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FREE TRADE AGREEMENTS, RULES OF ORIGIN AND TRADE EFFICIENCY – A STOCHASTIC FRONTIER GRAVITY MODEL APPROACH

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Abstract

My thesis investigates the effects of Free Trade Agreements (FTAs) on trade efficiency. The FTA is classified into two factors: the status of being a member of FTA captures the abatement of trade resistances; and, the Rule of Origin (RoO) represents the new kind of trade resistance. Trade efficiency is defined as the ratio of actual trade to trade potential, with the latter regarded as the maximum possible trade that can be achieved in a hypothetical case of most frictionless circumstances. The thesis used Vietnam panel data, focusing on Vietnam's exports to three main regional FTAs, including ASEAN, EU and NAFTA, for the period 1995-2013. Using the stochastic frontier gravity model approach to estimate trade efficiency, I found that the stochastic frontier approach is valid and Vietnam's trade efficiency increases over time. The Ordinary Least Square method (OLS) was then applied to measure the impact of the status of being a member of FTA and RoO on trade efficiency; the findings are that while Vietnam's membership of ASEAN increases trade efficiency, and the non-membership of EU and NAFTA reduces trade efficiency, the appearance of RoO in each FTA dampens the trade efficiency of Vietnam export flows to its trading partners. These findings have important policy implications: Vietnam should enter new FTAs and deepen economic integration by speeding up the process of trade agreement negotiation, especially with its main trading partners (the EU and US) to ensure RoO should be as least restrictive as possible.

Key words: FTA, Rule of Origin, Trade Efficiency, Stochastic Frontier Gravity Model.

1. Introduction

Free Trade Agreements (FTAs) have become increasingly prevalent since the early 1990s. According to the WTO, the number of FTAs in force in 2014 was 259. However, there has a tradeoff concerning the benefits of FTA membership (Frankel, Stein, & Wei, 1996). While there is a *trade creation* effect that arises from the abolishment of trade barriers such as tariffs on domestic goods and those of other members, there is the potential for a *trade diversion* effect due to the introduction of non-tariffs, such as Rule of Origin implications between member and non-member goods.

A large number of economists have questioned whether trade creation and/or trade diversion effects of FTAs appear. They created a dummy variable for the appearance of a FTA between two countries or constructed FTA dummies for each specific FTA to examine the impact of each of them on bilateral trade flows. Applying such an approach caused ambiguous results. A positive and significant impact on trade flows among members in the European Community was shown by several economists (Aitken, 1973; Abrams, 1980; Brada & Mendez, 1983), whereas others pointed out insignificant effects (Bergstrand, 1985; Frankel, Stein, & Wei, 1995). In his 1997 study, Frankel found a positive effect from MERCOSUR[1], a negative effect from European Community, and insignificant effects from the Andean Pact. Other papers tried to measure the trade diversion of FTAs by using dummy variables that receive the value of '1' if only one country joined into a FTA in each country pair. In research conducted by Frankel, Stein and Wei (1996), they used a gravity model to capture the effects of different FTAs represented by dummy variables with panel data of 63 countries in the period 1965-1992. They discovered trade creation in the Andean Pact, ASEAN, ANZCERTA,[2] European Community, and MERCOSUR. While there was trade diversion in ANZCERTA, EFTA, and NAFTA, other FTAs, such as ASEAN, MERCOSUR, Andean Pact and the European Community, showed unexpected results, with positive coefficients for the dummy variables. The mixed results arise because the previous

[1] Stands for "Mercado Común del Sur" or "Southern Common Market" which is a sub-regional bloc including Argentina, Brazil, Paraguay, Uruguay, and Venezuela.
[2] Australia New Zealand Closer Economic Relations Trade Agreement

studies only were focused on the status of being a member of a FTA, but ignored the role of RoO.

Rules of Origin (RoO) accompany FTAs to avoid trade deflection, by controlling the trade flows among FTA members. Because of the abatement of trade barriers, the trade creation effect will increase trade flows. Additionally, since producers are able to take advantage of economies of scale and produce more differentiated products within the regional trade areas, the overall trade volume is likely to increase more in the FTAs. However, it appears another kind of trade barrier appears together with an FTA: Rules of Origin, which might be defined in several ways. The following is the definition given by The International Convention on the Simplification and Harmonization of Customs Procedures (the so-called Kyoto Convention which entered into force in 1974): "The specific provisions, developed from principles established by national legislation or international agreements applied by a country to determine the origin of goods" (Annex D, currently Annex K to the Revised Kyoto Convention). Conceptually, Miguel (2003) argued "RoO is a set of requirements that must be met by a final good in terms of the inputs and intermediate goods used in its production, in order to define the nationality of the product, in the case of an individual country, or of a geographic territory, in the case of a group of countries".

Estevadeordal and Suominen et al. said:

> RoOs are widely considered 'hidden protectionism', an obscure and opaque trade policy instrument that can work to offset the benefits of tariff liberalization. RoOs in effect set up walls around FTA members that prevent them from using certain inputs in each final product. This limits the access of member country producers to inputs from the rest of the world, as well as extra-regional input providers' sales to the FTA region. (Estevadeordal and Suominen et al., 2009).

Restrictive RoOs can discourage exporters from taking advantage of tariff preferences provided by FTAs, due to an increase in production and administrative costs; RoO also undermines the possibilities for transshipment, reducing the intra and extra-FTA goods trade (Estevadeordal and Suominen, 2005). Briefly, the more restrictive the rules of origin, the higher are the walls they create, and the lower trade efficiency becomes. Therefore, RoO has a negative impact on both member-member and member-nonmember trade efficiency.

From the above analysis, FTA abates but does not completely eliminate the resistances to trade. This study will classify the effect of FTA into two factors: the status of being a member of a FTA captures the abatement of trade resistances, therefore it increases trade efficiency; RoO appears as a new kind of trade resistance, then it dampens trade efficiency.

Vietnam, FTAs, RoOs and Trade

Table 1: List of Vietnam FTAs in force, negotiation and proposal

FTAs in force	FTAs in negotiation	FTAs in proposal
ASEAN	Vietnam-EU	ASEAN-Hongkong and China
ASEAN-China	Regional Comprehensive Economic Partnership	ASEAN-Pakistan
ASEAN-Korea	ASEAN-EU	CEPA/ASEAN+6
ASEAN-Japan	TPP	East Asia FTA (ASEAN+3)
Vietnam-Japan	Vietnam-Customs Union of Russia, Belarus and Kazakhstan	Vietnam-Ukraine FTA
ASEAN-Australia and New Zealand	Vietnam-Korea	
ASEAN-India		
Vietnam-Chile		

Note: http://aric.adb.org/fta-country retrieved on March 2015

As of March 2015, Vietnam has 8 signed FTAs in effect, but does not yet have FTAs with its big trading partners such as the EU and US. However, it has negotiated and proposed to create FTAs with EU and US as well as other important partner countries (Table 1). The proliferation of FTAs around the world in general, and in Vietnam in particular, has focused policy attention to RoO and its trade effect. RoOs are typically specific to FTAs and they are products of serious and thorough negotiations among members before finalizing a trade agreement. From each RoO, we can know the degree of liberalization or restrictiveness of trade which then affects the trade efficiency.

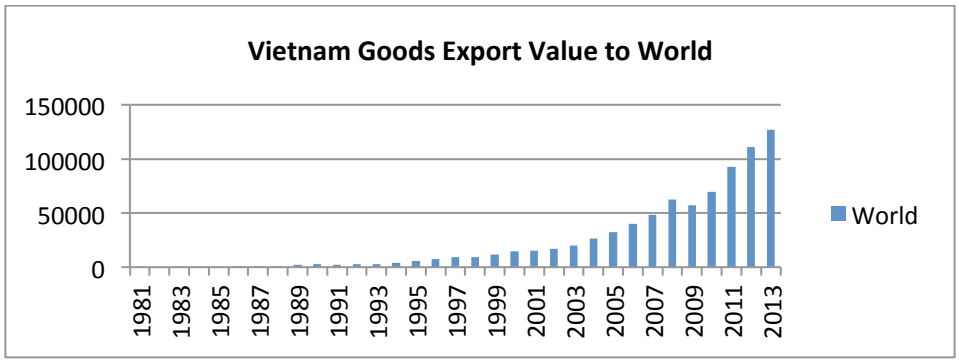

Figure 1. Vietnam goods export value to the world, millions USD

Note. Direction of Trade Statistics (DOTS)

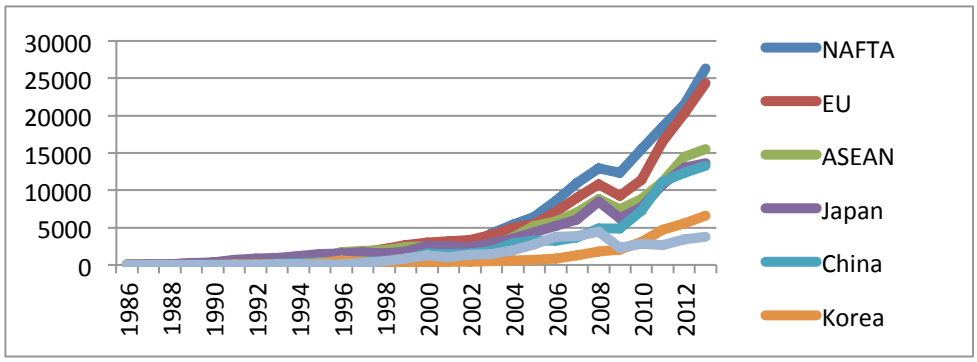

Figure 2. Vietnam goods export value to main FTAs over time, millions USD

Note. Direction of Trade Statistics (DOTS) and self-calculation

From Figures 1 and 2, Vietnam's goods export to the world and to main FTAs, in general, increases over time as a result of economic open policies that began from 1986, and are known as "Doi Moi" (Vietnam Economic Renovation). Joining ASEAN in 1995 is a milestone marking the integration of Vietnam to the world, followed by entering new FTAs with China (2005), Korea (2007), Japan (2008), Australia and New Zealand (2010), India (2010), and Chile (2013). In spite of increasing export value in direct proportion to the number of FTAs through time, Vietnam's actual exports are very low compared with potential exports, running at only about 31% of sample sizes of 28 main trading partners (self-calculation). There is a need to determine the driving forces of Vietnam's trade efficiency, especially if the FTAs' trade effect is negative. It becomes more important in the context that Vietnam has to determine further RoOs when it is planning to enter new FTAs. To put it simply, this study focuses on Vietnam's exports

to three main regional FTAs -- including ASEAN, EU and NAFTA -- that create specific RoOs with differing levels of restrictiveness. The main assumptions are that becoming a member of FTA increases export flows, but RoO dampens the export efficiency whether or not Vietnam and its trading partner belongs to a FTA. Therefore, there are two questions required to be answered: (1) Does the status of being a member of FTA increase trade efficiency? (2) Do rules of origin dampen trade efficiency?

2. Literature Review

The effects of RoO on trade have received rigorous theoretical attention, like that of Ju and Krishna (1998), Duttagupta and Panagariya (2003) and Estevadeordal and Suominen (2003a &b). They claimed that RoO can affect trade by causing two kinds of costs, being production cost and administrative cost. The various technical requirements cause the production costs. The costs of production may arise through the fact that RoOs are built on the content of the Harmonized System, which was not designed with an aim to determine origin. For example, a good that suffers a substantial transformation in practice may not meet the requirement to change its tariff classification, and therefore does not pass the Change in Tariff Classification test. The administrative costs derive from the procedures needed to determine the compliance with the RoO. These relate to bookkeeping costs which are imposed on both exporters and importers to certify the origin of goods before and after shipment. The variety of certification mechanisms also puts additional costs on firms and governments, especially when a country joins into some FTA with dissimilar kinds of RoO. Others features that may affect the impact of RoO on trade are, say, the characteristics of the firm – "how easy is it for the firm to change the share of its value added in the production by changing underlying production technology, sourcing intermediates from domestic sources/partner country substitutes, prices differentials between domestic and imported sources used to calculate the domestic content of its intermediate inputs and, thereby, prove origin", and of the sector/industry – "the height of the preference margin and the responsiveness of market demand for the final product to price changes" (Gasiorek, M., Augier, P., & Lai-Long, C., 2007). The theoretical results seem quite clear: RoO reduces the goods trade below the levels that would be traded without RoO.

Empirical studies of RoO's trade effects are scarce because of the difficulties in converting the complex technical requirements into a variable that captures the measure of restrictiveness of RoO. Estevadeordal and Robertson (2004) and Ghosh and Yamarik (2004) estimate the impact of preferential relationship with a simple FTA dummy. Augier, Gasiorek and Lai-Tong (2003) focus on the effect of one central RoO regime provision - cumulation. Estevadeordal and Souminen (2003c) and Sangkyom Kim, Innwon Park, and Soonchan Park (2013) extend this to a variety of RoO regime-wide provisions by using the dummy variable for De Minimis, Diagonal Cumulation, Full Cumulation, Drawback and Self-Certification. Their main limitation is that all of them used the dummy variable for RoO that does not capture the complex requirements of each RoO.

A lot of scholars have tried to measure the level of "restrictiveness" by using the index approach that is an overall indicator of how costly or trade-inhibiting the RoO is (Estevadeordal, 2000; Brenton & Manchin, 2002; Estevadeordal & Souminen, 2003c; Productivity Commission, 2004; Augier, Gasiorek, & Lai-Tong 2005). Indexes developed in those studies have focused on particular provisions of RoO – for example, whether a change in tariff classification (CTC) is at the tariff item (HS 8-digit), sub-heading (6-digit), heading (4-digit) or the chapter (2-digit) level. They have also taken into account other factors affecting the restrictiveness of origin rules, including tariff phase-out schedules, cumulation, duty drawback, tolerance, and outward processing provisions in FTA (Productivity Commission, 2004).

By dealing with the issue of restrictiveness level, economists are able to use the augmented gravity model to measure the changes in total aggregated trade flows between FTA countries. Estevadeordal and Souminen (2003c) first introduced the restrictiveness index created by Estevadeordal (2000) into a gravity model. This index is based on two assumptions: "(1) change at the level of chapter is more restrictive than change at the level of heading, and change at the level of heading more restrictive than change at the level of subheading, and so on; and (2) value content technical requirements (such as chemical transformations) attached to a given CTC add to the RoO's restrictiveness". Their econometric analysis allows them to make a conclusion that RoO undermines overall trade between preferential partners. However, their results are still biased because the conventional gravity model cannot control the resistances to

trade such as distance and official barriers to trade; most of them are hard to quantify and therefore they are added into the unobserved disturbance term (Drysdale & Garnaut, 1982). This study makes use of the stochastic frontier gravity analysis to solve the problem of with the unobservable resistances to trade. Armstrong (2007) said that this type of method is acceptable and appropriate, and can be used to estimate the unobservable resistances to trade.

Moreover, my study will use the Harris index to capture the restrictiveness level. Harris (2007) produces a thorough examination of Estevadeordal's methodology, "applying similar logic but much more precisely capturing details of the variation across products and across agreements in the definition of the rules of origin" (Estevadeordal, Harris, & Souminen, 2009).

3. Methodology

The methodology has several aspects. Firstly, a stochastic frontier gravity model will be used to estimate trade efficiency; secondly, an OLS model will be used to estimate the impacts of status of being a member of FTA and RoO on trade efficiency. The issue of which variables should be added in each model remains controversial, even in the production and social efficiency literature (Kumbhakar & Lovell 2000; Ravallion 2003).

To estimate trade efficiency, this study uses stochastic frontier gravity developed by Baldwin and Taglioni (2006) and Armstrong (2007), in which they combine the Gravity Model for Trade (Tinbergen, 1962; Anderson, 1979; Bergstrand, 1989) and the Stochastic Frontier Production Function Model (Aigner, Lovell, & Schmidt, 1977; Meeusen & van den Broeck, 1977). In their method, they divide the resistances to trade into two categories: natural resistance (such as borders, whether a nation is landlocked, and language) and man-made resistance (such as trade agreements, political distance, regional blocs, tariffs, and institutions).

The gravity equation has the form like:

$$X_{ijt} = f(Y_{ijt}; \beta) exp^{(v_{ijt} - u_{ijt})} \qquad (3.1)$$

where X_{ijt} is the bilateral export from country i to country j, $f(Y_{ijt}, \beta)$ captures factors which determine the potential trade (Y_{ijt}) – including natural resistances – and β

represents a vector of unknown parameters which will be estimated. Both u_{ijt} and v_{ijt} are error terms. While the single-sided error term, u_{ijt} is technical inefficiency that captures the man-made resistances, v_{ijt} represents the impact on trade of the rest of variables. u_{ijt} lies between 0 and 1 and it is assumed to have a non-negative truncated normal distribution with mean μ and variance σ_u^2. The double-sided error term v_{ijt}, that is assumed to be normal distribution with zero mean and σ_v^2, captures the measurement and specification error.

My model is a modified model based on above analysis:

$$LnExport_{ijt} = \beta_0 + \beta_1 LnGDP_{jt} + \beta_2 LnGDPVN_{it} + \beta_3 LnDistwces_{ij} + \beta_4 Landlocked_j + \\ + \beta_5 RelArea_{ij} + \beta_6 POP_{jt} + \beta_7 POPVN_{it} + \beta_8 T + v_{ijt} - u_{ijt} \quad (3.2)$$

Where:

$Export_{ijt}$ is the nominal actual export value of Vietnam (i) to country j at year t.

$GDP_{jt}/GDPVN_{it}$ are the gross domestic product of country j or Vietnam at year t. GDP is used as a proxy for economic size.

$Distwces_{ij}$ is the weighted distance between Vietnam (country i) and country j (Head & Mayer, 2002).

Landlocked is the dummy variable for landlocked country j. It takes the value 1 if country is landlocked, 0 otherwise.

$RelArea_{ij}$ is the relative land area between country j and Vietnam (country i). This variable can be included in the gravity model as a proxy for economic size.

$POP_{jt}/POPVN_{it}$ are country j's population or Vietnam's population at year t. Population is used as a proxy for market size.

T is a time trend variable that receives a value from 1 to 19 (Kalirajan & Singh, 2008).

Error term v_{ijt} is the measurement and specification error.

Error term u_{ijt} captures the trade resistances regarded as Vietnam export's inefficiency.

Potential export is defined as the maximum possible value of exports that could be achieved given the least resistance to trade (Kalirajan, 2000; Armstrong, 2007). Then, we can define trade efficiency as a ratio of actual to potential export:

$$TRE_{ijt} = \frac{exp[LnX_{ijt}]}{\exp\left[Lnf(Y_{ijt};\beta) + v_{ijt}\right]} = \frac{f(Y_{ijt};\beta)\exp(v_{ijt} - u_{ijt})}{f(Y_{ijt};\beta)\exp(v_{ijt})} = \exp(-u_{ijt}) \quad (3.3)$$

Measuring the determinants of trade efficiency, as opposed to trade resistances or trade inefficiency, can be conducted simultaneously in the statistical analysis (Coelli, 1996; Kumbhakar & Lovell, 2000; Drysdale et al., 2000). In the following model, policies that affect trade and other short-to-medium term determinants can be regarded as man-made trade determinants; "All trade-increasing policy variables (FTAs, regional arrangements and trade organizations such as the WTO) and trade-reducing policy variables (official and non-official trade barriers) able to be quantified, can then be used to explain trade resistances as a secondary regression" (Armstrong, 2007).

The trade efficiency model captures the main factors that determine the Vietnam export efficiency. In this study, the variable of interest – RoO – acts like a non-official trade barrier (Joseph, 1996) which is one of the components of FTA, captured by ROO; the other component is status of being a member of FTA, represented by ASEAN, EU, NAFTA. The official trade barrier is the average of effectively applied tariff rates weighted by the product import shares corresponding to each partner country. The import tariff is expected to reduce the trade efficiency. Other trade-increasing policies are represented by the trade freedom index that is a composite measure of the absence of tariff and non-tariff barriers, affecting imports and exports of goods. While the higher trade freedom in Vietnam leads to an increase in Vietnam export flows, the greater trade freedom for trading partners results into a rise in their import flows. Therefore, both trade freedom in Vietnam and its partner countries are expected to increase Vietnam trade efficiency.

$$TRE_{ijt} = \delta_0 + \delta_1 ROO_{ij} + \delta_2 ASEAN_j + \delta_3 EU_j + \delta_4 NAFTA_j + \delta_5 Tariff_{jt} + \delta_6 FreeTrade_{jt} + \delta_7 FreeTrade_{it} + w_{ijt} \quad (3.4)$$

where:

ROO_{ij} is the average of restrictiveness RoO index between two countries i and j. This study uses Harris index (2007) "based on a point system which adds or subtracts points based on different elements used in the definition of the rule of origin". The index typically takes a value between 1 and 12. The higher the score implies the higher restriction on trade.

ASEAN is the dummy variable for ASEAN countries. It takes 1 if country is a membership in ASEAN and 0 otherwise.

EU is the dummy variable for EU countries. It takes 1 if country is a member of the EU and 0 otherwise.

NAFTA is the dummy variable for NAFTA countries. It takes 1 if country is a member of NAFTA and 0 otherwise.

$Tariff_{jt}$ is the tariff rate applied to the weighted mean of the imported product (%) of country j imposed on an exporting partner country at year t. The higher the tariff rate in the import countries, the lower trade efficiency in Vietnam.

$FreeTrade_{i/jt}$ is the trade freedom index of country i or j at year t, which is a composite measure of the absence of tariff and non-tariff barriers in a country. Two inputs used to calculate this index include the trade-weighted average tariff rate and non-tariff barriers. The index of each country takes the value between 0 and 100. The higher the score implies the less the barriers of trade.

w_{ijt} is the error term.

To estimate the stochastic frontier gravity model, this study will use the STATA version 13. In detail, this study will use the time decay inefficiency model (Battese & Coelli, 1992) with the main assumption:

$$u_{ijt} = \eta_{it} u_{ij} = \{\exp[-\eta(t - T_i)]\} u_{ij} \quad (3.5)$$

η is a scalar parameter to be estimated and can be used to determine whether the efficiency increases, is constant or decreases. The last period ($t=T_i$) for trade from country i to j contains the base level of efficiency for trade between those countries ($u_{ijt} = u_{ij}$). If $\eta>0$, the level of efficiency increases towards the base level or the impact of country-specific man-made policy constraint to export increases over time; If $\eta=0$ or is insignificant, the level of efficiency remain constant or the impact of country-specific man-made policy constraint to export stays unchanged over time.

This method also applies to the parameterization of Battese and Corra (1977), who replaced σ_u^2 and σ_v^2 with $\sigma^2=\sigma_u^2+\sigma_v^2$ and $\gamma=\sigma_u^2/(\sigma_u^2+\sigma_v^2)$. It can be said that γ must take the value between 0 and 1. We can test whether we should put the error term u in the form of stochastic frontier function, or not, by testing the significance of the γ parameter. If the null hypothesis, that γ equals zero, is rejected, this would mean that σ_u^2 is non-zero and therefore the u term should be added into the model, leading to a

specification with parameters that should be consistently estimated using the stochastic frontier approach.

4. Data

This study will utilize panel data consisting of 28 Vietnam's bilateral trading partners on the goods exports period 1995-2013 (accounting for an average 82% total goods exports to the world). The list of countries included in this study is shown in Table (2), which was selected based on their relative importance to Vietnam exports in different regions including ASEAN, ASEAN+3, NAFTA, the European Union, and ANZCERTA (Australia and New Zealand). The main reason this study takes this period is because Vietnam joined ASEAN in 1995.

Table 2. Vietnam's trading partners in goods exports

Region/Country		Region/Country	
ASEAN		**EU**	
Indonesia	IDN	Belgium	BEL
Cambodia	KHM	Germany	DEU
Lao PDR	LAO	Denmark	DNK
Myanmar	MMR	Spain	ESP
Malaysia	MYS	Finland	FIN
Philippines	PHL	France	FRA
Singapore	SGP	United Kingdom	GBR
Thailand	THA	Greece	GRC
ASEAN+3		Italy	ITA
China	CHN	Netherlands	NLD
Japan	JPN	Poland	POL
Korea, Rep.	KOR	Sweden	SWE
NAFTA		**ANZCERTA**	
Canada	CAN	Australia	AUS
Mexico	MEX	New Zealand	NZL
United States	USA		

This study uses a variety of data sources. Exports data is taken from the International Monetary Fund (Direction of Trade Statistics-DOTS). Gross Domestic Products (GDP),

Population (POP), and all product tariff rates are taken from the World Bank database. Restrictiveness RoO index based on the Harris's method is taken from Estevadeordal, Harris, and Souminen's working paper (2009, p. 30). Data on the weighted distance measured in kilometers (Distwces) and land area (Area) are taken from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII), which was introduced by Mayer and Zignago (2005). The trade freedom index (FreeTrade) is taken from the Heritage Foundation. The list of ASEAN member countries was taken from official website asean.org. The dummy variable for political distance is self-calculated. Export, gross domestic products, and distance are transformed to logarithms.

Table 3: Statistical Summary

Variable	Mean	Std. Dev.	Min	Max
LnExport	19.59013	1.858102	11.31447	23.89586
LnGDP	26.64911	1.865011	20.97026	30.4505
LnGDPVN	24.73753	0.663819	23.75514	25.86721
LnDistwces	8.446464	.6638197	5.861461	9.608898
Landlocked	.0344828	.1826314	0	1
RelArea	6.668318	12.56863	.001951	51.56955
POP	101.335	234.7126	3.5245	1357.38
POPVN	81.23884	5.307292	71.9955	89.7089
ROO	5.775862	1.054246	2.4	8.6
ASEAN	0.275862	0.447354	0	1
EU	.4137931	.4929598	0	1
NAFTA	.1034483	.3048202	0	1
Tariff	4.047931	3.780699	0	30.72
FreTrade	76.00725	10.96949	15	90
FreTradeVN	56.69474	10.56134	44.6	79.6

*Note***.** Author's calculation based on data collection

5. Results and Discussion

The trade gravity model in equation (3.2) and the trade efficiency model in equation (3.4) are estimated simultaneously following Battese and Coelli's (1992) model using the "sfpanel" command in STATA version 13.

Table 4a: Maximum likelihood estimates of the stochastic frontier gravity equation for Vietnam's exports to the main trading partners, 1995-2013.

VARIABLES	Coeff.	P>|z|
LnGDP	0.543***	0.000
	(0.109)	
LnGDPVN	1.654***	0.000
	(0.375)	
LnDistwces	-0.655***	0.000
	(0.126)	
Landlocked	-1.235***	0.001
	(0.391)	
RelArea	0.069***	0.000
	(0.014)	
POP	0.0009**	0.042
	(0.0004)	
POPVN	1.264***	0.000
	(0.137)	
T	-1.322***	0.000
	(0.180)	
Constant	-118.3***	0.000
	(18.39)	
Sigma square	.9643	0.829
	(.4952)	
Gamma	.8326***	0.010
	(.0868)	
Mu	.8193*	0.069
	(.4508)	
Eta	0.0382***	0.000
	(0.0047)	
Loglikelihood	-334.3395	

Note: Values in parentheses ( ) are standard errors.

*** Significant at the 1 per cent level; ** Significant at 5 per cent level; * Significant at 10 per cent level

Table 4b: OLS estimation of trade efficiency for Vietnam's exports to the main trading partners, 1995-2013.

VARIABLES	TRE
ROO	-0.0485***
	(0.00529)
ASEAN	0.155***
	(0.0291)
EU	-0.112***
	(0.0264)
NAFTA	-0.237***
	(0.0227)
Tariff rate	-0.0115***
	(0.00353)
Trade Freedom	0.00235**
	(0.00108)
Trade Freedom VN	0.00349***
	(0.000957)
Constant	0.305***
	(0.0836)

Note: Values in parentheses ( ) are standard errors.

*** Significant at the 1 per cent level; ** Significant at 5 per cent level; * Significant at 10 per cent level

Results of the stochastic frontier gravity model are presented in Table 4a. It shows that the goods export flows from Vietnam to its trading partners are significantly affected by the GDP of Vietnam and its partners, the population of Vietnam, the weighted distance, and being landlocked. The estimated parameter signs for LnGDP, LnGDPVN, POP, and POPVN are positive and significant as expected. Furthermore, the negative sign for LnDistwces and Landlocked are also as expected.

Because GDP and population are proxies for economic size and market size respectively, both economic size and market size have strong impacts on trade as larger countries can produce more goods and services for export, and high incomes together with big market size will increase the demand for importing goods. Moreover, a positive effect of Vietnam's population is the expected result because the developing countries whose population are relatively high tend to specialized in labor-intensive

exports. This study uses weighted distance and landlocked to capture the natural trade resistances, and both of them are statistically significant. Results of the weighted distance and landlocked shows a negative effect on export value. The farther the distance between Vietnam and its trading partner, the more reduced the trade between them; if the country is landlocked, it also decreases the trade volume. Because distance and landlocked variables are also proxies to transport cost and other costs of trade such as transaction cost and communication cost, the greater the distance and the absence of seaports imply higher cost, which decreases Vietnam's exports to its partner country.

The parameter gamma ($\gamma = \sigma^2_u/(\sigma^2_u + \sigma^2_v)$) is significant and close to 1, which means that there is a variation in trade efficiency with each partner. In other words, it is effective to decompose the error term into u and v for the given data set, and the man-made resistances cause deviations of actual exports from potential exports (Kalirajan & Singh, 2008). The time trend is statistically significant, therefore it can be added into this model to capture the man-made resistances over time. Moreover, the eta (η) is also greater than zero and significant, which implies that there is a decrease in the man-made resistances or the trade efficiency increases given the time surveyed.

The results of equation 3.5a & b on factors impacting trade efficiency are displayed in Table 4b. The results indicate that all of the coefficients-related FTAs are statistically significant with the signs as expected. While Vietnam's membership of ASEAN increases trade efficiency, and non-memberships of EU and NAFTA reduce trade efficiency, the appearance of RoO in each FTA generally dampens the trade efficiency of Vietnam's export flows to its trading partners (hypotheses (1) & (2) are accepted). Briefly, both of the hypotheses mentioned in the Introduction are held, and are the most important conclusions in this study.

The tariff coefficient is negative and significant, implying that the import tariff in trading partners acts as one of driving forces to decrease the trade efficiency between Vietnam and those countries. Both the trade freedom coefficients significantly increased trade efficiency, reducing the gap between the actual and potential exports flows.

Export Performance

Estimated trade efficiencies are presented in Tables 5 to 9. Because we define trade efficiency as the ratio of actual to potential export, trade efficiency ranges from a low of 0% to the highest level of 100% (percentage form). In this thesis, I classify the level of

trade efficiency as following: very high efficiency (>80%), high efficiency (60-80%), moderate efficiency (40-60%), low efficiency (20-40%), and very low efficiency (<20%).

In general, Vietnam's trade efficiency with its trading partners is low (31%) but is increasing over time. This number is calculated by taking the average of Vietnam's trade efficiency across time. Table 5 shows the trade efficiency of Vietnam goods exports to members of the ASEAN. Although TRE with members of ASEAN rank top, TRE reaches a moderate level. In detail, trade with Singapore and Laos are very highly efficient, followed by trade with Cambodia and the Philippines at moderate efficiency, with Malaysia, Indonesia and Thailand at low efficiency, and with Myanmar at very low efficiency.

Table 5: Trade efficiency (in percent) of Vietnam goods exports to ASEAN

	1995-99	**2000-04**	**2005-09**	**2010-13**
Singapore	88.25	90.19	91.83	93.08
Lao PDR	86.74	88.92	90.75	92.16
Cambodia	42.93	49.73	56.15	61.52
Philippines	34.90	41.91	48.76	54.62
Malaysia	24.47	31.26	38.26	44.53
Indonesia	17.63	23.83	30.57	36.87
Thailand	13.03	18.56	24.86	30.97
Myanmar	0.59	1.43	2.98	5.16
Mean	38.57	43.23	48.02	52.36

Table 6 shows the TRE of Vietnam with ASEAN+3. Vietnam's export is highly efficient with Japan, followed by Korea and China at a low score of TRE.

Table 6: Trade efficiency (in percent) of Vietnam goods exports to ASEAN+3

	1995-99	**2000-04**	**2005-09**	**2010-13**
Japan	62.78	68.08	72.79	76.54
Korea	28.67	35.62	42.62	48.77
China	11.69	16.96	23.09	29.09
Mean	34.38	40.22	46.17	51.47

Trade efficiency with members of EU are presented in Table 7. While the trade with the Netherlands, Belgium, Germany and the UK are moderately efficient, the trade with

next three countries (France, Italy, and Spain) are recorded at low efficiency. Trade with the others reaches a very low efficiency rate.

Table 7: Trade efficiency (in percent) of Vietnam goods exports to EU

	1995-99	2000-04	2005-09	2010-13
Netherland	51.87	58.14	63.89	68.59
Belgium	51.24	56.32	62.24	67.09
Germany	35.36	42.36	49.19	55.03
UK	29.82	36.80	43.79	49.89
France	21.14	27.70	34.62	40.94
Italia	13.62	19.25	25.63	31.77
Spain	12.73	18.21	24.48	30.56
Poland	8.56	13.12	18.67	24.32
Denmark	6.79	10.83	15.93	21.27
Sweden	6.68	10.68	15.75	21.07
Finland	2.55	4.81	8.15	12.08
Greece	1.99	3.92	6.87	10.46
Mean	20.19	25.18	30.77	36.09

Tables 8 and 9 show that the Vietnam's TRE with ANZERTA and NAFTA countries are very low, but the efficiency has been improved over the years.

Table 8: Trade efficiency (in percent) of Vietnam goods exports to ANZERTA

	1995-99	2000-04	2005-09	2010-13
Australia	11.54	16.79	22.89	28.88
New Zealand	4.97	8.36	12.86	17.76
Mean	8.25	12.57	17.87	23.32

Table 9: Trade efficiency (in percent) of Vietnam goods exports to NAFTA

	1995-99	2000-04	2005-09	2010-13
United States	6.20	10.04	14.96	20.18
Mexico	3.24	5.87	9.60	13.88
Canada	1.06	2.33	4.46	7.27
Mean	3.50	6.08	9.68	13.78

6. Recommendation

The results show that trading with ASEAN FTA members is much more efficient than with others such as EU and US, and that result is used to reinforce the hypothesis of the trade creation effect of being a FTA member. However, the ASEAN's mean is still moderate due to the negative impact of new kinds of trade resistance policies, and RoO is the key one. Joining FTAs increases trade efficiency, therefore Vietnam should deepen economic integration by reforming the current FTA (ASEAN) and speeding up the process of trade agreement negotiation, especially with its main trading partners (the EU and US). Because RoO dampens trade efficiency, it should be as least-restrictive as possible. A simple and transparent RoO is important to minimize the restriction of RoO by reducing compliance and administration cost (Estevadeordal, Harris, & Souminen, 2009). One way that could be applied to relax the restriction of RoO is allowing exporters to use alternative or co-equal rules at the higher level of disaggregation, which would also liberalize the RoO, such as the use of Change in Tariff Classification as a co-equal method to the Value Added rule. Another method is a wider application of full cumulation at low cut-off rate, the "de minimis" rule with a generous ceiling and absorption principle which can be used to simplify RoO (Erlinda & Jenny, 2009).

To improve trade efficiency, other factors should be considered. Trade freedom in Vietnam has a positive impact on trade efficiency, therefore Vietnam should steadfastly maintain its open trade policy.

7. Conclusion

This thesis examined the impacts of Free Trade Agreements on trade efficiency by applying the stochastic frontier gravity model and ordinary least square methods. Because previous studies had ambiguous results when only using dummy variables for FTAs but ignoring the RoO, this study classified FTA into the status of being a member of FTA that captures the abatement of trade resistances, and the Rule of Origin that represents the new trade resistance. Pioneer economists estimated the RoO's trade effect, but their results were limited since they used the dummy variable for RoO that does not capture the complex requirements of each RoO. This study used the most precise index

to capture the restrictiveness level of RoO; the so-called Harris index (2007). There has been an increasing application of a gravity model (Tinbergen, 1962) to estimate the bilateral trade, but their results are still biased because the conventional gravity model cannot control the resistances to trade such as distance and official barriers to trade. This study makes use of the stochastic frontier gravity analysis to solve the problem of the unobservable resistances to trade.

The methodology was to use a stochastic frontier gravity model to estimate trade efficiency, and then use an OLS model to estimate the impacts of status of being a member of FTA and RoO on trade efficiency. To estimate trade efficiency, this study uses the stochastic frontier gravity developed by Baldwin and Taglioni (2006) and Armstrong (2007). In their method, they divide the resistances to trade into two categories: natural resistance and man-made resistance. The trade efficiency model captures the main factors that determine Vietnam's export efficiency. In this study, the variable of interest – RoO – acts like a non-official trade barrier (Joseph, 1996) which is one of the components of FTA, captured by ROO; the other component is the status of being a member of FTA, represented by ASEAN, EU, NAFTA. The official trade barrier is the average of effectively applied tariff rates weighted by the product import shares corresponding to each partner country. The import tariff is expected to reduce the trade efficiency. Other trade-increasing policies are represented by a trade freedom index that is a composite measure of the absence of tariff and non-tariff barriers, affecting imports and exports of goods.

This study utilized panel data consisting of 28 of Vietnam's bilateral trading partners on goods export periods of 1995-2013 (accounting for an average 82% of total goods exports to world). From the first model, I calculated that the stochastic frontier approach is valid (parameter gamma is significant and close to 1) and Vietnam's trade efficiency increases given the time surveyed (parameter eta is significantly positive). In the second model I found that while Vietnam's membership of ASEAN increases trade efficiency, and non-memberships of EU and NAFTA reduce trade efficiency, the appearance of RoO in each FTA dampens the trade efficiency of Vietnam's export flows to its trading partners. These findings have important policy implications: Vietnam should enter new FTAs and deepen economic integration by speeding up the process of trade agreement

negotiation, especially with its main trading partners (the EU and US). These FTAs should also include the least restrictive RoO provisions as possible.

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