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THE EXCHANGE RATE VOLATILITY IMPACT ON AGRICULTURAL TRADE: AN EVIDENCE FROM INDONESIAN PEPPER EXPORT

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Abstract: Pepper (*Piper nigrum*) is one of the most exported spices in Indonesia followed by cinnamon, cloves, and vanilla. Due to its strong dependency on international trade, Indonesian pepper exports are suspected to be prone to exchange rate volatility risks. Traditionally, exchange rate volatility is perceived to discourage exports. However, studies to date remain to provide an open question on whether volatile exchange rates discourage exports. This paper aims to examine the impact of exchange rate volatility on Indonesian pepper exports to its main trading partners from 2005 to 2019. Using gravity model and GARCH (1,1) for volatility measurement, the results reveal that Indonesian pepper exports are not affected significantly by exchange rate volatility. This is because Indonesia has been in the position as a net exporter of pepper where a majority of its production is consumed abroad and pepper only costs a small percentage of the total cost of food productions.

Keywords: exchange rate volatility, GARCH (1,1), gravity model, Indonesian pepper trade, Indonesian spice

Abstrak: *Lada (Piper nigrum) merupakan salah satu rempah-rempah yang paling banyak diekspor oleh Indonesia diikuti oleh kayu manis, cengkeh, dan vanili. Karena ketergantungannya yang kuat pada perdagangan internasional, ekspor lada Indonesia dicurigai rentan terhadap risiko volatilitas nilai tukar. Secara tradisional, volatilitas nilai tukar dianggap menghambat ekspor. Namun, studi sampai saat ini tetap memberikan pertanyaan terbuka tentang apakah nilai tukar yang bergejolak menghambat ekspor. Tulisan ini bertujuan untuk mengkaji dampak volatilitas nilai tukar terhadap ekspor lada Indonesia ke mitra dagang utamanya dari tahun 2005 hingga 2019. Dengan menggunakan model gravitasi dan pengukuran volatilitas GARCH(1,1), hasilnya menunjukkan bahwa ekspor lada Indonesia tidak terpengaruh secara signifikan oleh volatilitas nilai tukar. Hal ini dikarenakan Indonesia telah berada pada posisi net eksportir lada dimana sebagian besar produksinya dikonsumsi di luar negeri dan biaya lada hanya sebagian kecil dari total biaya produksi pangan.*

Kata kunci: *volatilitas nilai tukar, GARCH(1,1), model gravitasi, perdagangan lada Indonesia, rempah Indonesia*

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INTRODUCTION

Since the breakdown of Bretton Woods system in 1973, topic on the impact of exchange rate volatility on trade has been drawn attention of many researchers as most of the countries in the world shifted to flexible exchange rate system. The exchange rate volatility is traditionally believed to give a negative impact on international trade which likely leads to uncertainty in output and profit, brings risk to the exporter, thus causing traders give up on export (Clark, 1973; Ethier, 1973; McKenzie, 1999). On the other hand, previous researches also find that exchange rate volatility may affect positively on export (Bailey, Tavlas and Ulan, 1986; De Grauwe, 1988). Thus, discussion on this topic remains ambiguous and becomes an empirical issue.

Indonesia is an emerging country that heavily depends on agricultural export as one of its national income sources. It contributed 13.53% in 2017 (including forestry and fisheries) to the national Gross Domestic Products (GDP) (Ministry of Agriculture (MOA), 2018). As Indonesia's agricultural trade has become largely integrated with global trade, it inevitably involves other currencies on its transactions. Koo and Kennedy (2005) suggests that export-import prices are influenced by exchange rates, where any depreciation in the exchange rate will normally increase exports and appreciation otherwise. However, a wild movement of exchange rates is not desirable. If rupiah (IDR) versus other currencies move volatile, the price of Indonesian agriculture products will be affected. Simultaneously, the exchange rates will determine how competitive the price of Indonesian agricultural products is. This scenario implies that the exchange rate volatility may also play a role in determining Indonesia's agriculture export in the global market. Given the fact that rupiah has moved freely over time in the foreign exchange rate markets since 1997.

Pepper (*Piper nigrum*), known as "King of Spices," is one of the most exported spices in Indonesia and it has a strong connection to international markets. In 2019, for example, Indonesia exported 52,567 MT of pepper followed by cinnamon, cloves, and vanilla, with the quantity exported being 36,765 MT, 25,990 tons, and 261 MT, respectively (World Integrated Trade Solution (WITS, 2021)). Moreover, Indonesia is one of the world's main pepper producer and exporter. Based on data from WITS (2021), Indonesian pepper production is export oriented as its foreign market is larger than domestic market.

Despite having good profile as one of the world's main exporters, Indonesian pepper export development has shown a fluctuating trend in recent years. Figure 1 shows that the pepper export developed positively from 2005 to 2008. However, the positive export growth of this commodity could not be sustained. The fluctuations of pepper exports started in 2009 and have become more intense since that year. Furthermore, the Global Financial Crisis (GFC) took place in 2008-2009. This event caused Indonesian Rupiah appreciated with Rp 12,010 in March as the highest rate (Datastream, 2021). Following the theories, it means the rupiah appreciation likely makes pepper prices higher for its trading partners leading to a decline in Indonesia's pepper exports, as seen in Figure 1. Although Indonesia reached its peak in 2015, the export dropped significantly after that. The rupiah fluctuations were also indicated.

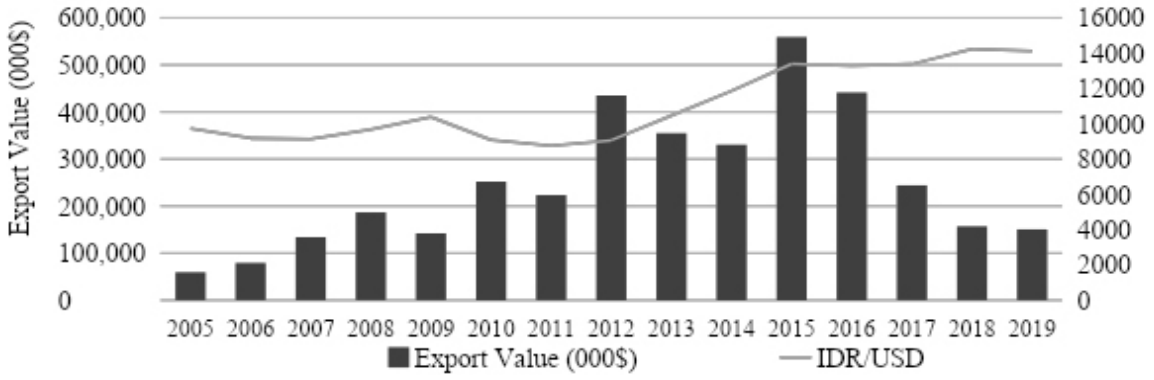


Figure 1. Development of Indonesia's pepper export (lhs) and IDR/USD rate (rhs) (WITS (2021) for export value data; Datastream (2021) for exchange rate data)

While the price of pepper will remain uncertain until payment is agreed and received by Indonesian pepper exporters, the magnitude of profit and the volume of exports will be hard to be determined. This makes pepper export development susceptible to fluctuation. If the risk-averse exporters bear the exchange rate volatility risk, it will lead to a decline in export activity. In the same way, if the importers bear the risk, they will reduce their imports (Hooper and Kohlhagen, 1978).

Studies about exchange rate volatility impact on agricultural trade are also ambiguous, however (Wang and Barrett, 2007; Fogarasi, 2011). One of studies that investigates the issue specifically on Indonesia's agricultural exports is by Satriana, Harianto and Priyarsono (2019). The authors evaluate Crude Palm Oil (CPO), natural rubber, coffee, and shrimp export performances. The findings of their study are varied in signs and magnitudes depending on commodity. It appears that the exchange rate volatility has a significant negative association with natural rubber, coffee and shrimp exports and only positively associated with CPO exports though it is insignificant. Hence, this raises the question of whether Indonesian pepper exports are also affected by the exchange rate volatility as most of Indonesian pepper production is traded internationally. A range of earlier studies only focus on analyzing the effect of changes in the level of exchange rate on Indonesian agricultural trade, while that focusing on Indonesian pepper and exchange rate volatility are scanty. Indonesian pepper export is dominated by pepper in the form of neither crushed nor ground (HS090411). Thus, paper aims to analyze the exchange rate volatility impact on this commodity to its largest trading countries. Following other studies, gravity model is used to determine the exchange rate volatility impact on Indonesia's pepper export. Moreover, this study employs the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) by fitting a GARCH (1,1) model to generate the exchange rate volatility estimated value using weekly data of bilateral exchange rate between 2005 and 2019.

As the exchange rate volatility cannot be observed directly and studies to date remain inconclusive, this analysis will provide an additional contribution to the existing literature. Concerning the mentioned contribution, this analysis will also provide important information for pepper exporters and related stakeholders to anticipate possible risks and opportunities caused by exchange rate volatility. Finally, support on the importance of maintaining exchange rate volatility can be provided for policy recommendation.

METHODS

This research employs secondary data from 2005 to 2019. The set of countries consists of eight main trading partners of pepper China, Germany, France, and the Netherlands, India, Japan, Malaysia, United States, Singapore, and Vietnam. In this research, exports to Germany, France, and the Netherlands are estimated as EU, considering the so-called "Rotterdam effect", and China is defined as the China mainland which excludes Hong Kong, Macau and Taiwan. Table 1 summarizes the source and definition of data for this research.

Table 1. Type, source, and construction of data

Variable	Definition and Construction	Source
$\ln EXP_{ijt}$	Annual pepper export value (US$ 1000)	WITS
$\ln GDP_{jt}$	Annual GDP per capita (constant 2010 US$)	World Bank
$\ln RP_{ijt}$	$RP_{ijt} = \left(ner_t \times \frac{CPI_t^i}{CPI_t^j} \right)$ ner_t = nominal exchange rate CPI^{ij}_t = annual CPI of exporter and importer respectively	Author's calculation with data from IMF IFS for Consumer Price Index and Datastream for annual exchange rate
$\ln Vol_{ijt}$	Annualized-average bilateral volatility of the GARCH (1,1) estimated conditional variances	Author's calculation with data from Datastream for weekly nominal exchange rate
$\ln Dist_{ij}$	Distance (km)	CEPII
FTA_{ijt}	FTA dummy variable; 1 for signed and in effect FTA and 0 otherwise	Asian Development Bank (ADB)

Gravity Model

There are numbers of earlier studies demonstrated that exchange rate volatility affects trades differently (negative, positive, significant and not significant). Indonesian pepper importers consist of both producing countries and non-producing countries. Pepper producers are largely from developing countries. Previous empirical studies have demonstrated that exchange rate volatility has different effects for developing countries and advanced economies due to limited access to currency-hedging instruments, so exporters tend to be discouraged to export more when the export destinations have higher exchange rate volatility (Kandilov, 2008; Hall et al., 2010; Héricourt and Poncet 2015). This study also checks for the impact of exchange rate volatility on pepper exports for each mentioned category.

The traditional gravity model by Tinbergen (1962) has been used by researchers extensively because of its consistency to determine trade flows. Considering that trade may be impacted by different factors, the gravity models for this study suggested by the literature are specified below:

$$lnEXP_{ijt} = \beta_0 + \beta_1 lnGDP_{jt} + \beta_2 lnRP_{ijt} + \beta_3 lnVol_{ijt} + \beta_4 lnDist_{ij} + \beta_5 FTA_{ijt} + u_{ijt} \quad (1)$$

$$lnEXPpc_{ijt} = \beta_0 + \beta_1 lnGDP_{jt} + \beta_2 lnRP_{ijt} + \beta_3 lnVol_{ijt} + \beta_4 lnDist_{ij} + \beta_5 FTA_{ijt} + u_{ijt} \quad (2)$$

$$lnEXPnpc_{ijt} = \beta_0 + \beta_1 lnGDP_{jt} + \beta_2 lnRP_{ijt} + \beta_3 lnVol_{ijt} + \beta_4 lnDist_{ij} + \beta_5 FTA_{ijt} + u_{ijt} \quad (3)$$

where EXP_{ijt} denotes the pepper export value of Indonesia in thousand U.S. Dollars to its trading partners (China, EU, India, Japan, Malaysia, United States, Singapore, and Vietnam), $EXPpc_{ij}$ is the pepper export value to partners who are also world's producer countries (China, India, Malaysia, and Vietnam), and $EXPnpc_{ij}$ is the pepper export value to partners who are non-producing countries (EU, Japan, United States, and Singapore).

Concerning that every commodity will have different relationship between exchange rate volatility and trade (McKenzie, 1999; Bahmani-Oskooee and Hegerty 2007), there are some considerations on the building of hypothesis based on pepper characteristics. Firstly, Indonesia is known as one of the biggest pepper suppliers in the world, where its foreign markets are mostly including the biggest pepper market such as EU and the USA as well as world's pepper producers such as Vietnam and India. Special case from Vietnam, pepper from Indonesia is mixed with Vietnamese prepper for foreign market penetration such as in EU and the USA due to sustainability issue (Centre for the Promotion of Imports (CBI), 2018) indicating that Indonesian pepper has better quality and potency. Therefore, the relationship between exchange rate volatility and pepper trade is expected to be positive.

GARCH (1,1)

Unlike other variables, the bilateral exchange rate volatilities in fact cannot be observed directly. According to Engle (2001), the GARCH (1,1) model is the simplest, yet provides a reasonably robust estimation among other volatility models that fit for financial data. Moreover, the GARCH (1,1) model is able to illustrate the behaviour of returns on currency and other financial time series data, even during an extreme turmoil condition such as the GFC (Paolella, 2019). Thus, GARCH (1,1) is used in this study.

Suppose the mean equation of r_t (returns) is estimated by Equation (4) and its first order autoregressive process is represented in the Equation (5). Now let σ^2_t denotes the conditional variance of u_t which is random variable at time *t*, $\{u_t\}$ is a sequence of random variables that fulfils the *iid* properties, then the structure of GARCH(1,1) model that allows the variance of r_t to change over time (Eq. 6) for this research is expressed as follows:

$$r_t = r_t + u_t \quad (4)$$

$$r_t = \gamma_0 + \alpha_1 r_{t-1} + u_t \quad (5) \text{ where, } u_t \sim N(0, \sigma^2_t)$$

$$\sigma^2_t = \gamma_0 + \alpha_1 u^2_{t-1} + \beta_1 \sigma^2_{t-1} \quad (6)$$

$$\text{where, } \gamma_0 > 0,\ \alpha_1 \geq 0, \text{ and } \beta_1 \geq 0$$

Equation (6) explains that the conditional variance of errors (u_t) depends on both squared error from the previous period of shock (lagged residual squared), which is captured by the ARCH term, and on its conditional variance of errors (u_t) from the previous period (lagged variance), which is captured by the GARCH term itself.

The total GARCH(1,1) models estimated in this research are 8 models for each pair of bilateral exchange rates. For model evaluation purposes, diagnostic tests such as Ljung-Box tests and ARCH-LM tests are applied. If both tests indicate free of autocorrelation and ARCH effects in the residuals, the GARCH(1,1) models are good. Finally, to get the Vol_{ijt} figures for gravity equations, the estimated conditional variances ($\hat{\sigma}^2_t$) obtained from GARCH(1,1) volatilities are multiplied by √52 for annualized estimation, where 52 is the total number of the week in one year (Héricourt and Poncet, 2015; Dalheimer, Brümmer and Jaghdani, 2017; Vo, Vo and Zhang, 2019).

The exchange rate volatility is perceived to discourage international trade. However, studies to date remain to provide an open question on whether volatile exchange rate harms exports. Globally, pepper is one of the most consumed spices, and Indonesia is one of the largest exporters in the world. Knowing that agricultural products may be sensitive to the exchange rate risks exposure, carrying a careful study on the subject is needed. The central question of this study is how the pepper export in Indonesia reacts towards bilateral exchange rate volatility. To investigate the research problem, this study focuses on the pepper export from Indonesia to its largest pepper importers in the world. Additionally, bilateral exchange rate volatility is used. While suspecting exchange rate volatility as a factor affecting export pepper in Indonesia, other variables are also included in the equation such as relative price, distance and FTA membership. The estimation technique to gauge the relationships in this research is the gravity model. In order to generate estimated conditional variances of the weekly bilateral exchange rate volatility, GARCH(1,1) is utilized. The GARCH(1,1) model is chosen because it is generally accepted to be appropriate and parsimonious in the application. From the above explanation, the research conceptual framework of this study is presented in Figure 2.

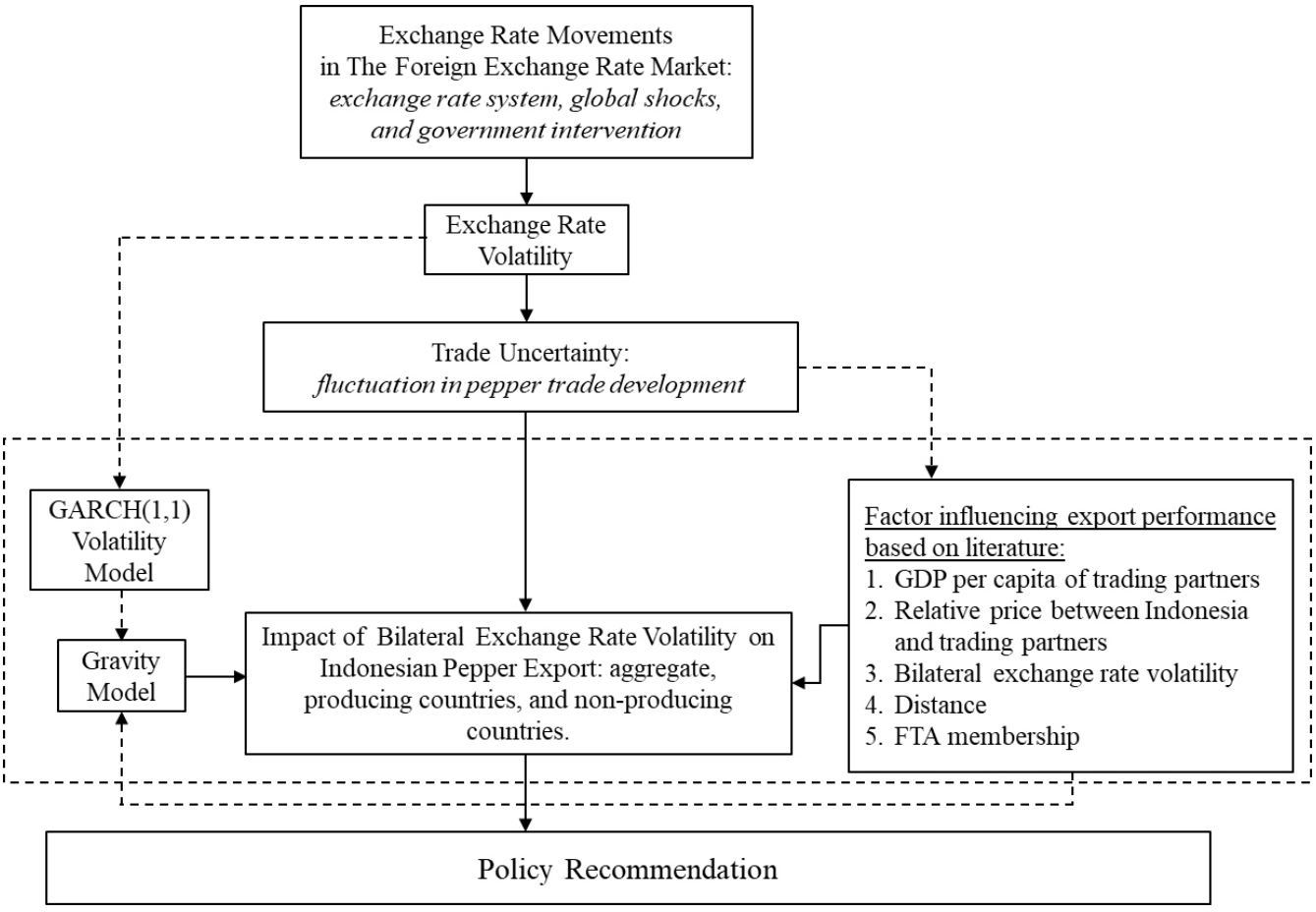


Figure 2. Research framework

RESULTS

Recent Trend of Indonesia's Pepper Trade in World Market

Pepper is a commodity produced mainly by tropical countries and it has also been an important spice crop traded worldwide. Today, Vietnam, India, Indonesia, Brazil, Malaysia, China, and Sri Lanka are the central countries of production. Indonesia as one of the main pepper producers has been a long time contributed actively to the world pepper trade. Figure 2 shows the export development of top pepper producers (HS090411) from 2005 to 2019. From Figure 2 it can be seen that Indonesia occupied the second place from 2005 to 20016, but starting from 2017 to 2019, Indonesia's position was overtaken by Brazil. Vietnam has always been in the first place with the value of export in 2019 US$566.099 thousand.

In terms of consumption, the majority of Indonesia's pepper production is consumed abroad. For example, based on data from IPC (2020), in 2019 Indonesian domestic market only absorbed 29,750 MT pepper while 52,557 MT pepper was absorbed by foreign market. Hence, Indonesian pepper growers are hardly dependent on international trade. The export earnings were significantly bigger than domestic earnings. From 2005 to 2019, the average export earning of Indonesia (US$244.77 thousand) was still below Vietnam (US$709.94 thousand), but higher than by Brazil (US$179.83 thousand) and India (US$118.86 thousand) in the third and fourth positions. Similar to Indonesia, Vietnam also does not have a huge domestic demand in pepper. This country produced on average of 141,767.3 MT pepper with an average amount of export earnings were US$709.94 thousand, but only consumed domestically 5,530 MT per year on average (IPC 2016, 2020). Thus, based on the comparison, Indonesian pepper farmers are benefited from pepper exports.

Black pepper and white pepper are the most widely traded types of pepper in the international market. Indonesian black pepper and white pepper are known globally as Lampung Black Pepper and Muntok White Pepper. The development of Indonesian black and white pepper prices has a fluctuating trend. In the period of 2005-2019, the average annual FOB (Freight on Board) price of Indonesian black pepper was slightly higher than that of Vietnamese and Brazilian black pepper, but lower than the price of Indian black pepper. As for white pepper, Indonesia has a slightly higher price than Vietnam and Brazil. Thus, it implies that Indonesia still has competitive prices in the world market (IPC, 2016; IPC, 2020).

Empirical Results of Exchange Rate Volatility

As the first step to perform GARCH(1,1) estimation, ADF test of data stationarity is required. The ADF unit root test results for all bilateral exchange rates, available upon request, show that all of the natural log ($I(0)$) data are not stationary, but they are stationary in the return or integrated one ($I(1)$) form as presented in Figure 3, for example.

From Figure 3 (b) it can be seen that the residuals of IDR/USD weekly returns exhibit a volatility clustering pattern which is one of the financial data characteristics (The rest of the plots is available upon request). There were some periods that has small swing followed by smaller swing and later they change to wide swing followed by wider swing. This characteristic of volatility indicates that the residuals suffer from conditional heteroscedasticity and will be treated with further steps of GARCH(1,1) model.

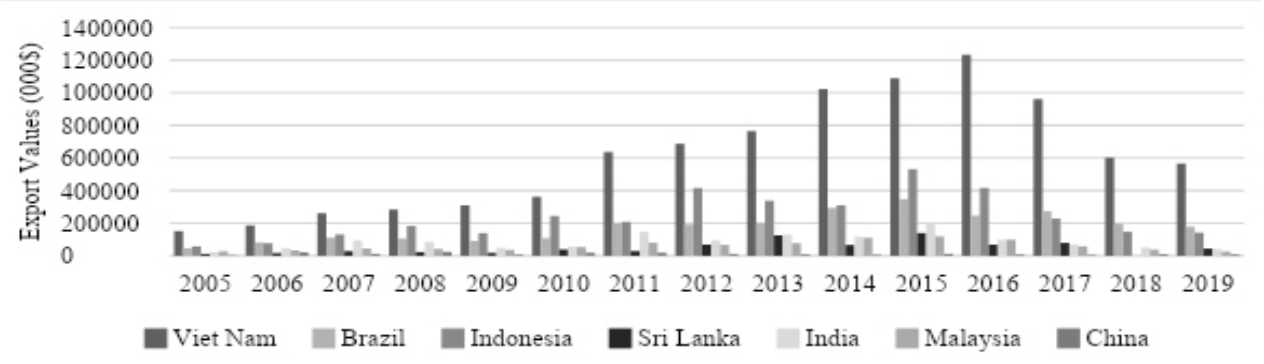
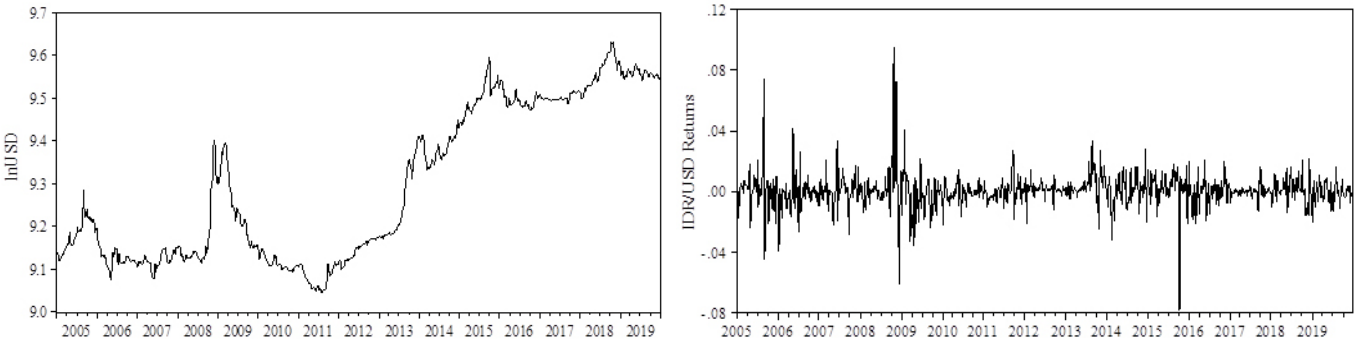


Figure 2. Export Value Development of The World Pepper Producers (HS090411) (WITS, 2021)



(a) (b)

Figure 3. (a) Empirical natural logarithm bilateral exchange rates of IDR/USD (lhs) and (b) Plot of the stationer IDR/USD weekly returns (rhs)

The next step is to detect ARCH effect in the residuals by applying ARCH LM heteroscedasticity test by Engle (1982). The summary of ARCH LM test is available upon request. The results indicate that all of the bilateral exchange rate series are significant at 5% level and it provides a strong evidence of ARCH effect presence in their residuals. It is then suitable for GARCH(1,1) estimation. Finally, the diagnostic tests of ARCH LM test and the Ljung-Box test on standardized residuals and standardized residuals squared for model evaluation are also performed. The results, available upon request, indicate that the residuals are free of autocorrelation and no remaining ARCH effects in all tests with the significant values are more than 5% level of significant. Thus, the GARCH(1,1) models are good.

Figure 4 shows the estimated volatility for all bilateral exchange rates in annualized form. Overall, it indicates that the highest volatility for all of the currencies was occurred between 2008 and 2009. An explanation to this result is related to the recent financial crisis or GFC, when the crisis of the US sub-prime mortgage started to take place in 2007. The GFC affected international economic competition and triggered a tremendous decline in the global economic growth. Countries such as the US, EU, China, Japan as well as other developing countries suffered from this pressure (ADB, 2011).

While neighbor countries in ASEAN such as Malaysia, Philippines, Thailand, and Singapore were experienced diminishing economic performance, Indonesia have experienced a resilient growth amidst the crisis (Tambunan, 2010). In term of exchange rate, external economic shocks led to the Rupiah depreciation and appreciation. From the government side, there were two policies implemented to response the 2008 GFC (Basri and Rahardja, 2010). The first is monetary policy: a reduced interest rate of Bank Indonesia by 300 basis points ranging from 9.5% to 6.5% resulting a relaxed liquidity. The second policy is fiscal policy: an implemented stimulus resulting the enlarged budget deficit and reduced taxes.

Exchange Rate Volatility Impact on Indonesian Pepper Export Performance

Table 2 summarizes the estimation results of all regressions. According to the Hausman test results, Model 1 and Model 2 are consistent with FE model. The p-values are less than chosen critical value of 0.05 so the null hypothesis is rejected. The Hausman test for Model 3, however, fails to reject the null hypothesis. This indicates that RE model is more efficient.

The bilateral exchange rate volatility coefficients as the main variable of interest in this study has negative sign but insignificant at any level of significance for Model 1 and Model 2. These findings are generally consistent and successfully replicate the results of previous empirical studies by Kandilov (2008). Surprisingly, Model 3 has a positive effect but it is not significant at the 5% level and has the same impact as Satriana, Harianto and Priyarsono (2019). Overall, this study contributes additional evidence to the existing literature that the sign of exchange rate volatility effects on trade are discovered to remain ambiguous as McKenzie (1999) and Bahmani-Oskooee and Hegerty (2007) have summarized.

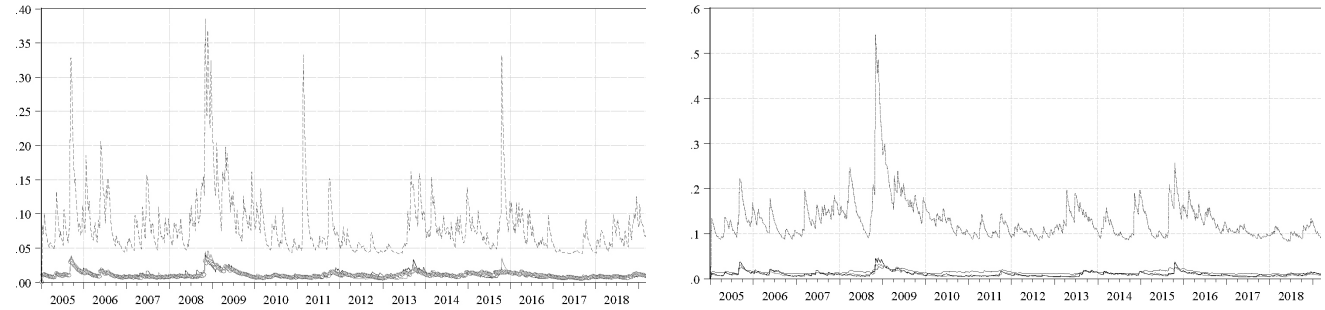


Figure 4. Annualized volatility of bilateral exchange rate (Author's production based on Author's estimates, 2021)

Table 2. Summary of regression results

Variables	Export Value		
	Model 1	Model 2	Model 3
lnGDPjt	4.998***	5.080***	-0.409***
	(1.011)	(1.739)	(0.124)
lnRPijt	-0.342	-0.243	0.499***
	(0.539)	(1.46)	(0.069)
lnVolijt	-0.285	-1.681	0.539
	(0.658)	(1.255)	(0.476)
lnDistij	-	-	0.399***
			(0.048)
FTAijt	-0.216	-1.444	0.367***
	(0.678)	(1.425)	(0.123)
Constant	-29.942***	-27.263***	15.15***
	(8.26)	(9.355)	(2.386)
R-squared	0.259	0.349	0.561

Note: ***significant at 1%, **significant at 5%, *significant at 10%; Standard errors for FE model in parentheses; Robust standard errors for RE model in parentheses.

Responding to the ambiguous findings on the topic, one possibility that can be explained is the use of trade data. Some of studies used total trade data in the analysis and some used sectoral data. This indicates that the characteristics of pepper will give unique results to other commodities. According to Bahmani-Oskooee and Hegerty (2007), utilizing bilateral trade data with specific commodities or industries has different volatility impacts in terms of magnitude and direction for every sector and depends on market and goods traded. Therefore, taking into account to these specifications is helpful to determine research hypothesis as well as which data, model specification and method should be used in the research as they may alter the results.

The mentioned signs may hold true about the exchange rate volatility impact on pepper export. The insignificant effect of bilateral exchange rate volatility can be explained due to the fact that pepper is an essential ingredient but accounts for only a small percentage of the total cost of food productions, an increment in pepper price does not hamper pepper trade excessively. For instance, the annual import value of EU grew by 1% from 2013 to 2017, though the price has been increasing (CBI, 2018). It is because pepper is included as necessity goods which its demand is relatively not responsive the price changes. Therefore, the effects are not large enough to affect Indonesian pepper exports.

Indonesia is a net exporter, so Indonesia has an important influence in fulfilling global pepper demand. Furthermore, the climatic condition in non-producing countries or consuming countries may become the most obvious reason why the sign is positive. The consuming countries in Model 3 are EU, the USA, Japan and Singapore. Most of them are temperate

countries which means this condition is not favorable for pepper plantation. Although Singapore is a tropical country, this country's agricultural production was approximately less than 10% of its own production. This becomes their critical issue that lead to import dependency (Nexus Commonwealth Network (NCN), 2011). Consequently, pepper consuming nations have to import pepper to fulfill their domestic needs.

Although based on the result exchange rate volatility effect is insignificant to the pepper exports, it is worth discussing for it can be a reference for policy makers and practitioners to avoid the risks. In Indonesia, pepper plantations were 96% dominated by smallholder farmers, while pepper private plantation only amounted to 4% (*Direktorat Jenderal Perkebunan* (Ditjenbun), 2019). It means that most Indonesian pepper growers are limited to capital access. At the same time, Indonesia has been known to be a net importer of fertilizers (FAO, 2005). Wang and Barret (2007) underpin this factor to be the cause of an adverse relationship between exchange rate volatility and agriculture commodity trade. Again, since exchange rate volatility is associated with revenue and relative price uncertainties, pepper trade in Indonesia still can be susceptible to the exchange rate volatility risks.

Concerning the different profiles of trading partners, the relationships of exchange rate volatility on the export to producing countries categorized as developing countries and consuming countries categorized as developed countries appear to have different signs. These findings may indicate that pepper exports from Indonesia are negatively affected if trading partners are from developing countries where volatility in the exchange rates is higher than developed ones that has positive sign. This condition is probably due to less access to hedging instruments (Hall *et al.,* 2010; Héricourt and Poncet, 2015).

GDP Per Capita

In Model 1 and Model 2, it appears that GDP per capita of importers has a highly significant and positive effect on Indonesian pepper export value, except for Model 3, which has a negative and significant effect. This variable implies pepper market size in importer countries. Hence, an increase in per capita income in the importing country will increase pepper exports. This finding is similar to the earlier studies such as by Natale, Borrello and Motova (2015). According to the empirical findings, the estimated coefficient of GDP per capita in Model 1 and Model 2 suggests that a raise in GPD per capita of pepper trading partners by 1% leads to an increase in pepper export values from Indonesia by 4.998% and 5.080% respectively, holding all else consistent. In Model 3, however, the GDP per capita affects significantly negative to the pepper exports as also shown in Ninka and Pere (2017) findings. The effect is much lower with only 0.409% than in Model 1 and Model 2. Holding all else equals, a 1% increase in GDP per capita of pepper importers will lead to a 0.409% decrease in Indonesia's pepper exports.

Relative Price

The relative price variable tells a higher price of pepper in export destinations relative to Indonesia will lead to a lower pepper export. In Model 1 and Model 2, relative price is found to give a negative sign on Indonesian pepper export, while in Model 3 it shows positive sign. For Model 1 and Model 2, this variable is not significant in any significant level, while in Model 3 is significant at 1% level. The sign of estimated coefficient contradicts with the previous findings which means the Indonesian pepper exports are not affected by the raise of relative price. This positive sign is also found in the study of Nishimura and Hirayama (2013). They noted that this may happen because the commodity traded is an intermediate commodity which later will be re-exported and/or consumed by the importer countries. Therefore, in Model 3, an increase in the relative price by 1%, will boost Indonesia pepper export by 0.499%, *ceteris paribus*.

According to Ditjenbun (2019), Indonesian pepper export is dominated by pepper neither crushed nor ground amounted to 141,836.3 thousand U.S. dollars or 96% of total pepper export in 2019 (WITS 2021). Currently, Indonesia does not export pepper in the form of processed pepper or final value-added product (Ditjenbun 2019). Turning to the re-export activity by pepper trading partners, one example is the case of Europe that its pepper supplies are all fulfilled by import. European traders re-export their imported pepper in the form of processed product after they perform further processing and packaging (CBI 2018).

Geographical Distance

The coefficient estimated for distance in Model 3 shows a statistically significant positive impact at the 1% level with 0.399% elasticity to the pepper exports. It has the same sign as in Halaszovich and Kinra (2020) and Brei and von Peter (2018) studies. If the distance between Indonesia and the trading partner is farther by 1%, the pepper export will increase by 0.399%, holding all else equals. This implies that distance is not an issue for Indonesian pepper export and possibly the cost of transporting pepper only constitutes a minor portion of pepper trade cost. Halaszovich and Kinra (2020) state that geographic distance effect can be counterintuitive. Brei and von Peter (2018) note that due to globalization and international market integration, the effect of geographic distance may shrink.

Free Trade Agreement

It is suggested that the enforcement of FTA promotes more exports due to reduced trade barriers. Table 3 above presents the estimation result of FTA. The signs of estimations from Model 1 and Model 2 are found to be negative except for Model 3. This study finds that FTA dummy variable only affect pepper trade between Indonesia and non-producing countries in Model 3 with a significantly positive impact. This finding is consistent with the earlier study such as by Natale, Borrello and Motova (2015). In case of Model 3 the FTA dummy for Indonesia and pepper producing countries has a positive and significant impact at the 5% level of significance. Holding all other fixed, it implies that an enforced FTA between Indonesia and non-producing countries as pepper export destinations will encourage pepper exports by about 44.3% ($e^{0.367} - 1 = 0.443$).

Managerial Implication

Results of the model we use indicates a resistant of Indonesian pepper export towards exchange rate volatility risk. It implies that the floating rate regime adopted by the government of Indonesia as an exchange policy meets the expectation of a healthy trade performance, especially on regards of pepper. Further, it means that the ongoing policy does not need to change consequently. However, there are still rooms to improve the performance of pepper export, especially from the perspective of private managerial implication.

As the one of the world's largest pepper producer, Indonesia has a strong position to maintain the export value, to increase the competitiveness and further to expand its exports opportunity. Although not related directly with currency volatility, improvement in supply side of pepper exportation will be an important move, this time for the reason of taking the opportunity of favorable trade setting and for the sake of better competitiveness. There are some suggested efforts at the supply side worth mentioning to support Indonesian competitiveness, as explained below.

First, effort of ensuring better quality. Since most of pepper producer in Indonesia are small holder farmers who are vulnerable to financial constraints, managerial strategy should be made to facilitate capital need and to ensure a fair price. Good agricultural practice is of the first step to ensure a better pepper production. Second, related to this is keeping the ongoing property right certification with geographical indication certificate. This effort has been started some time before and needs to be maintained. The third, while keeping alive the spirit of farmers cooperative is highly recommended since it is the institutional way for farmers to maintain their socio-economic interests as a community.

Furthermore, unlike CPO, coffee and cacao that have been registered in the Indonesia Commodity & Derivatives Exchange (ICDX), pepper is still potentially to be affected by exchange rate volatility risks. Once pepper is registered in the ICDX, this commodity will be secured better for it has better hedging opportunity. Further effort at supply side, Indonesian pepper farmers should make an advantage of warehouse receipt system, an institutional arrangement provided by the government of Indonesia via Ministry of Trade (MoT). Farmers can actively use this institution facilitations in order to ensure capital security and fair price for their pepper harvest. Warehouse receipt system works on the basis of using the warehoused harvest as a collateral for capital borrowing by the farmers. Securing capital need and giving fair price in this case should be considered as a part of improving supply side conditions of pepper exportation.

Further managerial implication is the making use of existing trade arrangements – namely to hedge the risk of their trade items via using instruments such as future, forwards and option contracts.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The empirical result finds that exchange rate volatility does not affect Indonesian pepper export significantly. This study confirms that exchange rate volatility has different effect when it applied to sectoral and/or disaggregated data as previous studies noted as well as due to the different choices of data and model specification used in the analysis.

Recommendation

For future research, it is recommended to add more observations and include GFC dummy effect in the analysis that can give other meaningful results. In terms of exchange rate volatility measurement, it is also recommended to check for asymmetric effect of the exchange rate volatility, if any. Other GARCH family methods can also be used when it is appropriate.

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