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Revista de Antropología, Ciencias de la Comunicación y de la Información, Filosofía,  
Lingüística y Semiótica, Problemas del Desarrollo, la Ciencia y la Tecnología

Año 36, abril 2020 N°

# 91

Revista de Ciencias Humanas y Sociales

ISSN 1012-1537/ ISSNc: 2477-9385

Depósito Legal pp 198402ZU45



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Maracaibo - Venezuela

# **Impact of distance, exchange rate, population, and GDP on natural rubber export**

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## **Abstract**

The study aims to investigate the impact of distance, exchange rate, population, and GDP on natural rubber export. This study utilized two approaches, namely a descriptive approach and a quantitative approach, and used the gravity model approach in the process because the research used distance as one of the reference variables. As a result, a high GDP indicated higher income, and high income would lead to an increase in disposable income. In conclusion, the government should try to keep the rupiah exchange rate stable or even to increase it to maintain the stability of the Indonesian natural rubber trade flow.

**Keywords:** Distance, Exchange rate, Gravity model.

## **Impacto de la distancia, el tipo de cambio, la población y el PIB en la exportación de caucho natural**

## **Resumen**

El estudio tiene como objetivo investigar el impacto de la distancia, el tipo de cambio, la población y el PIB en la exportación de caucho natural. Este estudio utilizó dos enfoques, a saber, un enfoque descriptivo y un enfoque cuantitativo, y utilizó el enfoque del modelo de gravedad en el proceso porque la investigación utilizó la distancia

como una de las variables de referencia. Como resultado, un PIB alto indica un ingreso más alto, y un ingreso alto llevaría a un aumento en el ingreso disponible. En conclusión, el gobierno debería tratar de mantener estable el tipo de cambio de la rupia o incluso aumentarlo para mantener la estabilidad del flujo comercial de caucho natural de Indonesia.

**Palabras clave:** Distancia, Tipo de cambio, Modelo de gravedad.

## 1. INTRODUCTION

Indonesia is one of the world's top three exporters of natural rubber, ranked second, below Thailand, and above Malaysia. The fact suggests that Indonesia is competitive, and the product quality is guaranteed. The natural rubber crops had been exported to various trading partner countries, which were then studied by using a gravity model, so that they used several variables, both in demand and supply sides. On the supply side, the variables that can affect Indonesia's natural rubber exports included the distance between countries, import tariffs, and real currency rates. The distance between countries became a very significant variable because it would affect the transportation costs required. If the transportation cost is too high, it could reduce the export rate. With the existence of trade liberalization, it is expected that trade barriers such as tariffs would be eliminated, and if the tariffs can be annulled, it would be able to boost export. The real currency rate is used as the basis of reference in planning the goods price to be sold abroad (BAIDA, 2011: SHIGAPOV & NEDASHKOVSKY, 2019).

On the demand side, the GDP and population variables are variables that could increase exports. GDP and the large population of the importing countries would increase the demand for imported goods. Therefore, it is expected that the results of this study would be able to become one of the references for the government in setting policies, especially those concerning rubber export. Rubber is one of the world's attractive main export commodities. Rubber ranks the highest commodity in the export category of non-fossil raw materials, although the amount is still far from being able to match the global main export commodity, i.e. petroleum.

This is due to rubber characteristics that could not grow in all geographical climates. Rubber is the only commodity that could bring Indonesia to the top three largest exporters globally. In the country itself, rubber export ranks in the fourth position under petroleum, animal/vegetable oil products, and electronic components. Indonesia should be able to maximize its potential natural to become the top world rubber exporter. This notion is possible when looking at the fact that Indonesian rubber plantation areas are far wider than Thailand. Many aspects could influence why Indonesia only ranked second in the world rubber exporters, among which are the constraints in exporting, such as distance, export destination countries, the population in export destination countries, etc.

Table 1: Indonesian Rubber Export Volume 2006-2015  
Source: Central Bureau of Statistics (BPS)

Year	Net Weight (Thousand tons)				
	US	Japan	China	South Korea	Brazil
2006	557.2	278.9	281.5	82.1	44.6
2007	609.0	325.2	295.7	85.6	57.9
2008	589.5	370.3	299.0	103.2	71.5
2009	368.5	266.9	431.1	98.4	56.5
2010	507.4	307.6	406.6	90.1	107.3
2011	570.8	381.6	394.8	119.1	92.3
2012	545.6	384.1	425.8	141.9	68.5
2013	576.7	418.9	500.0	146.6	86.6
2014	571.2	401.6	357.8	158.4	102.8
2015	594.8	419.7	281.3	182.8	94.4

Based on BPS statistics, Indonesia exports rubber to the US, Japan, China, South Korea, and Brazil, as the top five main export destinations all these years. These five countries were selected based on Indonesia's largest export volume out of all Indonesian natural rubber-trading partners. Although the overall trend increases, Indonesian rubber export always fluctuates annually in all trading partner countries. The flux of export values drove the researchers to analyze further what factors caused these fluctuations. Even though the amount was considered as high-volume export, it did not release Indonesian rubber exports from problems. Many factors, both from within the country and from the importing countries, become obstacles in the rubber exports processes, including GDP, trade barriers in the form of the distance between the exporting and the importing countries, and the population of the importing countries which can

affect the rubber export quantity itself, as well as the currency rate (SARWOKO, 2009).

In his research, NATALE (2015) utilized the gravity theory which considers the two regions as masses that pulled each other. This pulling motion in life is then interpreted as trades that are also influenced by certain variables used. In his research, Natale used independent variables of population, distance, GDP, and income. YEBOAH (2007), suggested that population and GDP differences between the exporting countries and the United States were interconnected. Therefore, the gravity model can be applied in Indonesian rubber export research because it considered Indonesia and its trading partner countries as masses that pull each other (YEBOAH, 2007).

As a basis for determining the analysis technique and the variables used, the researchers used a combination of the two aforementioned variables, namely distance, as the main reference variable, GDP, population, and currency rate as the additional independent variables in determining whether these factors could influence Indonesian natural rubber export. The aim to achieve in this study was to examine the influence of several variables, namely population, distance, exchange rate, GDP, and the currency rate on the volume of rubber trade export from Indonesia. The researchers used previous studies previously described and used five Indonesian rubber trading partner countries as the basis.

## **2. LITERATURE REVIEW**

Indonesia is one of the world's top three natural rubber exporters, ranks second, below Thailand and above Malaysia. This fact indicates that Indonesia is competitive, and its product quality is guaranteed. The natural rubber crops have been exported to various trading partner countries, which are then studied by using a gravity model so that several variables, both on-demand, and supply sides, were employed.

On the supply side, the variables which can affect Indonesia's natural rubber exports included the distance between countries, import tariffs, and real currency rates. The distance was a very significant variable because the distance between countries would affect the transportation costs required. If it is too high, it could reduce exports. With the existence of trade liberalization, it was expected that trade barriers such as tariffs would be eliminated, and if the tariffs were not enforced they would be able to boost exports. The real currency rate was used as the reference basis in planning the goods price to be sold abroad.

On the demand side, the GDP and population were the variables that could increase exports. A high GDP and a large population of the importing countries would increase the demand for imported goods. Henceforth, it was expected that the results of this study could become one of the references for the government in setting policies, especially those related to the natural rubber export.

### **3. METHODOLOGY**

This study applied two approaches, namely descriptive and quantitative approaches. The descriptive approach was used to explain the results obtained from the analysis of the studied variables. The quantitative approach employed by the researchers was the panel data regression approach, which was a combination of time series data and cross-section data while the gravity model approach was applied in the process (YUNIARTI, 2007).

This study collected data by conducting a previous literature study of international and local journals, scientific articles, and textbooks whose relevance to the research topic had been verified. Then, the secondary data was collected online from the websites from the United Nations, the Federal Reserve Bank of St. Louis, and also from the Indonesian government agencies, such as the Indonesian Central Bank (BI), and the Central Statistics Agency (BPS) whose conformity to the study had also been verified. This study used panel data which was a combination of time series data and cross-section data.

To prove the hypothesis proposed in this study, all independent variables that the authors used in the form of GDP, distance, population, and the exchange rate should significantly affect Indonesia's natural rubber exports to the five largest Indonesian natural rubber importing countries. The five countries were the United States,



Japan, China, South Korea, and Brazil within the 10-year study period, starting from 2006 to 2015.

#### 4. RESULTS

Based on the Hausmann Test, the best model in this study was the Common Effect Model.

Table 2: Panel Data Regression Results of PLS Method

Variable	Coefficient
LgDISij (X1)	0.285257****
LgRERij(X2)	0.506656****
LgPOPj(X3)	0.694741****
LgGDPij(X4)	1.117330****
C	-1867241****
$R^2$	0.911030
Adjusted R-Squared	0.903122
Prob (Fstat)	0.000000
DW	0.873587

Source: E-Views 8.0 Regression (2017, Processed)/ 5% Significance level

The panel data estimation results by using the PLS model in Table 1 indicated different values and different coefficient values for each variable. The following is the interpretation of the panel data results in more detail for each variable using the Pooled Least Square method. Variable X1 (distance between capital countries) had a

positive effect with a significance level of 5%. It could be interpreted that every 1% increase in the distance between countries would increase Indonesian natural rubber export by 0.28%, assuming that the other variables remained the same. This fact was contrary to the applied theory assumption.

Variable X2 (currency exchange rates between countries) had a positive effect with a significance level of 5%. It could be interpreted that every 1% increase in the currency value would increase the Indonesian natural rubber export to the country by 0.50%, assuming that the other variables remained the same. Variable X3 (population of the destination country) had a positive effect value with a significance level of 5%. It could be interpreted that every 1% increase in the population of the importing country would increase the Indonesian natural rubber export to the country by 0.69%, assuming that the other variables remained the same.

Variable X4 (GDP of the destination country) had a positive effect value with a significance level of 5%. It could be interpreted that each increase of 1% in the Gross Domestic Products of the destination country would increase the Indonesian natural rubber export by 1.11%, assuming that the other variables remained the same. The aforementioned PLS panel data regression also indicated the value of 0.000 for each variable probability which was not greater than the significance level ( $\alpha$ ) of five percent. From these data, it could be interpreted that each variable that the authors used simultaneously had a significant effect on Indonesian natural rubber exports.

## **5. DISCUSSION**

In the aforementioned table of the PLS method panel data regression results, it could also be seen that the obtained coefficient of determination (R-Squared) was 0.911030. These results indicated that 91.10% of the variation of the determined dependent variables, namely the export of Indonesian natural rubber in the model used, could be explained by the independent variables used, namely distance, population, GDP, and exchange rate. Then, the remaining 8.90% was explained by other variables beyond the model used.

The regression results, obtained by using the Pooled Least Square method with the panel data type, indicated that the four independent variables used in this study (distance, exchange rate, population, and Gross Domestic Product) had a significant positive effect on Indonesian natural rubber export simultaneously. It could be concluded that every one-unit addition of the independent variable would result in Indonesian exports increase in the amount of each variable coefficient.

All the independent variables that the authors used in this study (distance, exchange rate, population, and GDP) amounted to a 91% rate in explaining the Indonesian natural rubber export rate as the observed dependent variable. This was indicated by the regression results amounting to 0.911030. Thus, 9% of the dependent variable could not be explained by the independent variables, and could only be explained by other variables not used in this study.

The discussion of the influence of distance on Indonesian natural rubber export is as follows. Based on the results of the PLS method panel data regression carried out in this study, distance had a significant positive effect on the increase in Indonesian natural rubber export with a coefficient value of 0.285257 and a probability value of 0.000 which was smaller than the significance level set at 5%. It could be interpreted that a distance increase of 1% (kilometer) between Indonesia and the export destination countries would increase Indonesian natural rubber exports to the countries by 0.28%. This was contrary to the gravity theory stating that if the distance between countries got farther away, the export value would decrease (SEKARINI, 2011). In other words, the further the distance between countries, the smaller the export value. It was estimated that with the technology growing rapidly now, the effect of distance as one of the obstacles in trade has become smaller. Technology creates transportation, meaning more efficiency in both travel time as well as in the use of fuel. Better technology enables larger carrying capacity than the existing transportation equipment.

The necessary level of the importing countries for rubber commodities could also be the cause where countries that have large industries requiring natural rubber as their raw materials would not be affected by the long distances with the exporting countries because economic interests become a priority.

Based on the results of the PLS method panel data regression conducted in this study, the currency exchange rate had a significantly

positive effect on the increase in Indonesian natural rubber exports, with a coefficient value of 0.506656 and a probability value of 0,000 which was smaller than the significance level set at 5%. It could be interpreted that every time rupiah was depreciated against the currency of the country importing Indonesian natural rubber, the domestic prices would be much cheaper when compared with foreign prices. This situation would improve competitiveness and increase export to get maximum profits (FRAUELIN, 2011). Besides, a stronger rupiah exchange rate would cause more incoming foreign currency, causing the export selling price and the foreign exchange received to increase (NATALE, 2015; YEBOAH, 2007).

Based on the results of the PLS method panel data regression conducted in this study, the population had a significant positive effect on the increase in Indonesia's natural rubber exports with a coefficient value of 0.694741 and a probability value of 0,000 which was smaller than the significance level set at 5% (PAKASA, 2011). This means that a 1% increase in the population of export destinations country would cause a 0.69% increase in Indonesian natural rubber export. The population in the export destination countries was the existing market potential. The greater the population in those countries, the greater the demand for goods, and the increase occurred to meet the population needs. The size of the population in export destination countries signifies a large market potential (YUNIARTI, 2007). The population will influence trade through the demand side. Thus, the greater the population, the greater the demand for a commodity (FRAUELIN, 2011).

Based on the results of the PLS method panel data regression conducted in this study, it was discovered that GDP had a significant positive effect on Indonesian natural rubber exports, with a coefficient value of 1.117330 and a probability value of 0,000 which was smaller than the significance level set at 5 %. It could be concluded that a 1% GDP increase of the Indonesian natural rubber export destination countries would increase Indonesian natural rubber exports to the countries by 1.11%. Therefore, a high GDP indicated higher income, and high income would lead to an increase in disposable income. In the end, both investment and consumption would also increase.

## **6. CONCLUSION**

The overall independent variables used by the authors in this research (distance, GDP, currency exchange rate, and population) had significant effects on Indonesian natural rubber export to five destination countries, namely the United States, Japan, China, South Korea, and Brazil. Distance had a significant positive effect on Indonesia's natural rubber exports to five of the largest importing countries, namely the United States, Japan, China, South Korea, and Brazil in 10 years from 2006 to 2015. To save travel costs and time, the importer would buy large quantities in one transaction.

The currency exchange rate had a significant positive effect on Indonesian natural rubber exports to the five largest importing countries, namely the United States, Japan, China, South Korea, and

Brazil in 10 years from 2006 to 2015. The depreciating exchange rate would cause domestic prices to be cheaper in comparison to the prices abroad. This situation would increase the competitiveness and export to get maximum profit. The Indonesian government could expand the Indonesian natural rubber market to increase its foreign exchange rate, without neglecting the neighboring countries.

The population had a significant positive effect on Indonesia's natural rubber exports to the five largest importing countries, namely the United States, Japan, China, South Korea, and Brazil in the 10 years, from 2006 to 2015. The population was one of the factors that influence the demand size for an item. The more the population, the greater the demand for goods. The government should try to keep the rupiah exchange rate stable or even to increase it to maintain the stability of the Indonesian natural rubber trade flow.

GDP had a significant positive effect on Indonesia's natural rubber exports to the five largest importing countries, the United States, Japan, China, South Korea, and Brazil. In dealing with competitors of natural rubber exports, Indonesia should be smart in reacting, so that consumers did not divert their trade flows, especially in terms of pricing.

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Revista de Ciencias Humanas y Sociales

Año 36, N° 91 (2020)

Esta revista fue editada en formato digital por el personal de la Oficina de Publicaciones Científicas de la Facultad Experimental de Ciencias, Universidad del Zulia.  
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