θ=0 and λ=0; (ii) Spatial Error Model (SEM) which contains only the spatial lag term of the error term, where ρ=0 and θ=0; and, (iii) Spatial Durbin Model (SDM) which contains both the dependent variable and independent variable spatial lag term, where λ=0.

Second, we propose two weighting methods by adopting alternative spatial weight matrices. Following Peng et al. (2018) and Feng et al. (2019), we construct and employ the general spatial weight matrices based on the geographical correlation, which includes the inverse distance (W1) and the first-order binary contiguity (W2) to investigate the effects of the exchange rate and macroeconomic variables and its interaction term on FDI inflows in the ASEAN region. Specifically, these two spatial weight matrices are constructed as follows:

$$W_1 \begin{cases} \frac{1}{d_{ij}}, if\ i \neq j \\ 0\ , if\ i = j \end{cases} \quad (2)$$

$$W_2 \begin{cases} 1, if\ i\ and\ j\ are\ adjacent \\ 0\ ,\ otherwise \end{cases} \quad (3)$$

where d_{ij} denotes the great circle distance between country i and country j. We adopt the normalization procedure of row-normalized spatial weight matrix of Elhorst (2010), Kelejian & Prucha (2010) so as to ensure that the rows sum up to 1 and their diagonal elements are set to 0.

IV. Results and Discussion

A. An Empirical Analysis for the Whole Sample (FDI Global)

We begin the investigation by estimating the non-spatial panel data based on two spatial weight matrices in order to select the optimal model for our analysis. First, following Anselin et al. (1996), we use several LM test procedures to examine whether a spatially lagged dependent variable (LM spatial lag) or a spatially autocorrelated error term (LM spatial error) should be included in the model. Table 4 reports the estimations in our non-spatial panel data and the LM test results of the whole sample (FDI Global). We then use the LR test to evaluate whether the model has a spatial fixed effect and time fixed effect. From Table 4, the LR test of FDI Global result of the spatial fixed effect is significant at the 1% level, but not significant for the time fixed effect for all spatial weight matrices, indicating that the model contains only spatial fixed effects. In light of this, LM statistics should be calculated based on the spatial fixed effects model. The estimations of SAR and SEM, indicated by the LM-lag, LM-error and Robust LM-error statistics are significant below 10% levels for W1 and the LM-error, Robust LM-lag and Robust LM-error statistics are significant below 5% levels for W2.

To select the best data-fit model, we look at alternative approaches, including the spatial Durbin model (SDM) to minimize endogeneity problems that would arise due to omitted variables bias in spatial regressions containing endogenous and exogenous spatial lags (Fingleton & Gallo, 2010; Lacombe & Lesage, 2012; J. P. LeSage & Pace, 2008). The Wald or likelihood ratio (LR) test is used to judge whether the SDM can be simplified into the SAR or SEM. The results show that the two effects are significant at 1% levels, indicating we should adopt the SDM rather than SAR or SEM.

Table 4

Coefficient estimation and LM test of the non-spatial panel model

	W1			W2		
Variables	FDI Global	FDI Intra-ASEAN	FDI Extra-ASEAN	FDI Global	FDI Intra-ASEAN	FDI Extra-ASEAN
MARKET	1.365***	0.070	1.295***	1.365***	0.070	1.295***
	(-4.507)	(-1.333)	(-4.536)	(-4.5070)	(-1.333)	(-4.536)
OPENNESS	-1.012***	-0.088***	-0.923***	-1.012***	-0.088***	-0.923***
	(-5.291)	(-2.663)	(-5.122)	(-5.291)	(-2.663)	(-5.122)
POL	0.137	0.050**	0.087	0.137	0.050**	0.087
	(-1.112)	(-2.318)	(-0.753)	(-1.112)	(-2.318)	(-0.753)
XR	-0.029	0.035***	-0.063	-0.029	0.035***	-0.063
	(-0.544)	(-3.785)	(-1.274)	(-0.544)	(-3.785)	(-1.274)
INF	-0.760**	0.023	-0.783**	-0.760**	0.023	-0.783**
	(-2.369)	(-0.419)	(-2.591)	(-2.369)	(-0.419)	(-2.591)
INFRA	0.004	0.007***	-0.003	0.004	0.007***	-0.003

	(-0.998)	(-9.990)	(-0.781)	(-0.998)	(-9.990)	(-0.781)
R-squared	0.338	0.570	0.291	0.338	0.570	0.291
Adjusted R-squared	0.319	0.558	0.270	0.319	0.558	0.270
Log Likelihood	-121.299	193.852	-110.657	-121.299	193.852	-110.657
LM spatial lag	3.115*	0.016	4.725**	0.067	0.095	0.114
LM spatial error	6.989***	1.200	7.405***	5.004**	0.497	4.214**
Robust LM spatial lag	2.076	2.534	0.789	13.665***	4.868**	11.697***
Robust LM spatial error	5.950**	3.718*	3.469*	18.602***	5.270**	15.798***
Spatial fixed effect LR test	123.126***	94.855***	124.310***	123.126***	94.855***	124.310***
Time fixed effect LR test	15.563	9.873	14.848	15.563	9.873	14.848

Notes: The t-values are given in the parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively. LM means Lagrange multiplier. LR means likelihood ratio. All testing results of Lagrange multiplier and robust Lagrange multiplier are under the spatial fixed effect.

Second, we consider the spatial Durbin model specification for the Global FDI reported in Table 5. We find that the direct coefficients of the exchange rate (XR) when the spatial weight matrix changes from W1 to W2 are significantly negative at the 10% significance level and 1% significance level, respectively. This result is consistent with the theory of the monetary approach to the balance of payments and the strategic behavior of international firms which propose that an appreciation of a country's currency induces foreign capital inflows. The empirical analysis of Paun et al. (2013) shows evidence of the presuppositions of the monetary approach of the balance of payments in emerging market, i.e., the depreciation in the real foreign exchange rate generates surpluses in the current account (improving the export to import ratio) while at the same time, causes an increase in the capital or financial account deficit. Furthermore, the theory of the strategic behavior of international firms demonstrates that an appreciation of the real exchange rate in a country encourages a large current account deficit and thus attracts international firms to invest in these markets (Kosteletou & Liargovas, 2002). These findings support similar views of Boateng et al. (2015), Campa (1993), Darby et al. (1999), Kogut & Chang (1996), Cushman (1985).

Table 5

Estimation results of spatial panel model in the whole sample (FDI Global case)

Variables	W1			W2		
	SAR_FE	SEM_FE	SDM_FE	SAR_FE	SEM_FE	SDM_FE
	Spatial fixed effects	Spatial fixed effects	Spatial fixed effects	Spatial fixed effects	Spatial fixed effects	Spatial fixed effects
MARKET	1.637***	1.704***	1.585***	1.400***	1.515***	1.580***
	(5.013)	(6.347)	(4.212)	(4.496)	(5.440)	(4.428)
OPENNESS	-1.070***	-1.013***	-0.618***	-1.024***	-1.009***	-0.996***
	(-5.543)	(-5.917)	(-3.429)	(-5.246)	(-6.090)	(-4.225)
POL	0.111	0.138	-0.140	0.132	0.189	0.217*
	(0.890)	(1.130)	(-1.207)	(1.058)	(1.525)	(1.689)
XR	-0.021	0.013	-0.092*	-0.029	-0.042	-0.134***
	(-0.395)	(0.255)	(-1.852)	(-0.545)	(-0.819)	(-2.600)
INF	-0.901***	-1.242***	-0.524*	-0.783**	-1.046***	-0.911***
	(-2.804)	(-4.213)	(-1.794)	(-2.414)	(-3.432)	(-2.821)
INFRA	0.006	0.008**	0.011***	0.004	0.002	-0.003
	(1.559)	(2.125)	(2.845)	(1.031)	(0.473)	(-0.763)
W*MARKET			3.690***			2.509***
			(3.694)			(3.901)
W*OPENNESS			-0.903**			-0.342
			(-2.047)			(-1.018)

W*POL			-0.477			0.385*
			(-1.392)			(1.805)
W*XR			0.151			-0.318**
			(0.759)			(-2.045)
W*INF			-4.755***			-3.028***
			(-4.836)			(-4.321)
W*INFRA			0.108***			-0.021*
			(4.963)			(-1.794)
W*dep.var.	-0.227*		-0.779***	-0.048		-0.139*
	(-1.638)		(-4.634)	(-0.657)		(-1.723)
spat.aut.		-0.541***			-0.295***	
		(-3.135)			(-3.734)	
teta						
R-squared	0.807	0.798	0.874	0.803	0.800	0.844
Wald test spatial lag			73.662***			39.249***
LR test spatial lag			64.824***			40.688***
Wald test spatial error			62.319***			36.395***
LR test spatial error			57.845***			32.585***
Hausman Test	21.102***	-42.818***	43.396***	37.866***	-20.692***	30.990***

Notes: The t-values are given in the parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively. LR means likelihood ratio.

As with our results for the exchange rate, we find that the direct coefficients of OPENNESS are significantly negative at the 1% significance level for both spatial weight matrices, indicating that a rise in trade openness in the host country significantly decreases foreign direct investments in the host country. This finding confirms the motives for 'tariff jumping' that allows the home country investor undertake foreign direct investment (FDI) in that host country to sidestep trade barriers by relocating production to the destination market and creating benefit for the foreign firms (Blonigen et al., 2019; Ghodsi, 2020). This confirms the findings of Garretsen & Peeters (2009) and Marouane (2019), who found that when trade openness in the host country increases, it encourages FDI discharge from the MENA Region and Dutch outbound FDI into 18 OECD economies respectively. The increase in inflation in the host country also has a significantly negative effect for FDI inflows at the 10% and 1% significance level respectively, when the spatial weight matrix changes from W1 to W2. This indicates that the instability and uncertainty of macroeconomic factors in the host country, as reflected by the inflation rate, might restrain FDI from flowing into the host country.

The direct coefficients of market size are significantly positive at the 1% significance level when the spatial weight matrices are W1 and W2. This reveals that the increase in the gross domestic product (GDP) of the host country has facilitated foreign direct investment (FDI) inflows from the world into the ASEAN countries during the research period. This is understandable as stability of macroeconomic fundamentals is key to attracting capital inflows into a host country. Therefore, the positive effect of MARKET to FDI is consistent with Head & Mayer (2003), Nwaogu (2012), Hoang & Goujon (2019). Political risk, however, shows no significant effect on FDI inflows in the ASEAN region for W1 but is positive at 10% significance level for W2, albeit the coefficient being relatively low at 10%. This is consistent with the work of Marouane (2019) and Garretsen & Peeters (2009) who argue that government stability in the host country is not a determining factor for foreign investors entering the host country.

Our analysis uses the total number of airports as a proxy for infrastructure development, due to incomplete data, in contrast to Marouane (2019), Nwaogu (2012), Hoang & Goujon (2019), and Ismail (2009) who employ the number of telephone lines and mobile phones. The direct coefficients of INFRA are significantly positive at the 1% significance level when the spatial weight matrix is W1, while the coefficient of INFRA is not significant when the spatial weight matrix is W2. The positive effect of this coefficient shows that infrastructure development can be a factor in attracting investors to a host country.

Third, we can see from the results of the estimated coefficients for the spatial autoregressive coefficients for Global FDI in Table 5, that there are differentials for the estimates of the spatial weight matrices using W1 and W2. When using the SAR model, it is complicated to prove the existence of spatial autoregressive coefficients (ρ) for both the spatial weight matrices. However, when we include the spatially lagged macroeconomic variables, we find that the spatial autoregressive coefficients are significantly negative at the 1% and 10% significance level respectively, when the spatial weight matrix changes from W1 to W2. This implies that the negative spillover effect of foreign direct investment inflows in the neighboring or surrounding countries significantly influence foreign direct investment in a particular country (e.g., Garretsen & Peeters, 2009; Ledyaeva, 2009; Marouane, 2019; Regelink & Paul Elhorst, 2015). This is an indication of a competitive relationship between countries in ASEAN and that there is a substitution interaction effect for foreign direct investment inflows rather than a complementary one. Therefore, if the third country has better prospects than the host country, foreign capital may likely leave the host country and move to the neighboring economies.

Our analysis also finds the coefficient (W * MARKET) positively significant at 1% significance levels when using W1 and W2. This coefficient which represents market potential of a neighboring country shows the existence of an export-platform FDI relationship among the ASEAN countries. The positive spillover effects from the market potential confirm that an increase in economic activity in neighboring countries causes higher FDI inflows in a particular country when the spatial econometric model takes into consideration the geographical correlation (e.g., Garretsen & Peeters, 2009; Hoang & Goujon, 2019; Marouane, 2019; Nwaogu, 2012; Regelink & Paul Elhorst, 2015). This is consistent with the theory that export-platform FDI creates neighboring market-seeking characteristics, where multinational companies will seek to invest and produce in a host country if they are able to dispose of their products in a third country. This finding supports the work of Uttama & Peridy (2009) and Hoang & Goujon (2019) for FDI inflows in ASEAN, Blonigen et al. (2007) for FDI inflows in European OECD, Garretsen & Peeters (2009) for FDI inflows in OECD countries, and Regelink & Paul Elhorst (2015) for FDI inflows in European countries. Our finding is also consistent with that of Ekholm et al. (2007) who demonstrate that when there are free trade agreements among countries, export-platform FDIs are very likely to occur, as in the case of ASEAN where trade agreements between countries are in existence.

Fourth, the spatial lag coefficient of the exchange rate is positive but does not pass the significance test when the spatial weight matrix is W1, whereas it is significantly negative at the 5% significance level when the spatial weight matrix is W2. This indicates that with the spatial econometric model which takes into consideration state boundaries, an appreciation of the neighboring country's currency improves the investment expectation arising from the enhancement of future profits in the host country. However, the spatial spillover effects of the exchange rate on FDI inflows in ASEAN are inconsistent when the spatial weight matrix changes. Similarly, the

spatial spillover effect of infrastructure development on FDI inflows in ASEAN is also inconsistent when the spatial weight matrix changes. The spatial lag coefficient of INFRA is significantly positive at the 1% significance level when the spatial weight matrix is W1, but weak when the spatial weight matrix is W2, since the negative coefficient of the spatial lag on INFRA is only significant at 10%. This indicates that infrastructure development in the neighboring country will induce inflows of foreign direct investment in a particular country when the spatial weight matrix considers the distance between the two capitals.

The spatial lag coefficient of trade openness is significantly negative at the 1% significance level when the spatial weight matrix is W1 but does not pass the significance test when the spatial weight matrix is W2. The negative spatial spillover effect which is indicative of a reduction in trade barriers, as depicted by an increase in trade openness, in neighboring countries acts to enhance foreign direct investment in the host country. Ekholm et al. (2007) have shown that a country's export-platform FDI increases when trade costs between potential destination countries are lower relative to the home country and destination country (third-country). This incentivizes investors to establish MNEs in the host country and it is most likely to occur among countries with free trade agreements. Therefore, when trade openness in the third-country increases, it is better for MNEs to sell their products directly to the third-country rather than produce the final goods in the host country to be sold later to third parties. In our study, the spillover effect of POL is negative but does not pass the significance test when the spatial weight matrix is W1. However, it is significantly positive at the 10% significance level when the spatial weight matrix is W2. The empirical evidence for political risk in the neighboring country and FDI inflows in the host country, however, is relatively weak since the positive coefficient of the spatial lag for POL is only significant at 10%.

Lastly, for our robustness check, we compare the SDM with SAR and SEM, and the results are quite similar or identical to the SDM. Our empirical results using SAR and SEM show that FDI Global is significantly responded to by the market size, trade openness, inflation when W1 and W2 are used. Moreover, infrastructure development is significantly positive for the SEM model when using W1. For the spatial autoregressive coefficients, the results show a negative sign at 10% significance level when the spatial weight matrix is W1 and has no significance when the spatial weight matrix changes from W1 to W2.

B. FDI by Source Country Comparison Analysis

Generally, the characteristics of foreign direct investment originating from intra-ASEAN and extra-ASEAN are largely different, and likewise with the factors that influence the decisions of investors entering the ASEAN region. The impact of the exchange rate and macroeconomic factors on FDI inflows may differ vastly between countries due to these differences. To that end, we need to examine the existence of spatial heterogeneity in FDI forms. Therefore, the subsamples of the standpoints of the source country's FDI (i.e., FDI from intra-ASEAN and extra-ASEAN) are utilized to re-estimate the regressions. Specifically, we adopt three model tests (SAR, SEM, and SDM) in order to determine the most suitable model for FDI from intra-ASEAN and extra-ASEAN. Similar to the selection steps for the whole sample, we have chosen the spatial Durbin model to analyze the spatial fixed effect for FDI inflows of the source country, except for FDI inflows from extra-ASEAN which use the spatial random effect when the spatial weight matrix is

the inverse distance (W1). Table 6-7 report the estimation results for these two standpoints of the FDI source country.

We find that the estimation results for these two subsamples have some differences with those of the whole sample. Specifically, there are several distinctions in the characteristics of the factors that influence FDI in intra-ASEAN and extra-ASEAN. First, the direct coefficient of the exchange rate in the intra-ASEAN FDI model is positive but does not pass the significance test when the spatial weight matrix is W1, while it is significantly positive at the 10% significance level when the spatial weight matrix is W2. However, this value is relatively weak because it is only significant at 10% while W1 is not significant. The direct coefficients in the intra-ASEAN FDI model, for market size (MARKET) and political risk (POL) are significant and positive at 10% significance levels when the spatial weight matrix is W1 and significantly positive at the 5% significance levels when the spatial weight matrix is W2. The positive effects of POL reflect an increase in the index, indicative of a decrease in political risks that could encourage investors to set up MNEs. This is consistent with Nwaogu (2012) and Hoang & Goujon (2019). The direct coefficients of infrastructure development are significantly positive at the 1% significance level for both spatial weight matrices, showing that infrastructure development and FDI inflows from intra-ASEAN are complementary. Meanwhile, the direct coefficients of trade openness and inflation have no significant effect on FDI inflows from intra-ASEAN for both spatial weight matrices. The insignificant coefficients for infrastructure development and trade openness may be attributable to the substantial reduction in trade barriers between the source countries and host countries since 1993 when the ASEAN Free Trade Area (AFTA) was implemented.

Table 6

Estimation results of spatial panel model in FDI Intra-ASEAN case

Variables	W1			W2		
	SAR_FE	SEM_FE	SDM_FE	SAR_FE	SEM_FE	SDM_FE
	Spatial fixed effects	Spatial fixed effects	Spatial fixed effects	Spatial fixed effects	Spatial fixed effects	Spatial fixed effects
MARKET	0.074	0.086*	0.132*	0.065	0.079	0.149**
	(1.256)	(1.702)	(1.877)	(1.18)	(1.501)	(2.411)
OPENNESS	-0.089***	-0.096***	-0.003	-0.087**	-0.091***	-0.029
	(-2.637)	(-2.968)	(-0.096)	(-2.573)	(-2.797)	(-0.719)
POL	0.049**	0.051**	0.036*	0.050**	0.049**	0.053**
	(2.273)	(2.351)	(1.685)	(2.316)	(2.271)	(2.390)
XR	0.034***	0.035***	0.011	0.035***	0.034***	0.016*
	(3.734)	(3.798)	(1.174)	(3.769)	(3.666)	(1.756)
INF	0.021	-0.002	0.055	0.027	0.011	0.004
	(0.371)	(-0.029)	(1.015)	(0.484)	(0.192)	(0.064)
INFRA	0.007***	0.007***	0.007***	0.007***	0.007***	0.006***
	(9.880)	(10.080)	(9.453)	(9.685)	(9.954)	(7.880)
W*MARKET			0.375**			0.324***
			(2.150)			(2.946)
W*OPENNESS			-0.187**			-0.084
			(-2.322)			(-1.466)
W*POL			0.059			0.036
			(0.924)			(0.964)
W*XR			-0.094**			-0.058**
			(-2.553)			(-2.146)
W*INF			-0.536***			-0.463***

			(-3.098)			(-3.852)
W*INFRA			0.016***			0.000
			(3.740)			(-0.004)
W*dep.var.	-0.017		-0.342**	0.028		-0.101
	(-0.138)		(-2.211)	(0.375)		(-1.244)
spat.aut.		-0.233			-0.062	
		(-1.484)			(-0.753)	
R-squared	0.758	0.757	0.821	0.758	0.758	0.81
Wald test spatial			56.134***			46.792***
LR test spatial lag			51.293***			42.838***
Wald test spatial			52.863***			45.322***
LR test spatial			49.544***			42.413***
Hausman Test	22.546***	-19.678***	53.190***	19.267***	-18.239***	46.615***

Notes: The t-values are given in the parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively. LR means likelihood ratio.

Second, the direct coefficients of FDI for the extra-ASEAN model are quite different from the FDI for the intra-ASEAN model. In summary, the impact from macroeconomic factors in the host country affecting FDI inflows from extra-ASEAN are different from those from intra-ASEAN. While the effect of inflation and the exchange rate in the host country on intra-ASEAN FDI is weak, we find that for the FDI extra-ASEAN model, inflation and exchange rate in the host country have a significant effect. In other words, inflation and the exchange rate are factors of consideration for investors from outside of ASEAN, while investors from within ASEAN do not place much emphasis on them. The direct coefficient of the exchange rate shows no significant effect when the spatial weight matrix is W1 while it has a significantly negative effect on FDI inflows from extra-region at the 1% significance level when the spatial weight matrix changes from W1 to W2. Similarly, the increase in inflation in the host country has a significantly negative effect on FDI inflows at the 1% significance levels for both spatial weight matrices. As for the variables of market size and trade openness in the FDI extra-ASEAN model, they have effects similar to those for the whole sample (FDI global), where the direct coefficients of market size are significantly positive, and trade openness is significantly negative at the 1% significance level when the spatial weight matrices are W1 and W2.

The negative and significant relationship between trade openness and FDI inflows originating from outside ASEAN shows the substitution relationship between trade openness and FDI in the host country. The geographical distance between the home country and countries outside ASEAN or inside ASEAN represents a cost consideration for investors when they export their products. Nwaogu (2012) recommends the establishment of foreign affiliate companies for closer proximity to customers as well as for the reduction of trade costs. Concentrating on production abroad relative to exporting these products would generate fixed cost savings associated with foreign production facilities. Hattari et al. (2014) observe that there is a negative relationship between exports and FDI, suggesting a substitution effect between trade and FDI, which is similar to our finding. Surprisingly, the direct coefficients for infrastructure development show unexpected negative signs at 1% and 5% significance levels when the spatial weight matrix changes from W1 to W2, which are in contrast to our intra-region FDI model. Similar to the negative effects of trade openness, infrastructure development also seems to have a substitution relationship with FDI inflows originating from extra-ASEAN, indicating that an increase in airport development in the host country facilitates the delivery of raw materials by MNEs to the host country as against the establishment of a company in the host country itself. This suggests that

airport development can reduce FDI inflows from outside the ASEAN region as foreign investors could potentially save costs by just exporting their products instead of setting up resource-heavy foreign production facilities. Meanwhile, the direct coefficient of political risk is only positive and significant when using W1 as the spatial weight matrix, suggesting that the more stable the political situation in the host country, the more foreign investors from outside ASEAN will be encouraged to invest in ASEAN.

Third, we prove that the "export-platform FDI hypothesis" occurs in the FDI inflows originating from intra-ASEAN and extra-ASEAN when using W1 as the spatial weight matrix. We find that the spatial autoregressive coefficients of FDI intra-ASEAN and extra-ASEAN are significantly negative at 5% and 1% significance levels while market potential coefficients are significantly positive at 5% and 1% significance levels for W1, which in line with the full sample results. However, when the spatial weight matrix changes from W1 to W2, the "pure horizontal FDI hypothesis" occurs as the spatial autoregressive coefficient (ρ) is not significant with a negative sign for FDI source countries while there are positive spillover effects from the market potential, confirmed at 1% significance level. Therefore, it is complex to determine whether the characteristics of FDI intra-ASEAN and extra-ASEAN are purely horizontal or export-platform FDI by just looking at the geographical interdependence with the use of country boundaries. In pure horizontal FDI, foreign investors establish MNEs only to gain market access in the host country to side-step trade barriers, while the market size of neighboring countries is not an issue with pure horizontal FDI.

Table 7

Estimation results of spatial panel model in FDI Extra-ASEAN case

Variables	W1			W2		
	SAR_RE	SEM_FE	SDM_RE	SAR_RE	SEM_FE	SDM_FE
	Spatial random effects	Spatial fixed effects	Spatial random effects	Spatial random effects	Spatial fixed effects	Spatial fixed effects
MARKET	0.221**	1.595***	1.097***	0.218**	1.396***	1.415***
	-2.257	-6.305	-10.239	(2.229)	(5.255)	(4.095)
OPENNESS	-0.903***	-0.910***	-0.639***	-0.895***	-0.918***	-0.954***
	(-5.143)	(-5.641)	(-3.832)	(-5.102)	(-5.776)	(-4.175)
POL	0.267**	0.085	0.378***	0.267**	0.133	0.165
	-2.352	-0.745	-2.807	(2.356)	(1.132)	(1.325)
XR	-0.090*	-0.021	0.021	-0.089*	-0.070	-0.149***
	(-1.933)	(-0.444)	-0.757	(-1.912)	(-1.454)	(-2.985)
INF	0.063	-1.208***	-0.861***	0.064	-0.993***	-0.896***
	-0.3	(-4.349)	(-4.288)	(0.308)	(-3.422)	(-2.868)
INFRA	-0.006*	0.001	-0.015***	-0.006*	-1.334	-0.009**
	(-1.833)	-0.306	(-6.165)	(-1.828)	(-1.334)	(-2.236)
W*MARKET			3.636***			2.161
			-8.989			(3.473)
W*OPENNESS			-3.752***			-0.265
			(-5.790)			(-0.814)
W*POL			0.563			0.344
			(-0.916)			(1.667)
W*XR			-0.229			-0.257
			(-1.242)			(-1.706)
W*INF			-3.323***			-2.551
			(-3.117)			(-3.758)

W*INFRA			-0.043**			-0.022
			(-2.302)			(-1.873)
W*dep.var.	0.017		-0.929***	0.058		-0.102
	(-0.133)		(-5.585)	(0.753)		(-1.258)
spat.aut.		-0.540***			-0.271***	
		(-3.130)			(-3.399)	
R-squared	0.764	0.794	0.834	0.765	0.796	0.831
Wald test spatial			161.370***			29.025
LR test spatial			48.312***			31.021
Wald test spatial			101.404***			27.622
LR test spatial			25.942***			24.455
Hausman Test	12.561	-38.343***	10.738	7.483	-15.247	27.112

Notes: The t-values are given in the parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively. LR means likelihood ratio.

Fourth, the spillover effect using the great circle distance (W1) is more visible compared to country boundaries (W2) as a spatial weight matrix for FDI intra-ASEAN and extra-ASEAN. Possibly, this is because when using country boundaries, countries that do not share the same boundary are considered to have no spatial influence on the host country. In FDI intra-ASEAN, the spatial lag coefficients of the exchange rate and inflation are significantly negative at the 5% and 1% significance levels for both spatial weight matrices. This is indicative of the importance of maintaining stability in the inflation and exchange rate in the neighboring country for attracting FDI inflows from intra-ASEAN into ASEAN economies. The spatial lag coefficient of trade openness in FDI intra-ASEAN is significantly negative at the 5% significance level when the spatial weight matrix is W1 but does not pass the significance test when the spatial weight matrix is W2. This negative result shows that if the third-country is a potential destination which has reduced its trade barriers, this will reduce the interest of investors from intra-ASEAN to invest in the host country, which is in line with the FDI export platform hypothesis. Similarly, the spatial spillover effect of infrastructure development on FDI inflows from intra-ASEAN is also inconsistent when the spatial weight matrix changes. The spatial lag coefficient of infrastructure development in FDI intra-ASEAN is significantly positive at the 1% significance level when the spatial weight matrix is W1, but not significant when the spatial weight matrix is W2. For intra-ASEAN FDI, it appears that political stability is not an important factor, as seen from the two insignificant spatial weight matrices for the spillover effects of political risk.

Fifth, continuing with the spillover effects, we look at the geographic interaction factors that affect FDI inflows from extra-ASEAN. For extra-ASEAN FDI, inflation in the third-country appears to be the factor that most influences foreign investors from outside ASEAN, as gleaned from the spatial lag coefficient of inflation that is significant and negative for both spatial weight matrices at 1% significant levels. Furthermore, the development of airports in the third-country has a negative effect on the entry of foreign investments from outside ASEAN into a particular country in ASEAN. The spatial lag coefficients of infrastructure development are negative and significant at 5% and 10% significance levels when the spatial weight matrix changes from W1 to W2. These results show that if the infrastructure development in a particular economy increases, not only will FDI inflows increase from extra-ASEAN into that economy but will also affect the FDI inflows into neighboring economies. Similar to FDI intra-ASEAN, the spatial lag coefficient of trade openness in FDI extra-ASEAN is significantly negative at the 1% significance level when the spatial weight matrix is W1, but fails to pass when it changes to W2. Comparable to FDI intra-ASEAN, political stability for extra-ASEAN FDI is also not an important factor, evidenced by its

insignificance when W1 is used as the spatial weight matrix but is significant and positive at the 10% significance level when the spatial weight matrix is W2. This shows that the spillover effects of the exchange rate do not induce FDI inflows from extra-ASEAN, as reflected by the insignificant spatial lag coefficient of the exchange rate when the spatial weight matrix is W1 and is only significant at the 10% significance level when the spatial weight matrix is W2.

Lastly, similarly with FDI Global, we perform the robustness test using the SAR and SEM models for FDI intra-ASEAN and extra-ASEAN. In summary, the SDM estimation results for the subsamples of these two foreign direct investments by source countries are not always consistent for the SAR and SEM models. Our empirical results illustrate that neither the SAR model nor the SEM model for FDI intra-ASEAN is significantly determined by trade openness, political risk, and infrastructure development. For FDI extra-ASEAN, it is significantly determined by market size and trade openness, except for politic risk which is significant for SAR and inflation which is significant for SEM, for both spatial weight matrices. However, for the SDM model, we find that the market size, political risk, and infrastructure development affect FDI intra-ASEAN while market size, trade openness, inflation, and infrastructure development affect FDI extra-ASEAN when W1 and W2 are used. Moreover, political risk is significantly positive when using W1 while the exchange rate is significantly positive when using W2. The spatial autoregressive coefficients are not significant when the spatial weight matrix changes from W1 to W2 for FDI intra-ASEAN and extra-ASEAN.

V. Concluding Remarks and Policy Implications

This study employs a spatial panel data for 10 ASEAN countries for the period 2001-2018 and investigates the direct and spatial lag effects of the exchange rate, macroeconomic factors, and their interaction terms on foreign direct investment inflows in ASEAN, with the use of two representative spatial weight matrices. The spatial autoregressive (SAR), spatial error (SEM), and spatial Durbin model (SDM) are estimated for FDI inflows aggregate and FDI inflows by source country. The spatial Durbin model (SDM) is also adopted to analyze the spatial fixed effects of FDI inflows aggregate and FDI inflows by source country, except for FDI inflows from extra-ASEAN which are analyzed for the spatial random effect when the spatial weight matrix is the inverse distance (W1).

Our empirical investigations have derived several crucial findings. First, we find that the effects of the exchange rate and macroeconomic variables on foreign direct investment inflows are varied for different forms of FDI based on the source countries. This provides robust support for the establishment of spatial heterogeneity in FDI forms in ASEAN. For instance, market size, infrastructure development, and political risk of the host country have shown acceleration effects on foreign direct investment inflows from intra-ASEAN, while depreciation in the exchange rate and inflation, on the other hand, has shown inhibitory effects. Meanwhile, the market size and political risk in the host country encourage foreign direct investment inflows from extra-ASEAN. Conversely, infrastructure development, trade openness, depreciation, and inflation dampen FDI extra-ASEAN, which indicate that foreign firms from extra-ASEAN are more sensitive to the overall economic conditions in the host country, compared to foreign firms from intra-ASEAN.

Second, we find that aside from macroeconomic factors of the host country, foreign investors also contemplate the interlinkages among the ASEAN countries in their quest to invest in the most optimal location. From our analysis, the variables of market potential and infrastructure

development are the main transmission factors for positive spillovers of FDI inflows from intra-ASEAN. In contrast, market potential is only the main transmission factor of positive spillovers for FDI inflows from extra-ASEAN. Meanwhile, openness, exchange rate, and inflation corresponding to the third-country, generate negative spillovers, meaning that the growth in these factors in the third-country would lead to a decline in FDI inflows from intra-ASEAN. Likewise, openness, exchange rate, infrastructure development, and inflation are the main factors of negative spillovers for FDI inflows from extra-ASEAN.

Third, we find that the results are very sensitive to the structure of the matrix W. For our cases, this makes it quite challenging to prove the existence of the geographical interdependence of FDI inflows when the first-order binary contiguity (W2) is used as the spatial weight matrix. The implementation of the inverse distance matrix establishes the "Export-platform FDI hypothesis," but when the spatial weight matrix is the first-order binary contiguity, it is quite challenging to prove the existence of the geographical interdependence of FDI inflows, leading to the "Pure horizontal FDI hypothesis".

For policy practices, our empirical results have several implications. First, the strong competition for FDI inflows among ASEAN countries means that they must maintain or enhance their competitiveness, investment environment, as well as macroeconomic conditions in their respective economies to attract investments as well as to dissuade investors from moving to greener pastures. Second, to attract FDI, countries must look at the economic policies of other countries besides their own. This is because from our analysis, we observe that host country and third-country variables significantly affect FDI inflows from intra-ASEAN and extra-ASEAN into ASEAN countries. Third, we also find that the positive spillover effect of market potential leads an increase of FDI inflows into the host country. Focus should thus be given to the development of economic integration among the ASEAN countries. Authorities will be well advised to accelerate coordinated development to boost economic activities and growth in FDI in the ASEAN region. Fourth, the finding of 'tariff jumping' motives in our study indicate that authorities must tread carefully when implementing free-market policies or reducing trade barriers as they can lead to declines in FDI inflows, especially from extra-ASEAN regions. It would thus be very useful to probe deeper into the relationship between trade barriers and FDI inflows into ASEAN countries through more in-depth research. Lastly, the effect of infrastructure development on FDI inflows from extra-ASEAN contrast with FDI inflows of the intra-ASEAN model. From our study, infrastructure development is a complementary factor for FDI inflows from intra-ASEAN, while it is a substitute factor for FDI inflows from extra-ASEAN. The policies for infrastructure development should therefore be tailored to specific situations and conditions, taking into account the aspect of regional interdependence.

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Appendix A

Spatial Panel Data Model

The basic principle of the spatial data panel is to capture the tendency of the connection or dependence of economic activities among geographic units that makes the effects of spatial interactions between countries in a certain area unavoidable. Here is a complete form of panel spatial model, which is called Generating nesting spatial model (GNS):

$$Y_{it} = \rho WY_{jt} + \alpha_{lN} + X_{it}\beta + WX_{jt}\theta + \mu_i + \gamma_t + v_{it}$$

$$v_{it} = \lambda W v_{jt} + \epsilon_{it} \quad (4)$$

Let WY as the endogenous interaction effects among the dependent variable; WX is the exogenous interaction effects among the independent variables, Wv is the interaction effects among the disturbance term of the different units. $\mu_i \; and \; \gamma_t$ are fixed effects of spatial units (spatial unit fixed effects) and time-period fixed effects. ρ is the spatial autoregressive coefficient, λ is the spatial autocorrelation coefficient, β is the direct coefficient of the independent variable, and θ is the space lag coefficient of the independent variable.

The following matrix of inverse distance weights follows Blonigen et al. (2007), Garretsen & Peeters (2009), Ploeg & Poelhekke (2009), and Hoang & Goujon (2019):

$$W = \begin{bmatrix} 0 & \cdots & w_{ij} \\ \vdots & \ddots & \vdots \\ w_{ij} & \cdots & 0 \end{bmatrix} \quad (5)$$

where W defines the functional form of the weights between any two pair of host countries i and j. In order to select the type of spatial panel model, so the right side of the equation (4) is imposed the restrictions on one or more of its parameters. These restrictions are (i) Spatial autoregressive (SAR) model which contains endogenous interaction effects WY_{jt}, where θ=0 and $\lambda = 0$; (ii) Spatial error model (SEM) which contains interaction effects between error terms Wv_{jt}, where $\rho = 0$ and $\lambda = 0$; (iii) Spatial Durbin Model (SDM) which contains both the dependent variable and independent variable spatial lag term, where λ=0. In this paper, we select the appropriate specification of the spatial panel model from SAR, SEM, and SDM.

SAR:

$$FDI_{it} = \alpha + \rho \sum_{j=1}^{n} w_{ij} FDI_{jt} + \sum_{k=1}^{K} \beta_k x_{itk} + \mu_i + \gamma_t + \epsilon_{it} \quad (6)$$

SEM:

$$FDI_{it} = \alpha + \sum_{k=1}^{K} \beta_k x_{itk} + \mu_i + \gamma_t + v_{it}$$

$$v_{it} = \lambda \sum_{j=1}^{n} w_{ij} v_{jt} + \epsilon_{it} \quad (7)$$

SDM:

$$FDI_{it} = \alpha + \rho \sum_{j=1}^{n} w_{ij} FDI_{jt} + \sum_{k=1}^{K} \beta_k x_{itk} + \sum_{k=1}^{K} \sum_{j=1}^{n} \theta_k w_{ij} x_{jtk} + \varphi \sum_{j=1}^{n} w_{ij} GDP_{jt} + \mu_i + \gamma_t + \epsilon_{it} \quad (8)$$