

## Estimation of Indonesia's Trade with USA and India

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### ABSTRACT

This research estimates Indonesia's trade with the United States of America (USA) and India using the Structural Time-Series Model (STSM). STSM is a model that can assess and estimate trade data in a more structured and accurate with a decomposition process. This is important because USA and India are Indonesia's second and fifth biggest export destination countries in 2020. The focus of the research is the balance of trade between Indonesia, the USA, and India.

Based on Descriptive Analysis, the total trade between Indonesia and USA for January-May 2021 period compared to the same period in 2020 increased by 25%. Changes in Indonesia's non-oil and gas exports to the USA in January-May 2021 compared to the same period in the previous year increased by 30%. Textile and textile products, rubber and rubber products, and footwear are the three main export commodities from Indonesia to the USA. There are two products whose exports will increase significantly in 2021, namely: jewelry/gems (HS code 71), palm oil, and its derivative products (HS code 15).

Among ASEAN countries, bilaterally, Indonesia is India's number one trading partner in terms of total trade. The total trade between Indonesia and India for January-May 2021 period compared to the same period in 2020 increased by 44%. Changes in Indonesia's non-oil and gas exports to India in January-May 2021 compared to the same period in the previous year increased by 22%. Coal, palm oil products, and iron and steel products are Indonesia's three main export commodities to India. Changes in imports of Indonesian non-oil and gas products from India in January-May 2021 compared to the same period in 2020 decreased by 85%. Sugar, mineral fuels, and iron and steel are the three biggest imported products from India. The type of imports that experienced the largest increase was wheat (HS code 10) in the January-May 2021 period.

For this research, data will be collected from Indonesian Statistics (BPS), 113 monthly export and import data (Indonesia with the USA, and Indonesia with India in value and quantity of trade) on the period M1-2012 until M5-2021. We will utilize some statistical methodologies such as (a) stationarity test using Augmented Dicky Fuller (ADF), and (b) the Structural Time-Series Model (STSM).

The Structural Time-Series Model (STSM) estimates that the value and volume of Indonesia's non-oil and gas exports to the USA and India from 2022 to 2023 will be stable with an increasing trend. Indonesia's export and import policies need to consider the cycles, seasonal, and irregularity patterns. The stakeholders must consider if there are irregularities such as economic crisis and COVID-19 pandemic in 2020 and 2021. Currently, the rise in international commodity prices helps increase Indonesia's trade surplus with USA and India. However, more can be done to increase the value-added products that are exported from Indonesia to India and USA.

Based on the Structural Time-Series Model (STSM) estimation, Indonesia's import and export to USA and India will increase in the next two years. Indonesia's export to the USA is expected to increase around 10% in the next two years. Similarly, Indonesia's export to India is estimated to increase by around 9.6%. In terms of Indonesia, imports from USA and India will increase around 14.5% and 5.1% in 2023. Hopefully, the increase in export and import can help these three countries' business and economic growth.

*Keywords: Descriptive Analysis, Structural Time-Series Method, Value and Quantity Trade, Export-import.*

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## 1. Introduction

The exchange of goods and services by two economic actors in two different countries to mutually benefit each other is called foreign trade. The scope of this research paper focuses on trade in oil and gas and non-oil and gas products. The definition of economic actors is citizens, private companies, or government-owned companies. In today's digital world, trade does not occur only domestically, but there is a link between countries that need each other. Every country must be involved in foreign trade in the era of globalization and openness that occurs. In domestic trade, economic actors aim to benefit from their economic activities. Likewise with international trade. Every country that conducts trade aims to get benefits from the trade. In general, international trade consists of export and import activities. Countries that produce more than their domestic needs can export the excess production to other countries.

However, countries that are unable to produce on their own, can import from other countries. Factors that influence international trade can be seen from the theory of supply and demand. From the theory of supply and demand, it can be concluded that international trade can occur due to the excess production of a country with excess demand from other countries.

According to PWC (2015), India, the USA, and Indonesia can become the second, third, and fourth-biggest economies in the world in the year 2050. One way to improve the economy of a country is to increase trade with other countries. Amid the COVID-19 pandemic, it is difficult to predict the international trade condition in the future. Based on the existing research (Keck et al., 2010; Jati and Salam, 2019), Time-Series Model is one of the models that can help to estimate trade. To the best of our knowledge, not many research papers use Structural Time-Series to estimate international trade. So, there is a gap to contribute research to estimate the future trade between Indonesia and India and the USA using Structural Time-Series Model (STSM).

## 2. Methods

The value of a country's oil and gas and non-oil and gas export and import trade is a variable that is classified as a Volatile Variable (VV) or data variable that is relatively difficult to model. Therefore, we need a simple model that can explain the dynamics of VV. An alternative way to make short-term VV assessments and estimates more structured and accurate is to perform decomposition and estimation in a comprehensive model, namely the Structural Time-Series

Model (STSM) (Harvey and Shephard, 1993). There is a special value in this STSM approach when compared to the historical average variable, namely STMS is relatively more structured. In addition, STSM can model seasonal patterns and irregularity variables and make the model relatively more robust. STSM Decomposition (Harvey and Peters, 1990; Durbin and Koopman, 2001) consists of 4 components, namely:

(1) Trend components that follow the random walk process.

$$\tau_t = \mu_t + \tau_{t-1} + n_t, n_t \sim N(0, \sigma_n^2) \quad (1)$$

$$\mu_t = \mu_{t-1} + \nu_t \sim N(0, \sigma_\nu^2) \quad (2)$$

The variable  $t$  is the trend component, the variable  $t$  is the slope which can be stochastic, the variable  $i_t$  is the error of  $t$ , and the variable  $t$  is the error of  $t$ .

(2) Seasonal Component is a specification ( $ye_t$ ) that follows the trigonometric model.

$$\begin{bmatrix} \gamma_{j,t} \\ \gamma_{j,t}^* \end{bmatrix} = \begin{bmatrix} \cos \lambda_j & \sin \lambda_j \\ -\sin \lambda_j & \cos \lambda_j \end{bmatrix} \begin{bmatrix} \gamma_{j,t-1} \\ \gamma_{j,t-1}^* \end{bmatrix} + \begin{bmatrix} \omega_t \\ \omega_t^* \end{bmatrix} \quad (3)$$

for  $j = 1, \dots, [s/2]$ ;  $t = 1, \dots, T$ . Where  $t$  is the seasonal component,  $t$  is the error of  $t$ .

(3) Cyclical Component whose model resembles the Seasonal Component.

$$\begin{bmatrix} \psi_{j,t} \\ \psi_{j,t}^* \end{bmatrix} = \rho \psi \begin{bmatrix} \cos \lambda_c & \sin \lambda_c \\ -\sin \lambda_c & \cos \lambda_c \end{bmatrix} \begin{bmatrix} \psi_{j,t-1} \\ \psi_{j,t-1}^* \end{bmatrix} + \begin{bmatrix} K_t \\ K_t^* \end{bmatrix} \quad (4)$$

for  $t = 1, \dots, T$ . Where  $\psi_t$  is the cyclical component,  $\rho_\psi$  and  $\lambda_c$  are damping factors and frequency with values  $0 < \rho_\psi < 1$  and  $0 < \lambda_c < \pi$  while  $K_t$  and  $K_t^*$  are not mutually correlated  $N(0, \sigma_k^2)$ . (4) Irregularity Component, is another component other than the three above. Adding the four components together yields:

$$y_t = \tau_t + \gamma_t + \psi_t + \varepsilon_t \quad (5)$$

So  $y_t$  is the oil and gas and non-oil and gas export and import trade variable which is estimated by trend ( $\tau_t$ ), seasonal ( $\gamma_t$ ) and cyclical ( $\psi_t$ ), and irregular ( $\varepsilon_t$ ) components. This model was estimated using the MLE (Maximum Likelihood Estimation) method and the 4 components that

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were difficult to estimate were generated from the Kalman filter (Harvey and Shephard, 1993). Data collection for this model is obtained from Indonesian Statistics. The data period used is 113 monthly data from January 2012 to May 2021. The software used in this study uses EViews and Stamp OxMetrics 7.

### 3. Result and Discussion

The trade data variables were analyzed using EViews statistic software version eight before performing the Structural Time-Series Model (STSM) using OxMetrics software. The Augmented Dicky-Fuller (ADF) test can be used to see and detect the stationary of variables. The data of time coherent can be said stationary if the average value, variance, and autocovariance for each lag are constant over time (Gujarati, 2004). The result of the ADF test shows that all variables were stationary in the first difference / first integration order.

#### 3.1. Estimation of Indonesia’s Trade with the USA

##### 3.1.1. Estimation Development of Indonesia’s Imports from the USA

Structural Time-Series Model (STSM) to estimate the development of Indonesia’s import from the USA shows: (1) Indonesia’s import from USA trend derived from the high seasonal, cycle and irregular components associated with the supply of American exporter and demand of Indonesian buyer as well as fundamental changing in both countries over time, (2) seasonal component increased twice in a year, in the middle of the year and at the end of the year, one of the reason this can happen because during Eid Al-Fitr, Christmas/New Year and school holiday where the demand was high, (3) cycle component that decreased in the year 2014 and 2015 because most of the commodity price decreased along with the fall of world oil price (IMF, 2015), (4) there is an irregular component which shows that the model is relatively difficult to estimate.

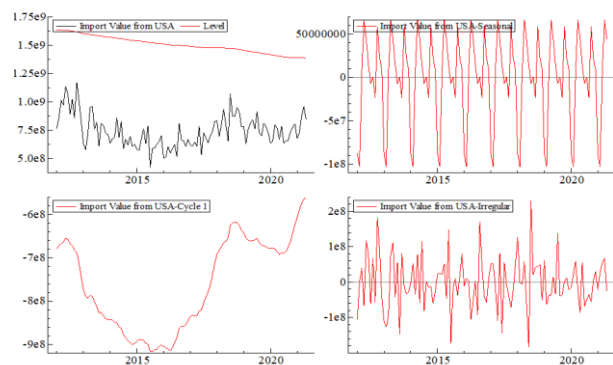


Fig. 1. Development of Indonesia’s Import from the USA and the Effect of Trend, Seasonal, Cycle and Irregularity Components. Source: calculation results of Stamp OxMetrics 7 software (2021)

Based on Table 1, the model estimates that Indonesia’s imports from the USA will increase around 14.5% from May 2021 to May 2023. The Coefficient of Variation (CV) estimation will increase around 6.7% from May 2021 to May 2023. It shows that the CV of import from the USA is relatively low and stable if we compared research from Darman (2013) that shows the average import of Indonesia from the USA during the year 2008-2012 is 12.71%. Some references (Kemendag, 2019; MoT, 2015) and research papers (Roy et al., 2020; Fatin et al., 2020; Jati and Salam, 2021) mentioned that if the result of the Coefficient of Variation (CV) estimation is below (<) 9%, so it is relatively stable.

Table 1. Estimation of Indonesia’s Import from USA

Period	Import from USA	% Changes
May-21	844,860,108	-
May-22	915,010,928	8.3
May-23	967,069,882	5.7
<b>Changes May 2021 - May 2023</b>		<b>14.5</b>
<b>Standard Deviation (SD)</b>		<b>61,327,673</b>
<b>Average May 2021 - May 2023</b>		<b>908,980,306</b>
<b>Coefficient of Variation (CV) May 2021 - May 2023</b>		<b>6.7</b>

Source: calculation results of Stamp OxMetrics 7 software (2021)

##### 3.1.2. Estimation Development of Indonesia’s Import

Structural Time-Series Model (STSM) to estimate the development of Indonesia’s import quantity from the USA shows: (1) Indonesia’s import quantity from USA trend derived from the high seasonal, cycle and irregular components associated with demand of importer in Indonesia and supply of exporter in the USA as well as other external factors, (2) similar like Indonesia’s import from the USA, the seasonal component increased twice in a year, (3) cycle component fluctuate more than usual in the year 2017-2018 because there is an increasing tension of trade war between USA and China (Steinbock, 2018), that affected other countries including trading between USA and Indonesia, (4) existing irregular component in this calculation result that shows it is difficult to estimate Indonesia’s import quantity from the USA.

Based on Table 2, the estimate shows that Indonesia’s import quantity from the USA will increase around 15.9% from May 2021 to May 2023. This result of quantity import changes is a little higher than the import in Table 1 (14.5%). The Coefficient of Variation (CV) estimation will increase 7.4% from May 2021 to May 2023. This result is higher compared with the CV of Indonesia’s import from the USA in table 1 (6.7%). Although the 7.4% result is still lower than

9% that shows Indonesia’s import quantity from the USA is relatively low and stable (Kemendag, 2019; MoT, 2015).

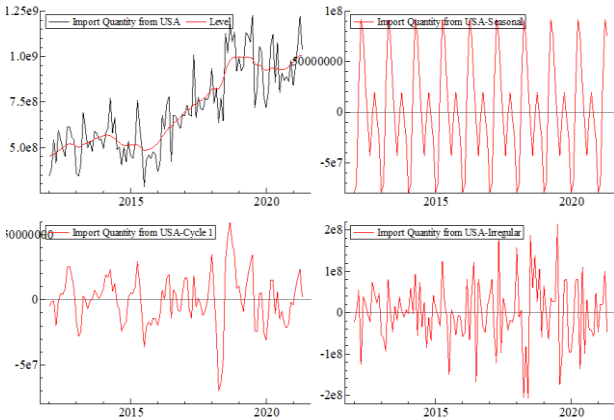


Fig. 2. Development of Indonesia’s Import Quantity from the USA and the Effect of Trend, Seasonal, Cycle and Irregularity Components.

Source: calculation results of Stamp OxMetrics 7 software (2021)

Table 2. Estimation of Indonesia’s Import Quantity from USA

Period	Import Quantity from USA	% Changes
May-21	1,036,183,589	-
May-22	1,141,346,821	10.1
May-23	1,200,928,438	5.2
<b>Changes May 2021 - May 2023</b>		<b>15.9</b>
<b>Standard Deviation (SD)</b>		<b>83,416,765</b>
<b>Average May 2021 - May 2023</b>		<b>1,126,152,949</b>
<b>Coefficient of Variation (CV) May 2021 - May 2023</b>		<b>7.4</b>

Source: calculation results of Stamp OxMetrics 7 software (2021)

### 3.1.3. Estimation Development of Indonesia’s Export to the USA

STSM model to estimate Indonesia’s export development to the USA shows: (1) Indonesia’s export to USA trend derived from the seasonal, cycle, and irregular components associated with the supply of Indonesian exporters and demand of American buyers as well as the fundamental changes in both countries over time, (2) seasonal component pattern was lower during the year 2012-2016, then started to increase during the year 2017 until 2021 due to the trade war between USA and China and pandemic of COVID-19 (2020-2021), (3) cycle component is similar with seasonal components, during the year 2012-2016 is smaller the compared the year 2017-202, (4) irregular component exists and it shows that relatively difficult to estimate Indonesia’s export to the USA.

Indonesia’s export to the USA is estimated to increase around 10% from May 2021 to March 2023 (see Table 3).

The Coefficient of Variation (CV) for this estimate is 6.2%, suggesting that the export to the USA is relatively stable because the number is still below the 9% threshold.

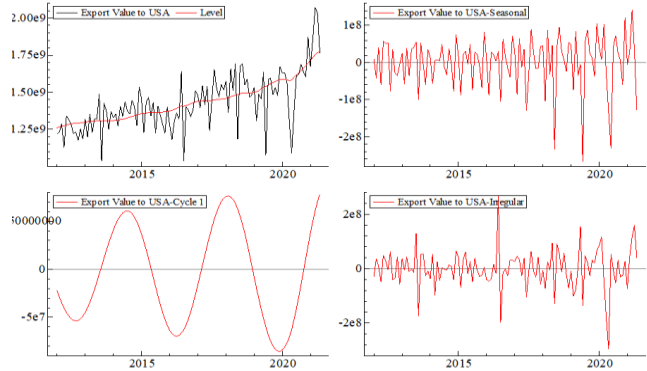


Fig. 3. Development of Indonesia’s export to the USA and the Effect of Trend, Seasonal, Cycle and Irregularity Components.

Source: calculation results of Stamp OxMetrics 7 software (2021)

Table 3. Estimation of Indonesia’s Export to USA

Period	Export to USA	% Changes
May-21	1,761,365,198	-
May-22	1,732,393,082	-1.6
March-23	1,938,198,407	11.9
<b>Changes May 2021 - March 2023</b>		<b>10.0</b>
<b>Standard Deviation (SD)</b>		<b>11,404,069</b>
<b>Average May 2021 - March 2023</b>		<b>1,810,652,229</b>
<b>Coefficient of Variation (CV) May 2021 - March 2023</b>		<b>6.2</b>

Source: calculation results of Stamp OxMetrics 7 software (2021)

### 3.1.4. Estimation Development of Indonesia’s Export Quantity to the USA

STSM model to estimate Indonesia’s export quantity development to the USA shows: (1) the trend of export quantity from Indonesia to the USA derived from the seasonal, cycle, and irregular components that related to the supply and demand of trading between Indonesia and the USA, (2) seasonal component is relatively stable with the same pattern every year with one time increased in the middle of the year, (3) cycle components increased from 2012 to 2015 but decreased from 2016 until 2020, (4) similar to the previous result of STSM, there is the irregular component in this variable that shows external factors also give a bigger contribution.

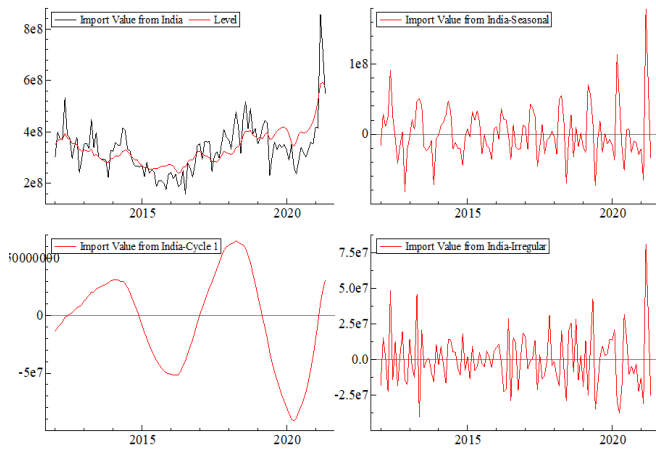


Fig. 4. Development of Indonesia’s Export Quantity to the USA and the Effect of Trend, Seasonal, Cycle and Irregularity Components.

Source: calculation results of Stamp OxMetrics 7 software (2021)

Table 4. Estimation of Indonesia’s Export Quantity to the USA

Period	Export Quantity to the USA	% Changes
May-21	595,982,744	-
May-22	620,169,490	4.1
March-23	694,502,503	12.0
<b>Changes May 2021 - March 2023</b>		<b>21.9</b>
<b>Standard Deviation (SD)</b>		<b>51,342,864</b>
<b>Average May 2021 - March 2023</b>		<b>636,884,912</b>
<b>Coefficient of Variation (CV) May 2021 - March 2023</b>		<b>8.1</b>

Source: calculation results of Stamp OxMetrics 7 software (2021)

Indonesia’s export quantity to the USA estimation will increase around 21.9% from May 2021 to March 2023 (Table 4). The estimate shows that the Coefficient of Variation (CV) will increase by around 8.1%. This result shows that the export quantity to the USA is still stable because it is still below the 9% threshold.

### 3.2. Estimation of Indonesia’s Trade with India

#### 3.2.1. Estimation Development of Indonesia’s Imports from India

Structural Time-Series Model to estimate the development of Indonesia’s import from India shows: (1) the trend is derived from the seasonal, cycle and irregular components associated with the supply of Indian exporters and the demand of Indonesian importer as well as fundamental economy of both countries, (2) seasonal component fluctuated overtime where in the year 2014-2015

is the lowest fluctuation because of low price of the commodity and in the year 2020-2021 is the highest fluctuation due to pandemic COVID-19 and increase of commodity price, (3) cycle component seems to follow fluctuation of world commodity price (like oil price), in the year 2014-2015, it decreased and increased again in the year 2016-2019, (4) exist of irregular component that shows it is difficult to estimate the import in the future.

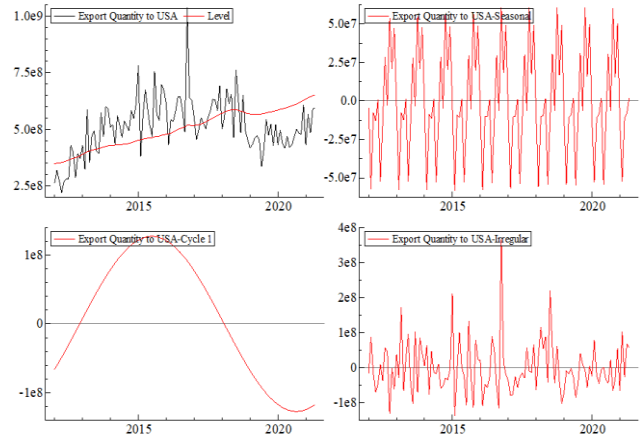


Fig. 5. Development of Indonesia’s Import from India and the Effect of Trend, Seasonal, Cycle and Irregularity Components

Source: calculation results of Stamp OxMetrics 7 software (2021)

Indonesia’s import from India estimation will increase around 5.1% from May 2021 to May 2023 (see Table 5). The estimate shows that Coefficient Variation (CV) will increase around 8.2% or a little bit higher compared with an estimation of Indonesia’s export quantity to the USA (8.1%). The CV number is below 9% shows that it is relatively stable and well maintain.

Table 5. Estimation of Indonesia’s Imports from India

Period	Import from India	% Changes
May-21	547,854,679	-
May-22	641,875,431	17.2
May-23	576,068,646	-10.3
<b>Changes May 2021 - May 2023</b>		<b>5.1</b>
<b>Standard Deviation (SD)</b>		<b>48,246,697</b>
<b>Average May 2021 - May 2023</b>		<b>588,599,585</b>
<b>Coefficient of Variation (CV) May 2021 - May 2023</b>		<b>8.2</b>

Source: calculation results of Stamp OxMetrics 7 software (2021)



### 3.2.2. Estimation Development of Indonesia's Import Quantity from India

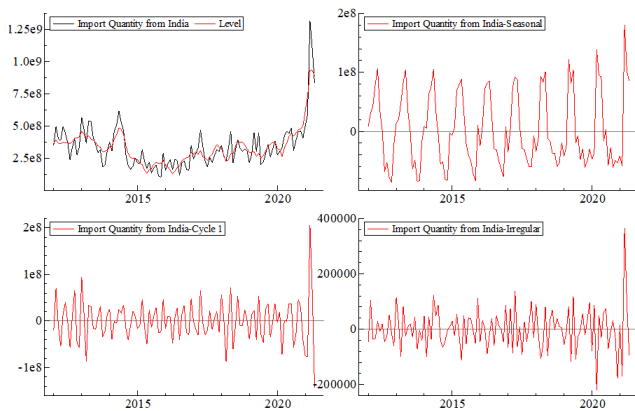


Fig. 6. Development of Indonesia's Import Quantity from India and the Effect of Trend, Seasonal, Cycle and Irregularity Components  
Source: calculation results of Stamp OxMetrics 7 software (2021)

STSM model to estimate Indonesia's import quantity development from India to India shows: (1) the trend is derived from the seasonal, cycle and irregular components that related to the demand and supply of import quantity of Indonesia from India, (2) seasonal component relatively similar every year, (3) cycle component also relatively similar every year except in 2021 there is an increase of fluctuation, (4) the pattern of irregular component similar like cycle component except the fluctuation in 2021 for the irregular component is higher compared to cycle component.

Indonesia's import quantity from India's estimation will increase around 30.9% from May 2021 to May 2023 (see Table 6). The estimate shows that the Coefficient of Variation will increase around 13.7%. It shows that the import quantity from India relatively fluctuates because the number is above the 9% threshold. The stakeholder needs to manage the impact of fluctuation of import quantity from India to Indonesia.

Table 6. Estimation of Indonesia's Import Quantity from India

Period	Import Quantity from India	% Changes
May-21	828,751,454	-
May-22	1,027,086,982	23.9
May-23	1,084,491,149	5.6
<b>Changes May 2021 - May 2023</b>		<b>30.9</b>
<b>Standard Deviation (SD)</b>		<b>134,185,824</b>
<b>Average May 2021 - May 2023</b>		<b>980,109,862</b>
<b>Coefficient of Variation (CV) May 2021 - May 2023</b>		<b>13.7</b>

Source: calculation results of Stamp OxMetrics 7 software (2021)

### 3.2.3. Estimation Development of Indonesia's Export to India

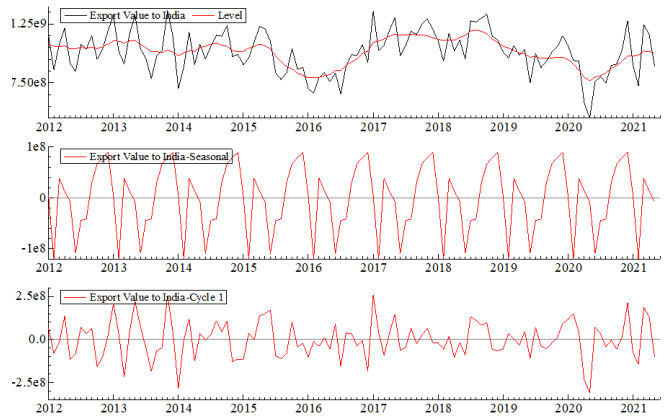


Fig. 7. Development of Indonesia's Export to India and the Effect of Trend, Seasonal, and Cycle Components  
Source: calculation results of Stamp OxMetrics 7 software (2021)

Structural Time-Series Model to estimate Indonesia's export to India shows: (1) the trend is derived from seasonal and cycle components, (2) seasonal component is relatively stable with the same pattern every year with two times increased in one year (the early and end of the year), (3) the lowest number of cycle components is in the year 2020 when the pandemic COVID-19 is starting to hit Indonesia and India, (4) there is no irregular component in this variable.

Based on Table 7, the model estimates that Indonesia's export to India will increase around 9.6% from May 2021 to May 2023. The CV estimation will increase by around 5.5%. It shows that the export to India is relatively stable because it is still below the 9% threshold.

Table 7. Estimation of Indonesia's Export to India

Period	Export to India	% Changes
May-21	885,857,624	-
May-22	979,814,832	10.6
May-23	970,893,850	-0.9
<b>Changes May 2021 - May 2023</b>		<b>9.6</b>
<b>Standard Deviation (SD)</b>		<b>51,863,122</b>
<b>Average May 2021 - May 2023</b>		<b>945,522,102</b>
<b>Coefficient of Variation (CV) May 2021 - May 2023</b>		<b>5.5</b>

Source: calculation results of Stamp OxMetrics 7 software (2021)

3.2.4. Estimation Development of Indonesia’s Export Quantity to India

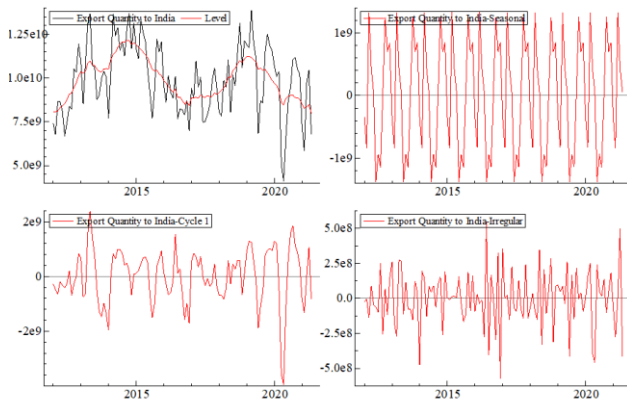


Fig. 8. Development of Indonesia’s Export Quantity to India and the Effect of Trend, Seasonal, Cycle and Irregularity Components  
Source: calculation results of Stamp OxMetrics 7 software (2021)

Structural Time-Series Model to estimate Indonesia’s export quantity to India shows: (1) the trend is derived from the seasonal, cycle and irregular components that related to demand and supply of trading between Indonesia and India, (2) the seasonal components in this model is relatively low value in the first half of the year and high value in the second half of the year, (3) the cycle components in this variable have a similar pattern with the cycle components in Indonesia’s export to India where the cycle component lowest number is in 2020, (4) exist irregular components where the highest value is in 2016 and 2021.

Based on Table 8, Indonesia’s export quantity to India estimation will increase around 18.2% from May 2021 to May 2023. The CV estimation also will increase by around 9.3%. This result shows that the export quantity to India is still stable because it is below the 9% threshold.

Table 8. Estimation of Indonesia’s Export Quantity to India

Period	Export Quantity to India	% Changes
May-21	6,773,868,239	-
May-22	7,986,540,104	17.9
May-23	8,003,760,029	0.2
<b>Changes May 2021 - May 2023</b>		<b>18.2</b>
<b>Standard Deviation (SD)</b>		<b>705,159,957</b>
<b>Average May 2021 - May 2023</b>		<b>7,588,056,124</b>
<b>Coefficient of Variation (CV) May 2021 - May 2023</b>		<b>9.3</b>

Source: calculation results of Stamp OxMetrics 7 software (2021)

4. Conclusion

USA and India are Indonesia’s second and fifth biggest export destination countries in the year 2020. Many opportunities can be achieved and some obstacles to be managed to increase the trade between these countries. Indonesia is one of the main trading partners for the USA and India.

In the year 2020 and early 2021, there was an economic crisis that affected the value and quantity of Indonesia’s trading with the USA and India. The pandemic of COVID-19 also increased the uncertainty of doing business in the future. It is important to know how big the export and import estimation is in the future to help recover from the economic crisis.

The total trade between Indonesia and the USA in the period of January-May 2021 compared to the same period in 2020 is increased by around 25%. The same condition where the total trade between Indonesia and India for January-May 2021 also increase around 44% compared to the same period last year. Furthermore, Indonesia’s non-oil gas exports to USA and India data is increase around 30% and 22% in January-May 2021 period compared to 2020 in the same period.

Based on the Structural Time-Series Model (STSM) estimation, Indonesia’s import and export to USA and India will increase in the next two years. Most of the development of Indonesia’s trade with USA and India trend derived from the seasonal, cycle, and irregular components, except for trend of Indonesia’s export to India that only derived from seasonal and cycle component (there is no irregular component). This is because coal, palm oil, and iron and steel products are the three main export commodities to India that stable and dominate the export around 66.7% compared to other commodities although there are external shocks. So, it is important to diversify Indonesia’s exports to India to other products.

The model estimates that Indonesia’s export to the USA will increase around 10% in the next two years. The same thing happened with the estimation of Indonesia’s export to India will increase by around 9.6%. In terms of Indonesia’s imports from the USA will increase around 14.5% and imports from India will increase around 5.1% in the next 2 years. Hopefully, the increase in export and import can help these three countries' economies recover from the economic crisis and it can support the increase of the business and economic growth during pandemic COVID-19.

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