Research Article

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Analysis of trade potential and factors influencing chili export in Indonesia

https://doi.org/10.1515/opag-2022-0205
received January 29, 2023; accepted May 5, 2023

Abstract: The aim of this study is to analyze the factors that affect the export of chili in Indonesia, determine the most dominant factor, and also the export potential of chili in the importing country. The analytical methods used are panel data analysis with gravity model and trading potential analysis. The results show that the independent variables that significantly affect Indonesia's chili exports are Indonesia's real GDP/capita, the real GDP/capita of the destination country, the rupiah exchange rate against the destination country, and the geographical distance between Indonesia and the destination country. The most dominant factor is the rupiah exchange rate. Indonesia's trade is still under trade (pp > 1), so it can potentially expand the chili trade to importing countries.

Keywords: export, chili, gravity model, trade

1 Introduction

Chili is a horticultural commodity as well as spices that are widely produced in Indonesia. In 2018, the total production of spices worldwide was 12.8 million tons, of which chilies accounted for 4.1 million tons, or about 32% of the total spice production [1]. Chili has a high economic value because it is widely used for household consumption and in the food industry. Most chili producers come from countries in Asia, such as India, Myanmar, Bangladesh, Pakistan, Thailand, Vietnam, China, and Indonesia [2].

Indonesia has the 5th highest chili production in the world after India, China, Turkey, and Bangladesh [3]. The total chili production produced by Indonesia is able to reach 2772.590 tons in 2020. The household sector mainly uses chili production, which is 90.64% of the total chili consumption. The average chili consumption in Indonesia is 5 kg/capita/year, and 90% of it is consumed fresh [4]. The types of chilies cultivated in Indonesia consist of red chilies, green chilies, and cayenne peppers. People's consumption of each type of chili varies according to needs. From 2002 to 2018, chili consumption growth fluctuated but relatively increased by 3.29% annually [5]. This consumption growth will affect the demand for chili which will ultimately result in price disruptions [6]. The price of chili from 2016 to 2019 has fluctuated at the international level. In 2016, the price of chili in the international market reached 1.88US$ per kilogram, and the lowest price occurred in 2017, which was 0.70 US$ per kilogram [7]. These fluctuations are caused by the availability of chili in each producing country which is influenced by environmental factors such as weather, climate, and natural disasters [7].

The availability of chili in each producing country affects its ability to export. When a country can produce chili in large quantities to meet domestic needs, export activities are carried out to increase the country's foreign exchange. Export activity also occurs because of the influence of market size and economic strength [8]. Export activities are an essential component of economic growth [9]. Over the last few decades, globalization and the integration of international markets have had a progressive impact on some or even all of the production, especially in developing countries [10]. Chili exports are carried out due to a production surplus and the great potential of the chili trade at the world level. The growth in the volume of world chili exports began to develop in 2004 when the average growth reached 6.04% annually [11]. Indonesia makes chili as a leading commodity in the export market. This is because the land area for chili harvesting in

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Indonesia is 318,772 ha, or about 27.17% of the total harvested area for vegetables and fruit. In addition, chili production is the highest compared to other horticultural commodities [12] (Figure 1).

As a leading commodity, the growth rate of chili exports is still relatively low compared to its production growth rate, where the annual export growth rate is 7.42%. In comparison, the production growth rate reaches 9.70% according to the Ministry of Agriculture, 2020. The low growth rate of chili exports was due to the high chili demand in Indonesia, slowing global economic growth, slowing world trade volume, and declining commodity prices [13–15].

Economic factors that affect exports tend to be macro, such as exchange rates, market capital availability, infrastructure, and price competition [16,17]. One of the variables that has been developed in many similar studies is the influence of international trade organizations on export volume. International trade is also influenced by a country's participation in international trade organization such as World Trade Organization (WTO) [18]. Therefore, the participation of a country in the WTO is a factor that can affect the quality and quantity of exports. In line with the research to find out the determinants of chili export volume in Indonesia, most studies use the gravity models as the approach method. The gravity model has been extensively used in literature to analyze the behavior of bilateral trade flow and has proved successful in explaining it.

In recent studies, Inayah et al. [19] stated that factors affecting export volume of Indonesian pepper are the GDP/capita of importing countries, economic distance, export price, real exchange rate, and participation in FTA as an international trade organization. Using gravity model, the result show that GDP/capita of the importing countries shows positive effect on the export volume of Indonesian pepper. Meanwhile, the economic distance, export price, real exchange rate, and participation in FTA have a negative effect on the export volume of Indonesian pepper. This is similar to the research of Novidayanti et al. [20] who studied about Indonesia volume export of nutmeg and concluded that partially the exchange rate and Vietnam's gross domestic product (GDP) have a positive and significant effect on export volume of Indonesian nutmeg; meanwhile, international price has a negative and significant effect on the export volume of Indonesian nutmeg. Prajanti et al. [21] also attempted to know the determinant of export volume of coffee in Indonesia, and found that the variable of domestic coffee production partially has positive and significant influence on coffee export volumes in Indonesia. However, the variables of domestic coffee prices, world coffee prices, and rupiah exchange rate toward US dollar do not significantly influence the coffee export volumes in Indonesia, but it simultaneously or jointly influences coffee export volumes in Indonesia.

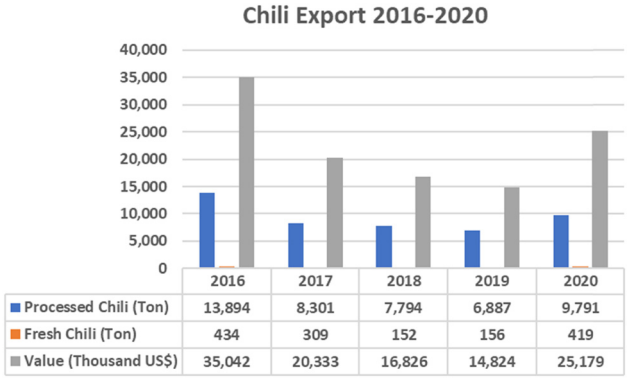

Figure 1: Chili export by Indonesia in 2016–2020.

The study by Gachena et al. [22] showed that Ethiopia's population, foreign direct investment, real exchange rate and institutional quality, the importers' GDP, GDP/capita and population, geographical distance, and the dummy variables (COMESA membership and sharing common borders) had significantly affected the turmeric and Korarima export performances using gravity model. However, the variables institutional quality and being COMESA membership were found to have unexpected negative influences on the export performance of major spices (turmeric and Korarima). Previous study [23] also stated that GDP, exchange rate, per capital water resources, arable land, geographic distance, and population are significant to export. Gravity model using panel data were applied. The result showed that GDP and exchange rate were positively correlated with export water, while per capital water resources, arable land, geographic distance, and population were negative factors that hindered virtual water import. It means that per capital water resources, arable land, geographic distance, and population influence indirectly on virtual water export.

The study by Dilanchiev and Taktakishivili [24] about the exchange rate depreciation indicate that the exchange rate depreciation has an inverse long-run impact on export. The estimated value of the exchange rate has been found to exert no direct pressure on the amount of export. The control variable interest rate also has an inverse impact on Georgia's export performance in the long-run as well as in the short-run. International reserves positively influence the export in the long-run with a high significance level. A study in China [25] about the impact of international organizations using a panel data model construct stated that the GDP and population growth are positively affected by trade,

and as the distance increases, trade is negatively affected. The dummy coefficients of ASEAN, APEC, and OPEC show that they are positive and statistically significant. Due to the fact that ASEAN and APEC consist of Asian countries and therefore are close to China, it has been observed that they are compatible with gravity model theory. The positive effect of OPEC member countries on Chinese exports was determined as importing the energy required for industrial production and converting intermediate goods into value-added products and exporting.

Pandemic era also caused a lot of constraints in international trade activities both exports and imports. The study by Petryle [26] using the gravity model about the structural changes in Lithuania's export during the first pandemic year showed that Lithuania's export is resilient to economic shocks. Although the effects of Covid-19 were heterogeneous, the pandemic year had only a negligible impact on Lithuania's export structure. The influence of distance, language, GDP, volume export, border, and WTO on Lithuania's export structure did not change during 2020.

Therefore, the aim of this study is to determine which factors influence Indonesian chili exports as one of the horticulture product exports that has rarely been studied. Based on the above research, this study analyzes Indonesia's chili volume exports using gravity model with determinants such as the real GDP of Indonesia, the real GDP of the destination country, the rupiah exchange rate, geographical distance, interest rates, and dummy membership of WTO. In addition to knowing which factors have a significant effect on chili exports, it is necessary to analyze the trade potential to determine how Indonesia's chili volume export potential is to four countries. Those four countries are Nigeria, Saudi Arabia, Malaysia, and Singapore. Singapore has become the second country that has consistently imported Indonesian chili after Malaysia since 1991 [27]. The lack of agricultural land and resources in Singapore causes the country's food needs to be supported by import activities. Singapore's location close to Indonesia makes it choose chili commodities from Indonesia [28]. Based on the data from a previous study [7], the chili types exported by Indonesia are fresh chilies, dried chilies, and crushed chilies. The export value of chili in 2020 reached US$25.18 million, an increase of 69.86% (US $10.36 million) from 2019, where the export value of chili in Saudi Arabia was US$ 9.23 million (3,300 tons), Nigeria was US$3.36 million (793 tons), Malaysia at US$1.86 million (1,370 tons), and Singapore at US$1.12 million (151.70 tons) [7]. Analysis of trade potential has been widely used by researchers who study international trade relations, especially in Eastern European countries. This study uses panel data regression and gravity model equation to describe the factors that affect exports [29,30] and to analyze trade potential and also predict the volume of trade between partner countries that cooperate. This analysis uses a sample of countries that have the potential for trade. These predicted values will be compared with the observed values to see the potential for bilateral trade [31]. Based on the research by Geda and Seid [32], which examines the potential for internal trade and regional integration in Africa, trade potential is calculated using the trade potential index (TPI) obtained through the gravity model equation. Based on our knowledge there is no research available till date investigating the factors that influence exports with the variable of participation in WTO and trade potential of Indonesian chili to four countries (Nigeria, Saudi Arabia, Malaysia, and Singapore) using panel data regression and gravity model equation especially in chili commodity. Considering this, the analysis of the factors that influence exports and trade potential of Indonesian chili is essential to study because it can provide a policy direction for a country to expand its market abroad.

2 Materials and methods

2.1 Data resources

The data used in this study are secondary data of 31 years, namely, data from 1990 to 2020. Data analysis was carried out from August to September 2021. Panel data are a combination of time series data and cross-section data. The time-series data include the volume of chili exports, the real GDP/capita of Indonesia, the real GDP/capita of the destination country, the rupiah exchange rate against the currency of the export destination country, the geographical distance between Indonesia and the export destination country, the real interest rate of the destination country, and involvement export destination countries in the WTO organization. The selected export destination countries are Nigeria, Saudi Arabia, and Malaysia because they are the main export destinations of chili [5]. In addition to these three countries, Singapore was chosen as an export destination because, according to the data from UN Comtrade [27], Singapore has consistently been an importer of chilies from Indonesia from 1991 to 2020, even though the quantity of chilies exported to Singapore is not as much as other export destination countries. Data on the volume of chili exports were obtained from the United Nations Commodity and Trade (https://comtrade.un.org/data/), data on the real GDP/capita of Indonesia

and the real GDP/capita of the destination country were obtained from the World Bank (https://data.worldbank.org/indicator/NY.GDP.PCAP.KN), the exchange rate of the rupiah against the currency of the export destination country was obtained from the World Bank (https://data.worldbank.org/indicator/PA.NUS.FCRF), the real interest rate of the destination country was obtained from the World Bank (https://data.worldbank.org/indicator/FR.INR.RINR), the geographical distance between Indonesia and the export destination country was obtained from Indonesia Distance World (http://indonesia.distanceworld.com/country/ID), and data on the involvement of export destination countries in the WTO organization were obtained from the World Trade Organization (https://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm).

2.2 Analysis method

This study uses four importers as Indonesia's export destinations: Saudi Arabia, Nigeria, Malaysia [5], and Singapore [27]. Saudi Arabia, Nigeria, and Malaysia are Indonesia's export destinations with higher export values than other countries [7]. In determining the factors that influence the volume of chili exports from Indonesia, the data were analyzed using panel data regression which was different from time-series data regression or cross-sectional data. Mathematically, panel data are described by the following equation:

$$y_{it} = \alpha + x_{it}'\beta + \mu_{it}, \tag{1}$$

where $i = 1, 2, \ldots, N$, $t = 1,2, \ldots, T$, i indicates the unit of destination export country (cross-section), and t indicates the time period being analyzed (time-series). y_{it} represents the response of the observations of the country i and the time period t. α is the intercept, β is the row vector of the regression coefficients for the observations of the country i, and the time periods t and μ_{it} are confounding factors. Most of the data panel application devices use a model with a one-way error component which is written as follows:

$$\mu_{it} = \tau_i + \epsilon_{it}, \tag{2}$$

where τ_i represents the unobserved individual effect and ϵ_{it} represents the confounding factor for the country i observations and time period T [33]. The panel data regression process is carried out through a pooled model approach, fixed effect model (FEM), and random effect model (REM).

a. Pooled Model is one of the models in panel data analysis where the regression coefficient (constant or slope) between the cross-section and time-series units is the same. Then, to estimate the parameters, the ordinary least squares (OLS) were used [34]. The equation of the pool model is as follows:

$$y_{it} = \alpha + \sum_{i=1}^{n} \beta_j x_{jit} + u_{it}, \tag{3}$$

where y_{it} is the dependent variable of country i in year t, x_{jit} is the independent variable of country i in year j, α is the intercept, β_j is the coefficient of the independent variable, and u_{it} is the error component [35].

b. The FEM is a model that can be used by considering that the omitted variables can result in changes in the cross-section and time-series intercepts. This FEM model focuses on changes within the individuals rather than differences between individuals. This allows researchers to separate the differential effects of increasing and decreasing predictor factors [36]. The assumptions for this model are that τ_i is assumed to be an estimated fixed parameter, ϵ_{it} is an independent stochastic confounder and identically distributed $(0, \sigma_\epsilon^2)$, and $E(X_{it}, \epsilon_{it}) = 0$, X_{it} is assumed to be independent with ϵ_{it} for all components i and t. The following equation describes the FEM:

$$y_{it} = \alpha + x_{it}'\beta + \tau_i + \epsilon_{it}. \tag{4}$$

If this equation is averaged over time, it will become equation (5).

$$\hat{y}_i = \alpha + \hat{x}_i'\beta + \tau_i + \hat{\epsilon}_i. \tag{5}$$

The next step is to reduce equation (4) with equation (5) to equation (6).

$$y_{it} - \hat{y}_i = (x_{it}' - \hat{x}_i')\beta + (\epsilon_{it} - \hat{\epsilon}_i). \tag{6}$$

The model in equation (5) is a form of transformation estimated by the OLS method.

The intercept in the FEM controls for each individual-specific and time-invariant, which is written in the following equation model:

$$y_{it} = \alpha_i + \sum_{i=1}^{n} \beta_j x_{jit} + u_{it}, \tag{7}$$

where α_i is the individual intercept in state i [37].

c. The REM is a model that incorporates different parameters between individuals and over time into the error to increase the efficiency of the estimated parameters. Unlike the fixed effects approach, random effects do not discard variation across individual units. The additional information on inter-individual variation

provides several advantages, namely, less variability and narrower confidence intervals [37]. The assumption for this model is that τ_i usually is distributed $N(0, \sigma_\tau^2)$, ϵ_{it} is an independent stochastic confounder and identically distributed, $E(X_{it}, \tau_i) = 0$ and $E(X_{it}, \epsilon_{it}) = 0, X_{it}$ are assumed to be independent with ϵ_{it} for all components i and t. REM allows to estimate the effect of variables that are individually invariant to time, as illustrated in the following equation model:

$$y_{it} = \alpha + \sum_{i=1}^{n} \beta_j x_{jit} + u_{it}, \tag{8}$$

where

$$u_{it} = \mu_i + \varepsilon_{it}, \tag{9}$$

where u_{it} is the error component, μ_i is the individual-specific random component, and ε_{it} is an idiosyncratic disorder [35].

A consistent estimator is obtained through OLS, which can create a square standard error. The use of the generalized least square (GLS) model is better because it assumes that the intercept and the regression coefficient are constant for each individual. At the same time, u_i changes according to the individual and is part of the error component ε_i. This model is tested using the Hausman test and the Lagrange Multiplier (LM) method known as the Breusch–Pagan test [38]. Hausman test was used to test the significance between the FEM and REM. This test is critical in selecting and evaluating parameters [39].

$H0 : E(\tau_i \mid X_{it}) = 0$ (Random effect is the suitable model)

$H1 : E(\tau_i \mid X_{it}) \neq 0$ (Fixed effect is the suitable model)

If $H0$ is rejected, then the FEM is more suitable. If $H0$ is accepted, then the results of the REM are better and should be continued with the Breusch–Pagan test to compare the REM with the pooled model. If the chi-square probability value is less than the significance value of α, then the REM is selected, and if the chi-square probability value is more than the α significance value, the pooled model is selected.

2.2.1 Gravity model

This study uses the gravity model, a model that aims to explain trade relations between countries through the variable volume of trade from the information contained in GDP, geographical distance between countries, and other additional factors of the two countries related to chilli export activities [40]. The gravity model measures efficiency and sees the potential for trade between countries [30]. The theory of trade gravity argues that trade between countries is proportionally increased by the size of their economies but inversely proportional to the distance that separates them. A study states that the farther the distance between countries in trade, the higher the transportation costs incurred, thereby suppressing trade cooperation relations because the goods exported become more expensive. Therefore, the hallmark of a gravity model is the use of components of geographical distance between countries [41]. The variables used in the gravity model of this research are the volume of chili exports from Indonesia to destination countries [42], Indonesia's GDP [30], and the GDP of destination countries [42], the exporter's exchange rate against the destination country [43], geographical distance [44], and the interest rate of the destination country [45]. The formulation of the econometric model for Indonesian chili exports is expressed in the following gravity model equation:

$$\begin{aligned} Y_{jt} = {} & \beta 0 + \beta 1 \mathrm{GDP}_{It} + \beta 2 \mathrm{GDP}_{jt} + \beta 3 \mathrm{ER}_{jt} + \beta 4 \mathrm{DIS}_{jt} \\ & + \beta 5 \mathrm{IR}_{jt} + \beta 6 \mathrm{WTO}_{jt} + \mu_{jt}, \end{aligned} \tag{10}$$

where Y_{jt} = the export volume of chili from Indonesia to country j in year t (kg), GDP_{It} = Real GDP/capita of Indonesia in year t (US$), GDP_{jt} = Real GDP/capita of country j in year t (US$), ER_{jt} = the real exchange rate of the rupiah against the country's currency j in year t (IDR/real exchange rate of the export destination country's currency), DIS_{jt} = Geographical distance from Indonesia to country j in year t (km), IR_{jt} = the real interest rate of country j in year t (%), WTOjt = Dummy WTO membership (0 = non-member, 1 = member), $\beta 0$ = Intercept, $\beta 0$ = Slope (n = 1,2,...., etc.), and μ_{jt} = Error term.

The method used in this study is the GLS. The estimation results from panel data are able to correct the problems of heteroscedasticity, multicollinearity, and bias in the data. Therefore, in this study, the classical assumption was not tested [33].

2.2.2 Hypothesis testing

The author uses the F test to test whether the independent variables in the form of real GDP/capita of Indonesia, real GDP/capita of the destination country, the real exchange rate of rupiah, geographical distance, the real interest rate of the destination country, and the dummy membership of the WTO together affect the volume of Indonesian chili exports or not. The t-test was conducted to determine whether the independent variables had an individual effect on the export volume of Indonesian chili or not. In addition, the coefficient of determination (R^2) measurement was also carried out to measure how much

the independent variable influenced the export volume of chili [46].

2.2.3 Analysis of trade potential

Analysis of trade potential has been widely used by researchers who study international trade relations, especially in Eastern European countries. This analysis uses a sample of countries that have the potential for trade. The method used in analyzing potential trade is based on the equations of the gravity model [31]. The gravity equation model is used to predict the volume of trade between partner countries that cooperate based on data from GDP, geographic distance, population, and other information that supports the analysis. These predicted values will be compared with the observed values to see the potential for bilateral trade. This method can be applied at the aggregate or industry level [47]. The TPI can be obtained through the following formula:

$$\text{TPI} = \frac{\hat{Y}_{jt}}{Y_{jt}}, \tag{11}$$

where $\hat{Y}_{jt}$ = Indonesia's predicted export volume to country j from the estimated gravity model, and Y_{jt} = the actual export volume of Indonesia to country j from the estimated gravity model.

If the TPI value is positive or between 0 and 1, it means that Indonesia's trade with the trading partner has not exceeded the existing trade potential (under trade). Meanwhile, if the TPI value is on the negative side or between −1 and 0, then Indonesia's trade with trading partner experiences or has exceeded the existing trade potential (over trade) [48].

3 Result and discussion

This section discusses the estimated results for determinants of volume export of chili and explored the potential export markets for Indonesia chili from its four global trading partners. The basic aim was to incorporate all trading partners but unavailability of data restricted the study to four trading partners from 1990 to 2020. The descriptive statistics and correlation matrix of selected variables are presented in Table 1.

The descriptive statistics are self-explanatory while correlation matrix shows that the signs of relationship for selected variables are in accordance with the economic theory.

3.1 Factors affecting the volume of chili exports from Indonesia

Chili is one of Indonesia's leading commodities. However, the growth rate of chili exports is still relatively low, so a study of the determinants of Indonesian chili exports is carried out using the gravity model. Table 2 presents the analysis of chili exports to several destination countries.

Based on the Hausman test results on data of chili export volume, real GDP/capita of Indonesia, real GDP/capita of the destination country, real rupiah exchange

Table 1: Descriptive statistics and correlation matrix

	Volume export	GDPInd	GDPdc	ExR	GD	InR	WTO
Mean value	182,190	1999.78	14888.27	34.50	5,546	3.42	0.7580645
Maximum	1,359,270	4135.20	66679.05	358.81	11,695	18.18	1
Minimum	0	463.95	270.22	1.25	1,148	−31.45	0
SD	272,955	1306.33	16469.89	72.97	4478.22	5.73	0.4299928
MacKinnon approximate Stasionary Test (prob)	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
Volume export	1						
GDPInd	0.1929	1					
GDPdc	0.0131	0.4126	1				
ExR	0.0557	0.2773	−0.3521	1			
GD	−0.3200	−0.0000	−0.5003	0.6041	1		
InR	0.0169	0.0688	0.0513	0.1744	−0.0788	1	
WTO	0.2437	0.5273	0.2543	0.2275	−0.0995	0.1068	1

Source: Secondary Data Analysis, 2022. ** significance at the level of 5%.

Table 2: Estimation results of the gravity model of Indonesian chili exports to destination countries

Variable	Coefficient	*t*-stats	Probability
Real GDP/capita of Indonesia	40.6395*	1.80	0.071
Real GDP/capita of destination country	−5.615322***	−3.09	0.002
The real exchange rate of the rupiah against the real exchange rate of the destination country	1091.508**	2.43	0.015
Geographical distance between Indonesia and export destination countries	−49.84931***	−5.66	0.000
Destination real interest rate	−4407.341	−1.12	0.263
WTO membership	76658.25	1.27	0.205
No. of observations	124		
R-squared	0.9261		
F-stat	7.41		
Chow test	7.68		
Hausman test	0.000		
Breusch–Pagan test	46.36		

Source: Secondary Data Analysis, 2022. * significance at the level of 10%; ** significance at the level of 5%; *** significance at the level of 1%.

rate, geographical distance, actual interest rate of the destination country, and dummy membership of the WTO, the chi-square value is obtained. The chi-square value is 0.00 less than chi-square table, that is, 150.989, so *H*0 (*H*0 = random effect is the suitable model) is accepted and *H*1 (*H*1 = fixed effect is the suitable model) is rejected, meaning that the random effect is the suitable model compared to the fixed effect model. The test was continued with the Breusch–Pagan test with the result that the chi-square value was 46.36 less than chi-square table that is 150.989, so the random effect was the suitable model compared to the pooled model. Therefore, the appropriate model for this analysis is the random effect. Based on the model estimation results, it is known that the *F*-stat probability value is smaller than the 1% significance level (0.00 < 0.01), which means that overall, the independent variables in the model are feasible to use. There is at least one significant variable in the model. The *R*-squared value obtained is 0.9261, meaning that this model can explain the diversity of chili exports by 92.61%, while the remaining 7.39% is explained by other factors not included in the model.

Based on the *t*-test, it can be seen that from the six independent variables that make up the model, only four independent variables influence the export volume of Indonesian chili. The four independent variables are Indonesia's real GDP/capita, the destination country's real GDP/capita, the rupiah exchange rate against the destination country, and the geographical distance between Indonesia and the destination country [19–23,25,49]. Two independent variables are not significant, namely, the interest rate of the destination country (0.263 > 0.01) and the involvement of the destination country in WTO (0.205 > 0.01) [21,26]. It shows that changes in the independent variable do not affect the volume of Indonesian chili exports to each destination country. This is contrary to the previous research [19,22] which stated that involvement with trade unions affects export volumes.

The independent variable of real GDP/capita in Indonesia has a significant effect at the 10% level on the export volume of Indonesian chili (0.071 < 0.1) with a coefficient of 40.6395. GDP is the total income of a country or the entire population. An increase in a country's per capita income will increase citizens' purchasing power and consumption. Based on the results, it is known that the independent variable real GDP/capita of the country of origin positively influences a country's export volume. In Indonesia, real GDP/capita is increasing with an average growth of 4.12%/year. Based on the previous studies [19,50], the increase in GDP will increase the purchasing power and consumption for various goods and services. This happens because if GDP increases, per capita income also increases, which indicates prosperity. Additional income will open consumption choices for other substitute goods that are better than what is usually consumed. According to Chao et al. [51], people with low income will like the spicy taste and get used to the taste. This is because they do not have many choices of food that can be reached with their income. Chili is a commodity that is easily accessible in terms of price and can be found anywhere. In addition, people with low incomes tend to allocate more of their income to food, while people with high incomes will allocate their income to secondary, tertiary, and investment needs [52]. Therefore, the higher the real GDP/capita, the less chili peppers will be consumed. Chili stock will be allocated more for export activities.

In contrast to the independent variable of real GDP/capita of Indonesia, the independent variable of real GDP/capita of

the destination country has a negative and significant effect on the export volume of Indonesian chili (0.002 < 0.01). However, the high real GDP/capita of the export destination country will make the country choose chili with high-quality standards [53]. Meanwhile, in Indonesia, the quality of chili is not better than in other exporting countries, so the destination country prefers to import chili from other countries. Due to changes in quality standards in chili importing countries, imports from Indonesia are reduced. Chili quality can be seen from the level of productivity. Countries with productivity levels above Indonesia are China, India, and Pakistan [54]. This result is different from that of previous studies [22,55] which state that improvement in real GDP/capita of the destination country would create demand for Indonesia's chili as one of the largest chili-producing countries. Generally, the percentage growth of real GDP/capita in destination countries shows positive growth of export.

The independent variable of the rupiah exchange rate against the export destination country has a significant effect on the 5% level of significance (0.015 < 0.05) with positive effect. This result is in contrast to the study by Gachena et al. [22] which reported that weaker currency makes costs of domestically produced goods lower, which consequently enhances competitiveness in exports to destination country. If the exchange rate of the rupiah against the destination country increases, the value of the rupiah weakens and results in a decrease in the value of exports. As the price of chili becomes cheaper, the demand for chili from importing countries will increase [56]. As an exporting country, Indonesia benefits from the increasing demand for chilies from other countries, and export destination countries benefit from low chili prices.

The independent variable geographical distance between Indonesia and the export destination country significantly affects the 1% significance level (0.000 < 0.01). The farther Indonesia is from the export destination country, the more chili exports will decrease. It happens because the farther the distance, the longer it will take for chili to reach the destination country. This will affect the quality of chili. Besides, it also makes shipping costs expensive which causes increase in chili prices in countries that are far away. Making it unable to compete with the price of chili produced by neighboring countries around the export destination country [41]. According to Chaabouni [57], chili exporters are negatively sensitive to far markets, which is consistent with the literature specifying that distance acts as a resistance factor in trade since it embodies transport fee and transaction costs. Shipping chilies to remote locations require special management and packaging so that the costs will increase. This is because chili is a horticultural commodity easily damaged and rotten if it is not at an optimal temperature [58]. Geographical distance in trade cooperation still has a high impact and tends to be detrimental. Anticipating improvements in transportation, goods packaging technology, providing insurance, and others are ways to deal with these losses. Even so, this variable is still one of the main factors influencing a country to export certain commodities to importing countries [48].

The independent variable, the interest rate of the destination country, has no significant effect at the 1% significance level (0.263 > 0.01), which means that any increase or decrease in the interest rate of the destination country will not affect Indonesia's chili exports. The interest rate of the destination country does not affect the export volume of chilies because exporters may not need loans to the destination country for working capital, so even if the interest rate of the destination country increases, it will not affect the volume of chili exports [59]. In addition, in less developed credit markets, exports are not very sensitive to changes in interest rates [60]. The result is in contrast to that reported by Cecilia et al. [61] who stated that exchange rate positively affects the price and amount exported, with exports more competitive within the foreign market.

The independent variable of membership of export destination countries in the WTO does not significantly affect the export volume of Indonesian chili (0.205 > 0.01). Membership of export destination countries in the WTO does not affect the export volume of Indonesian chilies because within the organization, there are several major world-producing countries, such as China, Mexico, and Turkey. Indonesia is not the highest chili exporting country in the world, so its competition with other big countries is still relatively low. On the other hand, Indonesia's chili importing country may not make Indonesia the leading country for importing chili products. Developed countries have benefited the most from their involvement as members of the WTO since it was founded in 1995. There was no rule to eliminate agricultural export subsidies before this rule was finally enacted in 2015. Several developing countries still apply agricultural export subsidies [62]. Even though there has been an agreement to eliminate agricultural export subsidies, developed countries, in particular, still maintain subsidies and protect their agricultural sector. This condition has impoverished developing countries, so Indonesia's involvement as a WTO member has not yet had a significant impact, especially on chili commodities [2].

3.2 Export potential of Indonesian chili in export destination countries

The estimation results of the gravity model are used to analyze the trade potential of Indonesian chili in each destination country. Based on the analysis results, it is known that each country's average trade potential ratio is more significant than one (Table 3), which shows that Indonesia's chili trade with chili importers from Indonesia has not exceeded the existing trade potential, so Indonesia still has the potential to expand trade to these countries. Indonesia can develop its market in countries that have become its trading partners [63].

Sequentially, the countries with the largest to smallest trade potential are Singapore, Nigeria, Malaysia, and Saudi Arabia. Singapore is a destination country for Indonesian chili exports with the highest average value of potential trade, which is 10.61 times the actual trade potential. Thus, Indonesia has the potential to expand trade with Singapore because based on geographical distance, the distance between Indonesia and Singapore is the closest compared to the other three countries, namely, 2,850 km. While the distance between Indonesia and Malaysia is 3,360 km, Saudi Arabia is 7,898 km, and Nigeria is 11,688 km [64]. Moreover, in 2020, the actual trade volume of Indonesian chilies to Singapore is only 151,696 kg, while the predicted trade volume will reach 193102.3 kg. Cooperation between Indonesia and Singapore has positive potential; the portion of Indonesia's non-oil and gas exports to Singapore reaches 6.36% of total exports. Singapore is the destination country with the highest export value within ASEAN [65]. As a country with limited natural resources, Singapore relies on imports of agricultural products, especially chili from Indonesia. The percentage of chili export value to Singapore is 4.44% of the total chili export value, or around US$1.1 million [7]. The relationship between Indonesia and Singapore in chili trading activities has been going on since 1991 or for approximately 28 years until 2020. Singapore started the cooperation by importing fresh Indonesian and ground chilies since 2012. Even though Singapore had experienced a recession for two consecutive quarters in 2020, it did not affect the performance of trade with Indonesia.

Nigeria is a country that has the second-highest average value of potential trade after Singapore, with a potential of 5.85 times its actual trade. Nigeria's geographical distance is the farthest from Indonesia, but it country imports chili with the largest average amount per year compared to the other three countries, even the percentage of export value to Nigeria reaches 13.35% of the total chili export value of around US$3.36 million. As the only chili importer country from the African continent, Nigeria's cooperation with Indonesia is quite potential. Nigeria has the most extensive total trade among other African countries such as South Africa, Egypt, Algeria, and Angola [66]. Although chili commodities are not the top export products from Indonesia, the export value contributed by chili commodities provides considerable potential, especially since Nigeria is the newest country to become an importer of Indonesian chilies compared to the other three countries, since 2013 or approximately 7 years. Since 2001, about 795 million people have experienced food crises, most of which are in Sub-Saharan Africa and Asia. In 2009, the world's production decreased by 32.2%, and the Sub-Saharan Africa region experienced a decline of 4.5 million tons of food commodities, which impacted their financial condition where most of the GDP comes from agricultural commodities. Nigeria is a country on the African continent that contributes more than 50% of production and consumption activities. Nigeria has experienced a lot of decline in the production of chili commodities. This country can produce 50% of the total production in Africa and accounts for 1.5% of the total world chili production. However, the food crisis has pushed Nigeria to import chilies from outside its territory, Indonesia. The quantity of chili exports to Nigeria experienced a significant increase, which amounted to 568,025 tons from 225 tons in 2019 to 793,025 tons in 2020 [27]. Therefore, this condition provides an advantage for Indonesia to become an exporter in the region of Nigeria [67].

Meanwhile, Malaysia has been an importer of Indonesian chili from 1990 for approximately 20 years. Malaysia is the only chili importing country that has been importing every year since 1990. Malaysia is a country that has the third-highest average potential trade value after Nigeria, with a potential of 4.46 times its actual trade. Although the value of the trade potential index is far below Singapore's, the value of chili

Table 3: Ratio of the average trade potential of Indonesian chili to destination countries 1990–2020

	Total exports	Export period (years)	Average exports per year	Average TPI
Nigeria	3,027,265	7	432,466	5.8539092
Saudi Arabia	2,315,027	13	178,079	2.7020567
Malaysia	12,659,467	31	408,370	4.4572248
Singapore	4,589,801	28	163,921	10.607265

Source: Analysis of secondary data for 1990–2020 based on TPI estimates.

exports to Malaysia is higher than Singapore's, which is US $1.8 million. In contrast, the export value of chilies to Singapore is US$1.1 million [7]. The value of chili exports to Malaysia accounts for 7.4% of the total chili exports [7] The geographical distance between Indonesia and Singapore, and Indonesia and Malaysia is relatively close compared to other importing countries [68]. As a country without agricultural land, Singapore depends entirely on Indonesian chili production [69]. In addition, the area adjacent to Indonesia provides an advantage for Singapore to meet the needs of chili in the country. The high demand, the closer distance, and the condition of the absence of agricultural land in Singapore provide a higher trade potential for Indonesia compared to the trade potential in Malaysia.

Chili exports to Saudi Arabia started in 1992 but did not continue and started again in 2001, then stopped and again started in 2010 until 2020. Even though it had stopped importing chilies from Indonesia, Saudi Arabia has been the primary destination for chili exports for the last 3 years since 2017. In 2020, the value of Indonesian chili exports to Saudi Arabia reached US$9 million. This value decreased in 2018, reaching only US$7 million [7]. The index value of chili trade potential in Saudi Arabia is the smallest among the other three export destination countries, indicating that chili exports to Saudi Arabia have lower trade potential than Nigeria, Singapore, and Malaysia. Saudi Arabia has the highest percentage of chili export value compared to other export destination countries. Types of chilies exported to Saudi Arabia include fresh, dried, and crushed chilies. However, the largest proportion exported has been crushed chili. As a country visited by pilgrims every year, the demand for food ingredients is always high; moreover, mashed chili spices are very much needed for processed food ingredients in Saudi Arabia. Most pilgrims come from countries that consume chilies in their food, such as Indonesia, Pakistan, India, Bangladesh, and Egypt [70]. This is a potential that can be developed to be able to expand the trading market in the region of Saudi Arabia. Based on the TPI, Indonesia has the potential to expand its trade to Singapore and Nigeria.

3.3 Implications of Indonesian chili export policy in the international market

Chili farming in Indonesia is profitable, both privately and socially. The chili that Indonesia exported are fresh chilies and ground chilies. From a trade perspective, adding value for agricultural products can be created if Indonesia is involved in global exchange. It can stimulate economic activity in the country and contribute more to even income distribution [71]. Chili export is one sector that is being boosted by the government. The fact that chili exports do not grow optimally compared to domestic chili production makes this sector interesting to study. The diverse increase in import of Indonesian red chili among countries presents it as consideration-worth export opportunity. This opportunity should be utilized by the government, to start exporting chili intensively [15]. In fact, if exports run well, it will not only improve the Indonesian economy, but also the competitive and comparative value of chili in the eyes of world trade [16,17]. Based on Table 1, it can be seen that several factors affect the volume of chili exports. The estimation results of the gravity model show that the variables of Indonesia's real GDP/capita, real GDP/capita of the destination country, the rupiah exchange rate against the destination country, and the geographical distance between Indonesia and the destination country have a significant effect on Indonesia's chili exports. The rupiah exchange rate against the destination country has the largest coefficient and positively affects the Indonesian chili trade.

Chili is mainly exported to Malaysia, Singapore, Saudi Arabia, and Nigeria. Figure 2 shows the volume of export to Malaysia, Singapore, Saudi Arabia, and Nigeria from 1990–2020. It is shown that there is an increasing trend in the volume of chili exported and extremely high increase in the volume of chili exported to Nigeria and Saudi Arabia from 2013–2020. The potential for chili exports in Nigeria, Saudi Arabia, Malaysia, and Singapore is under trade status, so there needs to be a market expansion policy in the destination country. Singapore and Nigeria are the most potential countries for export expansion. Figure 3 shows that the largest Indonesia chili export value are to Nigeria and Singapore. The total value of chili that Nigeria imports from Indonesia is about US$15.8 million for only 7 years. Then, followed by Singapore, which is about US$5.3 million, Saudi Arabia, which is about US$1 million, and Malaysia, which is about US$816 thousand.

Singapore has the closest distance to Indonesia compared to other destination countries, thus facilitating the delivery of goods in terms of financing and chili quality. Chilies are extremely sensitive to the seasons and weather, which will have an impact on the instability of the supply amount of red chili, and will affect the price of red chili if it is not managed well. Singapore, with the absence of optimal agricultural land, causes the food sector to depend on other countries, including Indonesia as an exporter of

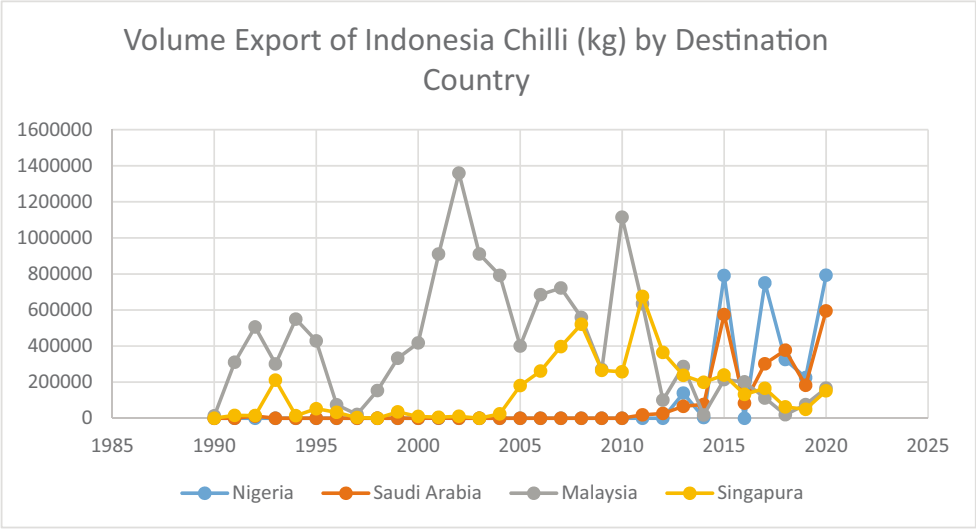

Figure 2: Volume export of Indonesia chili to destination countries during 1990–2020.

chili. This is a distinct advantage for the Indonesian agricultural sector, where most of the Indonesian people's livelihoods are farming. Comparative advantage in the agricultural sector, in this case chili, makes chili commodity special in the world trade. In the end, to maintain the country's economic stability, it is necessary to increase exports and reduce imports [72].

On the other hand, the food crisis in Africa impacts import of food from other countries, especially, Nigeria, the largest producer of the agricultural sector in Africa. Chili as a food and spice needed for the people of Nigeria has decreased in production, which has become a potential for Indonesia to supply chili needs in the country. International trade requires a mutually agreed currency. The rupiah exchange rate must be equal in value to what has been agreed upon. This exchange rate is important to global trade including to Singapore, Malaysia, Saudi Arabia, and Nigeria. Based on the estimation results of the gravity model, the rupiah exchange rate is the variable with the highest and most significant coefficient in influencing the export volume of chili. Efforts to increase exports can be made by increasing the rupiah exchange rate (depreciation) to lower the price of export goods and benefit export destination countries [73]. The depreciation of the rupiah exchange rate will worsen the trade balance in the short term but provide a better condition for the trade balance in the long term. Depreciation causes imported goods to be relatively expensive and

Figure 3: Value export of chili of Indonesia during 1990–2020 (USD).

the prices of exported goods to be relatively cheaper; with the assumption that changes in the volume of imports and exports take place slowly, it will cause the trade deficit to be larger or the trade surplus to decrease.

However, after some time, export volumes will increase along with relatively lower prices for export products, followed by a decrease in import volumes due to relatively high prices for imported goods. Therefore, the trade balance surplus will increase and exceed the surplus condition before the exchange rate depreciation. The relatively lower price of export chili due to the depreciation of the rupiah exchange rate will benefit export destination countries, especially Nigeria and Singapore, as countries with the highest TPI compared to Malaysia and Saudi Arabia. From this exposure, there is no one-size-fits-all strategy for increasing exports and trade benefits. As has been increasingly often pointed out in the most recent literature, it is crucial to consider the actual economic environment in order to make the best use of existing opportunities.

4 Conclusion

Indonesian chili exports are influenced by Indonesia's real GDP/capita, real GDP/capita of destination countries, rupiah exchange rate against destination countries, and geographical distance. Factors that positively affect the volume of chili exports are Indonesia's real GDP/capita and the rupiah exchange rate against the destination country. On the other hand, the factors that have a negative effect on the volume of chili exports are the real GDP/capita of the destination country and geographical distance. The most dominant factor is the rupiah exchange rate against the destination country. Efforts to increase exports can be made by increasing the rupiah exchange rate (depreciation) so that the price of export goods will be lower and benefit the export destination country. Meanwhile, interest rates and the involvement of destination countries in the WTO do not significantly affect the volume of Indonesian chili exports.

Based on TPI result above, Indonesia can potentially expand trade to trading partner countries in the future, especially to Singapore and Nigeria, which is shown by the average trade potential ratio of each destination country which is greater than one, which means that Indonesia's trade with trading partners has not exceeded the existing trade potential (under trade). Indonesia can increase its market share by prioritizing exporting chilies to Singapore and Nigeria. It is because Singapore's geographical distance from Indonesia is the closest. Also, Nigeria's average annual export volume is the largest compared to the other three countries, even though Nigeria has only imported chilies in the last 7 years. Indonesia needs to expand to countries with the most significant potential, such as Singapore and Nigeria, by considering the factors affecting the chili export volume.

The results above answer the research gap where Indonesia's chili volume exports are influenced by macro factors as mentioned above. Indonesia's joining the WTO is not the reason for increasing Indonesia's chili exports in world trade. The condition of Indonesian chili exports does not depend on bilateral or multilateral agreements with other countries. This is because the export volume of Indonesian chilies is not much. Other results also state that the best expansion to chili trade is to increase export to Singapore and Nigeria, which will be able to increase the rupiah exchange rate if exports develop. These results also indicate that there is no one-size-fits-all strategy for increasing exports and trade benefits. Further research suggests increasing the number of destination countries in the study because export conditions to each country constantly change yearly and even increase the number of importing countries. In addition, it focuses on why interest rates and the involvement of destination countries in the WTO do not affect the volume of Indonesian chili exports.

Acknowledgments: The authors would like to thank Universitas Sebelas Maret for the support funding.

Funding information: Universitas Sebelas Maret funded this research for the Fiscal Year 2021 with Number: 260/UN27.22/HK.07.00/2021

Author contributions: data collection and methodology: M.T.S.; supervision: D.D.; review and editing: J.S. and E.A. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors state no conflict of interest

Data availability statement: The datasets generated during and/or analyzed during the current study are available in the Indonesian Ministry of Agriculture, United Nations Commodity and Trade, World Bank, Indonesian Distance World, and World Trade Organization.

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