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Dynamics of Indonesian Coffee Export Sustainability in the Global Market

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ABSTRACT
Coffee has a big potential in the international market as proven by the level of coffee consumption that tend to rise despite the global crisis such as the economic crisis and pandemic. This study aimed to analyze the dynamics of macroeconomic indicators and real-sector variables influencing the Indonesian coffee trade in internastional market. This study included Indonesian coffee export volume, global coffee price, production amount of Indonesian coffee, Rupiah's exchange rate on US$, and economic crisis. This study used the Vector Autoregression (VAR) analysis method. The analysis result showed that global coffee price, production amount of Indonesian coffee, and economic crisis have significant influence on the certain lag in the development of Indonesian coffee export; meanwhile, the exchange rate does not have a significant influence. As conclusion, implementation of institutional development strategies for coffee farmers, improving the quality of coffee beans, developing human resources and infrastructure, and environmentally friendly production innovations can create sustainability for coffee commodities in both domestic and global markets.
Keywords: coffee; global coffee price; crisis; vector autoregression

INTRODUCTION
Coffee is a commodity with high buying interest globally due to its numerous benefits and advantages. Coffee also becomes the world's most traded commodity as proven by the 2017 data mentioned that 70% of the total exported coffee production ($19 Billion). It also has a $83 Billion retail market share that provides job vacancies for 125 million people.(1) Therefore, the current global priority is maintaining or calling for a more just and ethical trade system implementation. Also, this does not rule out the possibility for several producing countries to change their consumption geography and make the world consider developing a new trade model.(2,3) This study will be focused on discussing the dynamics of the Indonesian coffee trade in the international market since coffee is a huge and complex industry that has a long history and potential for development.

Aside from the positive market trends, there are also obstacles related to the coffee trade stability such as the significant difference among the related parties within the coffee value chain in terms of income, access to resources, and vulnerability to price volatility and climate change.(1,4-6) The falling price of coffee leads farmers to face a great loss since the result. obtained from coffee production is lesser than the production cost. Thus, even welfare for the coffee farmers has not yet been guaranteed. Since, as the representative of the first chain, farmers still have to strive to cover the basic production cost at the current price level, especially regarding the increasing input and logistic costs.(1)

Significant change within the institutional organization and management of the coffee chain becomes a reason to explain the coffee paradox. The coffee paradox is a co-existence of 'coffee booming' in the consumer countries and 'coffee crisis' in the producing countries.(7) The "coffee booming" increases demand in consumer countries, but the conditions that occur in producer countries are a "coffee crisis" that can be triggered by global trade injustice, price fluctuations that are detrimental to farmers and the impact of climate change that threatens the sustainability of the coffee industry. Social accountability has been implemented in the various forms of effective interaction between people and regional government. One of them is increasing human resources quality by involving more parties such as stakeholders, training activity, and people empowerment in supporting coffee productivity.(7-9)

In the new trade theory, economists use the industrial organization theory and market structure theory to explain the new phenomenon in international trade by considering the imperfect trade concept, return to scale, product differentiation, and the intra-industrial trade analysis.(10-12) Increasing returns related to the economic scale is considered not suitable for the competitive balance since the producer that enjoys the internal economic scale is usually in a position where they could influence the market by controlling the price and market share.(13) Producers with large production scales can dominate the market by manipulating prices and controlling market share, thereby undermining the principle of healthy competition and limiting opportunities for small producers to develop. The advanced evolution of international trade theory by Porter from Harvard Business School develops a new model to explain national competitive excellence. The Porter theory states that a country's competitiveness in an industry depends on the industry's capacity to innovate and increase. The theory focuses on the explanation of why several countries are more competitive in certain industries.

One of the high-level competition industries is the coffee commodity. Coffee is commercially produced in more than 50 countries and more than 3 billion cups of coffee are enjoyed every day. Millions of farmers, which are mostly including small farmers, have been increasing production by 50% over the last two decades. Producers will quickly adjust the production result with the existing

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certification regulation to compete in the global market. A sustainable certification and verification of coffee will be the scheme that can provide incentives for environmental protection and ethical business practice, as well as monitor and evaluate it.

Some variables that have a short-term and inline correlation with Indonesian coffee are the US Dollar exchange rate, Indonesian coffee, and Brazilian coffee export.[14] The coffee trade is significantly influenced by the exporter country's exchange rate depreciation, the amount of productive field in the exporter country, infrastructure, and the global monetary crisis. On the other hand, the importer country's tariff was found to significantly decrease the coffee trade as expected. RTA variable did not have a significant influence on coffee bilateral trade.[15]

Many proofs conclude that Indonesian coffee has been well-integrated with the international market for the long term.[7] Besides, in the short term, 76% of Indonesian coffee prices are influenced by international price change, and it is not vice versa. Next, concerning the sustainability of the coffee industry,[16] the sustainable coffee agribusiness development strategy can be executed through institutional development for the coffee farmers by strengthening the functional and institutional relationship, especially with government institutions and input/output service institution to strengthen the Robusta coffee agribusiness sustainability. This research contributes to analyzing the dynamics of Indonesian coffee trade as a form of strategic planning in achieving sustainable and superior coffee trade.

METHODS

The research object is the coffee commodity in Indonesia, concerning the production amount, and coffee export, which are related to the macroeconomic variables such as the Indonesian exchange rate, world coffee price, and economic crisis. The research year used in this study is 1990 to 2020. The data sources for the quantitative research come from Badan Pusat Statistik (Statistics Central Agency), Kementerian Perdagangan (Ministry of Trade), the International Coffee Organization, World Bank.

The analysis method used for the quantitative research is vector autoregressive (VAR). VAR model is often used to find out the routine of a variable from time to time continuously. The selection of the VAR method was carried out compared to the method because the application of this method is simpler without the need to sort between endogenous and exogenous variables. The first VAR equation model was used by Sims in 1980 that was used as an instrument to analyze the macroeconomics data whereas VAR analysis is a modification or combination of multivariate regression by uing time series data (adenomon),[6] The model specification of this study refers to the previous empirical study from other researchers,[14,17] hence, the model specification in this study is as follows:

$$CE_t = a + \beta_1 WP_{t-1} + \beta_2 CP_{t-1} + \beta_3 ER_{t-1} + \beta_4 CR_{t-1} + \varepsilon_t$$

CE : coffee export (the amount of Indonesian coffee export in tons))
WP : world coffee price (world coffee price in (US$/ton)
CP : Indonesian coffee production (the amount of Indonesian coffee production in ton)
ER : exchange rate (rupiah exchange rate/US$)
CR : dummy crisis (dummy variable for economics crisis in Indonesia)
a : constant
β : variable coefficient
ε : error term

The VAR analysis in this study includes: 1) VAR model estimation analysis; 2) impulse response function (IRF); and 3) variance decomposition (VD). However, before conducting the VAR analysis, we have to conduct a pre-VAR analysis that includes: 1) a data stationary test; 2: co-integration test; 3) an optimum lag test; and 4) a stability test. The VAR analysis in this study aims to observe the dynamics of macroeconomic variables and the real sector within the development of the Indonesian coffee trade. Thus, we could determine the indicators that have a significant influence on Indonesian coffee exports to formulate a suitable policy draft.

RESULTS

This study analyzed the data through vector autoregression (VAR) or Vector Error Correction Model (VECM). VAR modeling has several requirements such as each variable must be stationary at the level stage and there must co-integration. Data stationary tests can be conducted through several approaches. Some of them used in this study were Levin, Lin & Chu, Im Pesaran and Shin W-stat, ADF-Fisher Chi-Square, and PP-Fisher Chi-square. Based on the data stationarity test at the level stage as shown in Table 1, the probability values of all methods or approaches were less than 5% (a<0,05). Thus, the data in this study is stationary at the level stage, where one requirement to use the VAR model has been fulfilled.

The optimum lag test is used to determine the duration of the influence period on an endogenous variable in the past time or on other variables. The lag length is viewed from the likelihood ratio (LR), final prediction error (FPE), akaike information criterion (AIC) dan Schwarz information (SC). In this study, the lag length is determined through the AIC approach. The advantage of using AIC is that it could explain the model fitness with the existing data (in sample forecasting) and value occurs in the future (out of sample forecasting). Based on the AIC value in Table 2, the optimum lag length was obtained in lag 2.

The next step after finding the optimum lag is conducting the co-integration test. The co-integration test aims to test whether the research data used has the same stochastic trend and the same direction for the long term. In this study, the co-integration test used

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the Johansen test which compares the trace statistic value and the critical value. The trace statistic value that exceeds its critical value indicates a co-integration within the model in use. Based on the Johansen co-integration test with alpha 0.05 as presented in Table 3, the result showed that the trace statistic trace value was smaller than its critical value. This showed that there is no co-integration within the research data.

Table 1. Data stationarity test result at level stage

Method	Statistic	Prob.**	Crosssections	Obs	Note
Null: Unit root (assumes common unit root process)					** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.
Levin, Lin & Chu t*	-1.80377	0.0356	5	163	
Null: Unit root (assumes individual unit root process)					
Im, Pesaran and Shin W-stat	-2.11870	0.0171	5	163	
ADF - Fisher Chi-square	25.4046	0.0046	5	163	
PP - Fisher Chi-square	27.9702	0.0018	5	165	

Table 2. Optimum lag test result

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-36.41775	NA	9.16e-06	2.588609	2.817630	2.664523
1	34.73670	115.6260*	5.23e-07*	-0.296044	1.078084*	0.159441*
2	60.05033	33.22414	5.81e-07	-0.315646*	2.203588	0.519409

Table 3. Johansen co-integration test result

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.717899	81.64666	69.81889	0.0042
At most 1	0.484825	42.41645	47.85613	0.1474
At most 2	0.389178	21.85572	29.79707	0.3066
At most 3	0.163372	6.574259	15.49471	0.6276
At most 4	0.033136	1.044626	3.841466	0.3067

The next pre-VAR estimation test is the VAR stability test aims to test the data validity. If the VAR estimation result combined with the error correction model is considered as unstable, then the impulse response function and variance decomposition value will be declared invalid. VAR estimation stability test was conducted by checking the VAR stability in the form of polynomial roots of characteristics. A VAR system is considered stable if all of its roots have a smaller modulus than 1. Based on the VAR stability test result shown in Table 4.4, where the modulus value was less than 1, thus, the VAR estimation that will be used for IRF and VD analysis has been stable on its optimum lag.

Table 4. VAR stability test result

Root	Modulus	Note
0.976649	0.976649	No root lies outside the unit circle. VAR satisfies the stability condition.
-0.008369 - 0.722035i	0.722084	
-0.008369 + 0.722035i	0.722084	
0.720205	0.720205	
-0.624371	0.624371	
0.402875 - 0.459158i	0.610847	
0.402875 + 0.459158i	0.610847	
-0.413050	0.413050	
0.300093 - 0.119425i	0.322983	
0.300093 + 0.119425i	0.322983	

The VAR estimation result in Table 5 used 2 lags, that were based on the optimum lag test result and probability value. The estimation result showed that not all lags were optimum in the equation. The CE variable had an insignificant negative influence on the variable itself on lag 1 and 2 as proven by the coefficient value and negative t-statistics and the probability value exceeded the alpha 0.10. Next, the WP variable on lag 1 had a negative and insignificant influence, while it showed a positive significant influence on lag 2 with a probability value less than alpha 0.10.

The influence of CP on CE on lag 1 was positive and significant as proven by the positive coefficient value with probability value less than alpha 0.10. Next, the influence of CP on CE on lag 2 showed a positive and insignificant result as proven by the positive coefficient value with a probability value that exceeded alpha 0.10. therefore, when the national coffee production volume increased on lag 2, it influenced the rise of national coffee export, although it was insignificant. Based on the VAR estimation result,

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ER did not have a significant influence on CE as proven by the probability value that exceeded the alpha 0.10. The next variable that becomes an object in this study is economic crisis (CR). The estimation result showed that CR had a positive insignificant influence on lag 1 as proven by the positive coefficient value and t-statistics probability value that exceeded the alpha 0.10. After that, on lag 2, CR had a negative significant influence on CE as proven by the negative coefficient and t-statistics probability value less than alpha 0.10.

Table 5. VAR estimation result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGCE(-1)	-0.539712	0.334078	-1.615528	0.1092
LOGCE(-2)	-0.322280	0.357715	-0.900940	0.3697
LOGWP(-1)	-0.112399	0.163299	-0.688306	0.4928
LOGWP(-2)	0.325694	0.164686	1.977662	0.0506
LOGCP(-1)	0.647558	0.359865	1.799443	0.0748
LOGCP(-2)	0.162538	0.392872	0.413718	0.6799
LOGER(-1)	-0.092569	0.163863	-0.564915	0.5733
LOGER(-2)	0.031099	0.161237	0.192880	0.8474
CR(-1)	0.119568	0.090244	1.324950	0.1881
CR(-2)	-0.165279	0.086498	-1.910777	0.0588
C	8.403172	1.859185	4.519814	0.0000

The next step after conducting VAR model estimation is conducting the impulse response function (IRF) and variance decomposition (VD) test. The result of the IRF and VD tests in this research will be considered valid after passing the VAR data stability test. IRF test is used to find out the shock influence of a variable on other variables how long the shock will last and when the shock influence will subside. On the IRF graphic, the response and change of each variable as the result of new information was measured by a 1-deviation standard. The vertical axis on the graphic depicted the response value or growth of each variable while the horizontal axis depicted the time or period after the shock.[18] In this case, it was presented for the next 10 periods.

Indonesian coffee export variable gave a positive response to the variable itself at the initial period while showing negative response in period 2 and 3 until reaching -0,06%. In the next period, CE response to the movement of the variable itself showed a fluctuating result but managed to reach the equilibrium in period 8. The result indicated that the response of the amount of Indonesian coffee export on the variable itself fluctuated. Based on the VAR estimation, the influence was insignificant.

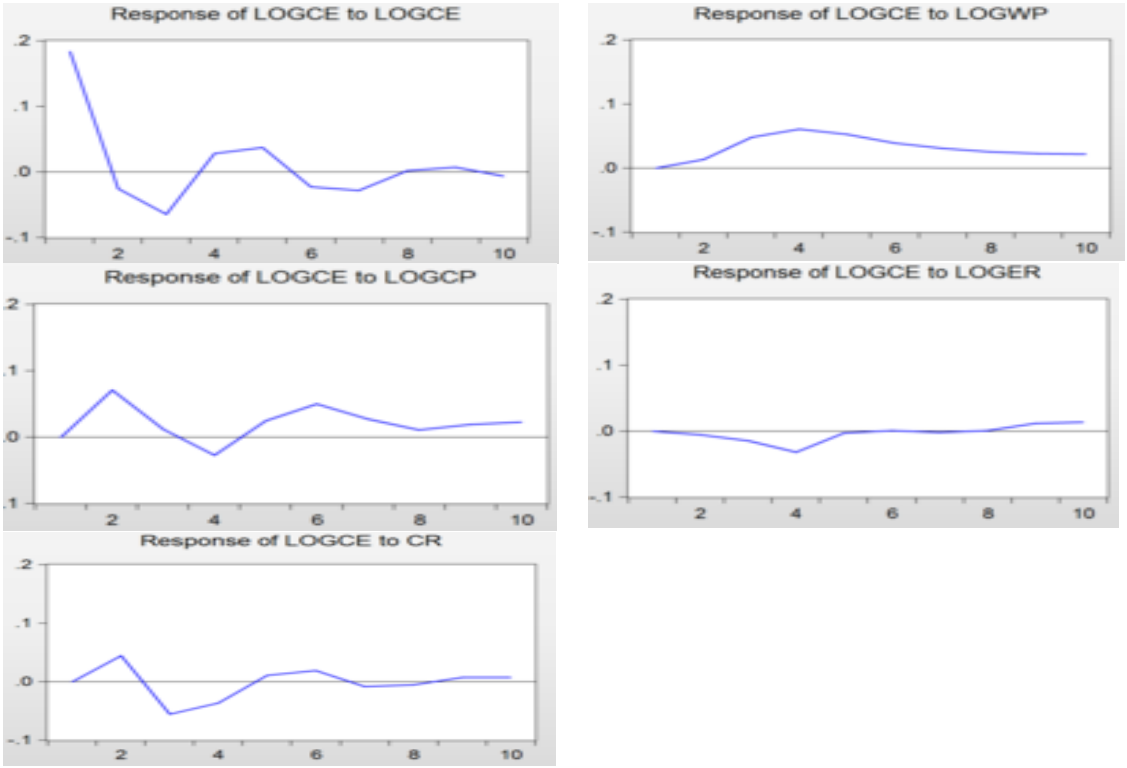

Figure 1. IRF test result

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CE response on WP was positive until 0,06% in period 4 and it kept declining in the next period, but was still responded positively until period 10. The positive response of CE on WP was significant based on the VAR estimation result. Indonesian coffee export responded positively to CP until 0,07% in period 2 and declined in period 3. In the next period, CE response to CP movement showed a negative response but regained a positive response in the next periods. CE response on ER in the first period reached the equilibrium and was responded negatively in the next period. CE response on the WP movement was negative until -0,03% in period 4 and went back to equilibrium in the next period. However, CE gave a positive response in period 10. The positive response of CE on ER was insignificant based on the VAR estimation result.

Indonesian coffee export variable responded positively on CR until 0,04% in period 2 and responded negatively in the next period until reaching -0,06%. In periods 5 and 6, the response of CE to CR movement was positive but went back to negative and fluctuated in the next period. The next step after analyzing the dynamic behavior through impulse response function (IRF) is observing the model characteristics through the variance decomposition (VD) test. VD test aims to formulate the forecast error variance of a variable, which includes how big the difference in the variance is before and after experiencing shock, either the shock that comes from within itself or from the other variables.[18] Besides, VD is also used to see the relative influence of each variable in a study on other variables outside the model.

Table 6. Variance decomposition test result

Variance decomposition of LOGCE:						
Period	S.E.	LOGCE	LOGWP	LOGCP	LOGER	CR
1	0.183454	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.203462	82.89511	0.395344	11.90114	0.072367	4.736038
3	0.226519	75.05265	4.705544	9.835877	0.503816	9.902113
4	0.242707	66.71109	10.29658	9.842208	2.205467	10.94465
5	0.252464	63.75298	13.87491	10.02043	2.056131	10.29554
6	0.261793	60.05655	15.05411	12.87871	1.912200	10.09843
7	0.266555	59.09609	15.79530	13.41867	1.850771	9.839167
8	0.268002	58.46337	16.51447	13.41382	1.830864	9.777470
9	0.269977	57.67463	16.96842	13.68840	1.972751	9.695798
10	0.272247	56.78551	17.29839	14.13522	2.186048	9.594829

Based on the VD test result presented in Table 6, the forecast error variance of Indonesian coffee export (CE) change in the first period, 100% of its variability was determined by the change occurring in the variable itself. For the next period, it tended to decrease even though it was still at a high level. In the second period, 11,90% CE variability was explained by GCP movement and this kept increasing until the next period although experiencing a decline in the third period. In the second period, CE variability was explained by 0,39% WP movement, 0,07% ER movement, and 4,36% CR movement.

In the fourth period, CE variability was mostly influenced by the movement of the variable itself at 66,71%, and in the second place was CR movement at 10,95%. The next was influenced by WP movement for 10,3%, GCP for 9,84%, and ER movement for 2,21%. In the 10th period, the forecast error variance of CE movement was explained by the variable itself for 56,79%, and the second biggest influence was from the changes of WP for 17,3%. Next, ate the 10th period, CP contribution in influencing the CE movement was 14,14%, CR contribution 9,59%, and ER 2,19%. In other words, in period 10, variables that had a significant contribution to the movement of Indonesian coffee export amount were the variable itself in the first place and the world coffee price was in the second place for having the second biggest contribution to the movement of national coffee export value. The variable with the smallest contribution compared to other independent variables was the rupiah exchange rate in US$.

DISCUSSION

The VAR estimation result used 2 lags, that were based on the optimum lag test result and probability value. Not all lags were optimum in the equation. The CE variable had an insignificant negative influence on the variable itself on lag 1 and 2. The WP variable on lag 1 had a negative and insignificant influence, while it showed a positive significant influence on lag 2. The condition mentioned in lag 1 was where the world coffee price increased and influenced the decline in Indonesian coffee export, however, the influence was not significant.[19] The significant result mentioned indicated that on lag 2, the rise in world coffee price will have a significant influence in the form of increasing the export volume of Indonesian coffee. The result fits the previous empirical study, mentioned that world coffee prices had an influence.[14]

The influence of CP on CE on lag 1 was positive and significant. The result indicated that the increasing amount of national coffee production will have a significant influence on the increasing amount of Indonesian coffee export. This analysis result fits the previous empirical stated that the amount of national coffee production had a significant influence on the volume of Indonesian coffee export.[14,17,19] Next, the influence of CP on CE on lag 2 showed a positive and insignificant result. Therefore, when the national coffee production volume increased on lag 2, it influenced the rise of national coffee export, although it was insignificant.

ER did not have a significant influence on CE. This indicated that on lag 1, the rupiah exchange rate that was depreciated over US$ will influence the decreasing value of Indonesian coffee exports. Yet the influence was insignificant. The analysis result

supported the study explained that the rupiah exchange rate on the US dollar did not have a significant influence on the Indonesian coffee export value.[19] Nevertheless, the rupiah exchange rate stability shall always be kept so that it will not disrupt the Indonesian export and import process.

CR had a positive insignificant influence on lag 1. Hence, if there was an economic crisis on lag 1, it would cause a rise in Indonesian coffee export value even though the impact was insignificant. After that, on lag 2, CR had a negative significant influence on CE. This statement indicated that any crisis on lag 2 will cause a significant decrease in national coffee export value significantly. An institution[1] collected proofs in 2020 showed that organization that sells coffee to the US, Europe, and local markets maintain at least one or sometimes two income source(s) during the coffee demand disruption caused by the COVID-19 pandemic. Hence, an effort to maintain coffee agribusiness in a crisis could utilize the combination of the available savings and insurance, as well as the safety net and supporting mechanism provided by the national or regional authority.[1,20,21] Producers shall be able to access the capital to overcome the damage caused by the pandemic and to re-invest it in the form of production.

CE response on WP was positive until 0,06% in period 4 and it kept declining in the next period, but was still responded positively until period 10. The positive response of CE on WP was significant based on the VAR estimation result. The result indicated that each world coffee price movement will be getting a positive and significant response from Indonesian coffee export. Thus, the rise in world coffee prices will influence the rising amount of national coffee exports. This situation may happen when world coffee consumption increases although the world coffee price is rising, that impacts the increasing national coffee demand.

Indonesian coffee export responded positively to CP until 0,07% in period 2 and declined in period 3. In the next period, CE response to CP movement showed a negative response but regained a positive response in the next periods. This result indicated the response of Indonesian coffee export amount to the fluctuance or movement of national coffee production amount fluctuated. However, it still had a positive influence despite having one negative influence in a certain period. Based on the VAR estimation, this result showed a significant influence that means a rise in national coffee production amount will significantly push the rise in export volume. This condition may happen when the demand for national coffee in the global market keeps increasing, which is also supported by the national coffee production quality.

CE response on ER in the first period reached the equilibrium and was responded negatively in the next period. CE response on the WP movement was negative until -0,03% in period 4 and went back to equilibrium in the next period. However, CE gave a positive response in period 10. The positive response of CE on ER was insignificant based on the VAR estimation result. The result indicated that each movement of the rupiah exchange rate on US$, whether it was depreciated or appreciated, will be responded positively and negatively by the amount of Indonesian coffee export, but the influence was neither significant nor strong. This means the amount of Indonesian coffee export volume was not influenced by the rupiah exchange rate. It will be more likely influenced by another variable movement.

Indonesian coffee export variable responded positively on CR until 0,04% in period 2 and responded negatively in the next period until reaching -0,06%. In periods 5 and 6, the response of CE to CR movement was positive but went back to negative and fluctuated in the next period. This result indicated that the response of Indonesian coffee export amount on the economic crisis fluctuated which could show either a positive or negative influence. Based on the VAR estimation, the response was significant. It means, that in a crisis, the Indonesian coffee export volume will decrease or increase, depending on the type of the ongoing crisis. Such conditions may happen when the ongoing crisis affects the national economic system which will impact the coffee farm productivity.

In the fourth period, CE variability was mostly influenced by the movement of the variable itself at 66,71%, and in the second place was CR movement at 10,95%. The next was influenced by WP movement for 10,3%, GCP for 9,84%, and ER movement for 2,21%. In the 10th period, the forecast error variance of CE movement was explained by the variable itself for 56,79%, and the second biggest influence was from the changes of WP for 17,3%. Next, ate the 10th period, CP contribution in influencing the CE movement was 14,14%, CR contribution 9,59%, and ER 2,19%. In other words, in period 10, variables that had a significant contribution to the movement of Indonesian coffee export amount were the variable itself in the first place and the world coffee price was in the second place for having the second biggest contribution to the movement of national coffee export value. The variable with the smallest contribution compared to other independent variables was the rupiah exchange rate in US$.

CONCLUSION

The analysis result showed that world coffee price, Indonesian coffee production amount, and economic crisis had a significant influence on the development of Indonesian coffee export on certain lags. Meanwhile, the exchange rate did not have a significant influence. Based on the variance decomposition result, the variable itself had the biggest influence on the growth of Indonesian coffee exports, while the world coffee price was in second place. The economic crisis took third place while the rupiah exchange rate on US$ had the smallest contribution of all independent variables. A security and strategy development system will help the sustainability of the coffee commodity either in the domestic or global market, considered from the data analysis result. The system or strategy would be in the form of institutional development for coffee farmers, coffee bean quality improvement, human resource development, and eco-friendly infrastructure and production innovation.

The novelty of this study is the involvement of crisis variables in the analysis. Crisis phenomena, either the economic or those caused by natural or political conditions of a country, will affect trade activity. Since the crisis will affect the policy-making process to maintain the sustainability of national growth. Future research will require support from empirical study qualitatively by involving

several opinions from several experts that are related to the trade activity. Thus, the study will gain a policy draft that could create stability and sustainability of the national growth, especially those related to coffee commodity.

Ethical consideration, competing interest and source of funding

-All ethical principles are upheld in this research.
-The authors declare that there is no conflict of interest.
-Source of funding is authors.

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