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Intra-ASEAN trade – Gravity model and Spatial Hausman-Taylor approach

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Abstract: This study examines determinants of intra-industry trade between Vietnam and Asean countries. By solving endogenous problem and applying Hausman-Taylor model for panel two-way dataset, we detect that export flows of Vietnam gravitate to neighbouring countries and those with similar GDP. More importantly, the research indicates the existence of spatial-lag interaction.

Keywords: Intra-trade, export, import, gravity model, two-dimensions fixed effect panel model, Hausman-Taylor model, Spatial Hausman - Taylor model.

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CHAPER 1. INTRODUCTION

In the 1930s, Eli Heckscher and Bertil Ohlin introduce the model of international trade based on the theory of Ricardo. This model focuses on differences in production factors such as labor and capital between countries which are sources of international trade. In other words, countries tend to manufacture and export commodities that the country has a comparative advantage and might produce at a much lower opportunity cost (Eli F. Heckscher & Bertil Ohlin, 1933). However, the model could not explain the intra-industry trade which has been more and more popular in the more developed international trade. This fact is unexplained by the comparative advantage theory. Additionally, the theory of comparative advantage is unable to explain the transition of Taiwan or South Korea from developing countries to developed countries, from exporting shoes and clothes to exporting cars and computers. In fact, intra-industry trade is plausible as export and import might happen at the same time in the same industry.

According to Frenstra and Taylor (2011), this phenomenon could be explained through assumptions on economies of scale, in which the large-scale production reduces production costs. Consumers' interest in product diversity is also a plausible explanation. There are two types of intra-industry trade, namely horizontal intra-industry trade driven by product differentiation and vertical intra-industry trade driven by international fragmentation of the production. Accounting for approximately one-third of world trade (Reinert KA., 1993, 1994), intra-industry trade has become an important part of world trade. Through participation in intra-industry trade, a country can simultaneously reduce the number of types of self-produced products and increase the variety of goods to consumers in the local market. In the mid-1980s, some emerging economics such as China, Hong Kong, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan and Thailand constituted over 20 percent of intra-industry trade in East Asia (Helvin, 1994). As reported by Thrope, M and Z. Zang (2005), since mid-1970s to mid-1990s, intra-industry trade increased to about 50 percent from 25 percent. For the period from 1981 to 2001, intra-regional trade increased 3.1 times and 6.7 times in the world and East Asia respectively. This might reflect an increasingly important role of intra-industry trade in the international trade (Mitsuyo Ando, 2006).

In the past few decades, since the implementation of DoiMoi program in 1986, the Vietnamese Government has pursued a policy of liberalization and market-oriented pricing, better exchange rate management, modernized financial systems, tax reform and fair competition between private enterprises and monopoly state-owned enterprises. Consequently, Vietnam's economy has achieved high GDP growth, macroeconomic stability, trade promotion, investment and poverty reduction. The economic achievements of Vietnam in the last decade have been impressive, thanks to the policy of trade liberalization associated with international economic integration. Vietnam became a member of the Association of Southeast Asian Nations (ASEAN) in 1995, and joined the

World Trade Organization (WTO) in 2007. ASEAN has always been a strategic trading partner of Vietnam since 1995. Particularly, the annual growth rate of bilateral trade between Vietnam and ASEAN was about 12.3% during the period 1996 – 2006 and 8.1% for the period 2007 – 2016 (Vietnam Customs 2017). The bilateral trade between Vietnam and ASEAN countries would be even more strengthened with the establishment of ASEAN Economic Community (AEC) on 31.12.2015. This community brings ASEAN into a single market and production base; an equal regional development; competitive economic sector and strong integration into the global economy. Vietnam has actively participated in the integration of AEC activities, especially activities aimed at liberalizing trade in goods and services. Although Vietnam is not at the level of high development compared to some countries in the region, according to the grading of ASEAN, over the period of 2008 through 2013, Vietnam is one of three best countries, which fulfill the commitments in the AEC Blueprint. AEC is expected to bring about both opportunities and challenges because Vietnam has to totally cut import taxes imposed on goods bought from ASEAN countries to zero by 2018. Therefore, Vietnam should take advantages of this opportunity for its economic development. This fact has motivated us to shed the light on determinants of intra-industry trade flows between Vietnam and ASEAN countries in recent years. Particularly, the objectives of this research are: (i) Explore determinants of intra-industry trade flows between Vietnam and ASEAN countries in recent years; (ii) Draw implications on how Vietnam could integrate more effectively and take advantages of joining ASEAN in the perspective of trade; (iii) Evaluate spillover from the economic growth of ASEAN countries to exports of Viet Nam.

In order to do so, we apply Gravity model and Spatial Hausman-Taylor approach. Different from other intra-trade studies using the Hausman Taylor spatial model, the purpose of this research is to estimate time-invariant variables and spillovers between ASEAN countries.

CHAPER 2. BACK GROUND OF THE RESEARCH AND METHODOLOGY

2.1. Background of the research

In the last decade, Vietnam has actively integrated into the world market, which was evidenced by its WTO membership and its conclusion of some regional and bilateral free trade agreements (FTA). Among them, the ASEAN Free Trade Agreement (AFTA) is the most important regional FTA. To analyze the impacts of various factors on internal trade in the sectors between Vietnam and other ASEAN member countries, we used the gravity model. This model was initiated by Tinbergen (1962) and Poyhonen (1963) and widely applied in experimental studies to quantify commercial impact of the economic linkages bloc. They concluded that exports are positively affected by the income of the trading countries and that distance can be expected to negatively affect to exports. In the later years, in 1979, Anderson applied product differentiation referred to the Armington Assumption which implied that there is imperfect substitutability between imports and domestic goods, based on the country of origin. He assumed Cobb-Douglas preferences and these products differentiated by country of origin. Gravity model of international trade flows has been widely used as a base model to calculate the impact of a range of policy issues relating to regional trade groups, monetary union and various trade distortions.

In Vietnam, there have been many studies using gravity models to assess the impact of FTAs that Vietnam participated. Thai (2006) analyzed trade between Vietnam and 23 countries in Europe (EC23) through gravity model and panel data. Variables included in the model are GDP of Vietnam and partner countries, population, exchange rates, geographical distance and history dummy. Tu Thuy Anh and Dao Nguyen Thang (2008) evaluated the factors affecting the level of integration of Vietnam trade between ASEAN +3 countries. The model deployed in the study included three groups of factors that affect trade flow, including the group of factors affecting supply (GDP and population of the exporting country), the group of factors affecting demand (GDP and population importing country) and the group of attractive factors or prevention (geographical distance). Nguyen Anh Thu (2012) used a gravity model to examine the impact of the economic integration of Vietnam under the ASEAN Free Trade Agreement (AFTA) and the Economic Partnership Agreement Vietnam-Japan (VJEPA) on Vietnam's trade. The dependent variables in the model are GDP, the gap between countries, per capita income, the real exchange rate and the dummy variables VJEPA, AFTA, AKFTA.

The gravity model has achieved undeniable success in explaining the types of international and inter-regional flows, including international trade in general and intra-industry trade in particular by applying varying types such migration, foreign direct investment and more specifically to international trade flows. Prediction of gravity model researches about bilateral trade flows depends on the economy scale and the gap between countries. According to this model, exports from country i to country j are explained by their economic sizes (GDP or GNP), their populations, direct geographical distances and a set of dummies incorporating some kind of institutional characteristics common to specific flows.

In order to examine the impact of every country, we deploy the panel data. In particular, Matyas (1997) designated an economic model so called “triple-way model” in which impacts of time, export and import countries are fixed and unobserved. However, Egger and Pfaffermayr (2002) prove that when the “triple-way” model is extended to include bilateral trading impacts, “three-way” should simply become “two-way” model with impacts of time and bilateral trade. Even though estimation techniques in panel data like Pooled OLS, Fixed Effect models, or Random Effect models have been applied widely, assumptions in which unobservable effects are correlated to regressors have been neglected in many researches. This makes research results biased. Therefore, Fixed Effect estimates are commonly used to limit the bias of estimations. However, it should be noted that Fixed Effects are not used to estimate time-constant variables like the distance. In order to meet this objective, we apply Hausman-Taylor Estimation in Heterogeneous Panels.

Our main empirical findings are summarized below. *First,* the impact of the GDP variables is always significantly positive, whereas the impact of population variables is found to be mostly insignificant. *Second,* the impact of the distance variable is always significantly negative. *Third,* the impact of similarity in relative size of trading countries is mostly significant and positive, while the impact of differences in relative factor endowments (RLF) is somewhat ambiguous. A distance variable is commonly used to estimate spatial relations (like geographical location, language, or free trade agreements…). However, this variable is unable to explain interactions amongst neighboring countries which might lead to spatial spillover effects. Therefore regarding HT estimation, there is a spatial interaction between spatial states.

2.2. Methodology

2.2.1. Grubel and Lloyd index (GL Index)

Grubel and Lloyd index (GL Index) (Grubel and Lloyd) is enormously popular for analysis of intra-industry trade. This index is considered the most appropriate evaluation of commercial structure in a specific period. It is calculated by the following formula:

$$IIT_{jk} = \frac{\sum_{i=1}^{n}(X_{ijk} + M_{ijk}) - \sum_{i=1}^{n}\left|X_{ijk} - M_{ijk}\right|}{\sum_{i=1}^{n}(X_{ijk} + M_{ijk})} \qquad (1)$$

where: IIT is intra-industry index; X_i is export and M_i is import; i denotes commercial good; j and k are export and import countries respectively; n is the number of traded commodities of two countries with each other.

IIT index has a value between 0 and 1, IIT equal 0 means that the trade between countries j and k is completely inter-industry trade; if the value is 1 trade between countries j and k is completely intra-industry trade. If IIT value is $\geq$ 0.5, trade between countries j and k mainly due to intra-industry trade. Otherwise, IIT <0.5 is mainly due to the impact of inter-industry trade.

2.2.2. Gravity model

Gravity model is an effective tool to formulize the volume and direction of bilateral trade between countries and widely used in international trade (Matyas 1997). The key assumption of this model, which is the commercial activities, complies with Newton's theory of gravity. Particularly, the intensity of trade between two countries is positively related to the size and inversely related to the geographical distance of the two countries. Standard equation is:

$$X_{ij} = G.(M_i \times M_j / D_{ij}) \quad (2)$$

Where: X_{ij} is trade flow between countries i and j, M represents measured volume (size), D is a distance between countries (or economic centers) and G is a constant.

It has become widely recognized that Gravity model has a number of advantages compared with other models because of the following reasons: (i) relative easiness in finding data, (ii) a transparent and simple function, thus makes sense in economic terms, (iii) the fact of the event and (iv) the ability to highly interpret and assess the impact of various factors separately for international trade, which may separate the effects of the free trade agreement (FTA).

However, there are some limitations associated with the use of a standard gravity model, including: (i) the sustainability of the economic functional form of model is a question mark, (ii) there may exist an endogenous relationship between changes in trade flows and the formation of the agreement (increasing trade leads to the formation of the agreement rather than the opposite. Hausman and Taylor (1981) suggest an IV estimator for this endogenous problem, so it could be solved through causality test or Hausman-Taylor estimation.

Bilateral exports and imports are defined as logarithms of export X^R_{hft} and import M^R_{hft}:

$$X^R_{hft} = X^N_{hft} \times \frac{100}{XPI_{US}} \text{ and } M^R_{hft} = M^N_{hft} \times \frac{100}{MPI_{US}} \quad (3)$$

where X^N_{hft} and M^N_{hft} are bilateral export and import measured in millions of US dollars, XPI_{US} and MPI_{US} are the US export and import price indices.

Then, the total volume of trade is given by:

$$\ln Trade = \ln(X^R_{hft} + M^R_{hft}) \quad (4)$$

GDP of country h (home country) and country f (foreign country) are defined as logarithms of GDP^R_{ht} and GDP^R_{ft}.

Furthermore, the standard gravity model is augmented with a number of variables to test whether they are relevant in explaining trade. These variables are specified in three dimensions. Firstly, the basic model specifies that or trade depends on the variable measured by GDP and population of home and foreign countries. Barrier to trade is measured by distance. Secondly, we consider the augmented specification, where trade flows are also allowed to depend on variables that take into account free trade agreements as well as dummy for common border. Finally, due to recent developments of the New Trade Theory advanced by Helpman (1987), Hummels and Levinsohn (1995) and Egger (2001, 2002), we thus add variables such as RLF and SIM. The difference in terms of relative factor endowments proxied by per capita GDPs between two countries is measured by the variable RLF and when there is equality in relative factor endowments, it takes a minimum value of zero. The larger is this difference, the higher is the volume of inter-industry which leads to the total trade will be, and the lower the share of the intra-industry trade.

$$RLF_{it} = \ln\left|PGDP_{ft}^{R} - PGDP_{ht}^{R}\right| \quad (5)$$

The relative size of two countries in terms of GDP is captured by the variable SIM. The value is bounded between zero which is absolute divergence in size and 0.5 which is equal country size. The larger this index is (meaning that the more similar two countries are), the higher the share of the intra-industry trade will be.

$$SIM_{it} = 1 - \left(\frac{GDP_{ht}^{R}}{GDP_{ht}^{R} + GDP_{ft}^{R}}\right)^2 - \left(\frac{GDP_{ft}^{R}}{GDP_{ft}^{R} + GDP_{ht}^{R}}\right)^2 \quad (6)$$

Real exchange rate in constant dollars at 2010 are defined as $RER_{it} = NER_{it} \times XPI_{US}$, where NER_{it} is nominal exchange rate between currencies h and f in year t in terms of dollars.

2.2.3. The Hausman-Taylor Panel Data Model

Gravity models have been very successful in interpreting flow factors, such as migration or traffic flow. For the international trade flows, the gravity model shows that the scale of bilateral trade flows are determined by the supply conditions of the export country, the demand conditions of import country, and other effects to the trade flow. After the study of Anderson (1979), some studies have found that the gravity model might be derived from different structures, such as the Ricardian model, the Hecksher-Olin model, increasing returns to scale model of modern trade theory.

Although the gravity model does not evaluate the validity of trade theories, the experimental success of the model is derived from the ability to combine the phenomena experienced in the global trade. Almost all previous studies used OLS with cross-sectional data. However, OLS estimations with cross-sectional data do not consider a non-homogenous characteristic related to the bilateral trade. For example, a country might export different volume of a product to two different countries even though GDP of these two import countries is similar. Therefore, OLS might lead to the bias of estimations. It is reasonable that the panel data has been used more widely in recent researches because it covers issues related of non-homogeneity. However, in the trade flow studies, distance amongst countries play an important role. In the previous researches, geographical distance, which is commonly used to examine the impacts of distance on export countries, is unable to present the spillover between neighboring countries. For instance, a country might export different volumes of the same product to different countries at different distances. However, these geographical distances might have impacts on the export volumes. Therefore, spatial spillovers play a crucial role in studies on the trade flow.

Our research explores the determinants of intra-industry trade flows between Vietnam and ASEAN countries in recent years and draws some implications on how Vietnam could integrate more effectively as well as take advantage of being an ASEAN member in the field of trade. A gravity model of international trade is empirically tested to investigate the relationship between the volume and direction of international trade and the formation of regional trade blocs where members are in different stages of development.

We apply our proposed Hausman Taylor (HT) estimation technique along with the conventional panel data approaches. There are some additional advantages of using the panel data rather than cross-sectional data or time series data. Besides handling both changing issues across the country at a time (cross-sectional) and changes over time, panel data can allow us to control impact of heterogeneity (abnormal movements which are consistent, but are not observed and measured among the economies over time). The fixed effects (represented by such variables as the constant distance between all exporters/importers) can be estimated directly, as opposed to the random effects (variables with specific distribution function), usually based on a strong assumption that the unobserved effects do not correlate with the observed effects. Another advantage of HT is to avoid the potential bias of the uncorrected estimates.

This extended panel data setup generalizes HT estimation, develops the underlying econometric theory, and proposes an alternative source of instruments in addition to the (internal) instruments suggested by HT; namely, some of (consistently estimated) heterogeneous time-specific factors under the assumption that they are correlated with individual specific variables but not with unobserved individual effects.

We begin with panel data model with two-way fixed effects as follows:

$$y_{hft} = \alpha_{hf} + \theta_t + \beta_1' x_{hft} + \beta_2' x_{ht} + \beta_3' x_{ft} + \beta_4' z_{ht} + u_{hft} \tag{7}$$

Where $h, f = 1, 2, ..., N, h \neq f$, $t = 1, 2, ..., T$; y_{hft} is the dependent variables (the volume of trade from home country h to target country f at time t); x_{hft} are explanatory variables with variation in all the three dimensions; x_{ht}, x_{ft} are explanatory variables with variation in h or f at t (GDP, population); z_{hf} are explanatory variables that do not vary over time but vary in h and f (distance); α_{hf} is an individual effect that might be correlated with some or all of the explanatory variables; θ_t are time-specific effects common to all cross-section units that are meant to correct for the impact of all the individual invariant determinant such as potential trend or business cycle.

Fixed effects model is not able to estimate the coefficients on time-variant variables such as distance. Thus we now consider the following more conventional double index panel data model:

$$y_{it} = \beta' x_{it} + \gamma' z_i + \varepsilon_{it}, i = 1, ..., N; t = 1, 2, ..., T \tag{8}$$

$$\varepsilon_{it} = \alpha_i + \theta_t + u_{it}$$

Where $x_{it} = \left(x_{1,it},...,x_{k,it}\right)'$ is a $k \times 1$ vector of variables that vary over individuals and time periods, $z_i = \left(z_{1,i},...,z_{g,i}\right)'$ is a $g \times 1$ vector of time- invariant variables. There are three components in the error term ε_{it}; namely, α_i refers to effects of all possible time invariant determinants and might be correlated with some of the explanatory variables x_{it} and z_i; θ_t is the time-specific effects common to all cross section units that is meant to correct for the impact of all the individual invariant determinants such as potential trend and business cycle; and u_{it} is a zero mean idiosyncratic random disturbance uncorrelated across cross section units and over time periods. We assume that these three components are unrelated to each other.

From the research model HT designate attractive model as follows:

$$\begin{aligned} \ln \text{Trade} = \ln \text{GDP}_{ft}^{R} + \ln \text{GDP}_{ht}^{R} + \ln \text{POP}_{ft}^{R} + \ln \text{POP}_{ht}^{R} + \text{SIM}_{it} + \text{RLF}_{it} \\ + \text{RER}_{ht} + \text{RER}_{ft} + \ln \text{DIST} \end{aligned} \tag{9}$$

2.2.4. Spatial Hausman-Taylor Panel Data Model

Baltagi et al (2016) introduces spatial spillovers in total factor productivity by allowing the error term across firms to be spatially interdependent. In order to make allowance for spatial correlation in the error term, this model is estimated by extending the Hausman-Taylor estimator. Baltagi also found an evidence of positive spillovers across firms and a large and significant detrimental effect of public ownership on total factor productivity. This economic problem is solved through several spatial econometric models. Firstly, Spatial Autoregressive model (SAR) is proposed when we review the spatial dependence as long run equilibrium of an underlying spatio-temporal process. In the cases of economic shocks or spatial dependence of omitted variables, we might use the Spatial error model

(SEM). However, regarding fixed-effects, these two models are unable to estimate time-invariant variables. We will refer to the spatial Hausman-Taylor model to solve our model in case of spatial correlation between regions or countries.

In recent years, there is a trend to estimate econometric relationships using spatial panels which typically refer to time series data of observations of a number of spatial units (zip codes, municipalities, regions, states, etc.). In this section we provide a review and organize these methodologies. It deals with the possibility to test for spatial interaction effects in standard panel data models, the estimation of fixed effects, the possibility to test the fixed effects specification of panel data models extended to include spatial error autocorrelation and a spatially lagged dependent variable.

Spatial effects

Starting to study about the impact of space, we will consider a simple panel data linear regression model as follows:

$$y_{it} = \beta x_{it} + \varepsilon_{it} \tag{10}$$

Where i is an index about the dimension of cross data with $i = 1, 2, ..., N$, t is an index about the dimension of time with $t = 1, 2, ..., T$. y_{it} is an observation on the dependent variable at i and t, x_{it} a $1 \times K$ vector of observation on the (exogenous) explanatory variable, β a matching $K \times 1$ vector of regression coefficients, and ε_{it} an error term.

Given our interest in spatial effects, the observations will be stacked as successive cross-sections for $t = 1, 2, ..., T$ and notate as y_t, X_t, ε_t. Then panel data regression model is written as follows:

$$y = X\beta + \varepsilon \tag{11}$$

where y as a $NT \times 1$ vector, X as a $NT \times K$ matrix and ε as a $NT \times 1$ vector.

In general, spatial dependence is considered when the correlation across cross-section units is non-zero, and the pattern of non-zero correlations follows a certain spatial ordering. When the appropriate spatial ordering is known a little, the spatial dependence is reduced from dependence of cross-section data. For example, the error components is spatial correlation when $E\left[\varepsilon_{it}\varepsilon_{jt}\right] \neq 0$ with each t and $i \neq j$, and the non-zero covariance conform to a specified neighbor relation. The neighbor relation is expressed by means of a so-called spatial weights matrix. We mentioned the concept of weights matrix, in this section, we will outline the detail of the two classes of specifications for model with spatial dependence. First, the spatial correlation pertains to the dependent variable in a so-called spatial lag model, in the other it affects the error terms, a so-called spatial error model.

Weights matrix

To studythe convergence across space, we have to build models and test whether the spatial dependence exists. In order to do so, it is necessary to build a weight matrix and implement the necessary testing.

Our proposed spatial econometric model uses countries as the spatial units. The method to identify a weight matrix is as follows: For each country, we identify a central point (the capital). We can identify the latitude and longitude of this central point by using a geographical map. Using the Euclidian distance in the two-dimension space, we have:

$$d_{ij} = d\left(s_i, s_j\right) = \sqrt{\left(s_i - s_j\right)^T \left(s_i - s_j\right)} \qquad (12)$$

Two countries are called neighbors if $0 < d_{ij} < d^*$, d^* is the critical cutting point. We also define two countries called neighbors if $d_{ij} = \min\left(d_{ik}\right), \forall i, k$. Put $N(i)$ is the set of all neighbors with country i, then the weighted matrix $W = \left(w_{ij}\right)_{N \times N}$ is determined as follows:

$$w_{ij} = \begin{cases} 1 \text{ if } & j \in N(i) \\ 0 & \text{otherwise} \end{cases} \quad (13)$$

Denote $\eta_j = \sum w_{ij}, w_{ij}^* = \frac{w_{ij}}{n_j}$, then $W^* = \left(w_{ij}^*\right)_{N \times N}$ is called a row-standardized binary version of a spatial weight matrix. Using this methodology, we can construct the weight matrix for the intra-trade gravity model of Asean.

Type of spatial weights matrix is very important for spatial econometric applications. Unless, the weights based on an official theoretical model for society or spatial interaction. In the empirical, we can choose according to geographical criteria as binary. In the empirical research, we can choose according to geographical criterias as contiguity (sharing common boundaries) or distance, including nearest neighboring distance (Anselin, 1988a, Chapter 3).

Combining generalization about the concepts of "economic" distance is increasingly being used regularly (Case et al, 1993; Conley and Ligon, 2002; Conley and Toga, 2002). A different kind of economic weights called weight block, where the observations of the same region are considered neighboring. If N_g the number of units in the block (such as districts in the province), all are considered as neighboring and spatial weight equal to $1/\left(N_g - 1\right)$ for all observations in the same block (Lee, 2002).

In addition, weight is examined in tamed cross data. We will expand the use of panel data which are assumed to be constant by the time. Notation W_N is the spatial weight matrix for cross data and the number of observations given in the model (11), so the matrix for panel datais defined as:

$$W_{NT} = I_T \otimes W_N$$

with I_T as an identity matrix of dimension T.

Unlike the case of time-series, "neighboring" observations are combined directly into the model through the operator above (means t-1), which it was not clear in establishing two-way space. For example, observing the irregular spatial units, such as surveyed districts or regions, often does not have the same number of neighbor, so the spatial operator above can not be done. Also, in spatial econometric, the neighbor observations included through the operator is called spatial lag, like a lag distribution rather than a change (Anselin, 1988a). In essence, a spatial lag operator creates a new variable contains weighted average of neighbor observations, with the weight here is W. Normally, if observation i of cross data is variable z, the spatial lag will be $\sum_j w_{ij} z_j$. In most applications, the large number of elements of the row is equal to 0 so the impact on the total of j is just the combination of the "neighbor" ones.

Spatial variables specified in the model are applied spatial lag operator of the dependent variables and to become the explanatory variables or error components. A variety of models for local spatial elements or the entire can be appointed in the manner above (Anselin, 2003). This expansion is set in the panel data by weighted matrix with level $NT \times NT$ associated with y, X, ε from the model (10). More specifically, we will denote as follows:

$$Wy = W_{NT} y = \left(I_T \otimes W_N\right) y$$

$$WX = W_{NT} X = \left(I_T \otimes W_N\right) X$$

$$W\varepsilon = W_{NT} \varepsilon = \left(I_T \otimes W_N\right) \varepsilon$$

Spatial Hausman-Taylor model

In this section, we will revisit Hausman-Taylor models with spatial correlation suggested by Baltagi et al.(2011). The spatial model for time t is given by:

$$y_t = X_t\beta + Z\gamma + u_t = A_t\delta + u_t \tag{14}$$

$$u_t = \rho W u_t + \varepsilon_t,$$

$$\varepsilon_t = \mu + \upsilon_t$$

Where $A_t = [X_t, Z]$ and $\delta = [\beta', \gamma']'$. The explanation variable can be decomposed (decomposed) into $X_t = [X_U, X_{Ct}]$ and $Z = [Z_U, Z_C]$, where subindex C denotes regressors which are correlated with μ while subindex U indicates regressors which are uncorrelated with μ. W is an $N \times N$ observed non-stochastic spatial weights matrix; $\mu_i \sim IID(0; \sigma_\mu^2)$ and time-invariant $\upsilon_{it} \sim IID(0, \sigma_\upsilon^2)$.

Aggregated model for all periods as below:

$$y = X\beta + (\iota_T \otimes Z)\gamma + u = A\delta + u \tag{15}$$

$$u = \rho(I_T \otimes W)u + \varepsilon,$$

$$\varepsilon = Z_\mu \mu + \upsilon$$

Where $Z_\mu = \iota_T \otimes I_N$ is an $NT \otimes N$ selector matrix of ones and zeroes.

For estimation, we employ moment conditions derived in Kapoor et al (2007) for the SRE model and Baltagi et al (2016). In which, need to note the following assumptions:

Assumption. (Instrument set H_{HT})

(i) The instrument are uncorrelated with the error ε.

(ii) The matrix $H_{HT} = [Q_0 X, Q_1 X_U, \iota_T \otimes Z_U]$, in which $Q_1 = T^{-1}(\iota_T \iota_T') \otimes I_N$ and $Q_0 = I_{NT} - Q_1$ has full column rank.

(iii) The elements of H_{HT} are uniform bounded in absolute value.

(iv) $\lim_{N\to\infty}\left[(NT)^{-1}H_I'H_I\right]$ exist, is finite and nonsingular.

(v) $\underset{N\to\infty}{\text{plim}}\left[(NT)^{-1}H_I'Z\right]$ exist, is finite and has full column rank.

Testing for specification SFE, SRE and SHT

For the specification test of FE, RE or HT we use the spatial Hausman test proposed by Mutl and Pfaffermayr (2011):

$$\hat{m}_{SH}=\left(\hat{\beta}_{SRE}-\hat{\beta}_{SFE}\right)'\left[\text{var}\left(\hat{\beta}_{SFE}\right)-\text{var}\left(\hat{\beta}_{SRE}\right)\right]^{-}\left(\hat{\beta}_{SRE}-\hat{\beta}_{SFE}\right)$$

Where superscript "-" refers to the generalized inverse, $\hat{m}_{SH}$ is distributed as $\chi^2\left(\text{rank}\left[\text{var}\left(\hat{\beta}_{SFE}\right)-\text{var}\left(\hat{\beta}_{SRE}\right)\right]^{-}\right)$ under the null hypothesis of no correlation between A and μ. If the null is rejected, the $\hat{\delta}_{SRE}$ is not consistent.

We also use the Hausman test to choose between $\hat{\beta}_{SHT}$ and $\hat{\beta}_{SFE}$ which is given as follows:

$$\hat{m}_{SHT}=\left(\hat{\beta}_{SHT}-\hat{\beta}_{SFE}\right)'\left[\text{var}\left(\hat{\beta}_{SFE}\right)-\text{var}\left(\hat{\beta}_{SHT}\right)\right]^{-}\left(\hat{\beta}_{SHT}-\hat{\beta}_{SFE}\right)$$

And is distributed as $\chi^2\left(K_U-R_C\right)$.

Testing for spatial dependence

Moran'I index:

Statistical test:

$$I=\frac{e^TWe}{e^Te}$$

where: e is residual vector, W is spatial weight matrix. With an assumption that residuals follow normal rules, I-Moran statistic will approach the normal distributions with:

$$E(I) = \frac{k-1}{N-k-1} tr(MW)$$

$$V(I) = \frac{tr\left(MW(MW)^T\right) + tr(MW)^2 + \left[tr(MW)\right]^2}{(N-k-1)(N-k+1)} - \left(E(I)\right)^2$$

where tr is the trace of an matrix, $M = I - X\left(X^T X\right)^{-1} X^T$.

Testing for spatial effects in spatial panel models centers on the null hypotheses $H_0 : \rho = 0$ and/or $H_0 : \theta = 0$ in the various models that spatial HT autocorrelation. The preferred approach is based on Lagrange Multiplier (LM) or Rao Score (RS) tests. This is followed by an illustration of applications of the LM tests in the spatial HT model, which is asymptotically distributed as $\chi^2(1)$, is readily extended to the panel data model with spatial weights matrix $(I_T \otimes W_N)$ as (Anselin et al, 2008):

$$LM_E = \frac{\left[e'(I_T \otimes W_N)e / \left(e'e / NT\right)\right]^2}{tr\left[\left(I_T \otimes W_N^2\right) + \left(I_T \otimes W_N' W_N\right)\right]}$$

Or, using simplified trace terms:

$$LM_E = \frac{\left[e'(I_T \otimes W_N)e / \left(e'e / NT\right)\right]^2}{Ttr\left(W_N^2 + W_N' W_N\right)}$$

Similarly, LM test statistic for a spatial lag alternative LM_L (Anselin, 1988a), becomes:

$$LM_L = \frac{\left[e'(I_T \otimes W_N)y / \left(e'e / NT\right)\right]^2}{\left[\left(Wy\right)' M\left(Wy\right) / \sigma^2\right] + Ttr\left(W_N^2 + W_N' W_N\right)}$$

with $Wy = (I_T \otimes W_N) X\beta$ as the spatially lagged predicted values in the regression, and $M = I_{NT} - X(X'X)^{-1}X'$. This statistic is also asymptotically distributed as $\chi^2(1)$.

2.2. 5. Empirical Application to the Intra-ASEAN Trade

2.2.5.1 Explanatory Data Analysis

The export and import data of Vietnam are based on data from Ministry of Industry and Trade for 11 continous years from 2004 to 2015. The data covers trading information (export and import) of product from all business sectors between Vietnam and countries in ASEAN region including Brunei, Cambodia, Indonesia, Lao PRD, Malaysia, Myanmar, Philippines, Singapore, and Thailand.

The gross domestic product (GDP) and population of home and countries of destination are obtained from World Bank database. GDP deflator index is from World Bank World Development Indicators and IMF data source. GDP per capita and nominal exchange rates are from the World Bank World Development Indicators. Data on the distance between the capital of Vietnam (Hanoi) and the capital of import countries is used to capture the distance from Vietnam to different countries; all distances are indicated according kilometers in the form of logarithm. This data is from the website Prokerala.com.

The gravity model uses distance to model transport costs which is not only a function of distance but also of public infrastructure. We use Liner shipping connectivity index since 2004 (maximum value in 2004 = 100) to capture how well countries are connected to global shipping networks. It is computed by the United Nations Conference on Trade and Development (UNCTAD) based on five components of the maritime transport sector: number of ships, their containercarrying capacity, maximum vessel size, number of services, and number of companies that deploy container ships in a country's ports. The import and export price index of United States are collected from Federal Reserve Bank of St. Louis.

Table 1. Lntrade by ASEAN countries

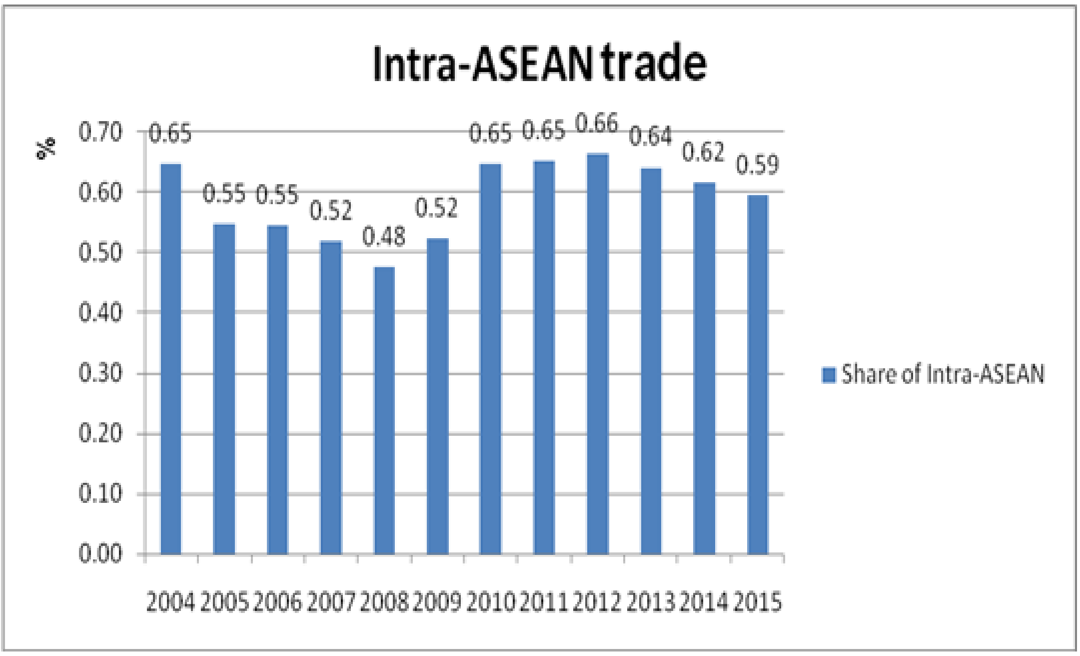
Country	**Lntrade**			
	Average	Std	Min	Max
Brunei	15.82287	1.138898	13.44579	16.97431
Cambodia	21.12426	0.603751	19.94215	21.88184
Indonesia	20.99428	0.565998	20.1188	21.72142
Lao PRD	19.14387	0.654676	18.20762	20.1062
Malaysia	21.5717	0.607231	20.4447	22.51727
Myanmar	17.91138	1.166513	16.47902	20.1212
Philippines	21.01103	0.352523	20.20371	21.39041
Singapore	21.58359	0.159089	21.31644	21.93355
Thailand	21.20318	0.522105	20.27488	22.04824

Source: Author’s estimation based on World Bank data

Table 1 below shows the log trade values. The table indicates that bilateral trade flows in ASEAN are relatively equal. However, Brunei is an exception with the log trade value is lower than other countries. It sounds reasonable because compared to other ASEAN countries, Brunei is relatively small market with a population of about 434000. Additionally, since Brunei has already established a long-lasting trading relationships (like Thailand), it is more difficult for Vietnam to export to Brunei (VCCI 2015). Interestingly, Myanmar has a growing trade flow.

This is in line with the fact that since being an ASEAN membership, Myanmar has started to open its economy and as a result increased its trade flows rapidly in recent years.

Figure 1. Share of Intra-ASEAN on ASEAN trade



Source: Author’s estimation

Figure 1 shows that the intra-ASEAN trade has always been a considerable part of ASEAN’ s total trade. Although the share of intra-ASEAN on ASEAN trade fluctuates within 12 years from 2004 to 2015, it still accounts for nearly two-thirds total trade of ASEAN. Beginning at 65% on total trade in 2004, the share of intra-ASEAN declined dramatically in the following 5 years. In 2010, the figure returned to original position, continually increased to 66% in 2012 before declining slightly to 59% in 2015 due to price increases in primary goods.

In general, it can be seen that intra-industry trade in Vietnam and other countries in Southeast Asia have gradually increased fluctuations, which reflects monopolistic competition market and diversity in tastes of consumers about export and import of products with similar quality.

In trading relations with Vietnam, Indonesia, Lao PRD and Malaysia are the countries have the highest intra-industry trade share with an average of more than 80% per year in the period 2004-2015, which followed by Singapore, the Philippines, Myanmar ... and Brunei accounts for least share of intra-industry trade with Vietnam.

Table 2. Share of Intra-ASEAN by ASEAN countries

Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Brunei	0.463	0.476	0.471	0.487	0.657	0.698	0.826	0.151	0.054	0.056	0.052	0.051
Cambodia	0.508	0.448	0.357	0.33	0.245	0.298	0.3	0.495	0.293	0.294	0.31	0.311
Indonesia	0.811	0.802	0.972	0.92	0.606	0.683	0.857	0.976	0.976	0.983	0.953	0.947
Lao	0.958	0.83	0.726	0.683	0.73	0.807	0.813	0.768	0.973	0.813	0.828	0.814
Malaysia	0.678	0.9	0.917	0.81	0.878	0.819	0.76	0.829	0.863	0.909	0.961	0.92
Myanmar	0.84	0.415	0.407	0.448	0.602	0.729	0.65	0.986	0.963	0.703	0.484	0.358
Philippines	0.548	0.404	0.609	0.6	0.351	0.471	0.582	0.688	0.68	0.72	0.737	0.721
Singapore	0.582	0.599	0.448	0.453	0.45	0.457	0.682	0.503	0.523	0.636	0.604	0.617
Thailand	0.436	0.533	0.47	0.431	0.416	0.454	0.348	0.466	0.657	0.66	0.617	0.612

Source: Author’s estimation

The values of SIM variable are more than 0 and towards 0.5. This demonstrates that there is a positive correlation between the intra-industry trade share and SIM. The values of RLF is relative high, it means that there has a clear difference in terms of relative factor endowments proxied by per capita GDPs between two countries. The larger is this difference, the higher is the volume of inter-industry which leads to the total trade will be, and the lower the share of the intra-industry trade.

In other words, we find a negative correlation between the intra-industry trade share and RLF, and a positive correlation between the intra-industry trade share and SIM. As Helpman (1987) indicated that it is interpreted as supporting evidence of the theory of IRS and imperfect competition in international trades.

Table 3. SIM and RLF by ASEAN countries

Country	SIM				RLF			
	Average	Std	Min	Max	Average	Std	Min	Max
Brunei	0.177099	0.015109	0.158565	0.208854	10.32569	0.054479	10.22025	10.39971
Cambodia	0.168479	0.023971	0.137073	0.20529	6.25025	0.160973	6.051945	6.498219
Indonesia	0.256887	0.026136	0.209019	0.284011	7.476939	0.132354	7.276593	7.672846
Lao PRD	0.106839	0.032133	0.067464	0.15373	5.150435	0.128838	4.906211	5.30005
Malaysia	0.439538	0.024712	0.404713	0.470422	8.959761	0.095705	8.810333	9.126074
Myanmar	0.167406	0.179111	0.028007	0.461831	6.10325	0.341297	5.34471	6.67705
Philippines	0.462407	0.024438	0.428672	0.492345	6.721034	0.069706	6.629614	6.856646
Singapore	0.449659	0.029617	0.411953	0.487942	10.69156	0.098774	10.52253	10.82318
Thailand	0.389786	0.026732	0.351409	0.427372	8.210206	0.083843	8.067706	8.31635

Source: Author's estimation

2.2.5.2 Estimation results

The research considers both dimensions of panel data, namely country and time dimensions. Firstly, in terms of country spatial one, we used a Hausman test to decide whether FE or RE should be used. The observed value is 34.21 with statistically significant level at 0.000; therefore, FE will be deployed.

Column 2 of table 4 presents results of model concerning spatial dimension. Variable lndist is constant over time so that it is removed from the model. As can be seen in column 2, coefficients of variables Lnpoph, Sim, and RERF are statistically significant. While the coefficient of lnpopvn is positive, that of lnpopf is negative. It means that in ASEAN trade, population of countries does not matter for export to them. More interestingly, populated countries are not as attractive as those with less population. Additionally, positive and significant coefficient of Sim indicates that countries with similar GDP are more attractive to each other than those with different GDP.

Table 4. Results of models concerning spatial effects and time effects

Country effects		Time effects	
Variable	**Coefficient**	**Variable**	**Coefficient**
LnGDPh	-0.0573 (0.952)	LnGDPh	1.1125 (0.753)
LnGDPf	0.1481 (0.151)	LnGDPf	-0.89*** (0.000)
Lnpoph	24.931*** (0.000)	Lnpoph	8.097 (0.478)
Lnpopf	-8.7343*** (0.000)	Lnpopf	2.074*** (0.000)
Sim	5.896*** (0.000)	Sim	2.457* (0.051)
RLF	0.2575 (0.277)	RLF	0.516*** (0.003)
RERF	2.9755*** (0.000)	RERF	5.27*** (0.001)
RERH	9233.5 (0.424)	RERH	11423.64 (0.788)
LnDist		LnDist	-1.555 (0.000)
F-test	197.3 (0.000)		
Hausman	34.21 (0.000)	Hausman	0.23 (0.9998)

Source: Author's estimation

(p-value in parentheses *** p<0.01, ** p<0.05, * p<0.1)

Column 4 of table 4 shows results of model concerning time dimension. Different from the model with spatial dimension, this model designates random effects. Positive and significant coefficient of lnpopf indicates that over time countries with large population are more attractive to export products than those with less population. Especially, coefficient of lndist is negative and is statistically significant at $p < 0.01$. This detects a fact that countries nearby are Vietnam are more attractive than other countries. Positive and significant coefficient of Sim helps to reconfirm the attractiveness of countries with similar GDP.

Table 5 represents estimated results of Hausman-model and spatial Hausman-Taylor model. The biggest difference between the two models is the spatial effect. Is there indeed a real interaction between space between nations? The tests on the existence of spatial interaction Moran'I and LM Lag are both statistically significant at $p < 0.01$. It means that there is spatial lag interaction. We use Hausman test to see whether FE spatial model or HT spatial model should be used. Observed value of the test is insignificant at $p < 0.1$. Thus HT spatial model is designated. As can be seen in column 4, coefficient of endogenous variable Lngdphis positive and significant at $p < 0.1$. It illustrates that GDP of Vietnam has a positive impact on export of Vietnam.

Moreover, the negative and statistically significant coefficient of lndist reconfirms results in the model with panel data concerning time dimension. Results in column 4 show that coefficient of LnGDPf is negative and statistically significant at $p < 0.01$ and that of Lnpopf is positive and statistically significant at $p < 0.01$. This leads to a suggestion that gravity of high GDP countries to Vietnamese goods is weaker than countries with low GDP. Additionally, in ASEAN, exports of Vietnam tend to be high in more populated countries.

Table 5. Estimation results of HT Model and Spatial Hausman-Taylor model

Hausman-Taylor Model		Spatial Hausman-Taylor model	
Variables	**Coefficient**	**Variable**	**Coefficient**
	TVendogenous		
LnGDPvn	-0.169 (0.86)	LnGDPvn	4.518* (0.054)
Lnpopvn	23.417*** (0.00)	Lnpopvn	-5.29 (0.100)
	TVexogenous		
LnGDPf	0.119 (0.24)	LnGDPf	-0.9283*** (0.006)
Lnpopf	-6.92*** (0.00)	Lnpopf	2.232*** (0.003)
Sim	5.48*** (0.000)	Sim	2.403 (0.465)
RLF	0.196 (0.402)	RLF	0.5 (0.273)
RERF	2.51*** (0.000)	RERF	6.193** (0.036)
RERH	11075.25 (0.334)	RERH	-45563.8 (0.16)
	TIexogenous		
LnDist	1.153 (0.919)	LnDist	-2.099* (0.053)
		Moran'I	0.582 (0.000)
		LME	0.6056 (0.43)
		LMLag	1636.2 (0.000)
Hausman test	6.52 (0.0891)	Test-HT	1.8974 (0.8316)

Source: Author's estimation

(p-value in parentheses *** p<0.01, ** p<0.05, * p<0.1)

CHAPTER 3. CONCLUSIONS AND RECOMMENDATIONS

3.1. Conclusions

Since Vietnam became a member of ASEAN in 1995, it has actively increased intra-trade with countries in the region. This paper explores the determinants of intra-industry trade flows between Vietnam and ASEAN countries in the recent years through Hausman Taylor (HT) estimation technique along with the conventional panel data approaches.

Estimation results indicate that in the short run, the population of import countries is not the crucial determinant for the export flow into these countries. However, in the long run more populated countries seem to attract more goods flows. In terms of GDP, Vietnam tends to export to countries with similar level of GDP. Concerning the spatial issue, neighboring countries of Vietnam are more attractive to export from Vietnam than other countries.

3.2. Recommendations

From the results of the study, the policy implications are manifold. Firstly, trade should be developed on the basis of fully exploiting comparative advantages and competitive advantage, especially advantages in the geographical area of ASEAN.

In the coming years, exports will remain the main driver of Vietnam's economic growth. Thus it is necessary to persist with the orientation of industrialization towards export. Due to the global financial crisis and recession, the export growth rate should be reduced. Therefore, in order to maintain the export development, Vietnam should attract FDI projects which are essential for the competitiveness improvement of the economy. By doing so, Vietnam could penetrate deeper into the global value chain, and integrate deeper into the world economy in general and ASEAN in particular as a result. Along with this, the government should have policies to enhance export of products with high competitiveness and high added value.

In addition, tough competition amongst countries in ASEAN in the context of global economic recession is also a pressure for Vietnam to quickly change to a new growth model based on its strengths and enhance the quality of exports for a better competition position in the region.

Secondly, there should be a strategy to focus on market development for products with high competitiveness, high added value or groups of products with large turnover.

First of all, we should exploit market opportunities from international economic integration commitments to boost exports to huge markets such as the United States, the EU, Japan, China, South Korea and ASEAN. State of the art technologies from developed countries with which Vietnam has FTAs should be imported. We should retrain imports of products which are widely manufactured in Vietnam and luxurious products. Additionally, there should be policies for developing supporting industries and import substitution industries. Smuggling goods from ASEAN countries should be combatted. Take advantages of new FTAs for opening market in order to diversify import market and import the state of art technology.

The third is about the effective implementation of the commitments, especially commitments with the WTO and FTAs. Vietnam should participate effectively in the world trade negotiations. We should renovate the mechanism and facilitate inter-sectoral coordination in negotiating and implementing commitments during the course of international economic integration. In order to gain a better forecast and effectively respond to major changes in the export market, the capacity and operation of agencies of foreign affairs and trade should be strengthened. Additionally, training activities for staffs involving in negotiations should be paid attention. The capabilities of these staffs could also be enhanced through exchange activities amongst ASEAN countries, especially with more developed countries like Singapore. Vietnam should increase exports to neighboring countries or those with lower GDP.

In order to improve competitiveness, exports to neighboring countries or countries with similar GDP should be promoted. Then Vietnam should develop technology and technical science to export to countries with higher development levels, especially in 2018 tariff barriers on some goods are removed.

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