APPLYING GRAVITY MODEL TO ANALYZE TRADE ACTIVITIES OF VIETNAM

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Abstract: This paper applies gravity model in order to analyze bilateral trade activities between Vietnam and 60 countries from 2000 to 2010. We exploited the panel data on international trade of Vietnam taken from the data banks of International Trade Centre, International 'Monetary Fund and World Bank. The estimated results reveal that economic size of Vietnam, economic size and market size of foreign partners, distance and culture have huge effects on bilateral trade flows between Vietnam and these 60 countries. By applying method of speed of convergence, we also find out that Vietnam has trade potential especially with some new markets such as Africa and Western Asia.

Key words: Gravity model, International Trade, Vietnam

1. Introduction

In the year of 1986, Vietnam began to reform the economy from a centrally - planned to a market economy. The most important aims of the reform were to encourage the development of private economic sector as well as to push up international trade activities of domestic firms with foreign partners. As a result, Vietnam trade activities have been gradually liberalized and witnessed a dramatic growth, contributing to the growth of domestic private enterprises.

The question here is which factors affecting the choice of foreign trade partners of Vietnam in order to effectively exploit the comparative advantages of each country. There were a great number of research using gravity model to point out that gross domestic product (GDP), number of population, geographical distance and culture have important effects on trade flows between countries such as the work of Blomqvist (2004) on Singapore and Montanari (2005) on Balkans.

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To our best knowledge, there have been only two studies using gravity model to analyze the foreign trade activities of Vietnam. The first one belongs to Bac Xuan Nguyen (2010) investigating factors influencing trade flows between Vietnam and other countries from 1991 to 2006. The second one which is owned by Thai Tri Do (2006) is about trade between Vietnam and 23 European countries from 1993 to 2004. However, these two papers only concentrate on long-time (traditional) trade partners of Vietnam. Infact, Vietnam has recently expanded the trade activities to many new regions such as Western Asia and Africa while the traditional export markets tend to be saturated. Notably, bilateral trade between Vietnam and these new markets still has large room for growth. Thus, it is needed to have more research on Vietnam's international trade activities so as to acquire a deeper understanding of Vietnam's trend of trade with potential partners.

In this paper, we use gravity model based on panel data to evaluate influence of specific factors on Vietnam's international trade activities. We utilize data of 60 countries between 2000 and 2010 which is obtained from International Trade Centre (ITC), International Monetary Fund (IMF) and World Bank (WB). The estimated results of the study confirm the relationship between economic size, market size, geographical distance and culture with bilateral trade flows. The estimated results of gravity model are subsequently used to identify potential trade partners of Vietnam by applying method of speed of convergence. Accordingly, Vietnam has a high level of trade potential with some countries especially from European Union, Africa and Western Asia. This method also contributes to recognize the overtrade situation between Vietnam and some developed countries such as the United States, Switzerland and Ireland.

The paper is structured as follows. Section 2 reviews the literature on gravity model as a theoretical basis for the study. Section 3 provides an overview of trade between Vietnam and foreign countries. Section 4 illustrates the methodology and empirical results. Section 5 applies gravity model to calculate trade potential between Vietnam and trade partners. The final section is conclusion.

2. Theoretical framework

The English economist, Adam Smith, was the first one to propose the absolute advantage theory in foreign trade activities. In the book "The Wealth of Nation" published in 1776, he pointed out that countries should specialize in producing goods that have absolute

advantage, then trade with others and they all gain from international trade. However, this theory cannot explain why countries which do not have absolute advantage still get benefit from international trade.

David Ricardo, another English economist, answered that question by his comparative advantage theory which states that "A nation, like a person, gains from trade by exporting the goods or services in which it has its greatest comparative advantage in productivity and importing those in which it has the least comparative advantage" (Lindert, 1991). Subsequently, a model given by two Swedish economists Eli Hecksher and Bertil Ohlin had extended the D. Ricardo's theory and developed an influential theory of trade. Heckscher-Ohlin model is enhanced from the simple model of D.Ricardo by adding capital and land alongside labor and fundamental factors. As one of the leading theories about the determinants of trade pattern of a nation, Heckscher-Ohlin model predicts that a country will export products of which the production use abundant factors intensively and import products of which the production use scarce factors intensively.

Obviously, the classical trade theory indicates that countries which are less similar tend to trade more. Therefore it is unable to explain the huge proportion of trade between nations with similar factor of endowments and intra-industrial trade, which dominate the trade of developed economies. This is the motivation for new trade theories which has been established in the 1980s. New trade theories explain the world trade based on the economies of scale, imperfect competition and product differentiation thereby ease the strict assumptions of classical theory (Krugman and Obstfeld, 2005).

Recently, gravity model has been utilized intensively to explain bilateral trade flows between two countries which cannot be solved by other economic theories. In physics, according to Newton's universal law of gravitation, the gravitational attraction between two objects is proportional of their masses and inversely related to square of their distance. The gravity model is represented as follow:

$$F_{ij} = G \frac{M_i M_j}{D_{ij}^2} \quad (1)$$

Where:

F_{ij} is the gravitational attraction

M_i, M_j are the mass of two objects

D_{ij} is the distance

G is the gravitational constant

Timbergen is a Dutch economist who first applied gravity model to analyse foreign trade flows in 1962. In his model, while dependent variable is the trade flow between country A and B, GDP and geographical distance are independent variables. The final estimated results showed that as opposed to distance, the GDP variable has positive effect on the trade flow between two countries, which means countries with larger economic sizes and closer distance tend to trade with each other more.

Krugman and Obstfeld (2005) also utilizes gravity model for trade activities and they provides a common model as follow:

$$T_{ij} = A\frac{Y_i Y_j}{D_{ij}^2} \qquad (2)$$

Where:

T_{ij} is the total trade flow from origin country i to destination country j

Y_i, Y_j are the economic size of two country i and j. Y_i, Y_j are usually gross domestic product (GDP) or gross national product (GNP)

D_{ij} is the distance between two country i and j

A is a constant term.

After first research of Timbergen, there have been many other economists applying gravity model with similar purposes. For example, Martínez-Zarzoso and Nowak-Lehmann (2004) uses the model to assess Mercosur-European Union trade, and trade potential following the agreements reached recently between both trade blocs. Their estimated results indicate a number of variables, namely, infrastructure, income differences and exchange rates added to the standard gravity equation, are found to be important determinants of bilateral trade flows.

Rahman (2009) attempts to investigate trade potential for Australia using the augmented gravity models and cross section data of 50 countries. His results reveal that Australia's bilateral trade is affected positively by economic size, GDP per capita, openness and common language, and negatively by the distance between the trading partners. The estimated results also show that Australia has tremendous trade potential with Singapore,

Argentina, the Russian Federation, Portugal, Greece, Chile, Philippines, Norway, Brazil and Bangladesh.

Moreover, by applying gravity model, Chan-Hyun Sohn (2005) analyses trade flows in Korea, Ranajoy and Tathagata (2006) explains trends of trade in India, Alberto (2009) considers whether or not gravity model can explain exporting activities of countries in Africa, etc.

There have been a lot of research about international trade activities of Vietnam so far, however, to the best of our knowledge there are only 2 studies using gravity model as we mentioned in section 1.

Thai Tri Do (2006) applies this model in order to explain bilateral trade flows between Vietnam and 23 European countries from 1993 to 2004. He utilizes total value of trade between Vietnam and those countries as dependent variable, and GDP, population, real exchange rate, distance, history as independent variables. The estimated results show that the determinants of bilateral trade between Vietnam and European countries are economic size (GDP), market size (population) and the real exchange rate volatility. However, distance and history seem to have no effect. He also points out that Vietnam has not thoroughly exploited all the potentials in trading with some European countries such as Austria, Finland, Luxembourg.

The study of Bac Xuan Nguyen (2010) uses gravity model to analyse exporting activities of Vietnam with dependent variable being the exporting value from Vietnam to other countries during the 20 year period up to 2006; independent variables are GDP, distance, average real exchange rate and dummy variable ASEAN. After regression, the results show that the value of export from Vietnam to another country increases alongside the raises of GDP, exchange rate and the partner being in ASEAN. Conversely, geographical distance negatively affects exporting value. Vietnam has tendency to have more exports to countries closer to Vietnam geographically.

Based on the literature framework, the following hypotheses are advanced:

Hypothesis 1: *There is a positive effect of economic size and market size on bilateral trade.*

Hypothesis 2: *There is a negative effect of geographical distance on bilateral trade.*

Hypothesis 3: *There is a positive relationship between the devaluation of Vietnam's currency and total trade value.*

3. Methodology and empirical results

3.1. Data description

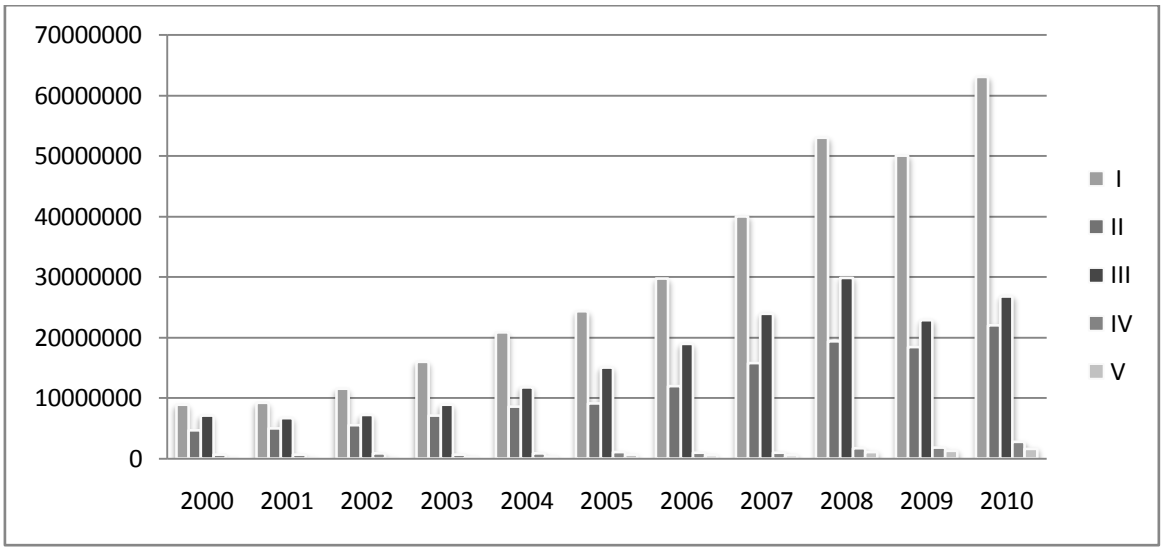
Data of imports, exports and factors influencing trade flows between Vietnam and trade partner is in the form of panel data, obtained from International Trade Centre (ITC), International Monetary Fund (IMF) and World Bank (WB) through the 10 year duration from 2000 to 2010.

The data represents economic variables of 60 countries divided 5 main groups:

- Group I: Top 3 most developed economies in the world: The United States, Japan, China
- Group II: 23 countries in European Union (EU) [(§)]
- Group III: 10 countries in Southeast Asia
- Group IV: 14 countries in Western Asia
- Group V: 10 countries in Africa

Figure 1: Trade values between Vietnam and groups of countries from 2000 to 2010

Thousand US dollars



(Source: ITC)

Figure 1 depicts the trade values between Vietnam and groups of countries above from 2000 to 2010. As can be seen, group I, II, and III outperformed the two remainders, and,

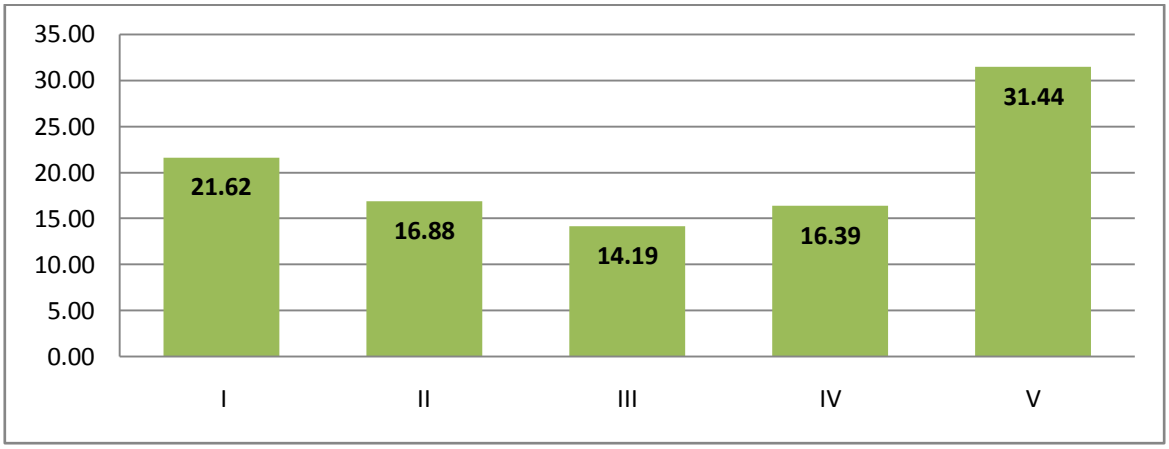
[(§)] Turkey which doesn't belong to EU is included in group II because Turkey is now a member of European Community (EC) and has many things in common with the 22 remainders.

the data for top 3 most developed economies (group I) has been by far the highest. Trade values between Vietnam and those groups also went up by years up to 2008, fell in 2009 because of the economic crisis but finally recovered a year later.

Figure 2 reveals average growth rates of trade value between Vietnam and 5 groups from 2000 to 2010. The data for Africa was highest with a striking 31.44% per year, which shows a huge trade potential between Vietnam and this region. Group 1 came second with 21.62% per year, followed closely by group II and IV (approximately 16.5% for each), group III bottomed out at just over 14%.

Figure 2: Average growth rates of trade value between Vietnam and groups of countries from 2000 to 2010

Percent



(Source: ITC)

Table 1 illustrates top 20 countries which have the highest values of trade with Vietnam in 2000, 2005 and 2010. Countries in group I, II and III still ranked first, however, at the end of the period bilateral trade between Vietnam and some countries in Western Asia and Africa was promoted.

Table 1: Countries gain highest trade values with Vietnam in 2000, 2005 and 2010

Thousand US dollars

2000			2005			2010		
Country	Group	Trade value	Country	Group	Trade value	Country	Group	Trade value
Japan	I	4876148	China	I	9146053	China	I	27946593
Singapore	III	3580200	Japan	I	8414389	US	I	18030686
China	I	2937528	US	I	6792703	Japan	I	16743746

Thailand	III	1183200	Singapore	III	6399278	Thailand	III	6785124
US	I	1096216	Thailand	III	3237088	Singapore	III	6222459
Germany	II	1025532	Malaysia	III	2284792	Malaysia	III	5506511
Malaysia	III	802800	Germany	II	1747435	Germany	II	4115135
France	II	714322	UK	II	1198166	Switzerland	II	3658620
UK	II	629289	Indonesia	III	1168839	Indonesia	III	3342606
Indonesia	III	594000	France	II	1104140	Philippines	III	2406719
Philippines	III	541300	Philippines	III	1038897	Netherland	II	2216153
Netherland	II	475632	Switzerland	II	997704	UK	II	2192944
Belgium	II	403900	Netherland	II	971248	France	II	2070297
Italy	II	388272	Italy	II	758149	Cambodia	III	1840445
Iraq	IV	321563	Cambodia	III	715857	Italy	II	1802611
Switzerland	II	270389	Belgium	II	715271	Spain	II	1341388
Spain	II	196235	Spain	II	487525	Belgium	II	1168990
Cambodia	III	178900	Kuwait	IV	370475	Saudi Arabia	IV	745439
Laos	III	176400	Sweden	II	272859	UAE	IV	731617
Kuwait	IV	114900	South Africa	V	219852	South Africa	V	659209

(Source: ITC)

3.2. Statistical model and variables

In the case of Viet Nam, we apply a variation of gravity model given by Krugman and Obsfelt (2005). In the original model, only two independent variables are introduced including GDP and distances. The model in this paper is further enhanced by adding the variables of population, exchange rate, culture and strategic partner that affect bilateral trade between Vietnam and the partner countries. The gravity model is estimated in logarithm form as follows:

$$\log T_{ijt} = \alpha_0 + \alpha_1 \log(Y_{it}) + \alpha_2 \log(Y_{jt}) + \alpha_3 \log(N_{it}) + \alpha_4 \log(N_{jt}) + \alpha_5 \log D_{ij} + \alpha_6 EX_{ijt} + \alpha_7 C_{ij} + \alpha_8 P_{ijt} + e_{ijt} \quad (3)$$

Where:

i = 1 (Vietnam)

j = 2, 3, 4,... (partner countries)

t = 2000, 2001, 2002,..., 2010

T_{ijt}: Vietnam's trade with country j in year t

Y_{it}: Vietnam's GDP in year t

Y_{jt}: GDP of country j in year t

N_{it}: Vietnam's population in year t

N_{jt} : Population of country j in year t

D_{ij} : Distance in kilometers between Vietnam and country j

EX_{ijt} : Exchange rate between Vietnam and country j in year t

C_{ij} : Culture dummy variable for the cultural gap between Vietnam and country j

P_{ijt} : Strategic partner dummy variable for the strategic partnership between Vietnam and country j in year t

e_{ijt} : Error term

Dependent variable is annual trade (exports plus imports) of Vietnam and partners. The data for this variable are obtained from International Trade Centre (ITC) database, the period from 2000 to 2010.

Gross domestic product of Vietnam and partner countries are used as measure of economic size. These two variables are expected to have positive impact on the trade promotion. Data on GDP of the countries are obtained from the database of International Monetary Fund (IMF).

Population is used to estimate the market size of each country which is a factor affecting international trade. The larger the market the more it trades, so the market size is expected to turn out with positive sign. Population figures for Vietnam and partners are obtained from the annual statistics of the World Bank (WB).

Previous studies, such as Bergstand (1985) and Dell'Arricia (1999), showed that the addition of the exchange rate on gravity model has helped to explain the trade variation among participating countries. Therefore, the exchange rate will be included as an explanatory variable in the model and calculated by the formula:

$$EX_{ijt} = \frac{\text{Annual average of the national currency unit of Vietnam per US dollar}}{\text{Annual average of the national currency unit of country j per US dollar}} \text{(in year t)}$$

With this formula, we will determine annual average exchange rate by the Vietnam's currency units per one unit of partner country's currency. Data on exchange rates of countries are acquired from the World Bank. An increase in exchange rate means that Vietnam's currency devalued, as a result imports would be more expensive and exports would be cheaper. However, Vietnam was still a net importer during the period 2000 – 2010. Therefore, devaluation of national currency leads the total value of trade flows

being anticipated to increase. In brief, exchange rate variable is expected to have a positive effect on trade between Vietnam and the partners.

Distance represents transportation cost when participating in international trade. It is calculated in kilometers from Hanoi, the capital of Vietnam, to the capitals of other countries. Data on distance is taken from Great Circle Distance between Capital Cities (Byers, 1997; website: www.chemical-ecology.net), considered as measuring the minimum geographical distance on the surface of the earth. This variable is expected to cause a negative impact on trade flows because transportation cost would be proportional to the distance between two countries.

We also include some control variables in this model which reflect individual characteristics of countries including culture and strategic partner. The variable of cultural gap is a qualitative variable which represents the extent of cultural similarity between Vietnam and partners. We base on a universal factor of every national culture to construct this variable; it is religion (state religion or the religion of the majority of country's population). The value is set to 1 if the country's religion is one of the religions having the closeness with Vietnam's culture: Buddhism, Taoism, and Confucianism; set to 0 for remaining countries. Culture variable is expected to show the positive sign.

The last variable is strategic partner. This is a qualitative variable representing the political and economic relationship with partners which are considered to have a significant impact on security, economic and international status of Vietnam. A value of 1 is set for countries that signed strategic partnership agreement with Vietnam and 0 is set for the rest. Strategic partner variable is expected to be positive.

Table 2 presents the descriptive statistics of variables used in the study.

Table 2: Descriptive statistics

No.	Variable	Description	Obs	Mean	Std. Dev.	Min	Max
1	T_{ijt}	Vietnam's trade with partner countries	660	987916	2756959	0	2.79e+07
2	Y_{it}	GDP of Vietnam	660	6.03e+10	2.61e+10	3.12e+10	1.06e+11
3	Y_{jt}	GDP of partner countries	660	6.18e+11	1.77e+12	2.77e+08	1.44e+13
4	N_{it}	Population of Vietnam	660	8.23e+07	2941405	7.76e+07	8.69e+07
5	N_{jt}	Population of partner countries	660	5.62e+07	1.71e+08	281205	1.34e+09
6	D_{ij}	Distance between Vietnam and partner countries	660	7026.92	3031.95	481.58	13346.30
7	EX_{ijt}	Exchange rate between Vietnam and partner countries	660	9829.20	12510.58	1.44	64942.39
8	C_{ij}	Cultural gap between Vietnam and partner countries: 0: Other religions 1: Religion of Buddhism, Taoism or Confucianism	660	0.117	0.321	0	1
9	P_{ijt}	Strategic partnership: 0: agreement not signed 1: agreement signed	660	0.017	0.128	0	1

There are three main models can be used to estimate in panel data: pooled model, random effects model (REM) and fixed effects model (FEM). In order to decide to choose which model, we need to consider the properties of the data as well as base on the results of tests.

Each entity has its individual characteristic which can affect its explanatory variables, called the individual effects. For example, the factor of preference or infrastructure, although not being mentioned in the model, will still affect trade flows of each country. If individual effects do not exist, the pooled model will be the best choice. However, if they exist and must be reflected in the model, the FEM and REM will be more preferred.

According to the theory of Gujarati (2003), FEM will be selected if there is a correlation between individual effects and explanatory variables. Meanwhile, the regression model will be able to control over and separate the impact of individual effects from explanatory variables so that we can estimate the net effects of explanatory variables on dependent variable. But if individual effects of the entities are random and not correlated with explanatory variables, REM will be more effective. REM considers the residual of each entity (which is not correlated with explanatory variables) as a new explanatory variable and can estimate the invariant factors such as gender, distance...

The main problem of FEM is that the variables which do not change over time cannot be estimated directly in this model. So variables such as distance, culture in equation (3) will not be supported in FEM. To solve this problem, the choice of many studies is using REM. In addition, there is a method to estimate these invariant variables in FEM, as the method which Cheng and Wall (2005) used in their study, running another regression with the dependent variable as individual effects and the independent variables as invariant variables. However, this method can affect the accuracy of the regression as well as the Hausman test for FEM and REM.

In this study, we decide to use pooled model and random effects model for estimation. Trade equation will be estimated by two models, then Breusch-Pagan LM test (xttest0) will be applied in order to select the most appropriate model for interpreting the estimate results.

3.3. Estimation Results

Table 3 presents the result of Breusch-Pagan LM test for random effects model. Test result indicates the hypothesis "individual effects from the entities do not exist" has been rejected, which shows the low effectiveness of pooled model. Thus, we decide to select random effects model and focus the interpretation on estimation results obtained from this model.

Table 3: Breusch-Pagan Lagrangian multiplier test for random effects model

Null Hypothesis: There is no significant difference across units

Model	Chi-square	P-value
Random effects model	1991.33***	0.0000

Note: *** is statistically significant at 1% level

We do some diagnostic test to relax the assumptions of random effects model. The result shows that there are multicollinearity and heteroscedasticity (see also Apendix). Multicollinearity can be explained by the high correlation of two variables Vietnam's GDP and Vietnam's population. However, this is a common statistical phenomenon of gravity model estimation. In the case of large enough sample size in our study, the impact of multicolinearity on estimated result can be controlled. For heteroscedasticity, we use feasible generalized least squares (FGLS) regression for heteroskedastic panel to resolve this phenomenon. Table 4 presents estimation results using equation (3) after resolving defects.

Table 4: Estimation Results

Dependent variable: T_{ij}

Independent variable	Coefficient	z-statistic	P-value
Y_i	0.644**	2.33	0.020
Y_j	0.808***	41.03	0.000
N_i	2.242	0.67	0.500
N_j	0.198***	9.52	0.000
D_{ij}	-1.281***	-17.23	0.000
EX_{ij}	7.28e-06***	3.47	0.001
C_{ij}	0.371**	2.41	0.016
P_{ij}	0.078	0.63	0.530

Note: ***;** are statistically significant at 1%;5% level

The variables which have influence on Vietnam's bilateral trade are: economic size of both Vietnam and partner country (Y_i, Y_j), foreign market size (N_j), distance (D_{ij}), exchange rate (EX_{ij}) and culture (C_{ij}). Vietnam's market size (N_i) and strategic partner (P_{ij}) seem to have no impact on bilateral trade because of insignificant coefficients.

The growth in GDP of Vietnam and partners will help to increase total trade value. The estimated coefficients of these two variables have statistical significance and show positive influences, in line with expectations when constructing the model. An increase of 1% in foreign partner's GDP will enhance trade value by approximately 0.8% and the same increase in Vietnam's GDP will enlarge that value by approximately 0.64%. This also shows that foreign economic size has bigger influence than Vietnam's. While Vietnam's market size does not affect bilateral trade, foreign market size is statistically significant with a positive impact. If population of partner country increases by 1%, the bilateral trade value will step up by roughly 0.2%. Therefore, hypothesis 1 - positive effect of economic size and market size on bilateral trade - is strongly supported.

Geographical distance is statistically significant and estimated to impair bilateral trade between Vietnam and partners, confirming hypothesis 2. With an increase by 1% of distance, the trade value will decrease by 1.28% on average. The exchange rate is highly statistically significant but the effect of this variable on trade is insignificant. However, its coefficient is just over zero so still partially supports hypothesis 3. In addition, culture variable also shows a positive correlation when participating in trade with countries which have similar cultures.

Estimated result obtained from the model in this study has similarities with previous studies in the application of gravity model to evaluate bilateral trade. Economic size and market size are influential in commercial activities, which means large countries, which can produce more goods and services for exports and have high-income with a large consumer market, will increase the demand of imports. The positive effect of exchange rate is also shown in many studies, but the influence is insignificant (0.00000728) in this paper. It indicates that the change in exchange rates of Vietnam's currency does not significantly support for commercial activities in the research duration. This can be explained by despite of the change in exchange rate, the value of exports still dominate imports, and exchange rate policy in Vietnam during this period does not have a influence on increasing the competitiveness of exports.

Geographical distance affects bilateral trade negatively; this has been indicated in the results of many models, including the first one of Tinbergen (1962). The variable of cultural gap is a new innovation for the gravity model and statistically significant. Culture drives bilateral trade in a positive way. Accordingly, these countries which have more cultural similarities with Vietnam, like China, Japan, Thailand… will have more potential in bilateral trade.

Finally, strategic partner variable cannot achieve its effect on trade value of Vietnam. A possible explanation of this problem is that the signing of partnership strategy agreement of Vietnam during the period 2001 - 2010 has been strengthened, however, not efficient. When having more strategic partner, Vietnam's resources will be distributed and hard to focus on investments promoting important economic and political relationships. Moreover, if looking at the list of Vietnam's strategic partners, we can see some countries that their influence on security, economic and international status of Vietnam does not match the meaning of the word "strategic".

4. Trade potential

4.1. Measurement method

Calculating trade potential is an intensive part in study of gravity model. According to research of Cheikbossianand Maurel (1998), the point estimated coefficients have been applied for the data of independent variables to measure trade potential from gravity model. Potential trade will be compared with the actual trade to consider whether the flows of bilateral trade between two countries has been overused or underused. However, recent studies have pointed out the error of applying this method to calculate the potential of bilateral trade (see also Egger, 2002). Acquiring criticisms about the uncertainty of the point estimates method, Jacobs et al. (2001) recommended a method of speed of convergence (SC) as follows:

$$\text{Speed of convergence} = \frac{\text{Average growth rate of potential trade}}{\text{Average growth rate of actual trade}} \times 100 - 100$$

The method of speed of convergence acknowledges the convergence if the growth rate of potential trade is smaller than that of actual trade and as a result the speed of convergence will be negative. In the opposite case, we have the divergence. The effectiveness of this

method is that it exploits the flexible structure of the data during the estimation process, in other words it provides more accuracy than the point estimates method.

However, we have found that the negative speed of convergence cannot reflect the convergence of potential and actual trade. We need to consider the difference between potential trade value and actual trade value. In particular:

$$\Delta T = \text{potential trade value} - \text{actual trade value}$$

If SC and ΔT are unlike signs, there will be the convergence between potential trade value and actual trade value. If SC and ΔT are like signs, we will have the divergence. Countries with the result of the convergence will have high potential for developing bilateral trade with Vietnam. For remaining partners, we will evaluate the current situation to see whether they are overtrade or restrictive potential.

5.2. Evaluation of trade potential

To estimate ΔT and SC in bilateral trade between Vietnam and partner countries, we use the results from regression of equation (3) by FGLS method to calculate the average growth rate and the difference of potential trade value and actual trade value.

Results of trade potential between Vietnam and foreign partners are shown in Table 5. The bilateral trade situations between Vietnam and partners are separated into two groups: convergence and divergence. According to the statistics in the table, we found that Vietnam had the convergence in trade with 31 countries out of 60 countries in the scope of the study. This result demonstrates Vietnam still has untapped potential for trade with many countries. Bilateral trade between Vietnam and these countries still has opportunity to grow in the next period.

Table 5: Trade potential between Vietnam and foreign partners

Country	Group	Speed of convergence (SC)	Difference between potential and actual trade value (ΔT)	Situation
Egypt, Arab Rep.	V	-22.56392	144639.7	1
Algeria	V	-23.1912	77493.2	1
Morocco	V	-26.09124	52808.55	1
Tanzania	V	-30.38629	-62720.69	0
Kenya	V	-26.74667	10960.64	1

South Africa	V	-42.63921	-345249.7	0
Angola	V	119.7605	-47101.06	1
Nigeria	V	-12.74869	89054.11	1
Cote d'Ivoire	V	-72.00916	-242271.3	0
Senegal	V	-33.68393	-81068.95	0
Brunei Darussalam	III	-33.15762	39842.59	1
Cambodia	III	-16.67505	-1475008	0
Indonesia	III	33.44904	-61523.25	1
Laos	III	130.8019	100087.1	0
Malaysia	III	-2.610986	-3924034	0
Myanmar	III	-12.79975	1129795	1
Philippines	III	23.38049	-435445.8	1
Singapore	III	241.8259	-4834830	1
Thailand	III	5.605048	1390090	0
Timor Leste	III	-65.20447	-48786.47	0
China	I	9.037809	2.93E+07	0
Japan	I	0.859266	1762056	0
United States	I	-53.52708	-1.13E+07	0
Bahrain	IV	184.5964	34592.88	0
Cyprus	IV	34.03049	3692.299	0
Iran	IV	84.58376	595267.7	0
Iraq	IV	-458.3756	-35727.73	0
Israel	IV	-35.31742	2113.047	1
Jordan	IV	-23.51915	4393.664	1
Kuwait	IV	85.41183	-174206.4	1
Lebanon	IV	-47.62498	11598.54	1
Oman	IV	-59.6176	96575.86	1
Qatar	IV	35.43642	54464.31	0
Saudi Arabia	IV	-48.14085	-110872.3	0
Syria	IV	-37.91984	60237.14	1
UAE	IV	-36.62859	-314324.5	0
Yemen	IV	253.7445	47294.7	0
Austria	II	7.359306	67609.94	0
Belgium	II	65.99056	-791891.3	1
Czech Republic	II	30.63013	-31556.45	1
Denmark	II	27.07494	-85361.97	1
Finland	II	0.8839738	46204.75	0
France	II	61.88382	-21687.25	1
Germany	II	14.52195	-1126971	1
Greece	II	28.67653	218598.6	0
Hungary	II	20.94687	-19523.81	1
Iceland	II	1115.561	-4200.171	1

Ireland	II	-13.19508	-5791.781	0
Italy	II	7.293665	3910.5	0
Luxembourg	II	-46.01102	9005.922	1
Netherland	II	11.54974	-1591889	1
Norway	II	-16.66734	74776.44	1
Poland	II	30.7571	158000.3	0
Portugal	II	-26.6704	62212.67	1
Slovak Republic	II	-25.20047	-32295.04	0
Spain	II	0.6396586	-215921.5	1
Sweden	II	-9.253313	-185632.5	0
Switzerland	II	-35.67072	-3271820	0
Turkey	II	-53.93424	335227.5	1
United Kingdom	II	24.28945	-155760.8	1

Note: 1 - convergence; 0 - divergence

With the exception of three most developed economies (group I), European Union (group II) and Africa (group V) which are leaders of trade potential with 14/23 countries in EU (61%) and 6/10 countries in Africa (60%) having the convergence in trade with Vietnam. Followed by Southeast Asia (group III) with 5/10 countries (50%) and West Asia (group IV) with 6/14 countries (43%). Particularly in group I, China is recognized as a restrictive potential partner of Vietnam because potential growth rate and trade value are higher than actual ones. Meanwhile, the indexes of the United States indicate the overtrade situation by a superiority of both actual growth rate and trade value than potential.

For countries with convergence condition, the most potential partners are countries which have the larger magnitude of SC and smaller magnitude of ΔT. In other words, the larger speed and the smaller difference will more quickly bring the actual trade value to the potential one. Result of dividing $\Delta T/SC$ will give a value reflecting the time of convergence. Countries which have smaller time of convergence will be potential partners of Vietnam in developing bilateral trade. And for countries with divergence condition, we need to find out whether they are overtrade or low potential. This can be recognized when reviewing ΔT. If $\Delta T < 0$, the result will be overtrade and if $\Delta T > 0$, the result will be restrictive potential.

Top 15 countries which have the smallest time of convergence in convergence condition is shown in Table 5 follow:

Table 5: Countries which have the smallest time of convergence

No.	Country	Time of convergence
1	Iceland	3.77
2	Israel	59.83
3	Jordan	186.81
4	Luxembourg	195.73
5	Lebanon	243.54
6	France	350.45
7	Angola	393.29
8	Kenya	409.79
9	Hungary	932.06
10	Czech Republic	1030.24
11	Brunei Darussalam	1201.61
12	Syria	1588.54
13	Oman	1619.92
14	Indonesia	1839.31
15	Morocco	2024.00

It can be seen clearly that in 15 partners with large potential for bilateral trade with Vietnam, there is the participation of 2/3 from EU and Western Asian. Among remaining partners, there are 3 African countries and 2 countries in Southeast Asia. This proves that a long-time market like EU still has much untapped potential. Besides, Western Asian is evaluated as a highly potential area for development of bilateral trade with Vietnam. Africa, with 6 countries of convergence condition and 3 countries in the top, also represents a new market which has many expandable opportunities. Trend in trade with major countries (with big economies and large populations) which has been predicted in gravity model also contributes to explain the existence of trade potential between Vietnam and Western Asia or some small countries in Europe such as Iceland, Luxembourg, Hungary…

For overtrade situation in some major countries, the United States is the most typical. The main reasons are the promotion of investment between the United States and Vietnam in this period and the remittance from Vietnamese community in the United States. It has contributed to improved bilateral trade between two countries. In addition, the enhancement in flow of foreign direct investment (FDI) may explain overtrade between Vietnam and some countries such as Sweden, Switzerland, and Ireland.

5. Conclusion

The main purpose of this study is determining factors which affect the bilateral trade flows between Vietnam and partner countries around the world; and reviewing the potential for trade growth between Vietnam and those countries. Gravity model was estimated with the data from 60 countries in the period from 2000 to 2010. Estimation results indicate that bilateral trade flows between Vietnam and partners are mainly affected by the economic size, foreign market size, geographical distance and national culture.

Growth in economic size of Vietnam and foreign partners has a positive impact on the flows of bilateral trade between them. In particular, foreign economic size has greater impact. Besides, the increase in foreign market size also positively influences on total trade value. Geographical distance and national culture are two factors which have impact on international trade. If the distance causes negative effect, the cultural similarity has positive effect on trade growth. Exchange rate is estimated to have positive impact on bilateral trade, but with an insignificant level.

By the result from measurement method of speed of convergence, we identify the countries which have high potential for trade growth with Vietnam, particularly concentrate on European Union and two new regions Africa and Western Asia. Moreover, this method also contributes to the explanation of the overtrade situation between Vietnam and some countries such as the United States, Switzerland and Ireland.

This study also has some limitations. It is limited in the data when some other areas in the world has not been observed and included in the research. In the future, a study with large-scale data of space and time should be conducted, and will certainly give a universal result and fewer errors. However, this paper, in our opinion, provides an interesting result and may help policy makers to obtain the clearer view of trade improvement's trend of Vietnam in the following periods.

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Appendix

Table A1: Correlations in the dataset

Variables	T_{ij}	Y_i	Y_j	N_i	N_j	D_{ij}	EX_{ij}	C_{ij}	P_{ij}
T_{ij}	1.00								
Y_i	0.32	1.00							
Y_j	0.71	0.19	1.00						
N_i	0.32	0.99	0.19	1.00					
N_j	0.57	0.04	0.58	0.04	1.00				
D_{ij}	-0.25	0.00	0.26	0.00	-0.04	1.00			
EX_{ij}	0.00	0.09	0.11	0.09	-0.31	0.17	1.00		
C_{ij}	0.40	0.00	-0.02	0.00	0.23	-0.76	-0.22	1.00	
P_{ij}	0.25	0.16	0.24	0.15	0.20	-0.06	-0.02	0.25	1.00

Table A2: Variance-inflating factor (VIF) of independent variables

Variable	Description	VIF
Y_{it}	GDP of Vietnam	46.06
N_{it}	Population of Vietnam	45.96
C_{ij}	Culture	2.89
D_{ij}	Distance	2.87
Y_{jt}	GDP of partners	2.12
N_{jt}	Population of partners	2.03
EX_{ijt}	Exchange	1.30
P_{ijt}	Strategic partner	1.17
Mean VIF		13.05

Table A3: Breusch-Pagan test for heteroscedasticity

Null Hypothesis: Variance of the residuals are not dependent on independent variables

Model	**F-statistic**	**P-value**
Random effects model	10.94***	0.0000

Note: *** is statistically significant at 1% level

Table A4: Modified Wald test for groupwise heteroskedasticity

Null Hypothesis: $\sigma_{(i)}^2 = \sigma^2$ *for all i*

Model	Chi-square	P-value
Random effects model	50787.06***	0.0000

Note: *** is statistically significant at 1% level

Table A5: Friedman's test and Pesaran's test for cross-sectional dependence

Null Hypothesis: No cross-sectional dependence

Model	Test	Test statistic	P-value
Random effects model	Friedman's test	10.495	1.0000
	Pesaran's test	0.818	0.4133