อุปสงค์การส่งออกราชาแห่งผลไม้ของไทย

EXPORT DEMAND FOR THAILAND'S KING OF FRUIT

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บทคัดย่อ

บทความนี้มีวัตถุประสงค์เพื่อค้นหาปัจจัยที่กำหนดการส่งออกราชาผลไม้ของประเทศไทยด้วยการใช้แบบจำลองแรงโน้มถ่วง วิธีการทางเศรษฐมิติหลากหลายแบบได้นำไปใช้กับแบบจำลองแรงโน้มถ่วงที่ไปประยุกต์กับการส่งออกทุเรียนของประเทศไทย ผลการศึกษาบ่งชี้ว่าการประมาณค่าด้วยวิธี PML แบบมี country-pair กับ fixed effect และมีผลกระทบร่วมระหว่างตัวแปรหุ่นการไม่มีทางออกสู่ทะเลกับตัวแปรหุ่นเวลาให้ผลลัพธ์ที่สมเหตุสมผลมากที่สุด ผลการศึกษาเชิงประจักษ์ชี้ให้เห็นว่าการเพิ่มผลิตภาพแรงงานในการเพาะปลูกทุเรียนเป็นกลยุทธ์หนึ่งในการเพิ่มการเพาะปลูกและการส่งออกทุเรียน ผู้ส่งออกทุเรียนอาจใช้กลยุทธ์ราคาต่ำลงเพื่อเพิ่มรายได้ ผู้ส่งออกทุเรียนของไทยควรเจาะจงหาประเทศในแต่ละกลุ่มระดับรายได้ที่คนส่วนใหญ่ชื่นชอบทุเรียน

คำสำคัญ: การส่งออก แบบจำลองแรงโน้มถ่วง ราชาผลไม้ ทุเรียน

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Abstract

This paper aims to find the determinant of Thailand's king of fruit exports based on the gravity model. Several primary econometrics methods apply to the gravity model applying to Thailand's durian export. The result indicates that the country-pair and time-fixed effect PML with interaction regarding the landlock and time dummy variables give the most logical results. The empirical results suggest that enhancing labor productivity in durian cultivation is a strategy to increase durian cultivation and export. Durian exporters might use the lower price strategy to enhance their income. Thailand's durian exporters should find a specific country in each income-level group where most people love durian.

Keywords: Export, Gravity Model, King of Fruit, Durian

Introduction

It is common in Southeast Asia that the durian is known as the king of fruit since its physical has a crown and unique taste with a combination of intensely fragrant, sweet, and creamy all at once. Durian likes hot and humid weather. Optimum temperatures range from about 25 to 30 degrees Celsius, with a relative humidity of about 75 to 85 percent. That is, Thailand is suitable for growing durian, one of Thailand's significant export fruits. The price of durian has been at a reasonable level for many consecutive years, thus causing farmers to change the area to plant more durian instead of other crops such as rubber, oil palm, and different types of fruit. According to the Thailand's Office of Agricultural Economics data, most of the durian cultivation area is in the eastern and southern regions, and the main products come from these two regions. The quantity and value of durian export from Thailand in 2011 were 271,948 tons and 4,662 million Baht; in 2019, 65,362tons and 45,486 million Baht (Information and Communication Technology Center, Office of the Permanent Secretary Ministry of Commerce); the amount and value of durian export from Thailand grew 140 % and 875 %, respectively, during this period. Durian generates income to the farmer and distribute income to local provinces in Thailand.

Thailand is the leader in durian exports in the world market, with market share values between 58.8% and 78.8% from 2007 to 2020[2]. According to the strong fragrant, not all people

[2] The Observatory of Economic Complexity (OEC) retrieved from https://oec.world/en/profile/hs/fruit-edible-durians-fresh?yearSelector1=tradeYear7

love durian. It can be seen from Table 1 that countries in Asia[3] and Europe[4] and Canada, the United States, Australia, and New Zealand have been importing Thailand's durian continually for ten years. Some countries in Africa imported Thailand's durian from time to time: Congo, Egypt, Eswatini, South Africa, and Morocco. No countries in Latin America and the Caribbean imported Thailand's durian. However, the number of countries that Thailand's durian exports to shows an increasing trend.

Most export determination research mainly adopted the gravity model for total bilateral trade. For example, Poncet (2006) adopted the total import and export of Yunnan and the riparian countries of the Mekong, Westerlund and Wilhelmsson (2011) adopted the total import of the European Union (EU) and developed countries, Kahouli and Maktouf (2014), Cheong *et al.* (2016), and Baier and Bergstrand (2007) adopted trade flow of 96 countries. The gravity model was also adopted for groups of products. Sarker and Jayasinghe (2007) adopted six major agri-food products (red meat, grains, vegetable, fruits, sugar, and oilseeds) from European Unions countries. Yang and Martinez-Zarzoso (2014) adopted the exports of agricultural, manufactured, Chemical, and Machinery and transport equipment of 31 countries (China, ASEAN-10 countries, and China's top 20 trading partners in 2010). Sheng et al. (2014) adopted the import of parts and components and final goods of ASEAN and China, Borchert and Yotov (2017) adopted manufacturing goods of 69 countries, and Parra et al. (2016) adopted manufactured and agricultural products of 10 the Middle East and North African (MENA) countries to 61 destinations.

[3] They are China, South Korea, Japan, Hong Kong, PDR Lao, Viet Nam, Cambodia, Myanmar, Malaysia, Singapore, Indonesia, Brunei, Bangladesh, India, Qatar, Kuwait, Saudi Arabia, Bahrain, Oman, and United Arab Emirates.

[4] They are Russia, Denmark, Norway, Sweden, the United Kingdom, the Netherlands, France, Germany, and Switzerland.

Table 1 Descriptive Statistics for the Durian exports of Thailand (Metric Tons) from 2007 to 2020 classified by Area

		Year													
Destination	**Statistics**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Middle Africa	Mean														17.28
	Sd														-
	Count														1
	Share of Export														0.00%
Northern Africa	Mean	9.07					0.03	0.74	17.00		0.09		0.07	0.03	
	Sd	-					-	-	-		-		-	-	
	Count	1					1	1	1		1		1	1	
	Share of Export	0.01%					0.00%	0.00%	0.00%		0.00%		0.00%	0.00%	
Southern Africa	Mean				0.02						0.05				
	Sd				-						-				
	Count				1						1				
	Share of Export				0.00%						0.00%				
Eastern Asia	Mean	29,220	38,900	52,552	43,181	56,903	79,005	69,382	85,128	80,918	60,943	54,439	58,310	119,500	132,841
	Sd	31,454	40,455	54,115	50,962	60,332	85,469	86,403	86,207	80,812	74,604	57,481	79,240	153,321	183,203
	Count	4	4	4	4	4	4	5	4	4	5	4	5	4	4
	Share of Export	83.76%	85.19%	87.46%	87.57%	88.13%	94.10%	97.53%	94.98%	92.86%	76.97%	45.25%	59.90%	73.64%	86.23%
South-Central Asia	Mean	0.02	0.04	0.19	0.16	0.01	0.34	0.29	2.97	4.01	0.61	3.41	5.81	3.89	1.67
	Sd	-	0.01	-	-	-	0.31	0.40	-	-	0.34	3.39	4.12	4.71	1.14
	Count	1	2	1	1	1	2	3	1	1	2	2	3	3	3
	Share of Export	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
South-Eastern Asia	Mean	3,077	2,839	4,164	3,345	3,709	2,431	1,060	1,952	3,050	12,930	32,837	24,278	33,993	10,507
	Sd	7,281	7,508	9,660	7,577	8,584	5,917	1,584	3,576	6,029	29,376	84,688	61,366	65,296	26,071
	Count	7	9	7	7	8	8	8	9	8	7	8	8	5	8
	Share of Export	15.44%	13.99%	12.13%	11.87%	11.49%	5.79%	2.38%	4.90%	7.00%	22.86%	54.59%	39.90%	26.18%	13.64%

Table 1 Descriptive Statistics for the Durian exports of Thailand (Metric Tons) from 2007 to 2020 classified by Area (Cont.)

Destination	Statistics	Year													
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Western Asia	Mean	7.07	2.42	17.63	0.01	0.89	2.68	5.25	8.68	10.15	12.38	9.13	10.17	6.84	5.95
	Sd	6.92	-	16.93	0.00	1.61	4.14	7.31	7.71	6.25	7.94	5.94	7.91	6.66	6.01
	Count	2	1	2	2	6	7	6	6	6	6	6	6	7	6
	Share of Export	0.01%	0.00%	0.01%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.02%	0.01%	0.01%	0.01%	0.01%
Eastern Europe	Mean					0.06	0.94	2.13	2.49	0.29	0.80	0.09	0.42	2.04	2.14
	Sd					-	-	-	-	0.21	-	-	-	-	1.21
	Count					1	1	1	1	2	1	1	1	1	3
	Share of Export					0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Northern Europe	Mean	9.01	4.91		0.93	3.05	3.63	5.71	4.73	6.13	2.31	4.67	5.54	10.15	11.42
	Sd	10.14	-		0.64	2.16	3.92	5.27	4.60	7.84	1.61	3.90	3.51	11.96	15.10
	Count	3	1		3	4	4	5	5	5	6	6	5	5	6
	Share of Export	0.02%	0.00%		0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.00%	0.01%	0.01%	0.01%	0.01%
Southern Europe	Mean			0.40				0.86	2.73	1.47	4.39	9.69	19.85	17.39	2.58
	Sd			-				-	-	0.98	-	1.61	2.69	2.04	0.93
	Count			1				1	1	2	1	2	2	2	2
	Share of Export			0.00%				0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.00%
Western Europe	Mean	1.90	7.30	15.78	31.89	22.90	23.97	5.20	23.37	6.94	9.85	11.19	6.79	18.90	6.41
	Sd	1.27	2.43	8.98	26.20	22.16	39.67	7.89	23.19	5.15	16.62	17.14	8.98	17.34	1.46
	Count	4	2	4	3	3	4	6	5	4	6	5	5	4	4
	Share of Export	0.01%	0.01%	0.03%	0.05%	0.03%	0.03%	0.01%	0.03%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%
South America	Mean											14.47			
	Sd											-			
	Count											1			
	Share of Export											0.00%			

Table 1 Descriptive Statistics for the Durian exports of Thailand (Metric Tons) from 2007 to 2020 classified by Area (Cont.)

Destination	Statistics	Year													
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Northern America	Mean	516.29	638.84	408.44	476.87	380.93	93.42	90.04	91.57	155.70	225.62	249.03	368.57	414.96	297.53
	Sd	411.64	534.80	378.27	475.61	358.51	32.74	53.31	64.16	147.11	209.75	207.51	289.40	316.18	291.69
	Count	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Share of Export	0.74%	0.70%	0.34%	0.48%	0.29%	0.06%	0.05%	0.05%	0.09%	0.11%	0.10%	0.15%	0.13%	0.10%
Oceania	Mean	31.97	101.61	40.73	27.69	74.62	24.63	12.30	19.65	25.83	22.10	27.96	36.88	44.93	30.10
	Sd	-	92.28	2.19	5.05	53.35	3.74	4.27	1.88	10.04	9.80	20.07	10.27	2.80	14.62
	Count	1	2	2	2	2	2	2	2	2	2	3	2	2	2
	Share of Export	0.02%	0.11%	0.03%	0.03%	0.06%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.02%	0.01%	0.01%
	Total Count	25	23	23	25	31	35	40	37	36	40	40	40	36	41
	Sum Share	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Not much research adopted the gravity model for specific commodities. Examples are as follows. Castillo et al. (2016) adopted bottled and bulk wine export of the nine significant countries that operated in the global wine market to 14 importers; Dreyer and Fedoseeva (2016) adopted German beer exports to 167 countries. De Matteis et al. (2018) adopted US distillers dried grains with solubles exports to 29 countries. This paper extends the literature that adopts the gravity model to a specific commodity, Thailand's durian export. As mentioned above, durian is a vital fruit export in Thailand; however, not much research focuses on the determinant of its export. Moreover, understanding the determinant of durian export would benefit durian exporters to set up strategies and realize the behavior of their customers.

This paper has five sections. The following section is a literature review; the third section is the theoretical framework and model. The result is in the fourth section; the last section is the conclusion.

Literature Reviews

The gravity model has been extensively adopted to study the determinants of the levels of exports. Tinbergen (1962) was the first to adopt the Law of Universal Gravitation to study the flows of international trade. Many researchers have followed this idea, later called the "gravity model," to study the determinants of bilateral trade flows. Unfortunately, the gravity model did not find favor with economists because there were no economic theories underpinning the model. Later, Anderson (1979), Helpmen (1984), Bergstrand (1985) and Deardorff (1998) proved that the gravity model relates to economic theories. Nowadays, the gravity model has been accepted and adopted to study bilateral trade flow. Borchert and Yotov (2017) summarized the general form of gravity equation of trade as follows

$$X_{ij,t} = G_t \frac{\pi_{i,t}\chi_{j,t}}{T_{ij,t}}, \forall i, j.$$

The dependent variable $X_{ij,t}$ is the export from source i to destination j at time t; $T_{ij,t}$ represents all bilateral frictions between i and j, and $\boldsymbol{\chi}_{j,t}$ captures all possible exporter and importer characteristics, respectively. G_t is a gravity constant at time t. The concept summarized by Borchert and Yotov (2017) was applied to the empirical model.

The gravity model has extensively studied the determinants of international trade. Borchert and Yotov (2017) summarized the general form of the gravity model of international trade, which depends on exporter and importer characteristics, bilateral friction, and a gravity constant, which is a function of the output value in the world at time t. The exporter and importer characteristics can be proxy by sets of economic variables. For example, Baier & Bergstrand (2007) and Castillo et al. (2016) used real GDP; Westerlund and Wilhelmsson (2011),

Yang and Marinez-Zarzoso (2014), and Persson and Wilhelmsson (2015) used GDP and population; Sarker and Jayasinghe (2007), Sheng et al. (2014), and Caporale *et al*. (2015) used GDP and GDP per capita. Poncet (2006) and Batra (2006) used the multiplication of exporters' and importers' GDP and GDP per capita between exporter and importer. Borchert & Yotov (2017), Parra *et al*. (2016), and Cheong *et al*. (2016) used exporter and importer time fixed effects. The bilateral friction in this literature was the distance between two cities, dummy variables of landlock, common language, border sharing, island, and regional trade area agreements. The double log function form applies to the gravity model.

Several econometrics methods apply to estimate the gravity model. Pooled OLS (POLS) was adopted in Poncet (2006), Baier and Bergstrand (2007), Sarker and Jayasinghe (2007), Sheng *et al*. (2014), Yang and Martinez-Zarzoro (2014), Li *et al*. (2019), and Shabbir (2022), since it is simple. Although POLS gives biased results, it can compare to other econometrics methods, such as fixed effects, e.g., Poncet (2006), Baier and Bergstrand (2007), Sheng et al. (2014), Kahouli and Maktouf (2014) Parra *et al*. (2016), and Borchert and Yotov (2017). The strength of the fixed effect is that it controls for exporters and importers' unobservable time-invariant bilateral factors and unobserved time-variant multilateral resistance. Random effect and panel GLS were adopted to control autocorrelation within and across panels. Moreover, these methods can control cross-sectional correlation and heteroskedasticity across panels (e.g., Kahouli and Maktouf, 2014; Sheng *et al*., 2014; Shabbir, 2022). The mixed fixed and random effects methods were adopted by Kahouli and Maktouf (2014). This method is consistent, and performance is at least fixed effect and random effect; in other words, this method can be including a time-invariant variable and model unobserved individual heterogeneity. Shabbir (2022) and Kahouli and Maktouf (2014) adopt the system GMM or difference GMM. They provide consistent estimates in the presence of different sources of endogeneity explanatory variables. It is efficient in the presence of heteroskedasticity; these methods are helpful for short panel data.

Anderson and van Wincoop (2003) indicated that the omitted multilateral resistance variables in the gravity model lead to biased results. They suggest that the constraints in unobserved multilateral resistance should be included in the existing gravity model and use non-linear least squares to estimate the parameters. Anderson and van Wincoop (2003) suggest an alternative estimation method: replacing the unobserved resistance terms with country-specific dummies and using the fixed-effect model to the gravity model to achieve consistent estimates. Later, Baier and Bergstrand (2007) showed that the first-differenced data and country-and-time effect provide more robustness than the fixed effect.

Santos Silva and Tenryro (2006) argued that standard empirical methods, e.g., linear and non-linear least squares, are inappropriate for estimating the gravity model since the log-linearization of the empirical gravity model in heteroskedasticity leads to inconsistent estimates. They proposed that the Poisson pseudo-maximum likelihood (PPML) method is

robust to different heteroskedasticity patterns. They prove that PPML does not require the dependent variable to be Poisson distribution. Westerlund and Wilhelmsson (2011) proved that the fixed-effect Poisson maximum likelihood (PML) gets rid of heteroskedasticity problems while simultaneously taking care of the bias caused by country-specific heterogeneity. Fally (2015) showed that estimating the gravity model with fixed-effect in the PPML is consistent with the definition of outward and inward multilateral resistance indexes and the equilibrium constraints that Anderson and van Wincoop (2003) needs to satisfy. Recently, the fixed effect PPML was widely adopted in the gravity model, for example, Dai *et al*. (2014), Anderson and Yotov (2016), Borchert and Yotov (2017), Cheong *et al*. (2016), Li et al. (2019), Parra et al. (2016), and Rangkakulnuwat and Weravess (2022).

Empirical Model and Data

The gravity model can be analyzed using various econometric methods. Pooled OLS, Fixed Effect, and Random Effect are some of the commonly used methods. PPML is recommended for cases with heteroscedasticity. Poisson ML estimator is often used with good accuracy. Seven econometric methods have been applied to examine Thailand's durian export using the gravity model summarized by Borchert and Yotov (2017). Following Westerlund and Wilhelmsson (2011), the exporter characteristics in this empirical model are Thailand's real GDP and population, and the importer characteristics are Thailand's partners' real GDP and population. The export price of durian adds to the gravity model as in Castillo et al. (2016). The bilateral friction is the distance between the capital city of Thailand (Bangkok) and the capital cities of Thailand's partners (following Sarker and Jayasinghe, 2007). Another bilateral friction is the dummy variable of landlock. This paper adds a dummy variable that represents income class to test if durian's export from Thailand depends on income class level. The empirical model can express as follows,

$$x_{ijt} = \alpha_0 y_{it}^{\alpha_1} pop_{it}^{\alpha_2} y_{jt}^{\alpha_3} pop_{jt}^{\alpha_4} p_{jt}^{\alpha_5} dist_{ij}^{\alpha_6} \exp\left(\alpha_7 lock_j + \sum_{m=1}^{3} \gamma_m class\_m_{jt}\right) \eta_{ijt}$$

or

$$\ln x_{ijt} = \ln \alpha_0 + \alpha_1 \ln y_{it} + \alpha_2 \ln pop_{it} + \alpha_3 \ln y_{jt} + \alpha_4 \ln pop_{jt} + \alpha_5 \ln p_{jt} + \alpha_6 \ln dist_{ij} + \alpha_7 locked_j + \sum_{m=1}^{3} \gamma_m class\_m_{jt} + \ln(\eta_{ijt})$$

where x_{ijt} denotes the quantity of durian exports (thousands of metric tons) from Thailand to importer *j* in period *t*. y_{it} and y_{jt} are the real GDP (2010 billion USD) of country *i* (Thailand) and *j* (Thailand's partner), respectively, and pop_{it} and pop_{jt} are their populations (millions). p_{jt} is Thailand's price of durian (USD per kilogram) of importer *j*. $dist_{ij}$ is the distance between the capital city of Thailand and importer *j* (kilometers). The dummy variables $lock_j$ take the value

of 1 if importing country *j* is landlock[5], and 0 otherwise. The World Bank classifies all countries into four income classes: high-income, upper-middle-income, lower-middle-income, and low-income. Hence, three dummy variables represent income class. $class\_m_{jt}$ takes the value of 1 if an importing country *j* is in group *m* at period *t*, and 0 otherwise; where *m*=1 means high-income, *m*=2 means upper-middle-income, and *m*=3 means lower-middle-income. The low-income group is used as the base group. η_{ijt} is disturbance term with $E(\eta_{ijt} \mid y_{it}, pop_{it}, y_{jt}, pop_{jt}, p_{jt}, dist_{ij}, locked_j, class\_1_{jt}, class\_2_{jt}, class\_3_{jt}) = 1$.

According to Linnemann (1996) and Caporale *et al*. (2015), the explanatory variables of Thailand's real GDP and population are the proxies of the potential supply of exports. Thailand's real GDP and population are the proxies of potential demand for imports. The higher potential supply of exports implies more variety in export products (Caporale *et al*., 2015), hence the less productive resources for durian cultivation, *ceteris paribus*. That is, the effect of the real GDP of Thailand is expected to be a negative relationship to their durian exports. The higher Thailand's population implies more productive resources of labor; this leads the Thailand' population to have a positive relationship with their durian exports. The higher potential demand for imports implies a larger market size for the importers; hence, the importers' real GDP and population are expected to have a positive relationship to durian exports from Thailand. *dist* and *lock* represent the trade barriers. More trade barriers imply more trade and transportation costs; hence, the relationship between distance and durian export is negative, and Thailand's durian exports are less to landlocked countries.

This paper uses the panel data set for Thailand's durian export partners covering 14 years from 2007 to 2020. The trade quantities and values of durian exports from Thailand to its partners are taken from the website of the Office of the Permanent Secretary, Ministry of Commerce[6] and based on the Harmonized System (HS) code 081060. The price of Thailand's durian exports is calculated by its trade values divided by trade quantities. Real GDP and population obtain from the World Development Indicators (WDI) of the World Bank. The data concerning whether a country is landlocked or not has been taken from the United Nations. The distances between the two countries obtain from the webpage of *timeandtable*[7]. The data concerning the income class of a country is from World Bank.

[5] "*Landlocked Developing Countries: Things to Know, Things to Do*", UN-OHRLLS, Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries, and Small Island Developing States,.

[6] Office of the Permanent Secretary, Ministry of Commerce retrieved from https://tradereport.moc.go.th/searchhs.aspx?TabHs=22

[7] Time and Table retrieved from https://www.timeanddate.com/worldclock/distanceresult.html?p1=28&p2=14

Results

Table 2 shows the coefficient estimates of the empirical model by four econometrics methods: pooled OLS, random effect, PPML, and PML. The results show that the coefficients of the potential supply of exports: Thailand's real GDP, and population, have no significant effects on Thailand's durian exports. For the effects of potential demand for imports, Thailand's partners' real GDP has significant and positive effects on Thailand's durian export. However, the method of PPML and PML have much lower effects. Thailand's partners' population has a significant negative effect only on the method of POLS. The price elasticity of Thailand's durian export demand is inelastic on RE, PPML, and PML, while it is elastic on the method of POLS. The distance has a negative and significant relationship to Thailand's durian export demand for trade barrier effects. Thailand's durian export is significantly less to landlock on the method of PPML and PML. Thailand's durian export to High-Income-class the most based on PPML and PML compared to low income-class. The R-squares from PPML and PML are higher than the first two methods. The Ramsey RESET test indicates misspecification occurs using these methods.

When the fixed effect adopts in the empirical model, the time-invariant variables must be removed. Since the distance between two cities (*dist*) and the dummy of landlock (*lock*) variables are time-invariant, they replace with the interaction terms between these two time-invariant variables and the time dummy variable. $class\_m_{jt}$ (m = 1, 2 and 3) is a time-variant variable because the income class can move up or down over time. The country-pair fixed effect is adopted to the empirical model to control the unobservable time-invariant bilateral factor between Thailand and its partners, such as the preference for Thailand's durian taste and the closeness of Thai durian exporters and importers in trading partner countries. The country-pair fixed effect is adopted along with four cases regarding adding or removing the interaction term between *dist*, *lock*, and time dummy variables. Then the time effect is added to control for the unobserved time-varying multilateral resistance, such as quality development of Thailand's durian and its competitors and logistic development. The country-pair and time effect adopt along with four cases as explained before. Hence there are eight cases in this estimation. The results show in Table 3. Thailand's real GDP and population and Thailand's partners' population do not affect Thailand's durian export in all eight cases.

Table 2: Coefficients estimates of the empirical model of pooled OLS, random effect, PPML, PML

Variable	POLS	RE	PPML	PML
$\ln(y_{it})$	−2.688	1.042	−0.007	−0.007
	(5.425)	(3.360)	(0.011)	(0.011)
$\ln(pop_{it})$	50.155	25.520	0.443	0.443
	(39.910)	(24.745)	(0.476)	(0.456)
$\ln(y_{jt})$	1.866	1.673	0.0004	0.0004
	(0.333)***	(0.421)***	(0.0001)***	(0.0001)***
$\ln(pop_{jt})$	−0.811	−0.649	0.0007	0.0007
	(0.335)**	(0.412)	(0.0004)	(0.0004)
$\ln(p_{jt})$	−1.725	−0.882	−0.473	−0.473
	(0.219)***	(0.157)***	(0.184)**	(0.184)**
$\ln(dist_j)$	−2.148	−1.945	−0.966	−0.966
	(0.269)***	(0.419)***	(0.102)***	(0.102)***
$lock_j$	0.988	0.294	−4.355	−4.355
	(0.791)	(1.580)	(0.574)***	(0.574)***
Lower-Middle-Income	0.968	−1.021	4.846	4.846
	(0.704)	(0.502)**	(0.424)***	(0.424)***
Upper-Middle-Income	0.710	−3.222	3.898	3.898
	(1.016)	(0.995)	(0.473)***	(0.473)***
High-Income	0.544	−2.143	5.828	5.828
	(1.373)	(1.405)	(0.355)***	(0.355)***
Constant	−204.43	−120.74	−27.82	−27.82
	(137.4)	(85.31)	(27.07)	(27.07)
N (Observations)	472	472	472	472
R-square	0.460	0.125	0.616	0.697
Ramsey RESET Test:	21.21	10.05	35.81	45.48
(P-value)	(0.000)***	(0.007)***	(0.000)***	(0.000)***

Note: The numbers in parentheses are robust standard errors for PPML and PML.

***, ** and * represent the 1%, 5% and 10% significance levels.

The squares and cubes powers of fitted values are used in the Ramsey RESET test.

Within R^2 is shown for a random effect, Pseudo R^2 is shown for PPML and PML.

Table 3 Coefficients Estimates of the empirical model by Fixed Effect Model

Variable	Country-Pair Fixed Effect				Country-Pair and Time Fixed Effect			
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
$\ln(y_{it})$	1.041	0.259	0.450	0.737	10.915	8.982	5.148	5.627
	(6.798)	(6.103)	(3.393)	(3.327)	(11.267)	(9.985)	(5.035)	(4.953)
$\ln(pop_{it})$	−6.564	−4.678	9.027	9.998	−53.792	−46.864	−14.786	−14.661
	(50.828)	(45.999)	(25.217)	(24.801)	(73.210)	(65.338)	(33.574)	(33.067)
$\ln(y_{jt})$	3.691	3.357	3.551	2.820	3.678	3.342	3.215	2.450
	(1.315)***	(1.293)**	(1.124)***	(1.071)***	(1.332)***	(1.312)**	(1.133)***	(1.083)**
$\ln(pop_{jt})$	2.612	2.656	2.874	2.910	2.464	2.519	2.365	2.454
	(1.869)	(1.859)	(1.845)	(1.840)	(1.877)	(1.869)	(1.859)	(1.856)
$\ln(p_{jt})$	−0.690	−0.699	−0.686	−0.701	−0.727	−0.740	−0.738	−0.765
	(0.169)***	(0.166)***	(0.160)***	(0.159)***	(0.172)***	(0.170)***	(0.169)***	(0.168)***
Lower-Middle-Income	−1.758	−1.355	−2.052	−1.671	−1.933	−1.474	−1.925	−1.472
	(1.218)***	(0.595)**	(0.608)***	(0.563)***	(0.675)***	(0.618)**	(0.612)***	(0.570)**
Upper-Middle-Income	−5.282	−4.702	−5.872	−5.244	−5.374	−4.759	−5.265	−4.578
	(1.218)***	(1.166)***	(1.185)***	(1.145)***	(1.241)***	(1.194)***	(1.204)***	(1.173)***
High-Income	−3.850	−3.256	−4.624	−3.970	−3.920	−3.280	−3.697	−2.951
	(1.705)**	(1.660)*	(1.644)***	(1.612)**	(1.724)**	(1.685)*	(1.680)**	(1.658)*
Constant	−9.009	−11.04	−70.53	−72.602	132.62	116.0	5.177	5.483
	(175.3)	(159.0)	(86.67)	(85.261)	(244.4)	(218.7)	(112.7)	(111.0)
$\ln(dist_j)$*time_dummy	Yes	Yes	No	No	Yes	Yes	No	No
$lock_j$*time_dummy	Yes	No	Yes	No	Yes	No	Yes	No
Country-Pair Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	No	No	No	No	Yes	Yes	Yes	Yes
N (Observations)	472	472	472	472	472	472	472	472
Within R-square	0.189	0.169	0.168	0.143	0.209	0.186	0.192	0.165
Ramsey RESET Test:	7.45	7.42	8.03	8.57	7.95	7.41	7.35	6.88
(P-value)	(0.001)***	(0.001)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.001)***	(0.001)***

Note: The numbers in parentheses are robust standard errors for PPML and PML.

***, ** and * represent the 1%, 5% and 10% significance levels.

The squares and cubes powers of fitted values are used in the Ramsey RESET test.

Table 4 Coefficients Estimates of the empirical model by first difference data with Fixed Effect

Variable	Country-Pair Fixed Effect of First Difference Data				Country-Pair and Time Fixed Effect of First Difference Data			
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
$\Delta\ln(y_{it})$	0.051	−1.477	−3.064	−3.224	−1.906	−0.406	2.358	2.776
	(5.161)	(4.587)	(2.927)	(2.867)	(10.138)	(9.064)	(5.079)	(5.010)
$\Delta\ln(pop_{it})$	−145.590	−108.61	59.995	56.250	−75.806	−95.125	15.487	7.624
	(189.98)	(170.10)	(103.31)	(105.396)	(313.68)	(279.23)	(172.39)	(168.32)
$\Delta\ln(y_{jt})$	6.777	7.307	8.695	8.812	8.669	8.174	7.507	6.961
	(3.901)*	(3.877)**	(3.501)**	(3.485)**	(3.975)**	(3.995)**	(3.967)	(3.948)*
$\Delta\ln(pop_{jt})$	−4.111	−4.446	−5.131	−5.098	−4.405	−4.607	−5.146	−4.850
	(8.41)	(8.402)	(8.295)	(8.283)	(8.332)	(8.394)	(8.475)	(8.461)
$\Delta\ln(p_{jt})$	−0.389	−0.374	−0.453	−0.441	−0.435	−0.408	−0.443	−0.441
	(0.156)**	(0.154)**	(0.153)***	(0.151)***	(0.157)***	(0.155)***	(0.158)***	(0.155)***
ΔLower-Middle-Income	0.047	0.494	−0.047	0.478	0.198	0.485	0.005	0.608
	(0.848)	(0.731)	(0.843)	(0.728)	(0.887)	(0.772)	(0.855)	(0.740)
ΔUpper-Middle-Income	0.160	0.645	−0.342	0.191	0.366	0.556	0.204	0.694
	(1.691)	(1.636)	(1.675)	(1.622)	(1.704)	(1.683)	(1.714)	(1.680)
ΔHigh-Income	2.055	2.500	1.632	2.167	2.209	2.400	2.160	2.709
	(1.975)	(1.925)	(1.946)	(1.901)	(1.978)	(1.962)	(1.984)	(1.956)
Constant	0.610	0.456	−0.188	−0.183	0.709	0.713	0.033	0.056
	(0.743)	(0.663)	(0.382)	(0.375)	(1.188)	(1.056)	(0.591)	(0.579)
$\Delta\ln(dist_j*time\_dummy)$	Yes	Yes	No	No	Yes	Yes	No	No
$\Delta(lock_j*time\_dummy)$	Yes	No	Yes	No	Yes	No	Yes	No
Country-Pair Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	No	No	No	No	Yes	Yes	Yes	Yes
N (Observations)	386	386	386	386	386	386	386	386
Within R-square	0.138	0.104	0.098	0.065	0.191	0.140	0.123	0.088
Ramsey RESET Test:	2.54	3.24	4.93	4.19	2.05	1.82	4.58	5.87
(P-value)	(0.081)*	(0.041)**	(0.001)***	(0.016)**	(0.130)	(0.165)	(0.011)**	(0.003)**

Note: The numbers in parentheses are standard errors

***, ** and * represent the 1%, 5% and 10% significance levels.

Thailand's partners' real GDP has a significant, positive effect and is greater than one in all cases. The price elasticity of Thailand's durian export demand is significant and inelastic. The coefficients of the income-class dummy are significant and opposite to Table 2. The Ramsey RESET test indicates misspecification occurs in all eight cases.

Table 4 shows the estimation results using fixed effect with the first difference panel data along with the eight cases as before. The coefficients of Thailand's real GDP and population and Thailand's partners' real GDP and population have the same pattern in Table 3. The price elasticities from eight cases are inelastic and significant. In contrast to Table 3, the coefficients of income-class dummy variables turn to all insignificant. The Ramsey RESET test indicates no misspecification in the fifth and sixth cases.

The results of the coefficients estimate of the empirical model by fixed-effect PPML, along with the eight cases before, are in Table 5. Thailand's real GDP coefficient turns positively significant in the first, second, seventh, and eighth cases, and the coefficients are close. The coefficients of Thailand's population turn significant from the third to the eighth case, but they are positive in the third to fifth cases and adverse effects in the seventh and eighth cases. The coefficients of Thailand's partners' real GDP are positive and significant in all cases, but the absolute value much decreases from POLS, RE, the eight cases of fixed effect, and the first difference data with fixed effect. The coefficients of Thailand's partners' population are negatively significant in the third, fourth, fifth, sixth, and eighth cases. The price elasticities of Thailand's durian exports are negatively significant except for the third and fourth cases. The price elasticity of demand for Thailand's durian exports becomes elastic when the time effect is controlled in the fifth to eighth cases. There is evidence that Thailand exports durian to the high-income class the highest amount and export to the low-income class the least amount. The results estimation of the empirical model using the fixed effect PML is in Table 6. The coefficient estimates and significance are similar for most cases, except for Thailand's real GDP and population coefficients in the seventh and eighth cases, opposite to those in Table 5. The Ramsey RESET test indicates no misspecification in the seventh and eighth cases of methods in Tables 5 and 6.

The Ramsey RESET statistics are significant in all estimation results in Tables 2 and 3, which means that misspecification occurs. At the same time, those are insignificant in the fifth and sixth cases of Table 4 and the seventh and eighth cases of Tables 5 and 6. That is, there is no misspecification occurs in those estimation results. The comparison of the expected sign

for the potential supply of exports and potential demand for imports, along with estimation results with no misspecification occurring, is shown in Table 7. The seventh case of Fixed-Effect PML (Table 6) gives the results closest to expected signs; in other words, they provide the most logical estimate.

According to the result of the seventh case of Fixed-Effect PML, Thailand's real GDP's coefficient is –0.049, which means that a 1% increase in Thailand's real GDP would reduce Thailand's durian export by 0.049%. The result corresponds to the expected sign and implies that the greater variety of Thailand's outputs would cause competition for resources in durian cultivation; hence, the lower export in durian. Thailand's population's coefficient is 3.428, which is a significant effect on Thailand's durian export. That is 1% increase in Thailand's population would increase durian export by 3.428%, implying that durian cultivation depends heavily on labor. Thailand's partners' real GDP and population show an insignificant on Thailand's durian export; that is, Thailand's durian exports do not depend on its partners' income and population. Thailand's durian price export shows a negative and significant relationship to its export. The price coefficient is –1.863, which implies that Thailand's durian export demand is elastic. Lower durian price of export would enhance revenue to exporters.

Table 5 Coefficients Estimates of the empirical model by Fixed Effect PPML

Variable	Country-Pair FE PPML				Country-Pair and Time FE PPML			
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
$\ln(y_{it})$	0.033	0.033	−0.002	−0.002	0.004	0.008	0.041	0.041
	(0.010)***	(0.010)***	(0.007)	(0.007)	(0.014)	(0.013)	(0.009)***	(0.009)***
$\ln(pop_{it})$	0.940	0.886	0.705	0.699	2.138	1.846	−0.258	−0.339
	(0.729)	(0.708)	(0.355)**	(0.352)**	(0.680)***	(0.630)***	(0.048)***	(0.048)***
$\ln(y_{jt})$	0.001	0.001	0.001	0.001	0.001	0.001	0.0004	0.0004
	(0.0003)**	(0.0003)**	(0.0002)***	(0.0002)***	(0.0003)***	(0.0003)***	(0.0003)	(0.0003)
$\ln(pop_{jt})$	−0.020	−0.020	−0.068	−0.067	−0.036	−0.034	−0.041	−0.042
	(0.027)	(0.027)	(0.023)***	(0.022)***	(0.019)*	(0.020)*	(0.025)	(0.025)*
$\ln(p_{jt})$	−0.712	−0.701	−0.258	−0.255	−1.171	−1.026	−1.863	−1.710
	(0.348)**	(0.347)**	(0.171)	(0.169)	(0.446)***	(0.402)**	(0.622)***	(0.569)***
Lower-Middle-Income	1.151	1.147	2.761	2.695	1.599	1.581	2.904	2.844
	(1.002)	(0.986)	(0.807)***	(0.796)***	(0.949)*	(0.933)*	(0.800)***	(0.792)***
Upper-Middle-Income	1.279	1.264	2.524	2.460	0.356	0.399	3.182	3.106
	(1.088)	(1.075)	(0.860)***	(0.849)***	(1.274)	(1.244)	(0.889)***	(0.884)***
High-Income	2.127	2.039	3.263	3.200	0.522	0.439	3.264	3.206
	(1.584)	(1.575)	(0.995)***	(0.984)***	(1.701)	(1.703)	(1.301)**	(1.270)**
Constant	−69.77	−72.99	−49.96	−54.17	−139.15	−127.96	NO.[8]	
	(44.5)	(43.7)*	(21.22)**	(21.10)*	(41.2)***	(38.2)***		
$\ln(dist_j)$*time_dummy	Yes	Yes	No	No	Yes	Yes	No	No
$lock_j$*time_dummy	Yes	No	Yes	No	Yes	No	Yes	No
Country-Pair Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	No	No	No	No	Yes	Yes	Yes	Yes
N (Observations)	472	472	472	472	472	472	472	472
R-square	0.946	0.945	0.851	0.851	0.968	0.967	0.886	0.885
Ramsey RESET Test:	9.29	10.21	16.64	16.43	6.95	8.54	3.80	2.92
(P-value)	(0.010)**	(0.006)***	(0.0002)***	(0.000)***	(0.03)**	(0.014)**	(0.149)	(0.232)

Note: The numbers in parentheses are standard errors

***, ** and * represent the 1%, 5% and 10% significance levels.

[8] If the constant term is included, the Thailand' s population is automatically excluded from the empirical model.

Table 6 Coefficients Estimates of the empirical model by Fixed Effect PML

Variable	Country-Pair FE PML				Country-Pair and Time FE PML			
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
ln(y_{it})	0.033	0.033	−0.002	−0.002	0.004	0.008	−0.049	−0.045
	(0.01)***	(0.01)***	(0.007)	(0.007)	(0.014)	(0.013)	(0.020)**	(0.018)**
ln(pop_{it})	0.940	0.886	0.705	0.699	2.138	1.846	3.428	3.159
	(0.729)	(0.708)	(0.355)**	(0.352)**	(0.680)***	(0.630)***	(1.115)***	(1.022)***
ln(y_{jt})	0.001	0.001	0.001	0.001	0.001	0.001	0.0004	0.0004
	(0.0003)**	(0.0003)**	(0.0002)***	(0.0002)***	(0.0003)***	(0.0003)***	(0.0003)	(0.0003)
ln(pop_{jt})	−0.020	−0.020	−0.068	−0.067	−0.036	−0.034	−0.041	−0.042
	(0.027)	(0.027)	(0.023)***	(0.022)***	(0.019)*	(0.020)*	(0.025)	(0.025)*
ln(p_{jt})	−0.712	−0.701	−0.258	−0.255	−1.171	−1.026	−1.863	−1.710
	(0.348)**	(0.347)**	(0.171)	(0.169)	(0.446)***	(0.402)**	(0.622)***	(0.569)***
Lower-Middle-Income	1.151	1.147	2.761	2.695	1.599	1.581	2.904	2.844
	(1.002)	(0.986)	(0.807)***	(0.796)***	(0.949)*	(0.933)*	(0.800)***	(0.792)***
Upper-Middle-Income	1.279	1.264	2.524	2.460	0.356	0.399	3.182	3.106
	(1.088)	(1.075)	(0.860)***	(0.849)***	(1.274)	(1.244)	(0.889)***	(0.884)***
High-Income	2.127	2.039	3.263	3.200	0.522	0.439	3.264	3.206
	(1.584)	(1.575)	(0.995)***	(0.984)***	(1.701)	(1.703)	(1.301)**	(1.270)**
Constant	−69.77	−72.99	−49.96	−54.17	−139.15	−127.96	−215.244	−204.28
	(44.51)	(43.72)*	(21.22)**	(21.10)**	(41.18)***	(38.21)***	(67.28)***	(61.89)***
ln($dist_j$)*time_dummy	Yes	Yes	No	No	Yes	Yes	No	No
$lock_j$*time_dummy	Yes	No	Yes	No	Yes	No	Yes	No
Country-Pair Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	No	No	No	No	Yes	Yes	Yes	Yes
N (Observations)	472	472	472	472	472	472	472	472
R-square	0.947	0.946	0.926	0.926	0.957	0.955	0.937	0.936
Ramsey RESET Test:	9.29	10.21	16.64	16.43	6.95	8.54	3.80	2.92
(P-value)	(0.0096)***	(0.006)***	(0.0002)***	(0.0003)***	(0.03)**	(0.014)**	(0.149)	(0.232)

Note: The numbers in parentheses are robust standard errors

***, ** and * represent the 1%, 5% and 10% significance levels.

Table 7 Comparison the expected signs and estimates signs with no misspecification error

Variable	Expected Sign	Country-Pair and Time Fixed Effect of First Difference Data		Country-Pair and Time FE PPML		Country-Pair and Time FE PML	
		Case 5	Case 6	Case 7	Case 8	Case 7	Case 8
$\ln(y_{it})$	–	NS	NS	+	+	–	–
$\ln(pop_{it})$	+	NS	NS	–	–	+	+
$\ln(y_{jt})$	+	+	+	NS	NS	NS	NS
$\ln(pop_{jt})$	+	NS	NS	NS	–	NS	–
$\ln(p_{jt})$	–	–	–	–	–	–	–

Note: NS stands for non-significant

Conclusion and Policy Implication

Conclusion

This paper aims to use primary econometrics methods with the gravity model of Thailand's durian export. They are Pooled OLS, Random Effect, Poisson Pseudo ML, Poisson Pseudo ML, country-pair Fixed Effect (with eight difference cases), country-pair Fixed Effect of First Difference Data (with eight difference cases), Fixed Effect PPML (with eight difference cases), and Fixed Effect PML (with eight difference cases). The first four cases adopt the country-pair fixed effect regarding adding or removing the interaction term between *dist*, *lock*, and time dummy variables. The last four cases adopt country-pair and time-fixed effects regarding adding or removing the interaction term between *dist*, *lock*, and time dummy variables. The unbalanced panel data adopts periods from 2007 to 2020, and the cross-section units are Thailand's partners. Misspecification occurs in several econometric estimations, but six estimation methods have no this problem. The first two estimation methods, having no misspecification, are country-pair and time fixed effect of first difference data with an interaction term of *dist* and time dummy variable and with both interaction term of *dist* and time dummy, and *lock* and time dummy. The following two estimation methods, having no misspecification, are country-pair and time-fixed effect PPML with and without an interaction term of *lock* and time dummy. The last two estimation methods, having no misspecification, are country-pair and time-fixed effect PML with and without an interaction term of *lock* and time dummy.

The estimation results of the first two estimation methods, having no misspecification, have three non-significant coefficients of Thailand's real GDP and population and Thailand's partners' population, and two significant coefficients of Thailand's partners' real GDP and Thailand's export price of durian are positive and negative as expected, respectively. The estimation results of the country-pair and time-fixed effect PPML with and without an interaction term of *lock* and time dummy give non-significant coefficients of Thailand's partners' real GDP, two significant coefficients of Thailand's real GDP and

population are positive and negative, opposite to the expectation, respectively; the coefficient of Thailand's export price of durian is negative significance as expected.

The estimation results of the country-pair and time-fixed effect PML with and without an interaction term of *lock* and time dummy give non-significant coefficients of Thailand's partners' real GDP. Two significant coefficients of Thailand's real GDP and population are negative and positive, similar to the expectation, respectively; the coefficient of Thailand's export price of durian is negative significance as expected; the coefficients of Thailand's partners' real GDP are insignificant. The coefficients of Thailand's partners' population are similar to the case of PPML.

Policy Implications

The most logical results with no misspecifications are the country-pair and time-fixed effect PML with interaction regarding *lock* and the time dummy variable. The coefficient of Thailand's real GDP has a significantly negative effect, corresponding to the hypothesis. If Thailand's export products are more diversified than before, the resource of durian cultivation, e.g., labor, would move to the industrious sector. Thailand's population has a significant positive effect as expected, this implies that labor is primary durian cultivation. Therefore, enhancing labor productivity is a strategy for increasing durian cultivation.

Thailand's partners' real GDP and population do not affect Thailand's durian export since durian is a particular fruit that someone would love or hate; the higher Thailand's partners' total income or population would not show any effect on Thailand's durian export. Furthermore, the price of durian is relatively high; people who purchase durian might have relatively high income; this leads to a higher total population of Thailand's partners might not impact Thailand's durian export. The results indicate that Thailand's durian export price elasticity is elastic. The durian exporters would use the lower price strategy to enhance their income. The coefficients of high-income, upper-middle-income, and lower-middle-income dummy variables are positive and significant. The highest coefficient is for the high-income dummy variable, the second is for the upper-middle-income dummy variable, and the third is for the lower-middle income dummy variable. It informs that Thailand's durian exports the least to the low-income group. Thailand's durian exporters should find a specific country in each income-level group where most people love durian, e.g. China.

References

Anderson, J. E. (1979). A theoretical foundation for the gravity equation. *American Economic Review, 69*(1), 106-116.

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

Anderson, J. E., & Yotov, Y. V. (2016). Terms of trad and global efficiency effects of free trade agreements, 1990-2002. *Journal of International Economics, 99*, 279–298.

Baier, S. L., & Bergstrand, J. H. (2007). Do free trade agreements actually increase members' international trade?. *Journal of International Economics, 71*(1), 72-95.

Batra, A. (2006). India's global trade potential: the gravity model approach. *Global Economic Review, 35*(3), 327–361. https://doi.org/10.1080/12265080600888090

Bergstrand, J. H. (1985). The gravity equation in international trade: Some microeconomic foundations and empirical evidence. *Review of Economics and Statistics, 67*(3), 474-81.

Borchert, I., & Yotov, Y. V. (2017). Distance, globalization, and international trade. *Economics Letters*, *153*, 32–38.

Caporale, G. M., Sova, A., & Sova, R. (2015). Trade flows and trade specialization: The case of China. *China Economic Review, 34*, 261–273. https://doi.org/10.1016/j.chieco.2015.03.010

Castillo, J. S., Villanueva, E. C., & Garcia-Cortijo, M. C. (2016). The international wine trade and its new export dynamics (1988–2012): a gravity model approach. *Agribusiness: An International Journal, 32*(4), 466–481. https://doi.org/10.1002/agr.21463

Cheong, J., Kwak, D. W., & Tang, K. K. (2016). The distance effects on the intensive and extensive margins of trade over time. *Empirical Economics, 50*, 253–278. https://doi.org/10.1007/s00181-015-0927-x

Dai, M., Yotov, Y. V., & Zylkin, T. (2014). On the trade-diversion effects of free trade agreements. *Economics Letters, 122*(2), 321-25. https://doi.org/10.1016/j.econlet.2013.12.024

De Matteis, M. C., Yu, T. E., Boyer, C. N., & Delong, K. L. (2018) Analyzing determinant of US distillers dried grains with solubles exports. Agribusiness: An International Journal, 35(2), 168-181. https://doi.org/10.1002/agr.21575

Deardorff, A.V. (1998). Determinations of bilateral trade: Does gravity work in a neoclassical world? In: Frankel, J. A., ed., The Regionalization of the World Economy, pp. 7-32. University of Chicago Press, Chicago.

Dreyer H., & Fedoseeva, S. (2016). Gravity models and asymmetric exchange rate effects: Insights from German beer exports. *Agribusiness: An International Journal,* 32(2), 289-295.

Fally, T. (2015). Structural gravity and fixed effects. *Journal of International Economics, 97*(1), 76-85.

Helpman, E. (1984). Chapter 7 increasing returns, imperfect markets, and trade theory. In Jones, R. W. and P. B. Kenen (eds.), *Handbook of International Economics*, 325-365. https://doi.org/10.1016/s1573-4404(84)01010-8

Kahouli, B., & Maktouf, S. (2014). The link between regional integration agreements, trade flows and economic crisis: A static and dynamic gravity model. *International Journal of Development Issues, 13*(1), 35-58. https://doi.org/10.1108/IJDI-11-2013-0082

Li, L., Sun, Z., & Long, X. (2019). An empirical analysis of night-time light data based on the gravity model. *Applied Economics, 51*(8), 797–814. https://doi.org/10.1080/00036846.2018.1523612

Linnemann, H. (1966*). An econometric study of international trade flows*. North-Holland Pub. Co.

Parra, M. D., Martinez-Zarzoso, I., & Suarez-Burguet, C. (2016). The impact of FTAs on MENA trade in agricultural and industrial products. *Applied Economics*, 48(25), 2341-2353. https://doi.org/10.1080/00036846.2015.1119792

Persson, M., & Wilhelmsson, F. (2015). EU trade preferences and export diversification. *The World Economy, 39*(1), 16–53. https://doi.org/10.1111/twec.12354

Poncet, S. (2006). Economic integration of Yunnan with the Greater Mekong subregion. *Asian Economic Journal*, *20*(3), 303-17. https://doi.org/10.1111/j.1467-8381.2006.00237.x

Santos Silva, J. M. C., & Tenreyro, S. (2006). The log of gravity. *Review of Economics and Statistics, 88*(4), 641-658. https://doi.org/10.1162/rest.88.4.641

Sarker, R., & Jayasinghe, S. (2007). Regional trade agreement and trade in agri-food products: evidence for the european union from gravity modeling using disaggregated data. *Agricultural Economics*, 37(1), 93-104. https://doi.org/10.1111/j.1574-0862.2007.00227.x

Shabbir, G., Naveed, A., Ali Khan, M., & Syed, S. H. (2022) Does peace promote bilateral trade flow? An economic analysis of panel data in asian perspective. *Comparative Economics Studies, 64*, 143-158. https://doi.org/10.1057/s41294-021-00155-2

Sheng, Y., Tang, H .C., & Xu, X. (2014). The impact of the ACFTA on ASEAN-PRC trade: Estimates based on an extended gravity model for component trade, *Applied Economics, 46*(19), 2251-2263. https://doi.org/10.1080/00036846.2014.899676

Tinbergen, J. (1962). Shaping the world economy: Suggestions for an international economic policy (3rd ed.). The Twentieth Century Fund.

Westerlund, J., & Wilhelmsson, F. (2011). Estimating the gravity model without gravity using panel data. *Applied Economics, 43*(6), 641-649. https://doi.org/10.1080/00036840802599784

Yang, S., & Martinez-Zarzoso, I. (2014). A panel data analysis of trade creation and trade diversion effects: The case of ASEAN-China free trade area. *China Economic Review, 29*, 138-151.