An Analysis of Factors Impacting Vietnam's Coffee Exports: An Approach from the Gravity Model

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Abstract

This paper uses the gravity model estimated by the random effect method to analyze the factors affecting Vietnam's coffee export turnover for the period 2007–2020 major markets according to statistics from the General Statistics Office and the General Department of Customs. Coffee export turnover was collected from the General Statistics Office, General Department of Customs, and Vietnam Cacao Coffee Association. The authors calculated the price of coffee based on output and export value from data on coffee export turnover; the authors calculated the economic gap based on population and Gross Domestic Product data (reference: geographic distance metrics on the website: http://www.distancefromto.net/countries.php) and other data was collected based on the databases of the Food and Agriculture Organization of the United Nations, the International Monetary Fund, and World Bank organizations. The results of the study show that from 2007 to 2020, the factors of Vietnam's export price of coffee, geographical distance, Gross Domestic Product of the importing country and Gross Domestic Product of Vietnam, the population of Vietnam, the economic gap between Vietnam and the importing country, the openness of the economy, all have an impact on Vietnam's coffee export turnover. Finally, some conclusions about the policy's impact are made based on the empirical results of the paper.

1. Introduction

Vietnam is a country with long-standing agriculture, with quite a great potential in the production of agricultural products. Coffee is one of Vietnam's main exports and the second largest agricultural export in terms of turnover after rice. Therefore, the coffee industry has played a huge role in the national economy. According to the basic model in the international trade theory of Heckscher-Ohlin, a country will have comparative advantages in production and, therefore, will export products that take advantage of the production elements that it is relatively abundant. With Ricardo's theory of comparative advantages, Vietnam's agricultural, forestry, and fishery products are still highly competitive in the world market. In the period when international economic integration is being promoted, each country has its own comparative advantages; coffee is considered a strength of Vietnam. According to the Vietnam Coffee and Cocoa Association, Vietnam's coffee exports are growing; in 2016, coffee exports reached 3.34 billion USD, up 24.9% compared to 2015. This shows that the main markets importing this item are increasingly favoring Vietnamese coffee, and the number of export markets of coffee products is expanding. Although there are many opportunities to promote comparative advantages and expand the market, the coffee export industry is also facing many difficulties and challenges in the face of fierce international competition because Vietnam does not have many advantages in terms of production level, types of goods, about the experience in international trade. After all, the price of coffee exported also depends largely on the world market, mainly exporting Robusta coffee, and the

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quality of coffee is not high. Therefore, the urgent issue is how to boost exports in the near future, especially exporting key items such as coffee. To develop an appropriate strategy, quickly seize opportunities, take advantage of strengths to boost exports, and improve the competitiveness of domestic enterprises, it is necessary to have a dosing analysis of factors affecting coffee exports in Vietnam. For that reason, the article uses the gravity model to analyze the factors affecting Vietnam's coffee export turnover from 2007 to 2020.

Many studies, both domestic and international, have used gravitational force models, combined with actual data to explain the effects of factors affecting the value of agricultural exports in general. This gravity model approach is quite commonly applied in some research works, such as Quang et al. (2017), Kien and My (2015), and Anh and Thang (2008). Internationally, some research also used gravitational models to show and assess the impact of factors on agricultural exports of countries such as the study of factors affecting agricultural exports in sub-Saharan Africa (Tesyafe e (2014)), the author study of factors impacting Egypt's agricultural exports. Besides, there are many papers by other authors applying the gravity model in international trade (Baltagi et al., 2016; Bergstrand, 1985, 1989; Carrère, 2006). Allayarov et al. (2018) investigated the factors that affect Kyrgyzstan's bilateral trade flows with its main trading partners and attempts to predict the trade potential for Kyrgyzstan. Using panel data, the gravity model is applied to estimate Kyrgyzstan's trade from 2000 to 2016 for its 35 main trading partners. That determines the flows of bilateral foreign direct investment in intra-ASEAN. It specifically focuses on the dimension of macro-economic, natural resources, human resources, and the quality of governance. Le (2021) used the gravity model to estimate the relationship between data series and considered the impact of factors on Vietnam's trade with Comprehensive and Progressive

Agreement for Trans-Pacific Partnership countries. Le and Kim (2021) investigated the effect of institutional quality on Foreign Direct Investment (FDI) inflows by using FDI outflows from Asian countries from 2009 to 2017. We used the FDI data from five major Asian economies which are South Korea, China, Japan, Singapore, and Hong Kong. The gravity model was used to examine the effect of institutional quality on FDI flows. The regression model considers several independent variables, and we select the most appropriate variables by using the Bayesian Model Averaging (BMA) estimator.

The above studies all use a dosing approach, using a gravitational model to point to several factors such as the economic size, population, exchange rate, and openness of the economy that have an impact on the export value of agricultural products. Therefore, this article will use the gravitational model to assess the impact of a number of factors affecting the value of Vietnam's coffee exports

over the years. The main content of the article is as follows: Section 2 of the article introduces Vietnam's coffee export situation in the period 2007–2020; Section 3 of the article introduces data, research methods, and model proposals; section 4 introduces the model estimate result, and section 5 is the conclusion of the article.

2. Vietnam's Coffee Exports from 2007 to 2020

Since the Period of Innovation, agricultural exports in general and coffee exports, in particular, have always been major contributors to export growth, as well as the economic growth of Vietnam. In 2007, Vietnam officially joined the World Trade Organization **(**WTO), opening a new phase in global economic and trade integration. From there on, trade barriers to export products from Vietnam, including coffee, are gradually removed, facilitating growth in both size and export value. According to data from the Center for Rural Agricultural Development Information, in the first year when joining the WTO, the value of Vietnam's coffee exports increased by 54.3%, and export output increased by 23.32%.

However, as soon as it entered 2008, Vietnam's coffee exports suffered negative effects from the global financial crisis. The rapid decline of the economies of countries, especially the major coffee import markets, caused a rapid decline in coffee demand. The financial crisis lasted until 2011, with its effects making the period 2008–2011, both the output and the total value of coffee exports of Vietnam not much increased compared to 2007; even from 2009 to 2010, the annual value of coffee exports of Vietnam is even lower than in 2007.

Turning to 2012, the world economy gradually recovered, and the demand for agricultural products, including Coffee in Vietnam, gradually recovered, leading to impressive growth in value and output in coffee exports in our country. The year 2012 marked for the first time Vietnam surpassed Brazil to become the largest coffee exporter in the world. Also the year Vietnam's coffee exports reached a record number, 3.5 billion USD. From 2013 to 2016, Vietnam's export value and output highly fluctuated; in 2013, the total value of Vietnam's coffee exports reached about 2.7 billion USD, down nearly 25% in value and 26% in output compared to the previous year. The following years recorded unstable growth in value and output. Since 2016, Vietnam's coffee exports have gradually recovered, with 2016 growing 24.7% in value compared to 2015, reaching over 3.3 billion USD. By the years 2017 and 2018, Vietnam's coffee exports continuously set new peaks.

The period of 2019–2020 witnessed a decrease in the value of Vietnam's coffee exports. Especially in 2020, due to the negative effects of the Covid-19 epidemic, the value of coffee exports has fallen to $2.7 billion, equivalent to 2013.

The fluctuation in the value of Vietnam's coffee exports in the period 2007–2020 can be partly expressed through the total value of Vietnam's coffee exports to 20 major markets during the research period (Figure 1).

3. Data and Research Methods

3.1. Data

Coffee export turnover was collected from the General Statistics Office, General Department of Customs, Vietnam Cacao Coffee Association (VICOFA), the price of coffee the authors calculated based on the output and export value from the data of coffee export turnover, the economic gap the authors calculated based on population and Gross Domestic Product (GDP) data, reference geographical distance metrics on the website: http://www.distancefromto. net/countries.php, other Figures are collected based on the database of Food and Agriculture Organization of the United Nations (FAO), International Monetary Fund (IMF), Word Bank organizations (WB). Variables and metric sources are described in Table 1 below:
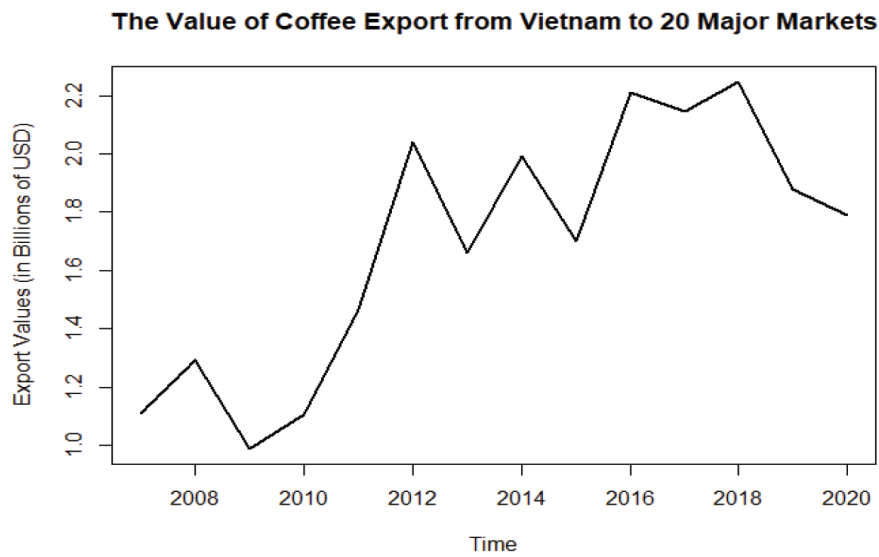

Figure 1: Value of Vietnam's Coffee Exports in the Period 2007–2020

Sources*: Estimation from Vietnam Cocoa Coffee Association*

Table 1: Variables and Metric Sources

Variables	Describe	Metric Sources
EXP	Coffee export turnover	VICOFA
Price	The price of coffee	The authors calculated based on the output and export value from the data of coffee export turnover
Distance	Reference geographical distance metrics	http://www.distancefromto.net/countries.php
GDP	Gross Domestic Product	FAO, IMF
Pop	Population	IMF
EDIS	The economic gap between the two countries, based on GDP per capita	The authors calculated based on population and GDP data
Openness	Measuring the proportion of foreign trade of a country to its domestic economy in terms of the total value	WB

3.2. Research Methods

The article uses the gravity model to analyze the factors impacting Vietnam's coffee exports to 20 key coffee markets, based on data collected from the General Statistics Office, General Department of Customs, and Vietnam Cacao Coffee Association in the period from 2007 to 2020. The gravity model in international economics is similar to the gravitational model in other social sciences, predicting that bilateral trade exchanges depend on the size of the two economies and the distance between them. This model was first used by Jan Tinbergen in 1962. The basic theoretical model between economies A and B is performed according to the following formula:

$$F_{AB} = G * \frac{M_A * M_B}{D_{AB}} \qquad (1)$$

where F is a two-way trade exchange, M is the size of each economy, D is the distance and G is a constant. Taking logarithms on both sides of Equation (1), we can convert them into a linear formula used for energy economic analysis as follows:

$$\ln(F_{AB}) = \alpha + \beta_1 \ln(M_A) + \beta_2 \ln(M_B) - \beta_3 \ln(D_{AB}) + \varepsilon \quad (2)$$

This model often considers other variables such as income level (GDP per capita), consumer price index, language relations, tariffs, neighborly relations, and historical colonial relations (country A was once a colony of country B and vice versa). This model is also used in international relations to assess the impact of treaties and trade unions. It is also used to assess the effectiveness of trade agreements and trade organizations such as the North American Free Trade Agreement (NAFTA) and WTO. Authors Baltagi et al. (2016), Bergstrand (1985,1989), and Carrère (2006) used the gravity model in the field of international trade with many experimental studies. In Vietnam, authors Anh and Thang (2008) used a gravitational model to analyze factors affecting Vietnam's trade concentration with Asean+3. The article uses the gravitational force model based on Vietnamese practice, bringing new factors to study the factors affecting Vietnam's coffee export turnover. The economic model used in this article is based on the model Bergstrand proposed in 1985. Some new variables are included for the dosing analysis of factors affecting Vietnam's coffee exports in the period 2007–2020:

$$EXP_{jt} = \beta_o (GDP_{VN_t})^{\beta_1} (GDP_{jt})^{\beta_2} (Pop_{VN_t})^{\beta_3} (Price_{jt})^{\beta_4}$$
$$(Distance_j)^{\beta_5} (EDIS_{jt})^{\beta_6} (Openness_{jt})^{\beta_7} .e^{u_{jt}}$$

Converting into Logarithm format:

$$\begin{aligned} \ln(EXP_{jt}) = & \beta_o + \beta_1 \ln(GDP_{VN_t}) + \beta_2 \ln(GDP_{jt}) \\ & + \beta_3 \ln(Pop_{VN_t}) + \beta_4 (\ln(Price_{jt}) \\ & + \beta_5 \ln(Distance_j) + \beta_6 \ln(EDIS_{jt}) \\ & + \beta_7 \ln(Openness_{jt}) + u_{jt} \end{aligned} \qquad (4)$$

In which:

EXP_{jt}:	Vietnam's coffee export value to j country in year t
GDP_{VN_t}:	Vietnam's GDP in year t
GDP_{jt}:	Country j GDP in year t
Pop_{VN_t}:	Vietnam's population in the year t
$Price_{jt}$:	Vietnam's coffee unit price exported to j country in year t
$Distance_j$:	Geographical distance between Vietnam and country j (calculates the distance between the two capitals)
$EDIS_{jt}$:	The economic gap between Vietnam and the country j year t (measured by the absolute difference in GDP per capita between the two countries)
$Openness_{jt}$:	Openness of the national economy of country j year t (measured in % trade/GDP)
u_{jt}:	Error

4. Empirical Results

The data of the article is used to estimate the model (4) in 3 ways: Pooled ordinary at least square-Pooled OLS, fixed effect (FEM), and random effect (REM). However, when applying the gravitational model with actual data, there is no specific recommendation on how to use it to get the most effective estimation results. Several statistical test results, including F - the test and the Hausman test, are used to find the most effective estimate with the data set of this article.

First, we inspect the estimated values using Pooled-OLS and FEM. The article uses Lagrange Breusch Pagan (BP) multiplier test to find the best model among the two. The results obtained in Table 2 show that the Chi-square value is greater than the critical value at a 99% confidence interval. Hence FEM is considered more effective than OLS due to the bias of the OLS estimates. Therefore, this study does not use OLS estimation results for analysis.

Table 2: Hausman Testing

Hypothesis H0	χ^2_{qs}	*p*-value	Statistically Significant at 5%
1. BP. Lagrangian Multiplier test H0: Var(u) = 0	434.89	< 2.2 * 10⁻¹⁶	Rejecting H0
2. Hausman test			
H0: REM is selected	4.5195	0.6067	Not rejecting H0

Table 3: Model Estimated Results

Variables	Ln (Export)
Intercept	190.26894*** (63.72621)
Ln (GDP$_{VN}$)	2.05466*** (0.65927)
Ln (GDP)	1.33823*** (0.18094)
Ln (Pop$_{VN}$)	−16.91407*** (5.77526)
Ln (Price)	−0.46883* (0.25513)
Ln (Distance)	−0.33299* (0.20349)
Ln (EDIS)	−0.38365*** (0.10316)
Ln (Openness)	0.7841*** (0.29846)
BP Test	434.89***
Chi-Square	97.4866***
Observations	275

Note: ***, ** and * indicates significant at 1%, 5% and 10% level of significance based on *t*-statistics.

Next, the article compares the estimated results between the FEM model and REM. Hausman testing is used for this comparison. Table 2 shows that according to the H_o hypothesis (the difference between the factors in the 2 estimates is not systematically significant) we obtain the calculation result that the estimated value of the Chi-square is less than the critical value at a 95% confidence interval. Therefore, we reject H_o, or in other words, we use the estimated result by REM to analyze the factors affecting Vietnam's coffee exports.

The article uses RStudio 3.6.3 programming software and the PLM library in the software to estimate parameters and test the model.

The model estimated results using the REM method are shown in Table 3 below:

5. Conclusion

The estimated value in the REM resized model for factors affecting the value of Vietnam's coffee exports is statistically significant and relatively consistent with the conclusions of economic theories. The regression coefficient of coffee export price (Price) is –0.46883, pointing that the price of coffee (decided by the world market) falling by 1% will have the impact of increasing the value of Vietnam's coffee exports to countries to 0.46883%. The value of the coefficient of the Distance variable is –0.333, meaning that the distance between Vietnam and other countries has an inverse impact on the value of coffee exported to other countries, in line with economic significance, as the greater the geographical distance will increase the costs to export coffee.

The independent transformation of Vietnam's economy affects the value of coffee exports which are statistically significant and appropriate in terms of economic significance. For Vietnam's GDP (GDP$_{VN}$) when the size of the economy increased by 1%, the value of coffee exports increased by 2.05%. Turning the population size of Vietnam (Pop$_{VN}$) into a negative value is in line with the economic rationale that as the domestic market size increases, there will be an increase in the demand for coffee in the country, reducing the volume and export value.

The independent variables related to Vietnam's import markets are also statistically significant and appropriate in terms of economic significance. The GDP of the importing country turns out that when the country's GDP increases by 1%, it will increase the value of Vietnam's coffee exports by 1.3%, showing an increase in the size of the economy leading to the increase in demand for coffee in Vietnam. The economic gap between Vietnam and the importing country (EDIS) shows that when the economic gap (or, more broadly, the level of economic development) between Vietnam and the importing country decreases, the value of Vietnam's coffee exports tends to decrease lower, shows that as Vietnam closes the economic gap with importing countries, the value of coffee exports is increased due to more opportunities to participate in international trade networks, expanding the market to export coffee to other countries.

Finally, the openness of the market shows that when the market has an increased opening, it will lead to an increase in the export value of coffee in those countries. It shows that the deeper integration of countries (maybe by participating in economic agreements) will further increase the value of

Vietnam's coffee exports, so Vietnam needs to be active to be more involved in economic agreements with members with high openness to the economy to make the most of it.

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