Vietnamese rice exports: Do large destination markets stimulate?

Hanh Thi Vu and Hung Quang Doan

Department of Applied Economics, Solvay Brussels School of Economics and Management, Belgium, Foreign Trade University, Hanoi, Vietnam

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Hanh Vu Thi

Department of Applied Economics, Solvay Brussels School of Economics and Management, Belgium

Email: hvuthi@ulb.ac.be

Hung Quang Doan

Foreign Trade University, Hanoi, Vietnam

Email: hungdq@ftu.edu.vn

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Abstract

What determines Vietnamese rice export flows? Data on rice export from Vietnam and its 124 destination markets in 2010 shows that high-income from agricultural sector of importing countries do not necessarily result in higher rice exports whereas exports tend to be higher to highly populated countries. In order to confirm the negative effect of the importing countries' GDP, We proceed to split the full sample into subsamples for Asian and non-Asian importing countries. While GDP covers the entire income of the whole economy, the value added agriculture performs better in determining the export pattern of firms operating in one sector. Specifically, distance in some cases encourages rice exports if destination markets are non-Asian countries implying a high export capacity of rice firms. For a heavy bulk good such as rice, the effect of landlocked dummy is far more sensitive to rice exports volume than exports value.

Keywords: Rice exports, Vietnam, Gravity model

JEL: F1, Q17

1. Introduction

In recent times, the need to satisfy domestic consumption has led to an unprecedented rise in international trade. Since every country has its own advantages in producing certain product items, the international trade is a significant catalyst for the local producers and foreign consumers. The classical and new trade theory constitutes two main strands of the theory on the international trade. While the classical trade theory for absolute and comparative advantage theories expose some limitations such as the economic models are simple, just only two trading countries and two products go into the model, the new trade theory is superior relating many more countries and factors that help to create the international trade pattern. A typical model which belongs to the new trade theory is so called the gravity model, employing GDP and geographical distance as the two main determinants of international trade.

The gravity model employs GDP factor as a driving force for the stimulation of trade among countries. By nature, it is a component of a pure expenditure system model where the consumption of one good in one country is thus equal to the income of that country. Nonetheless, this expenditure system models can only be practically applied if the assumption that income is equal sales must be satisfied. In fact, country does not spend all their income on imported goods from one country. Bergstrand (1985) has proved that the gravity equation is a reduced form from a partial equilibrium subsystem of a general equilibrium model with nationally differentiated products by deriving the utility function since the expenditure of a country is constrained by its income.

Empirical literature on the gravity model presents the role of income by country in encouraging bilateral trade thus yielding a positive sign in the regression models. A long list of gravity model papers indicates the total export and/or import trade which are treated as an endogenous variable go with GDP acting as an exogenous variable in the gravity model. Moreover, products exported or imported by one country to another which are calculated in total value and itself reflects the aggregated value of trade are positively affected by the GDP of a country partner according to most of the papers using a gravity model. However, the role of the firm in determining trade pattern has been ignored in most of the literature of gravity model.

Krugman (1980) a pioneer in the New Trade Theory, denoted that there is an incentive to concentrate production of a good near its largest markets since the seller could minimize transportation cost. His suggestion on the role of the transportation cost set a benchmark for the gravity model where

the geographical distance between exporting and importing country presents a typical indicator negatively affecting the international trade pattern. However, since firms are heterogeneous and some firms are more competitive than the other, more productive firms decide to involve in the international markets (Melitz, 2003). Moreover, firms' heterogeneity and productivity have been shown to be crucial factors determining their trade pattern in some recent empirical gravity models such as Bernard and Jensen (2007), Arkolakis and Muendler (2010), Bastos and Silva (2010). Especially, the total export and import trade by country are decomposed into firm's extensive and intensive margins in most papers on the gravity model.

In this paper, we use data on rice exports from Vietnam to over 100 countries coming from all five continents to investigate how firms in one sector operate. Unlike the other products, rice is a staple and generally, relative consumption of staples increase as the population grows in size. As such, we have used "Population" as of a proxy for country size. We have also added the independent variable "remoteness" in the model since the geographical distance may result in dubious estimates where two countries have reasonably large economies and consequently a high level of mutual trade. Further, the level of mutual trade between two contiguous countries depends on their degree of trade with the rest of the world. In some cases, foreign trade rests on how much domestic trade takes place within exporting or importing countries. If domestic trade accounts for most of a country's production capacity, its exports volume would fall correspondingly.

Although, contributions have been made in many empirical papers looking into country pair trade, the results in the few papers dealing with country-level data are biased since an insufficient sample at country level does not provide accurate estimates. Another factor is that exporting activities are differentiated by firms, products or sectors being heterogeneous. Some firms serve a wide variety of markets while others enter a single one. Moreover, some markets preferentially consume a certain kind of product which satisfies the different taste of local consumers.

To examine the role of firms in formulating the trade pattern, we have used the database on exports of firm in rice sector. Since rice is a homogeneous product, it is not convenient to decompose the total rice exports into the intensive margin of the product-firm-country. As such, we have regressed possible gravity factors with rice value and rice volume of firms. It is interesting that, firms do not find the high level of income in the importing country an attractive market whereas high population countries positively influence Vietnamese firms' rice exports. Comparatively, the variable "remoteness" is more

consistent than "geographical distance" in explaining the effect of transport cost on trade. The landlocked dummy has a consistently negative effect on firms' exports suggesting that countries surrounded by land are disadvantage for Vietnam's rice exports trade. Notably, the effect of landlocked countries is more sensitive to rice volume than the value probably because rice is a kind of homogenous and heavy products and clearly the weight is affected by the transportation cost for the fact that landlocked countries are seen as an obstacle to the imported goods from overseas. Data on individual Vietnamese exporting firms for the regional free trade area ASEAN indicate an important and positive effect on their exports.

The structure of the paper is organized as follows: Section 2 explains briefly the factors of the gravity model and the data. Section 3 focuses on rice firms' extensive and intensive margin in the international trade. Section 4 gives the empirical results and section 5, the final part comprises some concluding remarks.

2. Gravity model

2.1. Gravity model

The gravity model was first proposed by Tinbergen (1962) and considers the interaction among country pairs in terms of trade. It is in fact, based on a modified version of Isaac Newton's law of universal gravitation and is used to predict movement of commodities between countries and continents by considering two main factors, namely the economic size of the country and the distance between exporting and importing countries.

Empirical literature on the gravity model has successful in explaining trade by country with two core factors including economic size and trade cost (Gunawardana and Havrila, 2006; Papazoglou, 2007; Porojan, 2001; Rose and Frankel, 2000; Sapir, 2001; Silva and Tenreyoro, 2006). In parallel, augmented gravity models have been developed by Egger (2002), Baltagi *et al*., (2003), Egger (2004). Bastos and Silva (2010) added GDP/labor – a proxy for productivity in the importing country. Anderson

and Wincoop (2003)[1] introduced a multilateral resistance factor to explain the trade cost accounting not only the geographical distance between any country pairs but also between the country and the rest of the world.

Another strand of empirical literature on the gravity model focuses on firms extensive and intensive margins which are decomposed from the total exports or imports trade of a given country. Our study, however, differs the existing papers in a way that it examines how firms in one economic sector are influenced by the economic size of the destination markets. In addition, firms in the rice sector could diversify their activity within one market as well as across markets depending on the rice demand of the importing countries. In a conventional gravity equation where the income of exporter and importer are simultaneously included, it would capture the parallel effect of country partners' economic size on the bilateral trade. In the case of a single rice exporter and many importing countries, exporter income is captured in the constant term of the gravity model regression.

Being one important factor of the gravity model, GDP normally stands for the economic size of a country. However, GDP per capita is a better measure since it presents the per person output of a country. Theoretical framework shows a constraint on the demand of imported goods in any country with its budget which is derived from income and a higher income induces a larger demand of goods. In this paper, we examine the effect of GDP and Population on trade that present the economic and population size of a country particularly the population factor would encourage rice consumption demand. To some extent, rice trade value is not entirely dependent on the whole income of an economy since rice is a specific staple and clearly its consumption is largely relied on the consumption habit. We therefore employ the "value added agriculture" variable[2] for two reasons. First, unlike GDP which is composed of the net income of all sectors in an economy, the value added from agriculture only relates the net income of agricultural products including forestry, hunting, fishing as well as cultivation of crops and livestock production. Therefore, the effect of the value added agriculture of the importing country

[1] Multilateral resistance factor (remoteness) defines trade cost as $X_{ij} = \frac{Y_i Y_j}{Y_w}(\frac{t_{ij}}{P_i P_j})^{1-\sigma}$ where Y_i, Y_j are total income of country i and country j. Y_w is the GDP of the whole world, t_{ij} is the trade cost that the exporter incurs the importer and is assumed to be symmetric $(t_{ij} = t_{ji})$

[2] Value added agriculture is the net output of agricultural sector after adding up all outputs and subtracting intermediate inputs. Agriculture corresponds to ISIC division 1-5 and includes forestry, hunting , fishing and as well as cultivation of crops and livestock production (World Bank indicator)

on the export trade should be more plausible than the effect of GDP since it reflects the production capacity of a country regarding to one specific economic sector. Nonetheless, this regression result would be more consistent if we could obtain the data on value added rice by importing country. And if the value added agriculture is assumed to have a large contribution in the GDP then it correlates positively with GDP (see Figure 1 below)

For the correlation purpose, we proceed a model in natural log-linear form for a single year as the following forms:

$$\ln Export_{ij} = \beta_0 + \beta_1 \ln GDP_j + \beta_2 \ln POP_j + \beta_3 \ln Distance + B_4 ASEAN + \beta_5 landlocked_j + \beta_6 \ln Remoteness + \varepsilon_i + \phi_j + u_{ij}$$

Where $Export_{ij}$ stands for export value in USD and volume by firm i to country j.

GDP_j is Gross Domestic Product of country j.

POP_j is population of country j.

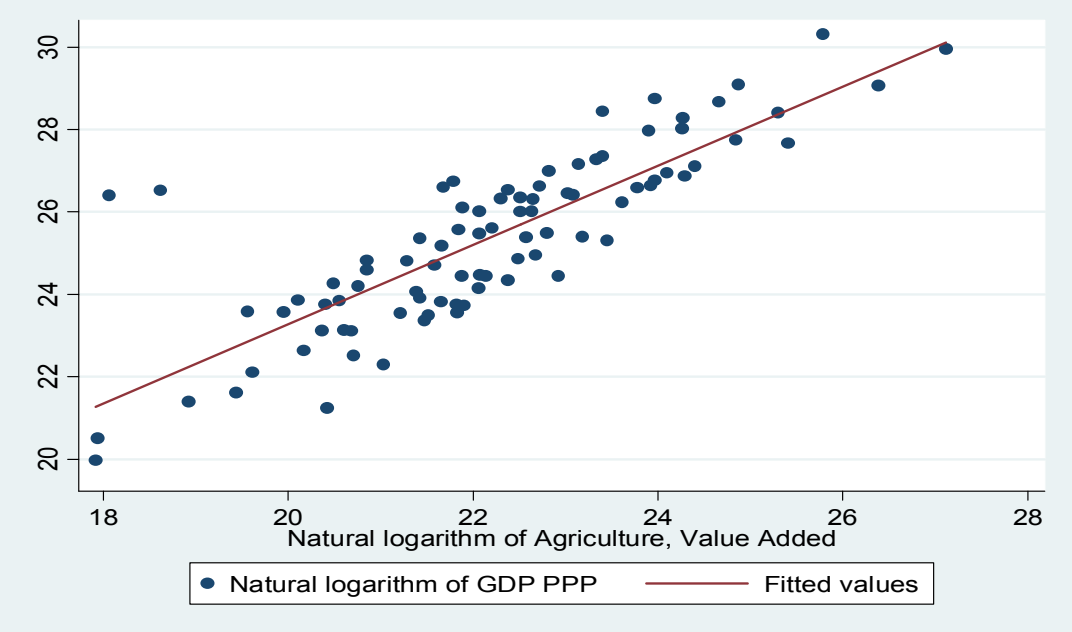

Figure 1. Correlation between GDP and value added agriculture

Distance reflects the geographical distance between the capital city of Vietnam and the capital city of importing country j .

ASEAN is a dummy variable that equals 1 if the importing country belongs to the Association of Southeast Asian Nations, or zero otherwise.

Landlocked is a dummy variable that equals 1 if importing country is surrounded by land, or zero otherwise.

ε_k is the pure firm unobservable effects

ϕ_j is the pure importing country unobservable effects

u_{ij} is the error term

Data

Micro data: Data on rice export value of firms in USD were extracted from the database of Vietnam Custom Office (VCO). This is the country's official information source on exports and imports. Firm level data are employed to determine the bias which may arise in the export aggregated data. A transaction record of rice exports covers the declaration dates of firms' export, firm tax ID, the code of importing countries, transaction method, payment currency code of rice products at 10-digit SITC level, unit value per product per firm, total value of each transaction in USD, EURO, JPY, AUD, SGD…, etc. We only use firms' export value in USD since the payment in USD dominates firms' rice exports, accounting for 98% of the all transactions. In the year 2010, 324 rice export firms entered the international market and supplied 44 different rice items. Unlike the other exporting industries like footwear or garments, rice products are homogeneous since the quality does not vary substantially.

Macro data: Data on GDP adjusted to Purchasing Power Parity (PPP) and value added agriculture was extracted from the website of the World Bank. Data on the population of importing countries were obtained via KILM[3] archived by the International Labor Organization.

[3] KILM: Key Indicators of the Labor Market

The geographical distance between Vietnam and its country partners is accessible on CEPII[4]. The data base is consisting of the country code, the distance measured for a country pair's capital and the other dummy variable showing if the importing countries are landlocked.

3. The gravity with rice firms' extensive and intensive margins

We examine the activity of Vietnamese rice firms through extensive and intensive margins. This approach allows us to test the role of heterogeneous firms involving in country trade meanwhile the total exports by country as well as by the rice sector in our case would ignore the dynamics of firm thus probably resulting in the distort of the gravity. Firm's intensive and extensive margins are obtained by decomposing the total exports and/or imports trade. In this paper, we apply the margins proposed by Arkolakis and Muendler (2010) that the total exports T_{sd} from source country s to destination d can be decomposed into $T_{sd} = M_{sd}\bar{t}_{sd}$ where M_{sd} is the number of exporters (intensive margin) in s with shipments to destination d and $\bar{t}_{sd} \equiv T_{sd} / M_{sd}$ are these exporters mean sales to d (extensive margin). Alternatively, in most cases where the total exports relate all varieties, total exports T_{sd} can be decomposed into: $T_{sd} = M_{sd}\bar{G}_{sd}\bar{z}_{sd}$ where M_{sd} is the number of exporters in s with shipments to destination d, $\bar{G}_{sd} \equiv \sum_{\omega \in \Omega_{sd}} G_d(\omega)$ is the total number of products exported from s to d and $\bar{z}_{sd} \equiv t_{sd} / G_{sd}$ is the average value of exports per product per firm (Bernard et al. 2007).

As stated earlier, since this study only tests the gravity model for one sector where rice is a homogenous product and the unit value is not used, the extensive margin is the average exports sale by a firm to destination markets.

[4] CEPII stands for Centre d'Etudes Prospective et d'Informations Internationales

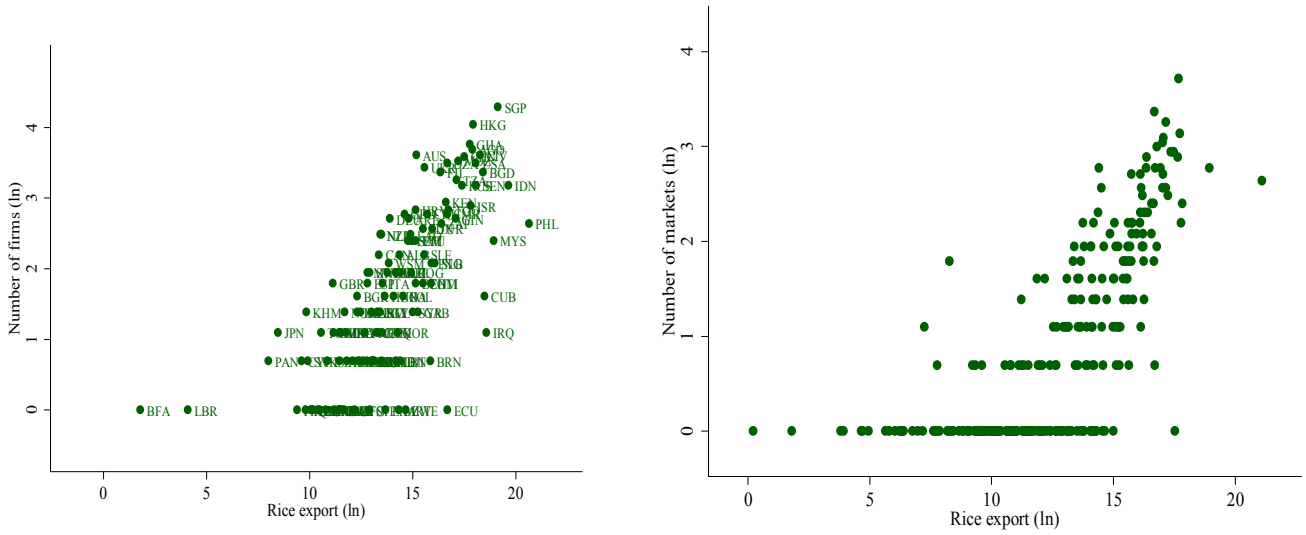

Figure 2. The correlation of firm's extensive and intensive margins

Remarkably, as shown in the Figure 2, the rice export value (extensive margin) have a strongly positive relationship with the number of firms and the number of markets (intensive margin) implying that both firm's extensive and intensive margins play an important role in the total rice exports. Graphically, heterogeneous firms who could diversify their markets, maximize their exports sale should be more productive than others. Moreover, since firms have to compete with the other rivals, only a few firms can dominate in the foreign markets. For comparison purpose, we expand the standard gravity model by regressing with rice firms' intensive margin here below (Table 1).

Table 1. Rice firms' intensive margin with Gravity

VARIABLES	(1) Total exports value (ln)	(2) Total exports value (ln)	(3) Total exports volume (ln)	(4) Total exports volume (ln)	(5) Number of exporting firms (ln)	(6) Number of exporting firms (ln)
lnAgri_VA	-0.91***	-0.88***	-1.21***	-1.12***	-0.31**	-0.39**
	(0.32)	(0.32)	(0.31)	(0.29)	(0.15)	(0.16)
lnPOP	1.28***	1.23***	1.58***	1.43***	0.44**	0.54***
	(0.37)	(0.38)	(0.36)	(0.37)	(0.17)	(0.18)
lnDistance	-0.03		0.43		-0.25	
	(0.63)		(0.58)		(0.25)	
lnRemoteness		-0.01		-0.03		0.01
		(0.29)		(0.28)		(0.10)
ASEAN	2.15	2.20*	3.05**	2.31*	-0.02	0.36
	(1.50)	(1.29)	(1.40)	(1.19)	(0.55)	(0.42)
landlocked	-2.69**	-2.90***	-2.05***	-2.42***	-1.28***	-1.12***
	(1.05)	(1.08)	(0.60)	(0.65)	(0.28)	(0.31)
Constant	13.74**	13.60***	12.17**	16.69***	3.65	1.57
	(6.10)	(4.04)	(5.28)	(4.24)	(2.75)	(1.56)
Observations	93	90	93	90	93	90
R-squared	0.23	0.24	0.23	0.23	0.23	0.22

OLS estimation, robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

In the first place, we substitute the value added agriculture as a part of the national income for the gross domestic product in the gravity model and the Table 1 reports the OLS regression for the correlation between total rice exports value, volume and the number of firms with gravity factors. We also check the robustness of the geographical distance by adding "remoteness" into the gravity model. An important point to note is that unlike the previous papers, the value added agriculture gives a negative sign whereas the population is positive to the total export value, volume and the number of firms. The findings counterbalance the theoretical background as well as many empirical studies that the economic size of the country supports trade (Anderson, 1979; Bergstrand, 1985; Bastos and Silva, 2010; Eton et al, 2004). One possible interpretation for these findings is that countries that have a high production capacity in agricultural products tend to import less rice from Vietnam. In contrast, highly populous importing countries stimulate rice exports trade of Vietnam partly because food consumption demand is large in those countries.

While landlocked countries negatively influence the rice exports trade, distance shows an ambiguous and insignificant sign. Bastos and Silva (2010), in contrast, found distance negative for firm's intensive margin but this effect is converse with firm's extensive margin. ASEAN dummy does not give consistent sign especially is negative and insignificant for firm's intensive margin.

4. Empirical results and discussion

4.1. Gravity and rice export value

Under the proposed model, we start by regressing the export value and export volume with the listed independent variables which we applied to full sample as described earlier. The destination markets are treated as the time variable, so for a specific firm which might or might not export to multiple countries can differentiate its export costs and profits. In our view, the model can also differentiate rice export value and quantity with respect to different firm-country clusters. For comparison purposes, the equation has been tested for the OLS, Fixed effects presented in Table 2 and random effects (see the Appendix Table A2). The OLS regressions do not discriminate for an individual firm across the destination markets. As a result, the regression is biased since for a specific firm, the intensive margin varies depending on the particular destination, product quality, firm productivity. From observation, almost all point estimates in the fixed effect regression are considerably smaller than those obtained in the OLS regression.

Table 2. Export value and the gravity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	OLS	OLS	Fixed effect	Fixed effect	Fixed effect	Fixed effect
lnGDP	-0.53***	-0.27			-0.31***	-0.08		
	(0.10)	(0.20)			(0.05)	(0.10)		
lnAgri_VA			-0.58***	-0.31**			-0.38***	-0.25***
			(0.15)	(0.13)			(0.07)	(0.07)
lnPOP	0.59***	0.32	0.77***	0.38**	0.34***	0.10	0.53***	0.32***
	(0.12)	(0.22)	(0.21)	(0.16)	(0.06)	(0.11)	(0.10)	(0.09)
lnDistance	-0.25		0.43*		-0.23**		0.23**	
	(0.19)		(0.26)		(0.10)		(0.11)	
lnRemoteness		-0.27		-0.44***		-0.24**		-0.23***
		(0.19)		(0.09)		(0.10)		(0.05)
ASEAN	1.28**	1.25**	0.95**	0.61	1.06***	1.05***	0.78***	0.71***
	(0.63)	(0.63)	(0.43)	(0.38)	(0.24)	(0.24)	(0.23)	(0.21)
landlocked	-2.10***	-2.11***	-0.69	-1.96***	-1.06**	-1.07**	-0.52	-0.92**
	(0.51)	(0.51)	(0.49)	(0.52)	(0.43)	(0.43)	(0.39)	(0.45)
Constant	18.24***	15.71***	8.33***	15.96***	16.56***	14.22***	9.91***	14.13***
	(2.36)	(1.17)	(2.56)	(1.31)	(1.41)	(0.88)	(1.19)	(0.90)
Observations	1,122	1,120	1,059	1,053	1,122	1,120	1,059	1,053
R-squared	0.14	0.15	0.10	0.16	0.62	0.62	0.63	0.64
Firm fixed-effects.	No	No	No	No	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, based on standard errors clustered by importing country. * significant at 10%; ** significant at 5%; *** significant at 1%.

Significantly, the R-squared obtained from the OLS approach is consistently low while comparatively, fixed effects regressions give a high level of R-squared confirming the importance of heterogeneous firms across the destination markets. We also ran the random effect model whereby comparing exporting firm groups may cause a contradictory conclusion. The Hausman test implicitly reaffirms the fixed effects approach is an appropriate option in this case.

Regarding the effect of market size, our empirical findings fundamentally differ in comparison with many studies on the gravity models employing country level data (Feenstra *et al*, 2001; Glick and Rose, 2002; Kangas and Niskanen, 2003; Roberts, 2004) as well as firm and product level data (Muûl and Pisu, 2009; Bastos and Silva, 2010; Crozet and Koenig, 2010; Nguyen and Arcand, 2009). As can be clearly seen from the Table 2 column (1), (2), the coefficients of GDP in the OLS specification show downward bias. Nonetheless, this indicator is not significant in the fixed effects model regression where the "remoteness" variable is included. The coefficient of GDP in column 5 of the Table 2 indicates that when importing countries have a 1% increase in GDP, Vietnamese rice exports by firms will decrease by 0.31%. This study specifically investigates firms active in agricultural exports, testing the hypothesis that the effect of a country's economic size would be valid for every export sector. Even in the study of wine trade in EU countries and their trading partners by Dascal *et al.* (2002), the effect of GDP per capita is found to be positive implying that an increase in income stimulates production and, thus, exports.

Compared with the study by Ševela (2002), the effect of economic size in our study is in line with those findings that the gross national income per capita (GNI per capita) negatively correlates with the agricultural-export volume. This negative sign highlights the fact that high income countries do not necessarily import more agricultural products.

We emphasize the role of heterogeneous firms in one sector by adding the value added agriculture in to the regression model. As interpreted in the above section, the value added agriculture significantly enlarges the economic size one country however does not stimulate rice exports trade from Vietnam. Notably, compared with the GDP of the importing countries, the value added from agriculture is consistently negative in all regression columns. Column 8 shows that if the value added from agriculture of in the importing countries rises by 1%, rice imports from Vietnam accordingly decreases by 0.24%.

Size of population of importing countries shows a positive correlation to rice exports. The finding is in line with the papers of Papazoglou (2007), Augier, *at al.* (2005). As seen in Table 2 column 8, when the population of the importing countries increases by 1%, Vietnamese rice export rises by 0.31%. As mentioned, the population effect is not always positive. On the one hand, populous countries may make use of their large labor endowment and hence be less reliant on imports. If the population effect dominates, it would give a negative sign (Iwanow and Kirkpatrick, 2007; Filippini and Molini, 2003). On the other hand, a country being highly populated could stimulate its consumption power.

We now turn to the analysis of the export cost effect which takes geographical distance as a proxy. Many previous papers on the gravity model confirm distance to be a good proxy for trade hindrance, thus giving the negative effect. However, Bastos and Silva (2010) found distance positive for both extensive and intensive margins. They argued that firms discriminate their product unit prices across markets and the export cost should not be an impediment for highly competitive firms. They also show that the aggregated export data gave a biased result for distance. In our view, other interesting results can be obtained if firm exports are observed yearly and the estimates of our model therefore capture firms' unobservable effects. In fact, firms first entering the market would impose different unit prices depending on operating conditions and their ability to expand their supply network.

With a specific export such as rice where non-Asian markets are proportionally smaller and the incentive for exporters is therefore lower, the unit price charge may be higher. This explains why geographical distance is nevertheless still a hindrance for rice exports. Nonetheless, distance is still puzzling in the case of rice export sector showing negative and positive sign in the column (5) and (7) respectively. We therefore include the remoteness into the gravity model with the aim of testing the consistency of the distance regarded as trade cost effect on exports trade. The result is interesting that remoteness is significantly negative implying that country that is relatively distant from its partner imports less rice from Vietnamese firms.

We continue to think that the effect of the ASEAN dummy on its members' exports trade is important though some recent papers have asserted that ASEAN has lost ground in stimulating intra-trade since many countries have gained by being fully integrated into the global economy (Nguyen, 2010; Nguyen and Heo, 2009) thus deceasing their active operation in the smaller economic bloc. As expected, becoming an ASEAN member led to an increase in Vietnam's rice exports to ASEAN

countries of 103%[5], holding all other variables constant. The importance of ASEAN countries to Vietnamese rice exports is understandable since it includes the 4 largest rice importing markets.

Lastly, what we want to test is whether landlocked importing countries could negatively affect Vietnamese rice exports. Just as the distance between a country pair is regarded as a hindrance of trade, landlocked countries also increase trade costs. While 92.96%[6] of the volume of Vietnamese rice export is transported by sea, and this highlights the landlocked countries' shipping cost disadvantage. The negative sign of landlocked dummy consistently confirms the important role of maritime transport in the international rice trade. In particular, with a heavy bulk good such as rice, the use of bulk carriers helps firms considerably by increasing transport capacity and keeping down costs. The landlocked dummy results in a notional reduction in rice exports of 58% in a given year, holding all other determinants constant.

4.2. Export volume and the gravity model

We also calibrate the gravity model using the firm export volume[7]. This is because rice products are both heavy and bulky, forcing the exporters to pay higher freight costs when shipping to distant markets. All the estimated coefficients are in Table 3 above where effect signs of the value added agriculture and population of the importing countries significantly remain negative and positive respectively. In terms of value and volume of exports, we find that highly populated countries dominate the rice importing markets whereas the demand for rice products is very limited in large economic size and distant countries.

The significant value of the Hausman test[8] emphasizes the role of firms in conjecturing rice export flows. As described earlier, firms are found to be heterogeneous and differentiate their cost prices in the international market. As such, OLS regression leads to a biased result since it does not capture the effect of firm-country clusters.

[5] Technically, the figure is obtained by taking the antilog (to base e) of the estimated dummy coefficient then subtracting 1 (*100). For further details, see Gujarati (2004, pp. 321).

[6] The number is calculated based on rice exports by Vietnamese firms to country partners.

[7] Rice export volume is simultaneously reported in kg.

[8] We have also run the random effects model that is presented in Appendix Table A3.

Table 3. Export volume and the gravity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	OLS	OLS	Fixed effect	Fixed effect	Fixed effect	Fixed effect
lnGDP	-0.54***	-0.28*			-0.33***	-0.01		
	(0.09)	(0.16)			(0.06)	(0.11)		
lnAgri_VA			-0.60***	-0.32**			-0.46***	-0.33***
			(0.13)	(0.15)			(0.08)	(0.07)
lnPOP	0.58***	0.32*	0.79***	0.39**	0.34***	0.01	0.62***	0.40***
	(0.12)	(0.18)	(0.20)	(0.18)	(0.07)	(0.13)	(0.11)	(0.10)
lnDistance	-0.24		0.46*		-0.31***		0.23*	
	(0.16)		(0.28)		(0.11)		(0.12)	
lnRemoteness		-0.26*		-0.44***		-0.32***		-0.23***
		(0.16)		(0.08)		(0.11)		(0.06)
ASEAN	1.29**	1.27*	0.94**	0.57	1.04***	1.03***	0.72***	0.65***
	(0.65)	(0.64)	(0.43)	(0.37)	(0.27)	(0.27)	(0.25)	(0.24)
landlocked	-2.07***	-2.08***	-0.46	-1.77***	-1.24***	-1.25***	-0.45	-0.86*
	(0.40)	(0.41)	(0.39)	(0.38)	(0.47)	(0.47)	(0.40)	(0.45)
Constant	19.39***	16.88***	8.95***	16.88***	18.57***	15.33***	11.05***	15.34***
	(2.05)	(1.22)	(2.85)	(1.41)	(1.53)	(0.92)	(1.29)	(0.91)
Observations	1,114	1,112	1,051	1,045	1,114	1,112	1,051	1,045
R-squared	0.13	0.13	0.09	0.14	0.51	0.51	0.53	0.54
Firm fixed-effects.	No	No	No	No	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, based on standard errors clustered by importing country. * significant at 10%; ** significant at 5%; *** significant at 1%.

In fact, each firm exports to different markets with dissimilar rice categories as well as different supply volumes so that the fixed effects regression in fact improves the plausibility of the results obtained using for the gravity model.

4.3. Exports value to Asian and non-Asian countries

Besides the gravity model regression with the full sample, we tested whether the estimators are robust to sample split. From the fact that Asian countries account most rice export value and volume from Vietnam and non-Asian countries do not have a high demand of rice consumption, we have reason to believe that there may be difference between the Asian and non-Asian importing countries with respect to these coefficients. To this end, we split our sample into two subsamples including those exporters who supply rice products to the Asian continent and those supplying remain non-Asian markets. The estimates of value of exports to Asian countries are presented in columns (1)-(4) of Table 4 and columns (5)-(8) report the estimates for export values by Vietnamese firms to non-Asian countries. Note that, all the estimates reported in the Table 4 only capture the firm fixed-effects regressions.

Table 4. Export value to Asian and non-Asian countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnGDP	-0.06	0.26			-0.47***	-1.37***		
	(0.17)	(0.28)			(0.06)	(0.28)		
lnAgri_VA			-0.31*	-0.39***			-0.53***	-0.06
			(0.16)	(0.13)			(0.12)	(0.16)
lnPOP	0.08	-0.24	0.49*	0.55**	0.57***	1.47***	0.59***	0.17
	(0.11)	(0.24)	(0.26)	(0.24)	(0.08)	(0.28)	(0.13)	(0.16)
lnDistance	-0.31		-0.23		1.08***		1.25***	
	(0.23)		(0.26)		(0.28)		(0.31)	
lnRemoteness		-0.32		-0.11		0.89***		-0.42***
		(0.23)		(0.14)		(0.27)		(0.08)
ASEAN	0.74**	0.74**	0.69**	0.71**				
	(0.30)	(0.30)	(0.28)	(0.28)				
landlocked	-2.06*	-2.07*	-1.54	-1.65	-1.18*	-1.22**	-0.78	-1.25*
	(1.09)	(1.09)	(1.07)	(1.13)	(0.61)	(0.61)	(0.68)	(0.74)
Constant	15.10***	11.88***	12.73***	12.24***	4.74*	15.62***	2.79	13.76***
	(3.95)	(3.54)	(2.78)	(2.65)	(2.76)	(1.04)	(3.35)	(1.23)
Observations	386	386	375	375	736	734	684	678
R-squared	0.65	0.65	0.69	0.69	0.73	0.72	0.71	0.72
Firm fixed-effects.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Fixed-effects estimation Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Gravity model regressions for Asian importing countries are presented in columns (1), (2), (3), (4). All the rest are presented for non-Asian countries.

Surprisingly, for the Asian sample, the GDP and population coefficients are not significant whereas these indicators have a high degree of significance in determining the exports trade by Vietnamese firms to non-Asian countries. Moreover, we also see that the value added agriculture effect in the column (8) is negative but insignificant showing the inconsistency of this indicator if applied to countries that do not have the same demand in rice consumption with Vietnam. Even the distance effect is positive in the gravity regressions in column (5) and (7) probably because more productive firms can supply this product in far distant market where the demand is rather low.

The landlocked dummy in the two subsamples remains negative but not significant in all regressions. While the effect of geographical distance is the opposite, as shown by the non-significantly negative sign in the Asian countries sample, but it is positive and significant in non-Asian importing countries.

4.4. Exports volume to Asian and non-Asian countries

We also use the rice exports volume of firm as a dependent variable for testing the gravity model. In fact, rice is a type of bulk cargo and it lead to a high transport cost if travelling to distant markets. As such, rice volume which could be directly compared with rice exports value was used in the gravity model. Similar to the regression of rice exports value, GDP of the importing countries is not significant in Asian sample but significantly negative in non-Asian sample. The value added agriculture remains negative to rice exports volume but insignificant in the column (8) of Table 5. Moreover, the population is not always positive to rice exports volume for both samples.

Although both exports volume and value are affected by the value added agriculture of the importing countries, export volume is more sensitive in the gravity model. Especially, the effect of distance and remoteness is not clear. Importantly, although the effect of the landlocked dummy is not significant in all regression for Asian sample, it shows a very strong negative effect in regard to the export volume for the non-Asian subsample.

Table 5. Export volume to Asian and non-Asian countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnGDP	0.06	0.28			-0.52***	-1.05***		
	(0.20)	(0.30)			(0.07)	(0.36)		
lnAgri_VA			-0.44**	-0.44***			-0.61***	-0.04
			(0.18)	(0.14)			(0.15)	(0.21)
lnPOP	-0.00	-0.22	0.65**	0.66***	0.62***	1.16***	0.67***	0.16
	(0.14)	(0.28)	(0.28)	(0.24)	(0.09)	(0.36)	(0.15)	(0.20)
lnDistance	-0.22		-0.01		0.66*		0.74*	
	(0.27)		(0.32)		(0.37)		(0.40)	
lnRemoteness		-0.22		0.01		0.53		-0.47***
		(0.27)		(0.17)		(0.36)		(0.11)
ASEAN	0.68*	0.68*	0.59*	0.59*				
	(0.35)	(0.35)	(0.33)	(0.33)				
landlocked	-1.62	-1.63	-1.21	-1.20	-2.15***	-2.18***	-0.84	-1.30**
	(1.12)	(1.12)	(1.10)	(1.17)	(0.54)	(0.54)	(0.61)	(0.57)
Constant	13.32***	11.10***	11.82***	11.64***	9.70***	16.37***	8.77**	14.77***
	(4.50)	(3.64)	(3.22)	(2.81)	(3.54)	(1.12)	(4.08)	(1.41)
Observations	385	385	374	374	729	727	677	671
R-squared	0.57	0.57	0.62	0.62	0.63	0.63	0.60	0.62
Firm fixed-effects.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Fixed-effects estimation Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Gravity model regressions for Asian importing countries are presented in columns (1), (2), (3), (4). All the rest are presented for non-Asian countries.

We are now fully convinced of our conclusion that importing country's value added agriculture and its population size affect Vietnamese rice exports. However, results are different if subsamples are applied. By splitting the sample on the basis of the destination markets, we see that a positive effect of the geographical distance may suggest that the more competitive firms could successfully penetrate the more distant markets. This finding is also valid for a firm's rice export volume but to a lesser degree.

Landlocked countries have a clear disadvantage in international trade since their status raises the trade cost. The rice export value shows the same level of sensitivity for the landlocked dummy whereas for the Asian subsample, export volume is negative but not significant consistent with the fact that there are be only a few landlocked Asian country partners of Vietnamese firms. For non-Asian landlocked countries which are therefore at an economics disadvantage, export volume is negatively affected, confirming that for heavy bulk goods such as rice products, freight costs are strongly correlated related to export volume.

5. Conclusions

As a very specific economic sector, rice exports have raised the question as to whether the large economic size of importing countries determines the direction of rice exports trade. Further, we also include the value added agriculture as an important part of the GDP to compare the importance between these two indicators. To the best of our knowledge, this would be the first study in the literature aiming to calibrate the gravity model at firm-level data for a particular export sector. As criticized by Chaney (2008), natural barriers to trade are positively influenced by the degree of firm heterogeneity. As such, international trade flows are significantly determined by heterogeneous firms. Likewise, a single firm could diversify its trading partners across the different markets, thus implementing its dissimilar export margins in a particular market.

Our regression results have confirmed the role of the country population size rather than the role of economic size in Vietnamese rice exports. In contrast to previous studies, this paper clearly demonstrates that while large importing countries have lower import demand for this product, highly populated destination markets are the major driving force behind a firm's export

intensive margin. It should also be noted that the effect of a country's economic distance is inconsistent.

Geographical distance between country pair and the landlocked dummy, proxy for trade costs, are generally negative, implying the existence of a hindrance in the international export trade. For a specific rice exports, landlocked countries restraint export volume. In particular, a positive sign for distance in the Asian subsample indicates that some firms who are able to supply more distant markets outside the Asian continent are already more competitive.

In short, the paper is, to some extent limited to examining firm unit price with the gravity model since, as discussed above, the data-set covers around 40 product categories that are coded at 10-SITC digit level. Therefore we did not test for product-firm-country clusters on unit price since too many observations would be missed during the data treatment. As a result, this would lead to biased conclusions as to a firm's unit price performance. Further, Vietnamese firms offer their unit price at different terms[9]. Although the export unit price could have been regressed under firm-fixed effects, we suspect that the test result would have been unreliable. Further aims should be left for future study to achieve.

[9] Basic international trade terms applied for export contracts include FOB, CIF, CFR, DAF, EXW, FCA, FAS.

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Appendix

Table A1. Descriptive statistics

	Obs	Mean	Std. Dev.	Min	Max
lnExportValue	1,200	12.24	2.20	0.22	20.63
lnVolume	1,191	13.08	2.30	3.22	23.33
lnGDP	1,123	25.67	2.12	19.56	30.31
lnPOP	1,201	16.66	1.70	11.55	21.01
lnAgri_VA	1,059	22.20	2.22	17.92	27.12
lnDistance	1,201	8.72	0.80	6.17	9.83
lnRemoteness	1,175	7.42	1.37	3.71	9.93
ASEAN	1,201	0.12	0.32	0	1
Asian	1,201	0.34	0.47	0	1
landlocked	1,201	0.03	0.18	0	1

Table A2. Export value and the gravity: Random effects

	(1)	(2)	(3)	(4)
lnGDP	-0.35***	-0.10		
	(0.05)	(0.10)		
lnAgri_VA			-0.42***	-0.28***
			(0.07)	(0.06)
lnPOP	0.38***	0.12	0.57***	0.35***
	(0.06)	(0.10)	(0.08)	(0.08)
lnDistance	-0.25***		0.23**	
	(0.09)		(0.10)	
lnRemoteness		-0.26***		-0.28***
		(0.09)		(0.05)
ASEAN	1.07***	1.06***	0.79***	0.67***
	(0.23)	(0.23)	(0.24)	(0.24)
landlocked	-1.36***	-1.37***	-0.51	-1.15***
	(0.36)	(0.36)	(0.36)	(0.38)
Constant	16.32***	13.80***	9.31***	13.85***
	(1.13)	(0.81)	(0.92)	(0.81)
Observations	1,122	1,120	1,059	1,053
Number of firms	273	273	273	271
Hausman test	10.04*	10.37*	5.96	13.18**
Firm random-effects.	Yes	Yes	Yes	Yes

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant

Table A3. Export volume and the gravity: Random effects

	(1)	(2)	(3)	(4)
lnGDP	-0.39***	-0.09		
	(0.06)	(0.11)		
lnAgri_VA			-0.50***	-0.34***
			(0.06)	(0.06)
lnPOP	0.41***	0.11	0.66***	0.42***
	(0.07)	(0.11)	(0.08)	(0.08)
lnDistance	-0.29***		0.26**	
	(0.09)		(0.11)	
lnRemoteness		-0.30***		-0.30***
		(0.09)		(0.06)
ASEAN	1.11***	1.10***	0.79***	0.61**
	(0.24)	(0.24)	(0.25)	(0.25)
landlocked	-1.59***	-1.60***	-0.37	-1.15***
	(0.30)	(0.30)	(0.29)	(0.33)
Constant	18.27***	15.32***	10.37***	15.37***
	(1.18)	(0.87)	(1.02)	(0.84)
Observations	1,114	1,112	1,051	1,045
Number of firms	273	273	273	271
Hausman test	11.36**	11.50**	3.23	9.77*
Firm random-effects.	Yes	Yes	Yes	Yes

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant