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Vector Autoregressive (VAR) Analysis of Cocoa Export in Indonesia

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Abstract: This study aimed to determine the value of cocoa exports in Indonesia to shocks from cocoa production, international cocoa prices, rupiah exchange rate, Gross Domestic Product (GDP), and Foreign Direct Investment (FDI). The data used is time series data from 1989-2020. The analysis used is Vector Autoregressive (VAR). Based on the results of the Impulse Response Function (IRF) test cocoa exports responded positively to a shock of the cocoa amount it means that an increase in the amount of cocoa production will impact increasing cocoa exports in Indonesia. The value of cocoa exports responded negatively to shocks international cocoa prices. The value of cocoa exports responded negatively to the exchange rate and positif response to the GDP shock. Based on the Variance Decomposition results, international cocoa prices contributed 16.70%, the rupiah exchange rate contributed 26.62%, GDP contributed 9.94%, and FDI contributed 1.33% to changes in cocoa exports. The amount of cocoa production is the variable that contributes the most from other variables to changes in cocoa exports, which is 43.97%. The implication of the study suggest that increasing productivity of cocoa can increase the cocoa exports and would bring more contribution to the GDP from agricultural sector.
Keywords: Cocoa; Export Value; Vector Autoregressive
JEL Classification: F41; F43; F63

Introduction

Indonesia is a country that adheres to an open economic system, so it is part of the world economy and participates in international trade. International trade is closely related to globalization. The existence of globalization makes the boundaries between countries increasingly narrow because of the ease of interaction between countries in various fields, including international trade. International trade is buying and selling goods and services, commonly known as exports and imports, which are carried out between countries to improve the economy. This international trade will drive the national economy to increase the country's foreign exchange. In the Indonesia economy, cocoa production has a large scale and one of the leading agricultural production of Indonesia, but not the leading agricultural exporter. Hence, there is need for the agricultural sector expansion, effective predictive models and reliable price mechanism. Edeki et al. (2018) stated that Nigeria as the third largest exporter of cocoa need agricultural expansion and need to improve the trend model with regard to cocoa production in Nigeria. Nwachukwu (2014) stated that agricultural growth can stimulate growth with the stability economic condition.

The advantage of agricultural sector drive the growth with the stability domestic economy. Abdulai and Egger (1992) found that dramatic fall in the country's imports of bovine cattle from the regional market has been largely caused by the decline in economic and exports performance.
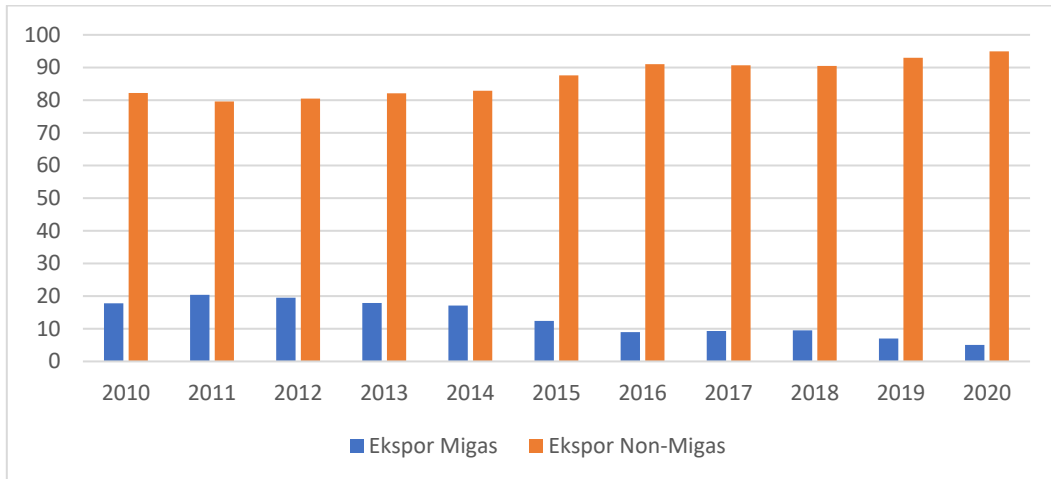

Figure 1 Term of Indonesia's Exports

Since 1980, commodities that have been focused on Indonesia's exports have been oil and gas commodities. However, due to the drastic decline in the price of world oil, the government began to set policies in the export sector regarding the existence of tax-free for various commodities. It allows domestic producers to increase non-oil and gas exports. This policy set by the government has significantly impacted the development of non-oil and gas exports. Three sectors play an essential role in the value of non-oil and gas exports: the agricultural, mining, and industrial sectors. Figure 1 shows that the non-oil and gas sector contributed the most to export value during 2015-2020. Debate still growing on whether economic growth requires diversification or whether diversification should come before growth. Mora and Olabisi (2023) stated that diversification need to stimulate growth and distribution of growth felt by the whole of group. Upton (2004) stated that agricultural markets have grown substantially with international trade, diversification and livestocks plays key role to the income and welfare of the rural poor.
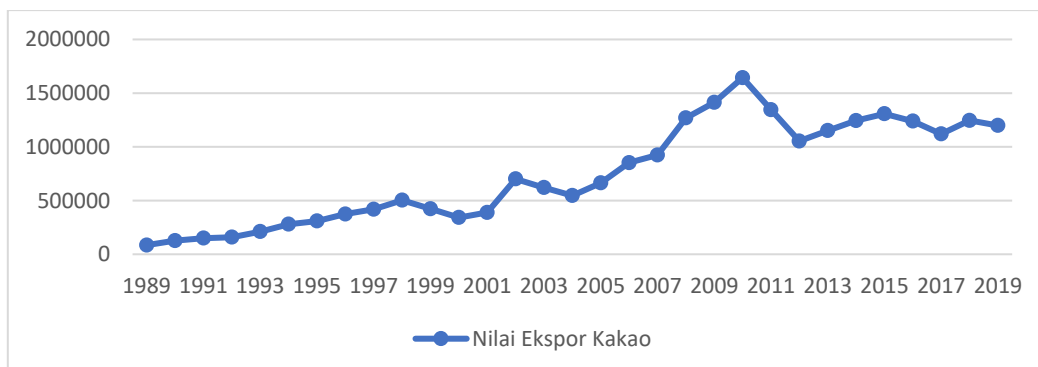

Figure 2 Value cacao exports

In Indonesia, the agricultural sector has produced various commodities. One of them is the result of the plantation sub-sector, namely cocoa. Theobroma cocoa (cocoa), commonly called chocolate, is a plantation commodity that plays a vital role as a source of income, a provider of employment, and a source of foreign exchange. In addition, cocoa also plays a role in regional development and agro-industry (Aklimawati & Wahyudi, 2013). The cocoa most widely grown in Indonesia is the Criollo type, known as noble chocolate because it has excellent quality. Cocoa is one of the leading commodities that are relied upon in Indonesia's export activities. Cocoa commodity exports are crucial, considering the potential of cocoa is very large. Sucipta and Sutrisna (2022) stated that Indonesian cocoa has an enormous opportunity to dominate the Southeast Asian and even the world markets. Anindita and Baladina (2017) noted that cocoa is one of the plantation commodities, which is quite important as a foreign exchange earner in addition to oil and gas. Based on data from the BPS in 2020, cocoa is one of the leading plantation commodities with the fifth largest production after oil palm, rubber, coconut, and coffee. The Indonesian Cocoa Council also stated that Indonesia was ranked third in the world as the largest cocoa producer in the world after Ivory Coast and Ghana in 2013 and officially became a member of the International Cocoa Organization (ICCO). Therefore, cocoa is a commodity that is quite important in export activities to improve the country's economy.

This paper examines the environmental of exports on commodity agricultural sector in this case cocoa in Indonesia. The instability of international cocoa price and cocoa production has important implications for Indonesia. Widayat et al (2019) stated that cocoa price in Indonesia unstable and can be categorized as having high price volatility. The volatility of cocoa prices with exports in Indonesia has an inverse relationship in the long-term and short term. Tambi (1999) observe that instability in world agricultural markets in which fluctuating world market prices, unstable currency exchange and interest rates led to major instability in export earnings. Instability in export earnings have major impact to the gross domestic product. Victor (2015) stated there is positive effect of relationship between exports and economic growth in the long run and increase in agricultural exports would bring more than a proportionate increase in Nigeria's gross domestic product. To bridge the gap between all previous studies, this study examines the shock of macroeconomic variables such us cocoa production, international cocoa prices, exchange rate, gross domestic product and foreign direct investment and how the response of cocoa exports.

Research Method

This research is a quantitative descriptive study with secondary data types. The variables used are cocoa export value, total cocoa production, international cocoa prices, rupiah exchange rate, GDP, and FDI. The data is in the form of a time series for 32 years, from 1989-2020. These data are obtained from official data-providing institutions/agencies such as the Directorate General of Plantations, Trade Statistics, the Central Bureau of Statistics, the World Bank, and other institutions.

The Vector Autoregressive (VAR) method was first introduced by Sims (1980). Sims (1980) argues that if there is a simultaneous relationship between the observed variables, these variables must be treated the same so that there are no more endogenous and exogenous variables. From this thinking, Sims introduced the concept of VAR, which answered the challenges and difficulties encountered in which this VAR model did not depend on theory but on determining the variables that interacted with each other, determining the number of gaps, and needing to include them in systems and models so that they can capture the interrelationships between variables in the model. the model. In general, the P-order VAR model can be formulated as follows:

$$x_t = A_0 + A_1 x_{t-1} + A_2 x_{t-2} + A_3 x_{t-3} + \cdots + A_p x_{t-p} + e_t$$

Where *xt* is a vector of size *nxl* containing n variables that enter into the VAR model; 0 is the intercept vector nx1; *A1, A2, A3* is a coefficient matrix of size nxn; and et is the error term. The advantage using VAR model are the structural analysis. Magnusson and Mavroeidis (2014) stated that structural shift in macroeconomics might be constructively utilized to identify structural relationships. Kurniawan et al. (2022) observe that structural analysis examines the transmission and effects of shocks on macroeconomic variables.

Result and Discussion

Stationerity Test

The first stage in the VAR analysis is to test the stationarity of the data. The stationarity test aims to determine whether the data is stationary or not in the study. If the data is stationary, then the data is protected from false regression. In testing stationarity, this study uses the Phillips-Perron approach unit root test. The data is said to be stationary if the t-count value from Phillips-Perron is greater than the test critical values at 1%, 5%, or 10%. The results of the unit root test in this study are shown in the Table 1.

Table 1 Result of Stationerity Test

Variables	Phillips-Perron Test	
	Level	**First Difference`**
Cocoa Export	2,336	-4,185***
Cocoa Production	2.202	-5,575***
Cocoa Price	0.012	-4.131***
Exchange rate	1,706	-4.003***
GDP	-2,799***	-4.312***
FDI	-1.451	-5,215***

Overall, the unit root test from the Table 1, that all variables are stationary at the first difference level using the Philips Perron approach because the Phillips Perron test statistic value of all variables is greater than the test critical values or alpha 1%, 5%, and 10%.

Optimum Lag

The lag test on the VAR estimation is used to see the length of the period of influence between variables. The criteria for deciding lag in this study use the Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Sharz Information Criterion (SIC), and Hannan Quinn (HQ). The Table 2 is the results of the optimum lag test that has been carried out.

Table 2 Optimum Lag Test

lag	LogL	LR	FPE	AIC	SC	HQ
0	140.9315	NA	2.63e-12	-9.637962	-9.352490	-9.550690
1	248.1573	160.8387	1.73e-14	-14.72552	-12.72721	-14.11462
2	296.2885	51.56919	1.08e-14	-15.59204	-11.88090	-14.45750
3	413.9863	7566284*	1.17e-16*	-21,42759*	-16.0361*	-19.76943*

Table 2 gives results at lag three, which are supported by LR, FPE, AIC, SC, and HQ values. This condition provides the relationship between the variables used in the VAR analysis using lag 3.

Stability Test

Furthermore, the stability test of the estimation of the VAR model was carried out through a polynomial test with the following results:

Tabel 3 Stability Test

Root	Modulus
0.602388 + 0.726196i	0.943521
0.602388 - 0.726196i	0.943521
0.402696 + 0.831830i	0.924178
0.402696 - 0.831830i	0.924178
0.842504 - 0.333108i	0.905965
0.842504 + 0.333108i	0.905965
-0.884037	0.884037
0.878908 - 0.023264i	0.879216
0.878908 + 0.023264i	0.879216
-0.168841 - 0.861193i	0.877588
-0.168841 + 0.861193i	0.877588
-0.570224 - 0.647561i	0.862838
-0.570224 + 0.647561i	0.862838
-0.501352 - 0.562581i	0.753558
-0.501352 + 0.562581i	0.753558
0.434935 - 0.554083i	0.704398
0.434935 + 0.554083i	0.704398
-0.684197	0.684197

Tabel 3, explain the results of the VAR stability test in the form of roots of characteristics polynomial show that the resulting modulus value is less than 1, indicating that the VAR model is stable.

Impulse Response Function

The impulse response helps know the change or response of a variable to an event (shock) over a certain period so that it can be seen the length of time it takes the dependent variable to respond to the shock of the independent variable. The response of cocoa export variables to the shocks of cocoa production variables, international cocoa prices, rupiah exchange rate, GDP, and FDI based on the IRF test are as follows:

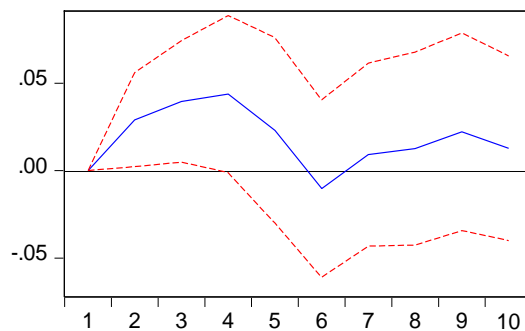**Cocoa Exports Response to Cocoa Production Shock**

Figure 3 Response of Cocoa Exports to Cocoa Production Shock

Figure 3 the response of cocoa exports to the amount of production indicated by the blue line. During ten periods, the reaction of cocoa export value will fluctuate. At the beginning of the period, cocoa exports did not respond to a shock or change in the cocoa production variable because the standardized value was zero. In the next period, the response from cocoa exports increased until the fourth period, from 0.029 to 0.044. Cocoa exports responded positively to the shock of cocoa production from the second to the fifth period. The positive influence of the shock on the output is in line with research conducted by Wardhany and Adzim (2018), which states that the cocoa production variable has a positive and significant effect on cocoa exports. Besides that Syarif (2018) also noted that the amount of production had a positive impact on the export value of cocoa partially.

However, in the sixth period, cocoa exports responded negatively, as evidenced by the standard deviation, which decreased from 0.023 to -0.010. Then, the response showed an increase towards a positive sign until period 10. Although in period ten, it fell from 0.022 to 0.013. Under the Minister of Finance Regulation (PMK) No. 67/PMK.011/2010 concerning Stipulation of Export Goods Subject to Export Duties and Export Duty Tariffs, it is hoped that farmers and entrepreneurs will be able to increase cocoa production before exporting, and this policy can increase added value so that Indonesia's cocoa industry will increase. Furthermore, after the stipulation of these regulations.

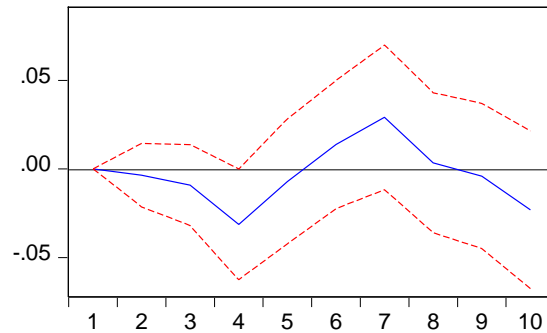**Cocoa Exports Response to International Cocoa Price Shock**

Figure 4 Response of Cocoa Exports to International Cocoa Price Shock

Figure 4 is the response of cocoa exports to the shock of international cocoa prices indicated by the blue line. It can be seen in the graph above that the answer to the value of cocoa exports has fluctuated. There was no response to the shock or changes in international cocoa prices by cocoa exports in the initial period because the standard deviation value was zero. The value of cocoa exports responded from the second period with a negative response to the fifth period. It is in line with research Wardhany and Adzim (2018) that international cocoa prices negatively and significantly impact Indonesian cocoa exports. In addition, this is also supported by research Puspita (2015) which states that global cocoa prices significantly affect Indonesian cocoa exports to the United States. Then, in periods 6-8, the result shows a positive number even though the standard deviation tends to decrease from 0.014 to 0.003. This positive response can be understood that when the international price of cocoa increases, the export value of cocoa will be high because sales activities drive it to global markets by producers. In addition, because domestic goods are relatively cheaper, domestic residents will buy only a small number of imported goods, thereby increasing the value of net exports.

Furthermore, in the 9th and 10th periods, international cocoa prices again had a negative effect on the value of cocoa exports. In the short term, global cocoa prices do not positively affect cocoa exports in Indonesia because international cocoa prices cannot cover production costs and operational costs in producing cocoa itself. It follows the law of demand cateris paribus, which states that demand and price are negatively related. If the price of an item increases, the quantity demanded of that good will decrease. On the other hand, when the price of a good decrease, the quantity demanded of that good increases. In other words, the higher the international cocoa price, the lower the quantity demanded, reducing the volume of cocoa and reducing the value of Indonesia's cocoa exports. Overall, the response of the cocoa export variable due to the shock of international cocoa prices up to the 10th period indicates that there is a short-term and long-term relationship between the global cocoa price variable and cocoa exports.

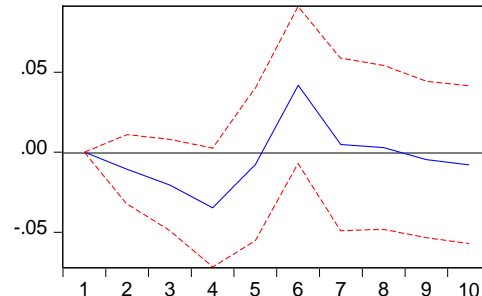**Response of Cocoa Exports to Exchange Rate Shock**

Figure 5 Response of Cocoa Exports to Exchange Rate Shock

Figure 5 explain the response of cocoa exports to the shock of the rupiah exchange rate, which is indicated by the blue line. It can be seen in the graph above that the response to cocoa exports due to the shock of the rupiah exchange rate fluctuated for ten periods. At the beginning of the period, cocoa exports did not respond because the standardized value was zero. Cocoa exports began to react in the second period with a negative response until the fifth. This negative response can be understood that the value of cocoa exports will increase when the rupiah exchange rate decreases (depreciates). It is due to the increasing competitiveness of domestic products in the international market. A lower currency value will increase the amount of currency in circulation to encourage export activities by increasing the production of the export commodity itself.

On the other hand, if the rupiah exchange rate increases (appreciation), then cocoa exports will tend to decline. It is because the price of domestic products has become relatively more expensive. It is in line with research conducted by Nolla et al. (2020) which states that the rupiah exchange rate has a significant and negative effect on the tobacco export variable in Indonesia. Besides that, it is also supported by research Nwachukwu (2014), which states that exchange rate significantly affects cocoa exports. Then, in periods 6-8, the response shows a positive number even though the standard deviation tends to decrease from 0.042 to 0.003. Furthermore, in the 9th and 10th periods, the shock from international cocoa prices was again responded negatively by cocoa exports. Overall, the cocoa export variable's response to the shock of the rupiah exchange rate until the 10th period shows a short-term and long-term relationship between the rupiah exchange rate variable and cocoa exports.

Response of Cocoa Exports to GDP Shock

Figure 6 explain the response of cocoa exports to Indonesia's GDP, which is indicated by the blue line. For ten periods, the response to the value of cocoa exports due to changes (shock) in GDP fluctuated. At the beginning of the period, cocoa exports did not respond to a shock or change in GDP because the standard deviation value was zero. Cocoa exports began to react in the second and third periods with a positive response. It is proved that in the second period, the standard deviation was 0.016531 to 0.016554. This positive response aligns with Victor (2015) research that GDP positively affects agricultural

exports. It indicates that an increase in GDP will increase the purchasing power of consumers and the ability of the people to carry out more significant production activities so that they can be exported to other countries. An increase in the production surplus marked by GDP growth will result in more than domestic output. The excess production is channeled through exports so that exports will increase. However, in the fourth and fifth periods, the change was responded negatively by cocoa exports with a standard deviation of -0.014 and -0.016. Then, cocoa exports reacted positively to a shock from GDP up to period seven and a negative response in period 8. Furthermore, cocoa exports responded positively to period 10.
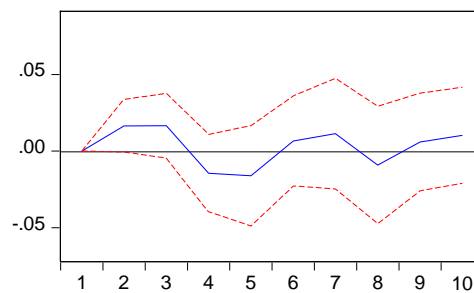

Figure 6 Cocoa Exports Response to GDP Shock

Overall, the cocoa export variable's response to the shock of Indonesia's GDP until the 10th period shows a short-term and long-term relationship between the GDP variable and cocoa exports.

Cocoa export response to FDI Shock

Figure 7 is the response of cocoa exports to FDI, which is indicated by the blue line. At the beginning of the period, cocoa exports did not respond to any shock or change in FDI because the standard deviation was zero. Cocoa exports began to react in the second period with a standard deviation of 0.002953. FDI has increased in the third to fourth period. It was responded positively by cocoa exports, as evidenced by the value of the standard deviation in the third to fourth periods, from 0.003273 to 0.010654. This positive response lasted until the fifth period, although it tended to decrease.
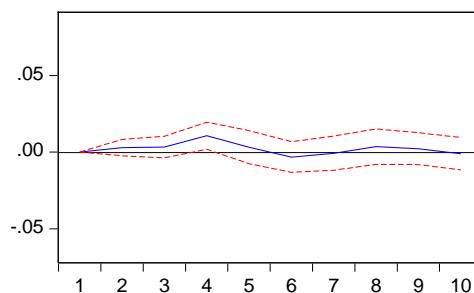

Figure 7 Cocoa Exports Response to FDI Shock

Furthermore, cocoa exports responded negatively to the FDI shock in the sixth and seventh periods, as evidenced by the standard deviation values of -0.003237 and -0.000743. After that, cocoa response fluctuated up to period 10. Overall, the reaction of the cocoa export variable to the shock from FDI until the 10th period shows that there is a short-term and long-term relationship between the FDI variable and cocoa exports. It is in line with research conducted by Herlambang et al. (2016) that observe FDI has a substantial and positive impact on Indonesia's creative industry exports.

Forecast Error Variance Decomposition

Tabel 4 shows that an essential source of variation in the value of cocoa exports is a shock to the variable itself. In the first period, the variation in export value from the variable reached 100%, while cocoa production, international cocoa prices, rupiah exchange rate, GDP, and FDI had no effect. In the next period, the change in cocoa exports was still dominated by the cocoa export variable at 59.95%, followed by the dominance of the cocoa production variable at 27.03%. The international cocoa price has a relationship with cocoa exports by 3.94%, the rupiah exchange rate by 3.63%, GDP by 8.7%, and FDI has a relationship of 0.28%. Vary for cocoa exports until the tenth period. The contribution given by the cocoa production variable fluctuates, increasing yearly, from 27.03% to 35.94% in the tenth period. Likewise, global cocoa price variables, rupiah exchange rate, GDP, and FDI also contributed to fluctuating movements that tended to increase until the tenth period. The value of the most significant relationship in the tenth period came from cocoa production by 35.94%, followed by the rupiah exchange rate variable at 22.48%, then international cocoa prices by 16.70%, GDP by 8.68%, and FDI with a correlation value by 1.06%. Therefore, it can be concluded that changes in cocoa exports are more influenced by cocoa production, followed by the rupiah exchange rate, international cocoa prices, GDP, and then FDI.

Tabel 4 Result of Variance Decomposition

Variance Decomposition of Cocoa Exports						
Period	SE	Cocoa Export	Production	Cocoa Price	Exchange rate	GDP	FDI
1	0.040	100,000	0.000	0.000	0.000	0.000	0.000
2	0.056	59,948	27.033	0.394	3,637	8,709	0.278
3	0.0747	34,250	43,978	1,739	9,730	9.950	0.353
4	0.0996	19,022	43,702	10,819	17,510	7.608	1.340
5	0.106	20,413	43,306	9,995	15,972	9.040	1,274
6	0.116	17,225	37,214	9,843	26,628	7,940	1.151
7	0.121	16,632	34,698	14,858	24,573	8180	1.059
8	0.122	16,448	35,071	14,640	24.139	8,580	1.122
9	0.124	15,982	36,903	14,180	23,347	8,477	1,110
10	0.128	15,135	35,945	16,702	22,485	8,676	1.058

Forecasting

According to Syarifuddin and Pratomo (2013) VAR model is used for short-term forecasting. Forecasting is done by first simulating and matching the actual data with the

fair value. There are two techniques in the simulation, namely static and dynamic. Static simulations use only the equations individually, while dynamic simulations use the equations in the VAR together (simultaneously). Following the purpose of the VAR model that interactions occur among the variables, the relevant simulation to use is dynamic. Figure 8 explain the result of forecasting and it is known that cocoa exports experienced a declining trend from 2010 to 2021. The variables of cocoa production, international cocoa prices, GDP, and FDI also experienced a downward trend. It is predicted that only the rupiah exchange rate will experience an increasing trend from 2010 to 2021 through the graph. It indicates that an increase in the rupiah exchange rate will result in a decline in cocoa exports in Indonesia. The downward trend of cocoa exports from 2010-2021 will impact the country's economic growth. One of the efforts made by the government is the downstream industry which was launched in 2010. Downstream is a strategy to increase the value-added or the added value of commodities owned by the state. Downstream aims to increase the selling value of commodities, strengthen the industrial structure, provide more jobs, and increase domestic business opportunities. Considering that Indonesia's natural resources are abundant, downstream is very important so that natural resources exported abroad have a higher selling value. With this downstream, the exported commodities are no longer raw materials but semi-finished or finished goods.
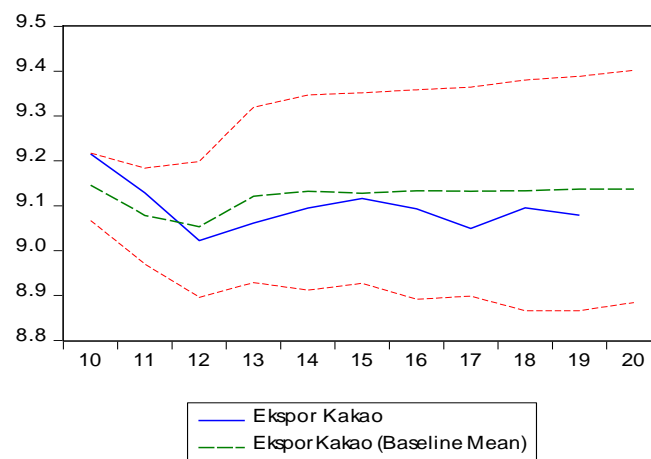
Forecast of Cocoa Export

Figure 8 Forecasting of Cocoa Exports Based on VAR estimation

One of the government's efforts to strengthen the downstream industry is to encourage more investment into the country by building a healthy investment climate. Several investment-related policies that the government has carried out to make it easier for investors to invest in Indonesia include:

a. The ratification of the Job Creation Act to simplify licensing, investment, and employment procedures.
b. Launched OSS-RBA or Online Single Submission Risk Based Approach to increase transparency in obtaining business licenses and facilitate the licensing process.

c. Issued the Investment Priority List (DPI) in Presidential Regulation No. 10 of 2021. In this case, investors will receive both fiscal and non-fiscal incentives if they invest in priority sectors.

d. Establishing an Investment Management Agency (LPI) aims to create jobs and contribute to the development of the national economy.

With various policies issued by the government, it is hoped that the investment process in Indonesia will be easier, faster, and more transparent. As the world's third cocoa bean producer, Indonesia has great potential, so the downstream of this industry will have great opportunities. Given this condition, the government also encourages the downstream cocoa-based industries by establishing processing units in cocoa bean centers to grow small and medium-scale entrepreneurs. In addition, the government also stipulates export duty policies through Minister of Finance Regulation Number 67 of 2010 concerning the Stipulation of Exported Goods Subject to Export Duties and Export Duty Tariffs. With this policy, the supply of cocoa for the domestic industry was getting bigger, and processed cocoa exports are hoped to increase with better quality. According to Aprianto and Qur'an (2021) that agricultural systems that must improve farmers resources and standard of living to be more prosperous.

Conclusion

The results of the impulse response analysis are the value of cocoa exports responded positively to a shock of the cocoa amount it means that an increase in the amount of cocoa production will impact increasing cocoa exports in Indonesia. The value of cocoa exports responded negatively to shocks international cocoa prices which means that when the global price of cocoa is higher, the quantity of cocoa demanded will be lower, thus reducing the volume of cocoa and the value of Indonesian cocoa exports. The value of cocoa exports responded negatively to exchange rate and means that the value of cocoa exports will increase when the rupiah exchange rate decreases (depreciates). It is due to the increasing competitiveness of domestic products in the international market. A lower currency value will increase the amount of currency in circulation to encourage export activities by increasing the production of the export commodity itself. The value of cocoa exports responded positively to a shock or GDP shock which means that an increase in GDP will increase cocoa exports due to the excess of domestic output caused by increasing consumer purchasing power and the ability of the community to engage in production activities. The value of cocoa exports responded positively to the shock or FDI shock and means that FDI increases, it will have an impact on increasing Indonesia's cocoa exports.

Based on the conclusions above, there are several suggestions, namely that exporters are expected to increase the quantity and quality of Indonesian cocoa production to increase the volume and value of Indonesian cocoa exports in the international market. It requires support from the government to increase cocoa productivity. One way is downstream the cocoa industry, namely changing and improving raw materials into semi-finished materials such as cocoa beans into processed cocoa. It needs to be supported by the

government by providing investing facilities for cocoa farmers in Indonesia. In addition, to maintain the performance of the cocoa industry, the government needs to make export and import policies that support the welfare of farmers and provide convenience for business actors in the cocoa industry.

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