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THE EFFECT OF TOTAL PRODUCTION, INTERNATIONAL PRICE, AND US DOLLAR EXCHANGE RATE ON THE VOLUME OF INDONESIAN COPPER ORE EXPORT

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ABSTRACT

Copper ore is one of the crude minerals that must be processed to create different requirements like electronic gear, electric vehicles, and other assembling hardware. Copper ore is also one of the mining materials that assume a part in the sustainability of Indonesia's export. This research aims to analyze the total production, international price, and the USD exchange rate simultaneously and partially on the volume of Indonesian copper ore export. This study uses each variable's annual data for 2001-2020. Types and sources of data use a quantitative approach with secondary data and multiple linear regression analysis. The study results show that the variables of total production, international price, and the USD exchange rate simultaneously significantly affect the volume of Indonesian copper ore export from 2001-2020. Partially, total production and international price positively and significantly impacted Indonesia's copper ore export. Meanwhile, the US dollar exchange rate does not affect Indonesian copper ore export.

KEY WORDS

Copper ore, production, international price, US dollar exchange rate.

Copper is one of the main types of metal and is the most crucial element widely used by humans. Copper is one of the oldest metal types discovered 10,000 years ago. This metal is found in the form of ores scattered almost all over the world. Currently, copper is often used in industry for electronic equipment, power plants, transmission, and automotive anti-microbial tools. The discovery of copper ore must go through various processes before it can be used for daily needs (Sahabat Tambang, 2016).

The copper ore found in the earth's crust will then be extricated utilizing two fundamental mining techniques: open-pit or underground mining. Open-pit mining happens when the copper mineral is close to the ground surface. Meanwhile, underground mining will be carried out if the copper ore is deep in the depths of the earth. In underground mining, excavators dig vertical shafts and make flat passages underground. Mined ores found in the earth's crust are then processed to separate concentrates containing copper minerals. Furthermore, the processed concentrate, which has an added value of 95 percent, will then be sent to refining factories at home and abroad (PT Freeport Indonesia, 2021).

Currently, copper is also needed in components or tools in driving turbines by utilizing windmills in cars with copper electric technology used to make them run. In the future, clean energy sources will take up a larger share of the global energy mix. With each energy transition, a new need for fuel arises. Copper is one of the fuel sources that connects, provides clean energy, and makes it an important material in manufacturing technologies such as wind, solar, energy storage, and electric vehicles. Clean energy generation technology uses copper as raw material, usually 4-6 times more than fossil fuels (Copper Development Association Inc, 2019).

In 2020, world consumption of refined copper was estimated to reach 23.4 million metric tons, China is the biggest client of refined copper, accounting for 54 percent or 12.5 million metric tons of total world copper consumption, and China imports 4.5 million metric tons. Refined copper from various countries. In the same year, about 20 million metric tons of copper were produced, and 23.9 million metric tons of refined copper were produced worldwide (Norilsk Nickel, 2020). Indonesia is the seventh-largest country with copper reserves worldwide and controls 28 million metric tons or 3 percent of the world's total copper

reserves. Meanwhile, in 2020 Indonesia's copper production in the global market will be 340 thousand metric tons, or 2 percent of the total world copper production. Chile is a country with the most substantial copper holds in the world, with reserves reaching 200 billion metric tons (United States Geological Survey, 2020).

Based on data from Statistics Indonesia, from 2010 to 2020, the contribution of copper ore export to the Indonesian mining sector decreased by 55.7 percent due to the policy of the Indonesian government to reduce export of raw minerals as per the law of the Republic of Indonesia Number 4 of 2009 concerning Mineral and Coal Mining. This aims to increase added value in raw minerals through domestic processing and refining with downstream development in the mining sector. However, export can still be carried out with the condition that the company must build a processing or refining facility for mining products (smelter) that help process raw mineral ores and increase metal content (Damayanti & Pratama, 2014).

Even though a regulation regarding minerals and coal has been issued, copper ore export may still be carried out. This regulation resulted in several rejections by several copper ore mining companies in Indonesia. Furthermore, within three years after the law's enactment, the republic Indonesia Number 4 of 2009 concerning Minerals and Coal, namely by 2013, all mining companies must have made smelter facilities. However, until the end of 2013, it turned out that no mining company had built a smelter to process copper ore. Many mining companies only collect raw minerals or mineral concentrates and sell them directly abroad. Because of this, the Ministry of Energy and Mineral Resources Republic of Indonesia issued law Number 1 of 2014 concerning Minerals and Coal starting on January 11, 2014, which will impose a ban on ore export, and mining products will only be allowed after processing with the construction of smelters in Indonesia (Masdarsada, 2014). As a result of the ban, Indonesia's copper ore export decreased in 2014 by 54.8 percent or 212.9 thousand metric tons from the previous year.

Furthermore, in 2019 copper ore export decreased by 69.43 percent compared to 2018. The decrease in copper ore export was due to a decrease in production during the transition period of mining operations from open-pit mining to underground mining located in Grasberg (Ramadhani, 2020). Although in 2019 copper ore export decreased, in 2020, despite being affected by the covid-19 pandemic, copper ore export increased by 1,274.5 thousand metric tons or 88.45 percent from the previous year. Because of an increase in domestic demand and the international market, producers continued to produce in line with the need for demand for copper. The government is implementing an increase in export quotas in the mining sector as a form of support for sectors affected by the covid-19 pandemic (Mulyana, 2020).

The central destination countries for Indonesia's copper ore export in 2020 are Japan, the Philippines, China, India, and South Korea, with export volumes of 336.7 thousand metric tons each; 70.4 thousand metric tons; 372.9 thousand metric tons; 127.4 thousand metric tons; 154 thousand metric tons. Japan is the largest importer of Indonesian copper ore, but since 2019 there has been a shift in the leading export destination for Indonesian copper ore commodities. Japan's position in 2018 was in first place, shifted by China, which was in second place. The decline in Indonesia's copper ore export to Japan by 79.09 percent made China the country with the largest importer of copper ore in Indonesia, amounting to 302.5 thousand tons. In 2020 copper ore export to destination countries increased compared to 2019. The most significant increase was to Japan by 233.29 thousand tons or 225.5 percent, with total export of 336.7 thousand tons. Even though export to Japan has increased, China is still leading the country with the export destination of Indonesian copper ore spread with a volume of 372.9 thousand tons. Indicates that China is the biggest potential market for Indonesia in the copper ore trade (Statistics Indonesia, 2021).

To increase exports in Indonesia, domestic exporters need to increase total production, which means that domestic needs have been met, so most of these products can be exported. According to Komalasari (2009), the effect between the total production and export is that if the total production increases, Indonesia's export also increases. On the other hand, if the total production decreases, Indonesia's export also decrease.

In Indonesia, the production of copper concentrate has fluctuated development. Based on data from Statistics Indonesia, total production experienced the highest increase in 2018 at 2,309.3 thousand metric tons. Meanwhile, the decline in production occurred in 2014 and 2014. The highest decline occurred in 2014 due to Law Number 4 of 2009 concerning Mineral and Coal Mining which requires companies holding Mining Business licenses to increase added value through processing and refining (smelters) mining products. This policy has a negative impact on mining companies that refuse to build smelters because the construction costs are costly, and the operational costs are very high. With the construction of a smelter, mining companies must reduce costs for producing materials that so far can be sold directly in the form of ore (raw material) or mineral concentrates directly abroad (Masdarsada, 2014).

Meanwhile, the decline in copper concentrate production in 2019 decreased by 26.18 percent caused by one of the largest mining companies, PT Freeport Indonesia changing its mining location from an open pit to an underground mine due to a decrease in mineral content in the open-pit mine located at the Grasberg mine, Papua. Then in the following year, the production of copper concentrate again increased by 33.91 percent. The increase in total production in the export quota of copper concentrate also affects the increase in the production capacity of this underground mine during the period of PT Freeport the underground mine (Petriella, 2020).

According to Hutasoit (2018), the effect shown between the price and the volume of Indonesia copper export in his research is that if the price of copper increases, the volume of export will also increase. According to Gitosudarmo (1984), the price is the value expressed in units of currency or medium of exchange for certain goods. Apart from physical factors that determine the size of the value or price, psychological factors and other factors influence the price.

Based on data from the World Bank (2019), 2011 was the highest peak for a copper price at 7953.63 dollars per metric ton. From 2012 to 2016, there was a very high price decline, with an average price decline per year of 555.37 dollars per metric ton. Furthermore, in 2019, the copper price decreased by 5.82 percent again due to several factors, including the trade war between the United States and China. In early May, the United States raised import tariffs on certain products from China which led to a retaliatory attack from China which increased tariffs on goods imported from the United States. In addition, the decline in cathode copper imports from China and news of a reduction in electricity network investment in China. As is known, in 2019, China was the major consumer of refined copper in the world, contributing 51 percent of the world's total copper consumption. The decline in international copper price was additionally because of frail stockpile by mining companies due to several production disruptions from the Chuquicamata mine in Chile (a strike) and the Grasberg mine in Indonesia (switch operations from an open pit to underground mining) (Norilsk Nickel, 2020).

The trade between two countries is the price at which residents of those countries exchange with each other. The exchange rate is separated into two to be specific, the nominal exchange rate and the real exchange rate. The nominal exchange rate is the general price of two countries' currencies. In contrast, the real exchange rate is the relative price of commodities between the two countries (Mankiw, 2018). The Rupiah currency is still classified as a currency with a weak value and is rarely used as a means of payment or comparison in exchange because its value is relatively unstable and often fluctuates in value. The currency often used as a comparison in exchange for international trade is the US dollar because the US dollar is a hard currency with a relatively stable value and is the reference currency for most developing countries. Besides that, most trade between countries uses the United States Dollar. Assuming the rupiah towards the US dollar is unstable will disrupt international trade, which can cause economic losses because trade is valued in dollars (Berlianta, 2005).

Based on data from Statistics Indonesia, the development of the rupiah exchange rate toward the US dollar from 2010 until 2020 often fluctuated. In 2010 the Rupiah exchange rate toward the United States dollar was IDR 8,991, and changes in the value of the rupiah

toward the United States dollar began to occur in 2013, amounting to IDR 12,189 per US dollar, then until 2020, change in the rupiah toward the United States dollar was IDR 14,105 per US dollar. According to Ginting (2013), the exchange rate negatively influences Indonesian export in the long term. This influence shows that the decline in Indonesia's export occurred due to the appreciation of the exchange rate. Vice versa, the depreciation exchange rate will lead to higher Indonesian export.

The appreciation exchange rate of the rupiah means that when the domestic currency appreciates, and the nominal exchange rate increases along with the real exchange rate also rises, then goods abroad are cheaper than domestic goods, while domestic goods are more expensive than foreign goods. This situation can be detrimental for Indonesian exporters in increasing their supply of goods and services abroad, leading to a decline in export. On the other hand, if there is a depreciation of the exchange rate, then goods abroad will be more expensive than domestic goods. This situation can benefit domestic exporters who want to offer goods on the international market, where exporters can sell at a lower price than goods abroad, and increasing exports. An increase in export will affect the production of domestic goods and increase the demand for commodities and services in the economy (Mankiw, 2018).

METHODS OF RESEARCH

This study uses an associative quantitative approach which aims to test hypotheses between research variables so that it can see between the variables related to the independent variables. This study uses the type of time series data, which in this study uses an analysis period of 20 years, namely from 2001 to 2020. The data collection method is the non-participant observation method, carried out by collecting data already available by certain agencies in which the researcher is not directly involved. The data sources used in this study were obtained from Statistics Indonesia, the World Bank, UN Comtrade, and the Copper Association Development Inc.

The data analysis used is multiple linear regression analysis. This analysis aims to find out or obtain an overview of the effect of the total production, international copper price, and the US dollar exchange rate on the volume of Indonesian copper ore export from 2001-2020. In addition, the classical assumption test is carried out first before performing multiple linear regression analyses to produce accurate and unbiased data analysis.

RESULTS AND DISCUSSION

Based on the results of data analysis obtained with the help of the application program Statistical Product and Service Solution (SPSS) version 16.

Table 1 – The results of the data analysis

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
1 (Constant)	-840644459.550	657480392.969		-1.279	.219
Total production	2628400.182	324783.173	1.155	8.093	.000
International price	71532.809	32855.442	.254	2.177	.045
USD exchange rate	12980.743	28658.204	.045	.453	.657

Source: Secondary data processed, (2022).

Based on the results of multiple linear regression data analysis in Table 1, when included in the regression equation, the following equation is obtained:

$$\hat{Y} = -840644459.550 + 2628400.182 X_1 + 71532.809 X_2 + 12980.743 X_3$$

The constant of 840,644,459.550 shows the value of the Indonesian copper ore export

variable if the variable total of production (X_1), international copper price (X_2), and US dollar exchange rate (X_3) is zero, meaning that if it is not influenced by the independent variable, the volume of Indonesian copper ore export (Y) amounted to 840,644,459.550 kilograms.

Based on the results of simultaneous tests on the output of the SPSS application program, it can be seen that the total production, international copper price, and the US dollar exchange rate have a simultaneous and significant effect on the volume of Indonesian copper ore export in 2001-2020. In this study, it is known that the significance value is 0.000, which means that at a significant level of 5 percent, the variable total production, international price, and the USD exchange rate have a simultaneous and significant effect on the volume of Indonesian copper ore export in 2001-2020.

In this study, the coefficient of determination (R^2) is 0.915, which explains that 91.5 percent of the variation in the volume of Indonesian copper ore export from 2001-2020 is simultaneously affected by the total production, international copper price, and the US dollar exchange rate. At the same time, the remaining 8.5 percent is impacted by different factors that are excluded from the study. The multiple linear regression model above has met the classical assumption test, indicating that the regression equation obtained from the data analysis has no bias.

The effect of total production on Indonesia's copper ore export volume

Based on results can explain that the significant value for the effect of the total production on the export volume of Indonesian copper ore is $0.000 < 0.05$ and the t value is 8.093, so it can be concluded that the variable total production (X_1) is a partial positive and significant effect on the volume of Indonesian copper ore export in 2001-2020. The regression coefficient for the variable total production (X_1) is 2,628,400,182, meaning that if the total production increases by 1 thousand short tons, the export volume of Indonesian copper ore will increase by 2,628,400,182 kilograms. These outcomes follow the research of Segarani & Dewi (2015) and Lestari (2016), concluding that total production has a positive and significant effect on the volume of export in Indonesia.

The results of this study prove that the total copper concentrate production contributes positively to the volume of Indonesian copper ore export. Because the copper ore mining products found in the earth's crust by copper ore mining companies are not fully used for export activities, there is some increase in added value through processing mining products into copper concentrate. This means that when mining companies carry out copper ore exploitation activities, apart from producing their production, they also process copper ore material into copper concentrate. Therefore, the more copper ore produced will increase the opportunity to process the material into copper concentrate, as well as raw minerals for copper ore that are not reprocessed and then exported to various countries.

The effect of international copper price on the volume of Indonesian copper ore export

Based on results can explain that the significance value for the effect of international copper price on the volume of Indonesian copper ore export is $0.045 < 0.05$, and the t value is 2.177, so it can be concluded that the international copper price variable partially has a positive and significant effect on the volume of Indonesian copper ore export in 2001-2020. The regression coefficient for the international price variable is 71,532.809, meaning that if the international copper price increases by 1 US Dollar per metric ton, the export volume of Indonesian copper ore will increase by 71,532.809 kilograms. These outcomes follow the research of Lestari (2016) and Kurniawati et al. (2016), concluding that international price has a positive and significant effect on the volume of Indonesia's export.

The results of this study prove that international copper price positively contribute to Indonesia's copper ore export. International copper price is following the market mechanism. If international copper price increase, copper ore exporters will try to offer more products. With the desire of exporters to sell more copper ore commodities because prices have increased, the exporters will experience profits. In addition, it also contributes to Indonesia's copper ore export.

The effect of the US dollar exchange rate on the volume of Indonesia's copper ore export

Based on results can explain that the significance value for the effect of the US dollar exchange rate on the export volume of Indonesian copper ore is $0.657 > 0.05$, and the t value is 0.453, so it can be concluded that the US dollar exchange rate variable partially has no significant effect on the volume of Indonesian copper ore export 2001-2020. These outcomes follow the research of Mohani et al. (2016) and Pranjanti et al. (2020), concluding that the exchange rate does not affect the volume of Indonesia's export. These outcomes rejected the research of Ginting (2013) and Igir et al. (2020), concluding that the exchange rate has a negative and significant effect on the volume of Indonesia's export.

The outcome of this research explains that the rupiah exchange rate towards the dollar has no significant effect on the volume of Indonesian copper ore export from 2001-2020. This is because Indonesia is one of the countries that implement a free-floating exchange rate system. Rupiah is a soft currency that causes frequent fluctuations in exchange rates. In addition, in conducting international trade transactions with importers, exporters in Indonesia tend to agree in advance regarding the number of products to be ordered and set a currency as the payment system. The importer's decision in buying how much copper ore commodity is also more likely to look at the prevailing price than the exchange rate at that time because if the price is low-price, the importer tends to buy more.

Research Implication

The implications of the research results provide additional information on how the variable total production, international price, and the US dollar exchange rate is on the volume of Indonesian copper ore export. The research results on the total production show that the variable total production has a positive and significant effect on the volume of Indonesian copper ore export. When the production of copper ore increases domestically, it will be able to fulfill domestic needs, and part of production will be traded to the international market. This shows that if Indonesia increases the production of copper ore commodities that are sold, the country will be able to sell or offer Indonesian copper ore commodities to various export destinations so that Indonesian copper ore export will increase.

International price is one of the factors affecting Indonesia's copper ore export. The research results show that the international copper price positively and significantly influences Indonesian copper ore commodities export. Based on the concept of supply, if an item's price increases, producers tend to increase the number of goods offered. Likewise, international copper price can affect the increase in Indonesian copper ore commodities export. Exporters will try to make more bids due to high international copper price.

This study's exchange rate did not affect Indonesian copper ore commodities from 2001-2020. This is not following the hypothesis put forward by Mankiw (2003), which explains that when the domestic currency appreciates and the nominal exchange rate increases, it will cause the prices of foreign commodities to be cheaper than the prices of domestic commodities, which causes a decrease in export. Indonesia is one of the countries that implement a free-floating exchange rate method which causes exchange rate fluctuations to occur frequently and is a natural thing in the economy. Besides, export-import market competition occurs naturally following international market mechanisms and exchange rates. The soft currency is rarely used as a means of international payment because its value is relatively unstable and tends to fluctuate, which causes importers to rarely use the rupiah currency as a transaction on Indonesian copper ore commodities. In addition, in international trade, importers tend to have made agreements with exporting companies in Indonesia regarding the payment system by specifying a currency as a means of payment.

CONCLUSION

Based on the analysis results that have been described, it can be concluded that the total production, international price, and the US dollar exchange rate significantly affect the

volume of Indonesian copper ore export from 2001-2020. The results of this study were proven by the simultaneous significance test of $0.000 < 0.05$. This is also supported by the coefficient of determination (R^2) value of 0.915, which means that the variable total production, international price, and the US dollar exchange rate affect the volume of Indonesian copper ore export by 91.5 percent, while the remaining 8.5 percent is influenced by other variables not included in the research model. Partially, the variable total production and international price has a positive and significant effect on volume of Indonesian copper ore export. Meanwhile, the USD exchange rate variable has no significant effect on Indonesian copper ore export volume.

Based on the research results, suggestions can be given to copper ore mining companies to optimize the use of smelters and increase the number of smelter developments in Indonesia. Construction of a smelter to increase copper ore's processing and refining capacity and provide added value to the resulting product. In addition, the smelter builds functions for processing and refining copper ore and other materials found in the earth's crust. In the long term, the construction of smelters can provide added value to the products produced and contribute to the sustainability of export in Indonesia.

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