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Geographical barriers in agricultural exports: A case study of Vietnam's rice exports to West Africa

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Abstract

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Vietnam is one of the world's leading rice exporters and West African countries are potential markets for Vietnam's rice exports. However, geographical barriers have always been considered an important factor hindering Vietnam's rice exports to West Africa. Applying the gravity model with the PPML estimation technique, the study shed light on the impact of geographical distance on Vietnam's rice exports to West Africa during 2001–2021. The estimated results confirm that geographical distance negatively impacts rice exports, but that the level of impact is significantly mitigated if economic factors are reinforced. The results also point out that becoming a World Trade Organization (WTO) member promotes Vietnam's rice exports to West Africa. This implies that Vietnamese rice exporters and policymakers should focus on economic factors to promote rice exports to West Africa. In addition, the country should consider establishing free trade agreements with West African countries.

Keywords: Economic distance; geographical distance; rice exports; Vietnam; West Africa

Introduction

With great achievements in agricultural development, Vietnam has emerged as one of the world's leading countries in exporting agricultural products. For more than two decades, rice has been the principal product of Vietnam's agricultural exports (Thanh & Singh, 2006; Tsukada, 2011; Phan, 2014; Nguyen, 2016; Maitah et al., 2020). According to the Food and Agriculture Organization of the United Nations (FAO), Vietnam is one of the world's three largest rice exporters in 2021, led by Thailand and India. Vietnam's rice exports in 2021 exceeded 6.2 million tons with a total value of more than 3.2 billion US dollars, representing a 12.5% market share of the global rice exports (VC, 2023). The main markets for Vietnam's rice exports are Asia and Africa, which account for roughly 60% and 20% shares, respectively. Notably, despite differences in rice agricultural culture and geographical distance, Vietnam's rice exports to Africa have grown significantly in both quantity and value over time (Ngo & Nguyen, 2021). African market, especially West Africa is considered a potential destination for Vietnamese rice exports since the domestic supply of rice in the region does not meet its demand (Tran, 2022).

According to the Africa Rice Center, rice is one of the primary food sources for West African countries and the second most important food source in Africa, just behind corn. In fact, African nations contribute only 13% of the world's population, however, imported rice accounts for 32% of the total world rice output[1]. Rice demand in Africa is growing rapidly, but its production cannot keep up with the growth

[1] https://www.africarice.org/why-rice-matters-for-africa.

in demand. According to Morder Intelligence, African countries' demand for rice products is expected to rise by 3.2% per year during 2023–2028 (MI, 2023). FAO points out that West African nations are the primary rice producers in Africa. However, more than half of West African countries are having to import rice to ensure national food security. Data from the African Rice Organization show that rice consumption in African countries will continue to increase and reach 34.9 million tons by 2025. However, the rice supply capacity of African countries is only enough for more than half of the need, and simultaneously the continents require more than 5 billion US dollars to guarantee food security by 2025[2]. Therefore, the vast majority of West African countries are believed to continue to rely on rice imports (MI, 2023).

Although West African countries are potential markets for Vietnamese rice exports, there are still many concerns about Vietnam's ability and capacity in exporting rice to this market. Aside from increasing competition with other rice-exporting countries such as Thailand, India, and Pakistan, the distance factor has been considered one of the barriers restricting Vietnam's rice exports in general, and rice exports to the West African market in particular[3]. The difficulty related to geographical distance has been discussed at many levels, from experts to exporting firms and policy-making agencies[4]. However, to our best knowledge, no research has provided empirical evidence of the negative impact of distance on Vietnam's rice exports to West Africa. To fill this gap, the study aims to examine the impact of distance on Vietnam's rice exports to West Africa. Note that the study mainly focuses on West Africa rather than Africa as a whole for the following reasons. (1) West African countries are countries are rice-tradition and culture, main rice-producing countries, and account for a large proportion of total rice imports not only from Vietnam but also from other rice exporters such as Thailand and India; (2) data is available and accessible (statistics on Vietnam's rice exports to other African nations are largely underreported, and in some cases, there are no rice exporting activities from Vietnam).

In terms of absolute value, Vietnam's rice exports to Africa in general, and West Africa in particular, have increased in both quantity and value in recent years. According to UN Comtrade, Vietnam's rice exports to Africa and West Africa stood at 106.15 million US dollars and 29.97 million US dollars in 2001, respectively. These figures rose to 558.74 million US dollars and 226.68 million US dollars in 2010 before reaching nearly 670.55 million US dollars and 405.29 million US dollars in 2021[5]. The figures show that Vietnam's rice export turnover to Africa and West Africa expanded 6.0 and 15.5 times, accordingly for only 20 years. Notably, despite being affected by the Covid-19 pandemic, Vietnam's rice exports to the African and West African markets still recorded significant growth (Table 1).

Table 1. Vietnam's exports and rice exports to Africa and West Africa (million US dollars)

Year	Export to Africa	Export to West Africa	Rice exports to Africa	Rice exports to West Africa
2001	173.77	50.02	106.15	29.97
2002	129.91	43.37	44.99	18.14
2003	209.49	79.05	127.95	50.13
2004	408.12	167.75	242.48	93.28
2005	639.65	237.29	394.81	82.67
2006	600.14	205.45	270.92	66.16
2007	655.78	209.05	197.29	62.61
2008	1272.12	521.36	567.22	254.04
2009	1512.05	559.27	631.64	275.38
2010	1786.39	627.97	558.74	226.68
2011	3486.29	875.91	738.59	443.65
2012	2446.00	841.27	760.21	348.89
2013	2830.95	976.97	767.75	341.97
2014	2954.43	854.12	395.10	216.75
2015	3104.64	785.33	399.10	219.21
2016	2699.35	690.72	408.05	250.43
2017	2627.31	742.94	397.10	225.78
2018	2524.15	739.96	422.20	222.43
2019	2761.36	873.78	593.78	273.14
2020	2676.35	1003.28	568.60	307.77
2021	3210.17	1158.43	670.55	405.29

Source: Authors' compilation from UN Comtrade database, 2023

The figure calculated based on the UN Comtrade database shows that Vietnam's rice exports to West Africa amounted for only 28.23% of Vietnam's overall rice exports to Africa in 2001. But, it rose to 40.57% in 2010, 54.93% in 2015, and 60.44% in 2021 (Figure 1). This demonstrates that Vietnam's rice exports to West Africa accounted for a relatively greater proportion of Vietnam's total rice exports to Africa than Vietnam's rice exports to the rest of Africa.

[2] https://www.foodformzansi.co.za/africa-turns-to-asia-as-demand-for-rice-surges/.

[3] https://www.vietnamplus.vn/tang-cuong-ket-noi-hop-tac-nong-nghiep-viet-namchau-phi/739711.vnp.

[4] https://vietnamnet.vn/day-manh-xuat-khau-nong-san-sang-thi-truong-chau-phi-774304.html.

[5] Due to discrepancies in collecting and calculating methods, data from UN Comtrade may not be similar to data from the General Department of Customs and the General Statistics Office. We primarily use data from UN Comtrade in this analysis; data from Vietnam's statistical authorities is provided for reference purposes only.

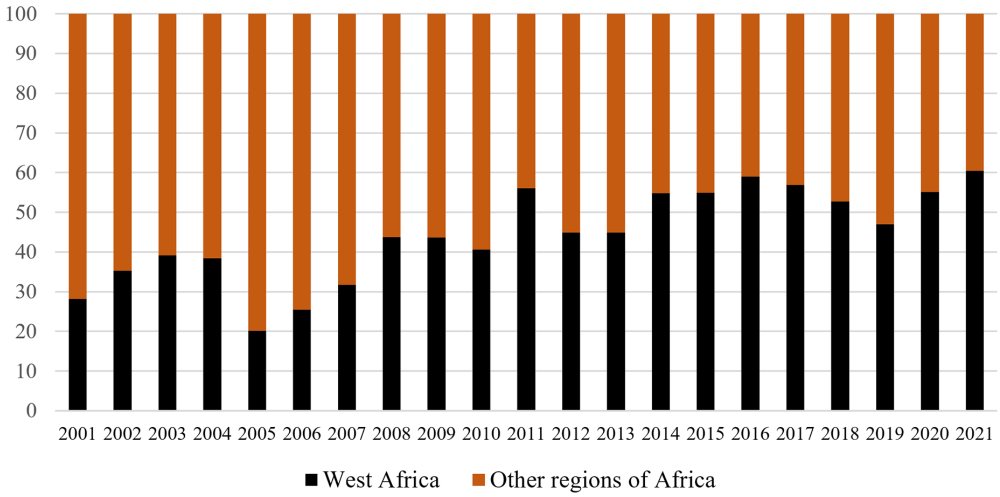

Fig. 1. Vietnam's rice exports to West Africa and other regions of Africa, %
Source: Authors' calculation from UN Comtrade database, 2023

There are some reasons able to explain the rapid growth of Vietnam's rice export turnover to West Africa. On the West African side, there is an increased need for rice imports to meet the rising domestic demand for rice due to the rapid population growth and domestic supply shortages caused by drought, natural catastrophes, epidemics, or the negative impacts of political instability. Meanwhile, thanks to the application of advanced technology in production. Vietnam's rice output had expanded massively, leading to an increase in rice supply for exports. Furthermore, the varieties of exported rice are diverse and plentiful; the quality of rice has improved; and the exporting rice structure is geared toward ones with high added value (Vo & Do, 2016; Tran, 2022).

Although Vietnam's rice exports to Africa have significantly increased in volume and value, the proportion of rice exports in total exports has fluctuated slightly over the years, maintaining a proportion of about 25% – 35% of Vietnam's total exports to Africa. Having the same trend, the volume and value of Vietnam's rice exports to the West African markets also recorded an increase over time, however the proportion of rice exports in Vietnam's total exports to West Africa had risen sharply since 2007 and maintained around 50% until 2021. In particular, Vietnam's rice exports to West African countries accounted only for 25.53% of total exports to West African countries in 2001 (similar to the proportion of Vietnam's rice exports in total exports to Africa of 25.48%). However, this figure rose to 40.07% in 2010, 54.86% in 2015, and 60.21% in 2021 (much higher than Africa with 35.15%, 25.30%, and 36.09%, respectively). In sum, Vietnamese rice plays an essential role and has an outstanding advantage in comparison to other exporting products of Vietnam to West African countries (Figure 2).

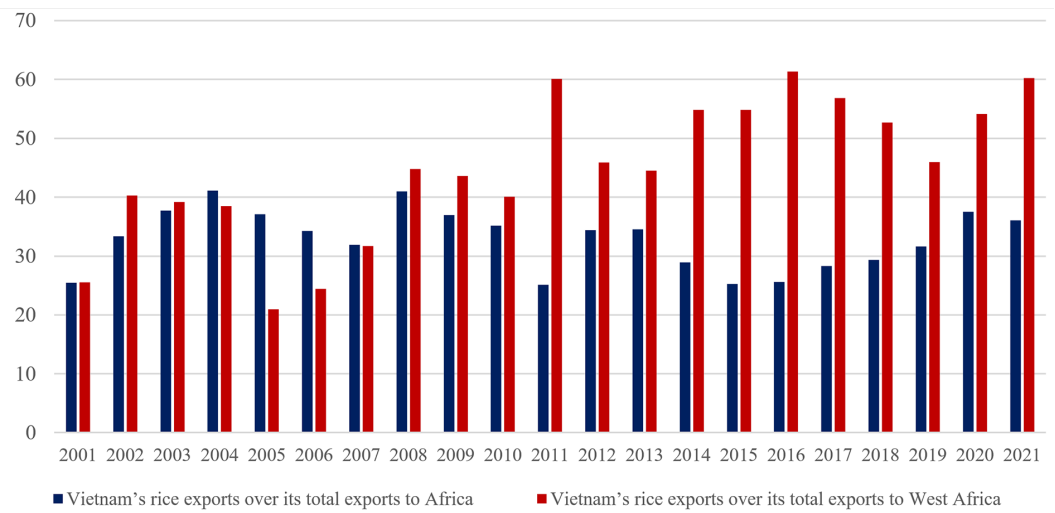

Fig. 2. The proportion of Vietnam's rice exports over its total exports to Africa and West Africa, %
Source: Authors' calculation from UN Comtrade database, 2023

Regarding export partners, the figures from the UN Comtrade database indicate that Ghana accounted for the largest proportion of Vietnam's rice exports to the West African region from 2001 to 2021, with nearly 40% market shares, followed by Senegal, Cameron, and Guinea with 18.06%, 9.37%, and 7.52% market shares, respectively (Figure 3). According to the Vietnam Customs, West African countries would continue to maintain a substantial market share while containing main partners in Vietnam's rice exports to Africa. In which, Ghana and Senegal would remain potential trading partners. According to the Asia-Africa Market Department, Vietnam Ministry of Industry and Trade, besides traditional partners, other countries in West Africa such as Gabon, Mali, and Gambia are considered as prospective rice exporting partners of Vietnam in West Africa. The two sides are actively advocating and implementing measures to enhance trade activities in general, particularly Vietnam's rice export activities[6].

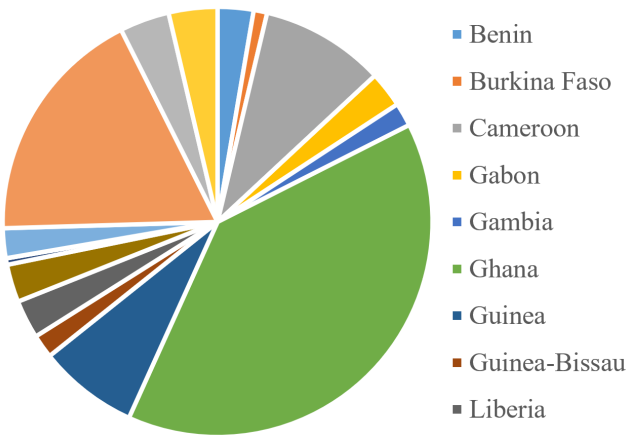

Fig. 3. Vietnam's rice exports to West Africa, 2001 – 2021, %

Source: Authors' calculation from UN Comtrade database, 2023

Undoubtedly, rice plays an essential role in the structure of Vietnam's exporting goods to West Africa. In addition, West African countries also serve as key markets for Vietnamese rice exports in the African region. Noted that Decision No. 942/QD-TTg of the Vietnam Prime Minister issued on July 3rd, 2017 which regulates and approves "Vietnam's rice export market development strategy for the period 2017-2020, and orientation to 2030", and Decree No. 107/2018/ND-CP of the Government dated on August 15th, 2018 on Vietnam's rice exporting activities marked Vietnam's new steps of policy and strategy in exporting rice product. Adopting the aforementioned decisions lays a strong foundation for institutionalizing rice exporting policy as well as establishing a solid legal framework for rice exporting activities, thereby promoting the development of rice exporting in new markets. Therefore, Vietnam's rice exports to the West African countries and other markets are expected to continue to grow in the years ahead.

Methodology and Data

Gravity model

In the field of international trade, the gravity model is considered one of the most common and popular methods to explain the structure of bilateral trade and the factors affecting bilateral trade relationships between countries (Anderson & Wincoop, 2003; Dong & Truong, 2020; Dong & Truong, 2023). The traditional gravity equation is presented in a log-formed function as follows:

$$lnexport_{ij} = \alpha_0 + \alpha_1 lngdp_i + \alpha_2 lngdp_j + \alpha_1 lndist_{ij} + \epsilon_{ij}, \quad (1)$$

where i and j are the exporting and importing countries, respectively; *export* is the export value of goods from country i to country j (in this study, *export* is the value of Vietnam's rice exports to countries in the West African region)[7]; *gdp* is gross domestic product; *dist* is the geographical distance between two countries and is measured by the distance between the capitals of the two countries; ϵ is the error terms.

The traditional gravity model is widely applied in studies of international trade. However, Anderson & Wincoop (2003) argue that estimation using the traditional gravity model could produce misleading results because it does not take multilateral trade barriers into account such as free trade agreements, culture, and political proximity. These factors need to be included in the model to increase the explanatory power of the estimated model and to reduce the potential estimated bias. In this study, we use an augmented gravity model proposed by Anderson & Wincoop (2003) to examine the determinants of Vietnam's rice exports to West African markets. Therefore, the gravity model in Eq. (1) is rewritten as follows:

$$lnexport_{ij} = \alpha_0 + \alpha_1 lngdp_i + \alpha_2 lngdp_j + \alpha_1 lndist_{ij} + \\ + \alpha_4 X_{ij} + \epsilon_{ij}, \quad (2)$$

where X is a vector of multilateral trade barriers including official members of the World Trade Organization (*wto*) and

[6] See more at https://ngkt.mofa.gov.vn/nang-cao-nang-luc-canh-tranh-cua-gao-viet-tai-chau-phi-thuan-loi-va-thach-thuc/

[7] In the gravity model, the independent variable can be aggregate trade, exports or imports.

Vietnam's diplomatic representation in West African countries (*embasy*).

Theoretically, estimating a gravity model with the ordinary least squares (OLS) technique would be ineffective since variables related to multilateral trade barriers such as free trade agreements and diplomatic relations do not change over time. To handle this problem, Anderson & Wincoop (2003) and Egger & Pfaffermayr (2003) suggest that estimation with a gravity model should integrate fixed effects by trading partner and fixed effects by time. In this study, we control fixed effects for time-invariant multilateral barriers.

Furthermore, while dealing with exporting data, many argue that missing observations are unavoidable due to the infeasibility of data collecting or the problems of zero-trade. In addition, heterogeneity problems are common because of endemic disparities between trading partners. Therefore, Silva & Tenreyno (2006) proposed the Poison pseudo-maximum-likelihood (PPML) technique with the aim of addressing these issues. The PPML estimation technique was proven effectively by Silva & Tenreyno (2011) with theoretical and experimental reinforcement. Moreover, Westerlund & Wilhelmsson (2011) concluded that the PPML technique efficiently solves the problem of natural disparities between nations in estimating gravity models. Given that we use the PPML technique to estimate the augmented gravity model and control for time-invariant effects. On this basis, the estimated model in Eq. (2) is as follows:

$$export_{ijt} = \alpha_0 + \alpha_1 lngdp_{it} + \alpha_2 lngdp_{jt} + \alpha_1 lndist_{ij} + \\ + \alpha_4 wto_{ijt} + \alpha_5 embasy_{ijt} + \varnothing_t + \epsilon_{ijt}, \quad (3)$$

where, t is the year of observation and $\varnothing_t$ is a dummy variable used to control for year-fixed effects. For comparing and identifying the effectiveness of the PPML method, the paper also performed the gravity model estimation with the OLS technique.

Data

Data on Vietnam's rice exports (i) to West African countries (j) and related data to Vietnam and 16 West African countries are gathered for the period 2001- 2021[8]. The UN Comtrade database[9] is used to derive the figures on Vietnam's rice exports to West African countries (*export*), while the World Bank database (World Bank Development Indicators)[10] is utilized to collect data on the gross domestic product (*gdp*) of these countries. Regarding gravity model and international trade theories, larger countries tend to have more trade activities. Therefore, the *gdp* variable of Vietnam and its partners in the West African region is expected to have a positive impact on Vietnam's rice exports to West African countries.

Data for multilateral trade barriers, say *wto* and *embasy* are collected from the official website of the WTO[11] and the Vietnam Ministry of Foreign Affairs[12]. The variable *wto* takes the value 1 if both Vietnam and its partners in the West African region are official members of the WTO, otherwise it takes the value 0. Being a member of WTO would boost trade activities of rice exports. And, if Vietnam has a diplomatic agency/representative office in a nation in the West Africa, the *embasy* variable takes the value 1, otherwise it takes the value 0. Establishing diplomatic representation in the West African countries would assist Vietnamese export enterprises better understand and easily engage in markets in the region. Given that the variables of multilateral trade barriers, both *wto* and *embasy* are expected to promote Vietnam's rice export activity to West Africa.

As mentioned above, the primary goal of this study is to provide empirical evidence on how distance impacts Vietnam's rice exports to West Africa. Therefore, variable *dist* in the model is the most interesting variable. The variable *dist* in Eq. (3) is the pure geographical distance of the traditional gravity model and the augmented gravity model. Theoretically, the *dist* variable is expected to limit trade activities since the larger physical distance is the greater costs associated with transporting and delivering goods between partners, which likely leads to a decrease in the rice exporting activities of Vietnam.

However, Caves (1996) argued that geographical distance is not the sole barrier constraining international trade as its impact would steadily diminish with the development of transportation means and modern methods of payment. Therefore, Caves (1996) concluded that the economic distance between two countries has a significant impact on trade activities. Many studies on international trade utilizing gravity models have supported this finding (Head & Mayer, 2010; Vo, 2016; Hoang et al., 2020). Therefore, we consider the weighted distance (or efficiency distance) proposed by Head & Mayer (2010), as a proxy of the economic distance between Vietnam and its partners in West Africa. Given that the *dist* variable in Eq. (3) is replaced by the weighted distance variables and computed as follows:

[8] Some West African countries were excluded from the study due to data unavailability

[9] https://comtradeplus.un.org/TradeFlow

[10] https://databank.worldbank.org/source/world-development-indicators

[11] https://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm

[12] https://www.mofa.gov.vn/vi/

– The distance variable between the two cities with the largest economic contributions () is measured by the distance between Ho Chi Minh city which has the highest economic contributions to Vietnam's GDP and other similar cities of West African countries.

– The population-weighted distance variable ($distp_{ijt}$) is calculated as follows:

$$distp_{ijt} = \sum_{k \in i} \frac{pop_{ikt}}{pop_{it}} \sum_{l \in j} \frac{pop_{jlt}}{\sum_{j=1}^{n} pop_{jt}} dist_{ij} \ , \quad (4)$$

where *k* and *l* are the provinces or cities that contribute the most to the populations of Vietnam and its exporting partners in the West African region, respectively; *n* is the number of West African countries in the model (16 countries); *pop* is the population of provinces or cities in these countries.

– The economic-size-weighted distance variable ($distg_{ijt}$) is calculated as follows:

$$distg_{ijt} = \frac{gdp_{jt}}{\sum_{j=1}^{n} gdp_{jt}} dist_{ij}. \quad (5)$$

Because the economic distance factors in Eq. (4) and Eq. (5) are weighted by factors that vary over time (population and GDP). So, these variables also change over time. The economic distance variable is projected to mitigate physical trade barriers between Vietnam and its partners in the West African region. Moreover, data used to calculate geographical and economic distances are extracted from CEPII's GeoDis[13]. Table 2 displays descriptive statistics for all variables utilized in the model.

Results

First. we estimate the augmented gravity equation with the traditional geographic distance variable (*dist*) using both OLS and PPML methods[14]. Table 3 shows the estimation results. The findings indicate that higher adjusted squared and many coefficients with statistically significant reflect the efficacy of the PPML approach compared to the OLS method. Therefore, the estimation results with OLS are simply for reference, and the explanations and economic implications in this study are solely dependent on the estimated with the PPML approach.

The estimation results from Table 3 show that the geographical distance is one of the factors that negatively impact Vietnam's exports to West African countries. An additional point of the geographical distance could decrease 0.98 point of Vietnam's rice exports to West Africa. This outcome is similar to the findings with the conventional gravity model and is also consistent with the study of Tran et al. (2019) when examining the impact of distance variables on Vietnam's rice exports with a gravity model. The findings of this study provide empirical evidence to reinforce the observations of both the Vietnamese side (authorities and exporting firms) and the West African partners about the obstacles caused by the geographical distance.

The estimated results for *dgp* variables of Vietnam's GDP and its partners' GDP are both statistically significant. In particular, an additional increasing point in Vietnam's gross domestic product (West African countries) would boost Vietnam's rice exports to West Africa by 1.09 points of rice exports (2.08 points). Thus, this finding supports the gravity model theory and is in line with the work by Bui & Chen (2017), who highlighted that the gross domestic product of Vietnam and its partners is an essential element that positively impacts Vietnam's rice exports.

Next, the estimated results for the *wto* variable are consistent with expectations and statistically significant, implying that becoming an official member of the WTO could help increase Vietnam's rice exports to West African countries by 0.58 points. This outcome supports the works by Tran et al. (2019) and Nguyen (2022), suggesting that free trade

Table 2. Descriptive statistics

Variables	Obs	Mean	Stand. Dev	Min	Max
export	336	1.31E+07	4.21E+07	0	394E+08
gdp_i	336	1.60E+08	1.06E+08	3.53E+07	3.63E+08
gdp_j	336	2.82E+07	8.38E+07	392278.2	5.68E+08
dist	336	11714.31	845.7468	10312	12677
distm	336	12152.91	904.1227	10500	13254
distp	336	12018.09	901.6648	10530	13096
distg	336	3157.1811	913.5212	515.7017	6204.8142
wto	336	0.6875	0.4642	0	1
embasy	336	0.0833	0.2767	0	1

[13] http://www.cepii.fr/CEPII/en/publications/wp/abstract.asp?NoDoc=3877

[14] To deal with zero trade in the logarithmic estimation with OLS, zero export observations are replaced by one.

agreements would help promote Vietnam's rice exports. It is noteworthy noting that the estimated results for the *embasy* variable were not as expected and were not statistically significant. This can be explained as follows. It is a fact that Vietnam has only one diplomatic presence in West Africa which is located in Nigeria, a weak partner for Vietnam's rice exports (see further discussion in section 2). So, diplomatic office in West Africa may have no impact on Vietnam's rice exports to the region. In sum, there is lack of empirical evidence to confirm the role of Vietnam's diplomatic unit in Africa (in Nigeria) on Vietnam's rice exports to West Africa.

Next, we perform the estimation with the weighted dis-

Table 3. Estimated results with geographical distance

Variables	OLS		PPML	
	(1)	(2)	(3)	(4)
lngdp_i	0.0461**	0.0056	0.1485***	1.0921***
	(0.0219)	(0.0288)	(0.2147)	(0.2002)
lngdp_j	0.0110	0.0745*	0.7275***	2.0831***
	(0.0297)	(0.0428)	(0.0788)	(0.1464)
lndist	-1.1428	-1.1545	-0.3785***	-0.9816***
	(2.6300)	(2.2541)	(1.8026)	(1.2505)
wto		0.8241		0.5806*
		(2.9808)		(0.3290)
embasy		-2.7106		-2.2878
		-1.2572		(0.6300)
_cons	1.5936	1.8279	-8.3684***	-9.2708***
	-3.4475	-3.448	(7.4357)	(8.2617)
Fixed effect	yes	yes	yes	yes
N	336	336	336	336
R-sq	0.3154	0.3383	0.3701	0.7537

Note: Standard errors in parentheses; ***, **, * significant at 1%, 5%, 10%, respectively.
Source: Authors' calculation

Table 4. Estimation results with economic distance by PPML

	Distance between the largest economic cities		Population- weighted		Economic-size-weighted	
	(1)	(2)	(3)	(4)	(5)	(6)
lngdp_i	0.0565	1.1082***	0.2273	1.1420***	0.0565	1.1082***
	(0.2098)	(0.2008)	(0.2173)	(0.1984)	(0.2098)	(0.2008)
lngdp_j	0.8472***	2.0971***	0.6051***	2.1025***	1.1582***	4.7042***
	(0.0874)	(0.1448)	(0.0707)	(0.1474)	(1.8916)	(1.3163)
lndistm	-0.0053***	-0.0801***				
	(1.9531)	(1.3386)				
lndistp			-0.2960***	-0.7768***		
			(1.6957)	(1.1999)		
lndistg					-0.0053***	-0.8013***
					(1.9531)	(1.3386)
wto		0.5759*		0.6237*		0.5759*
		(0.3292)		(0.3227)		(0.3292)
embasy		-3.0958		-2.6119		-2.0958
		(0.6286)		(0.6320)		(0.6286)
_cons	-10.9675***	-9.6208***	-8.8376***	-8.8557***	8.0868***	7.0709***
	(9.2071)	(7.0040)	(6.0263)	(6.7348)	(5.2156)	(9.8340)
Fixed effect	yes	yes	yes	yes	yes	yes
Obs	336	336	336	336	336	336
R-sq	0.0903	0.7530	0.0520	0.7671	0.0903	0.7530

Note: Standard errors in parentheses; ***, **, * significant at 1%, 5%, 10%, respectively.
Source: Authors' calculation

tance variables (*disg, distp and distm*). The estimated results demonstrate the suitability of the PPML approach compared to the OLS method. To save space, we only present the estimated results with the PPML method in Table 4. The estimations with the OLS technique are upon request.

Table 4 shows that the estimated coefficients and expected impacts of the economic distance variables on Vietnam's rice exports to West Africa are mostly compatible with the estimated results of the geographical distance variable using the PPML method in Table 3, that support the previous studies in literature. According to Vo (2016), economic distance has a negative link with subsidiary exports in the investing country, explaining the results and economic implications for economic distance variables as well as geographical distance variables. However, it should be noted that the impact of economic distance variables on Vietnam's rice exports to West African countries has obviously moderated when compared to the impact of pure geographical distance variables. Specifically, a one increase point in the economic distance between the city with the largest economic contribution, the population-weighted distance, and the economic-size-weighted distance in turn reduces 0.053 points, 0.7768 points and 0.8013 points of Vietnam's rice exports to West Africa. All figures are lower than 0.98 points for the pure geographical distance variable. This implies that the economic factors have significantly reduced the negative impact of pure geographical distance on Vietnam's rice exports to West African countries.

Discussion

The estimation results of the augmented gravity model using the PPML method provide empirical evidence on the negative relationship between geographical distance, economic distance and Vietnam's rice exports to the West African region. These findings contribute to practices by confirming the difficulty of geographical distance in trade relations between Vietnam and African countries in general and Vietnam's rice exports to the West African market in particular. However, by integrating the proxy for economic distance into the pure geographical distance variable, the negative impact of geographical distance on Vietnam's rice exports to the West African market has declined relatively, implying that there is an important issue in promoting Vietnam's exports to West Africa that policymakers and Vietnamese rice exporters need to consider carefully. The barriers of geographical factors are inevitable and unavoidable. Therefore, in order to promote Vietnam's rice export activities to the West Africa countries, policymakers need to clearly understand the economic characteristics of Vietnam and its export partners in West Africa, as well as market factors in the West Africa region (differences in economic distance). Understanding these economic differences, a rice exporting firm could dramatically reduce costs in its exporting activities, making it easier to penetrate exporting markets, meanwhile lowering transmission barriers. For policymakers, they could focus on considering and implementing effective measures instead of being concerned about geographical barriers. The development of countries in terms of transportation, payment, communication, and mutual market access as proxies of economic factors would reduce trade barriers. In other words, it will promote bilateral trade activities between Vietnam and the West African countries, promoting Vietnam's rice exports to West Africa.

Moreover, the estimation results of *wto* in the augmented gravity models indicate a positive correlation between Vietnam's rice exports to West Africa and becoming an official member of the World Trade Organization. It should be noted that the WTO is considered a proxy for free trade agreements at the global level. Therefore, strengthening the promotion of FTA strategies with African countries is an essential policy implication for Vietnam in promoting rice exports to West Africa. Although Vietnam and the West African countries have made great strides in economics, trade and investment cooperation, the effort to achieve bilateral free trade agreements seems to be faltering neglected and not given due attention. Furthermore, this empirical finding is preliminary evidence for future research on the influence of FTAs in bilateral trade ties between Vietnam and the West African countries.

Despite attempting to address and to integrate relevant issues, the study still contains some limitations. First, issues related to transportation modes have not been considered in the model. In fact, Vietnam's rice exports to West Africa are primarily transported by sea transport channels. Therefore, nations with seaports (closer to the sea) will be more beneficial than those without access to the sea. Second, the distance variables have been combined with economic factors but have not yet been integrated with logistical concerns, payment systems, or even political infrastructure. These variables would have certain impact on the distance between Vietnam and the West African countries. Finally, the study did not examine disparities in Vietnam's rice exports to West Africa such as differences in price quality, differences in rice types, differences in the markets of importing countries, differences in exchange rates, etc. Hence, we leave these issues for future research.

Conclusion

From a country that had to import food, Vietnam has gradually become a leading country in exporting agricultural products in the world. The highlight of Vietnam's agricultural performance is rice exports. This product has helped

Vietnam maintain its position as one of the three largest rice exporters in the world for many years. Vietnamese rice is gradually marking its position in the worldwide market in terms of quality, variety, and quantity.

West Africa has an enormous agricultural land area, but food is always in deficit due to the negative effects of drought, natural disasters, epidemics, conflict, and political instability. Rapid population growth in West Africa has led to an increased demand for food imports, especially rice to ensure the food security of these nations. As a leading rice exporting country, Vietnam is expected to expand rice exporting activities to the West African market. However, the geographical distance is always mentioned as a major challenge in Vietnam's rice exporting strategy to West Africa.

Using the augmented gravity model with the PPML estimation technique for the period 2001-2021, this study provides empirical evidence of the negative relationship between the geographical distance and Vietnam's rice exports to West Africa. Besides, the research also points out that the geographical distance barriers would be reduced by integrating the economic factors. Therefore, exporting firms and policymakers should focus on economic factors instead of worrying about the geographical distance in Vietnam's strategy to promote rice exports to West Africa. Moreover, the empirical findings suggest that free trade agreements could promote Vietnam's rice exporting activities to West Africa, implying that Vietnamese authorities should seriously consider pursuing trade liberalization policies and striking free trade agreements with the West African countries.

References

Anderson, J. E. & Wincoop, E. V. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review, 93*(1), 170-192.

Bui, T. H. H. & Chen, Q. (2017). An analysis of factors influencing rice export in Vietnam based on gravity model. *Journal of the Knowledge Economy*, *8*, 830-844.

Caves, R. E. (1996). Multinational Enterprise and Economic Analysis. New York: *Cambridge University Press.*

Dong, V. C. & Truong, Q. H. (2020). The determinants of creative goods exports: Evidence from Vietnam. *Journal of Cultural Economics, 44*, 281-308.

Dong, V. C. & Truong, Q. H. (2023). Determinants and potential of seafood trade: Evidence from a transitional economy. *Foreign Trade Review, 53*(3), 428-454.

Egger, P. & Pfaffermayr, M. (2003). The proper panel econometric specification of the gravity equation: A three-way model with bilateral interaction effects. *Empirical Economics, 28*(3), 571-558.

Head, K. & Mayer, T. (2010). Illusory Border Effects: Distance Mismeasurement Inflates Estimates of Home Bias in Trade. In The Gravity Model in International Trade: Advances and Applications, edited by Peter A.G. van Bergeijk and Steven Brakman, 165–192. Cambridge, UK: Cambridge University Press.

Hoang, N. T. T., Truong, H. Q. & Chung, C. V. (2020). Determinants of trade Between Taiwan and ASEAN countries: a PPML estimator approach. *Sage Open, 10*(2), 2158244020919516.

Maitah, K., Smutka, L., Sahatqija, J., Maitah, M. & Pham, A. N. (2020). Rice as a determinant of Vietnamese economic sustainability. *Sustainability*, *12*(12), 5123.

Morder Intelligence (MI) (2023). Africa Rice Market – Growth, Trend, Covid-19 Impact, and Forecasts (2023-2028). Telangada, India.

Ngo, H. & Nguyen, V. B. (2021). Export performance: Evidence from agricultural product firms in Vietnam. *Cogent Business & Management*, *8*(1), 1861729.

Nguyen, D. D. (2022). Determinants of Vietnam's rice and coffee exports: Using stochastic frontier gravity model. *Journal of Asian Business and Economic Studies*, *29*(1), 19-34.

Nguyen, T. X. H. (2016). Vietnamese rice exportation since Doi Moi Reform (1986-2016). *Journal of Economics and Development*, 48-55 (in Vietnamese).

Phan, N. T. (2014). Solution for promoting Vietnamese rice exports. *VNU Journal of Economics and Business*, *30*(3), 54-62 (in Vietnamese).

Silva, J. S. & Tenreyro, S. (2006). The log of gravity. *Review of Economics and Statistics*, *88*(4), 641-658.

Silva, J. S. & Tenreyro, S. (2011). Further simulation evidence on the performance of the Poisson pseudo-maximum likelihood estimator. *Economics Letters*, *112*(2), 220-222.

Thanh, N. C. & Singh, B. (2006). Trend in rice production and export in Vietnam. *Omonrice*, *14*, 111-123.

Tran, T., Nguyen, T., Tran, M. & Hoang, V. (2019). Impact of trade agreement on rice export: The case of Vietnam. *Uncertain Supply Chain Management*, *7*(4), 727-740.

Tran, T. T. H. (2022). The Current Situation of Vietnamese Rice Exports. Vietnam Institute of Strategy and Policy for Industry and Trade, Vietnam Ministry of Industry and Trade (in Vietnamese).

Tsukada, K. (2011). Vietnam: Food security in a rice-exporting country. *The World Food Crisis and the Strategies of Asian Rice Exporters*, 53-72.

Vietnam Customs (VC) (2023). Vietnam Goods Exports and Imports in 2021. Retrieved at https://www.customs.gov.vn/index.jsp?ngon_ngu=en.

Vo, M. S. & Do, V. X. (2016). Comparative advantage in producing and exporting Vietnamese rice. *Journal of Economics and Business Administration*, *11*(3), 49-61 (in Vietnamese).

Vo, V. D. (2016). Relationship between economic distance, geographical distance and exportations of son companies in Vietnam. *VNU Journal of Economics and Business*, *32*(1), 48-56 (in Vietnamese).

Westerlund, J. & Wilhelmsson, F. (2011). Estimating the gravity model without gravity using panel data. *Applied Economics*, *43*(6), 641-649.

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