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Natural Rubber Economics between China and Southeast Asia: The Impact of China's Economic Slowdown*

Siskarossa Ika OKTORA[1], Alfada Maghfiri FIRDANI[2]

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Abstract

China has become the second largest economy since 2010. China's economy is supported by the rapid growth of its automobile industry. The rapid growth of the automobile and tire industry will increase the natural rubber (NR) demand as its primary raw materials. Although as a significant producer, China cannot fulfill the consumption by its domestic production. Thus China relies heavily on import from Southeast Asia countries as the primary producers of natural rubber in the world. China and Southeast Asia are dependent on their economy in terms of the availability of natural rubber as raw materials. But the economic slowdown in China since 2008 is expected to affect the international trading between China and Southeast Asia countries. This research aims to analyze the determinants of NR export from Southeast Asia to China using panel data analysis. The results show NR price, exchange rate, and China's economic slowdown significantly affect NR export to China, while Southeast Asian NR production has no significant effect. China as the main importer of NR from Southeast Asia has a big role in growing NR export in Southeast Asia. If China's economy doesn't improve soon, it will affect the economy in Southeast Asia.

Keywords: International Trade, Natural Rubber, Panel Data Analysis.

JEL Classification Codes: P45, Q23, C33.

1. Introduction

China has become the second largest economy in the world since 2010. China's economy is currently above Japan and Germany. China's economic growth continued to increase from 2000 to 2016 with an average economic growth of 9.42 percent annually. The highest economic growth was in 2007, reached 14.23 percent (The World Bank, 2018).

The manufacturing sector is a leading sector in China. China's economy is supported by the rapid growth of its automobile manufacturing industry. In its journey, China experienced rapid growth in the transportation and automobile industries (Gan, 2003). As from the early 1970s to the present, the manufacturing sector always contributes more than one-third of China's total GDP. This condition is much higher than in other countries that also eminent in the manufacturing sector, especially the automobile industry. The average contribution of the manufacturing sector in China reached 31.52 percent annually from 2000 until 2015. While the United States and Japan, also well-known as a manufacturer of automobile, have only an average of the manufacturing sector's contribution to total GDP each 13.10 percent and 20.85 percent annually (The World Bank, 2018).

China is one of three main car manufacturers in the world besides the United States and Japan. The average growth of the manufacturing sector, especially the automobile industry in China since 2000-2016 was 18.31 percent annually with the highest growth in 2009 (48.30 percent) (OICA, 2018). The rapid growth of the automobile and tire industry will increase the demand for its main raw material. It is natural rubber. China is one of the main natural rubber producers in the world, where the number of product in 2016

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1 First Author and Corresponding Author. Lecturer and Researcher, Politeknik Statistika STIS, Indonesia [Postal Address: Politeknik Statistika STIS, Jl. Otto Iskandardinata No. 64C, Jakarta Timur, 13330, Indonesia] E-mail: siskarossa@stis.ac.id

2 Statistician, Statistics Indonesia (BPS), Indonesia. E-mail: alfadaf16@gmail.com

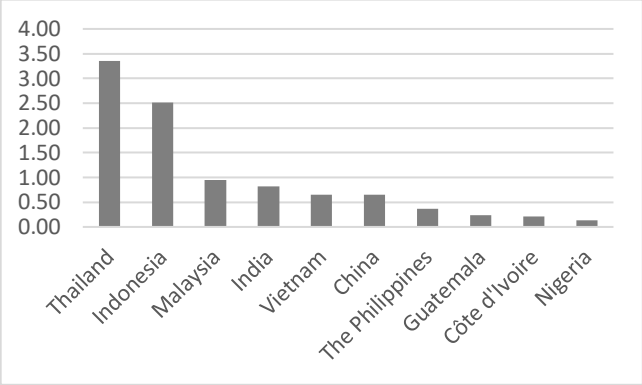
reached 6.16 percent of the world's total production. However, the plentiful total production has been unable to equalize its consumption. In 2015, China's natural rubber production reached 816,103 tonnes, while consumption reached 4,680,000 tonnes (FAO, 2018). It means China can only provide 17.44 percent of its natural rubber demand from its production.

Natural rubber consumption in China was the largest, reaching 38.53 percent of the world's total consumption in 2015 (Thai Rubber Statistics, 2018). Its domestic production cannot supply this huge consumption. Thus China relies heavily on imports. The main producers of natural rubber in the world come from Southeast Asia countries. Rubber trees need a constant high temperature between 26^0-32^0C and humid environment to produce optimally. Rubber trees originate from the Amazon basin and grow in the vicinity of the equatorial zone between 10^0N and 10^0S with continuous rainfall for twelve months (Li & Fox, 2012). These conditions exist in Southeast Asia, where most of the world's rubber is produced.

Southeast Asia countries are producers and suppliers of natural rubber needs in the world, especially for automobile producers such as the United States, Japan, and China. Thailand, Indonesia, Vietnam, Malaysia, and the Philippines are among the top 10 major natural rubber producers in the world, along with India and China. The following graph shows the average production of 10 major global natural rubber producers from 2000 until 2016.

Thailand's production annually since 2000-2016 was the largest in the world, reached 3.35 million tonnes or 31.80 percent of the world's production. Indonesia was the second with total production annually reached 2.51 million tonnes or about 23.86 percent of the world's natural rubber production. While Malaysia, Vietnam, and the Philippines each produced about 9.01 percent, 6.18 percent, and 3.42 percent of the world's production (FAO, 2018).

China is included in the top 10 of the world's natural rubber producers, where production annually reached 0.65 million tonnes or 6.14 percent of the world's total production. However, China is unable to fulfill its consumption needs. China's total imports from eight Southeast Asia countries (Thailand, Indonesia, Malaysia, Vietnam, Philippines, Cambodia, Myanmar, and Lao People's Dem. Rep.) in 2016 reached 98.51 percent of the total imports from the world. Thailand, Indonesia, Vietnam, Malaysia, and the Philippines are the five main natural rubber supplier countries to China. In 2016, China imported 2.33 billion tonnes of natural rubber from those five Southeast Asia countries, almost 93.16 percent of natural rubber total imports.



Source: FAOSTAT

Figure 1: Natural rubber production annually for top 10 natural rubber producer in the world, 2000-2016 (million tonnes)

Thailand dominated the number of natural rubber imported by China, almost 1.59 million tonnes, or reached 63.70 percent of China's total imports in 2016. China imported natural rubber from Indonesia and Malaysia each reached 11.18 percent and 11.52 percent of total imports while imports from Vietnam and the Philippines reached 6.79 percent of total imports, approximately equal to the total imports from other countries (UN Comtrade, 2018).

China has a high demand for natural rubber but cannot be fulfilled by its domestic production. China imports the main raw material of the tire to support the automobile industry from the world's main natural rubber producers from Southeast Asia. Or in other words, China is the main importer of natural rubber from Southeast Asia. Thus China and Southeast Asia are dependent on their economy in terms of availability of natural rubber as raw materials.

China's economic slowdown occurred since 2008. China's economic growth slowed to 9.65 percent, whereas in previous years China's economy continued to grow in the two-digit range. Even in 2007, China's economy reached 14.23 percent. China's economic slowdown continued until 2016. China's economic slowdown becomes a threat to natural rubber producers in the world. This slowdown will have an impact on the decline of China's natural rubber demand. It also implies the sustainability of domestic natural rubber economics in Southeast Asia which is heavily reliant on export. In the long run, economic slowdown in China, where the main export destination of Southeast Asia's natural rubber, does not only impact the economy of Southeast Asia generally but also has a social impact. It is based on Raju (2016) that concluded as an agricultural commodity and used for industrial raw material; natural rubber is produced by more than 80 percent small and marginal farmers. And because of more than 30 million

small farmers are at stake worldwide, natural rubber is also a social commodity.

2. Literature Review

The number of natural rubber trade flow to China is not only influenced by the number of productions from exporting countries. However, several other variables also influence the number of natural rubber trade flow to China. One of the variables affecting international trade is the exchange rate.

Following Wang and Lee (2012), it assumed that China's import demand depends on the real effective exchange rate to allow for a substitution of currency between China and another country. Zheng, Shao, and Wang (2017) also claimed that the exchange rate of trade partners was expected to have a positive effect on Chinese exports and adverse impact on Chinese imports based on the pass-through effect.

Natural rubber export prices of each exporting country also affect the amount of natural rubber that can be sold abroad and imported by the destination country. When the natural rubber price of exporting countries is high, then the exporting countries will further increase the number of commodities to be sold abroad. Thus, the number of items that can be imported by the destination country will be even greater. Natural rubber price instability, one of which is caused by the economic slowdown in developed and developing countries could affect the economic performance of exporting countries in many ways (Raju, 2016).

China has been one of Southeast Asia's main partners in trade, investment, and infrastructure development in the past decade. Southeast Asia is significantly benefited from China's economic growth which continued to strengthen from year by year. One of which is from high commodity prices driven by strong demand in China. China also plays the role of an important processing hub in expanding the regional production network (Ah, 2017). China as a new economic power of the world will affect the countries' economy that has international trade relations with.

China becomes the second-largest economy in the world and has the most extensive trading relationship in the economic system. So, when the economic downturn in China it will have a high impact on other countries. The slowdown in China may be having a significant effect on global trade, given China's large share of global demand about 15 percent of worldwide GDP and observed regional differences in the global trade slowdown (Blagrave & Vesperoni, 2016).

Many studies have analyzed the impact of China's slowdown on international trade, especially Asia. Because of China's slowdown, Blagrave and Vesperoni (2016) suggested that China's trading partners will face lower demand for exports, with a degree of this effect depending on countries' sectoral linkages with the Chinese economy. Dizioli, Hunt, and Maliszewski (2016) investigated the impact of China's economic slowdown on the economies of countries that have strong links with, like Southeast Asia countries. They reported that the GDP of Southeast Asia countries fell by about 0.2–0.25 of the change in China's GDP.

Low commodities demand, especially raw materials, was caused by slow economic growth in industrialized countries and also China. World economic growth had provided a boost for automotive industry growth which had increased natural rubber production. But the recession occurred in 2008-2012 affected the growth of the automotive sector and resulted in a lack of demand for natural rubber (Raju, 2016).

To analyze the determinants of international trade, the panel model is one of the most common methods. A panel regression model was used by Zheng, Shao, and Wang (2017) for the import and export of Chinese non-ferrous metals. The study used several countries as cross-section units and several periods as time series units with no missing values. Augmented Mean Group (AMG) model is used by Eberhardt and Teal (2010) to study productivity in global manufacturing production. And AMG is also used by Atasoy (2017) to take cross-section dependence in panel data.

This research aims to analyze the determinants of international trade between China and the five leading producers and exporter of natural rubber countries in Southeast Asia namely Thailand, Indonesia, Malaysia, Vietnam, and the Philippines, including the impact of China's economic slowdown to natural rubber trade flow from Southeast Asia countries to China.

3. Research Methods and Materials

The subject of this research is the natural rubber trade flow between China and five main natural rubber producers and exporter in Southeast Asia countries (Thailand, Indonesia, Vietnam, Malaysia, and the Philippines). This research uses annual data from 2000 to 2016. The data source used in this study are number of natural rubber exports volume (in kilograms) to China as natural rubber trade flow from UN Comtrade, natural rubber production (in tonnes) from FAOSTAT, natural rubber export prices (in USD/kg) from Factfish, and real effective exchange rate from The World Bank.

This research generates a foreign variable that directly connected with the openness of a country as research of Dinda (2017) about the impact of the People's Republic of

China's (PRC) slowdown on the global economy. This study measured the impact of PRC's growth affects any other country through openness, where export, import and GDP data are generated from The World Bank. The openness is defined by the ratio of export and import to GDP and also known as the trade intensity of a country for a given year. Adopted from Dinda (2017), this study also constructs a foreign variable as the product of the China's growth rate weighted with a country's openness, ChnImp = GrChn x ln Op, where ChnImp = China's Growth Impact, GrChn = China's Growth Rate, and Op = Openness.

For the empirical analysis, this study uses panel data regression analysis. We develop a panel data regression model for natural rubber trade flow to China for the research purpose in this study, respectively :

$$TF_{it} = c + \beta_1 Prod_{it} + \beta_2 Price_{it} + \beta_3 REER_{it} + \beta_4 ChnImp_{it} + \varepsilon_{it} \quad (1)$$

Where c is a constant/intercept coefficient, β_i (i = 1, 2, ...4) is slope coefficient, *TF* is natural logarithm of natural rubber trade flow to China, *Prod* is natural logarithm of natural rubber production, *Price* is natural logarithm of natural rubber price, *REER* is natural logarithm of the relative effective exchange rate, $ChnImp$ is China's Growth Impact, and ε_{it} is error term.

3.1. Cross-section dependence test

Cross-sectional dependence as an encountered situation in economics applications is an essential issue in panel data analysis. Ignoring this assumption will have a severe problem in econometrics modeling because the efficiency gains that the researcher had hoped to achieve by pooling the data will largely diminish (Sarafidis & Robertson, 2008). This research uses panel data where the number of cross-section unit (N) is small and the time dimension (T) is large, so traditional time series techniques, including log-likelihood ratio test, can be applied. The Lagrange Multiplier (LM) test of Breusch Pagan is suggested by Pesaran (2004) which is based on the average of the squared pair-wise correlation of the residuals could be used.

The LM test statistics proposed by Breusch and Pagan (1980) is calculated as follows:

$$LM = T \sum_{i=2}^{N} \sum_{j=1}^{i-1} r_{ij}^2 \quad (2)$$

where N denotes the number of cross-sections, T denotes the number of time series, and r_{ij}^2 denotes the residual correlation coefficient. The statistic test shows that the Breusch Pagan LM test is 26.012 and p-value is 0.0037. Thus, the null hypothesis of no cross-sectional dependence is rejected at 5% level.

3.2. Unit root tests

When using panel data analysis, especially when the number of time series is larger than the number of the cross-section, it is important to check the stationarity of all variables. For this test, we use the Im-Pessaran-Shin (IPS) test and Breitung test. These tests allow cross-sectional dependence in the data, especially the Breitung test, it has a good power test with a small data set. Based on the unit root test, as indicated in Table 1, the IPS test results conclude that only two variables are stationary in their level form (TF and $Price$). But for the Breitung test, all of the variables are not stationary in their level form with or without time trend is included.

Table 1: Unit Root Test in Level and First Difference

	IPS		Breitung	
	Intercept	**Intercept + Trend**	**Intercept**	**Intercept + Trend**
TF	-1.4666*	-1.3849*	-0.0184	1.0181
$Prod$	-0.2111	1.0838	2.7207	1.7139
$Price$	-1.3116*	-0.6158	-0.3422	0.5047
$REER$	1.2862	-0.6341	-0.8046	0.2020
$ChnImp$	-0.0219	-0.3808	-0.2317	0.1841
	IPS		**Breitung**	
	Intercept	**Intercept + Trend**	**Intercept**	**Intercept + Trend**
ΔTF	-4.4975***	-5.0327***	-3.7490***	-2.9992***
$\Delta Prod$	-3.1178***	-3.7211***	-2.9268***	-4.3247***
$\Delta Price$	-4.1459***	-4.3988***	-4.1812***	-1.5827*
$\Delta REER$	-3.8500***	-4.4338***	-2.3299**	-1.7200**
$\Delta ChnImp$	-3.8808***	-4.4073***	-5.0310***	-5.0920***

*, **, *** indicates that statistics are significant at 10%, 5%, and 1% level of significance. For the IPS and Breitung test, the null hypothesis is nonstationarity.

All the variables have been stationary using IPS and Breitung test after we do the transformation into the first difference form. But the estimated results of the first difference model might miss some important information because the first difference will reduce the sample size.

3.3. Augmented Mean Group (AMG) Estimator

Based on the cross-sectional dependence and unit root test, it can be concluded that there is a violation of assumptions. Thus, to avoid inconsistency of the estimation, this research uses a robust method. A proven robust model to many empirical setups is introduced by Eberhardt and

Bond (2009) namely the Augmented Mean Group estimator. AMG estimators are robust to nonstationarity estimators, whether or not cointegrated, and cross-sectional dependence (Eberhardt & Teal, 2010). AMG estimator accounts for cross-sectional dependence by including a common dynamic process in the regression. This process is extracted from the year dummy coefficients in the first difference (FD-OLS) of pooled regression and represents the level-equivalent mean evolution of unobserved common factors across cross-section units (Eberhardt & Teal, 2010).

AMG employs a two-stage method to estimate the unobserved common dynamic effect and includes the common dynamic effect parameter to allow for cross-sectional dependence (Atasoy, 2017). First, it configures the first difference regression model using time dummies. This step is used to anticipate bias estimation because of nonstationary variables.

$$\Delta y_{it} = \beta_i \Delta x_{it} + \sum_{t=2}^{T} c_t DUMMY_t + \varepsilon_{it} \quad (3)$$

where the year dummy coefficients will be relabelled as μ_t.

Second, μ_t is included in each of the N cross-section regressions including linear trend terms, or alternatively, μ_t can be substracted from the dependent variable, which implies the common process is imposed on each cross-section with a unit coefficient (Eberhardt & Bond, 2009).

$$y_{it} = \alpha_i + \beta_i x_{it} + c_i t + d_i \mu_t + \varepsilon_{it} \quad (4)$$

We can obtain the mean group estimator for AMG by calculating the mean of each coefficient over each regression as follows :

$$\hat{\beta}_{AMG} = N^{-1} \sum_{i=1}^{N} \hat{\beta}_i \quad (5)$$

This research includes the estimate of traditional methods such as fixed effect and random effects as the comparison. The Mean Group (MG) estimator also includes in this research. It produces consistent estimates when the time dimension is long enough.

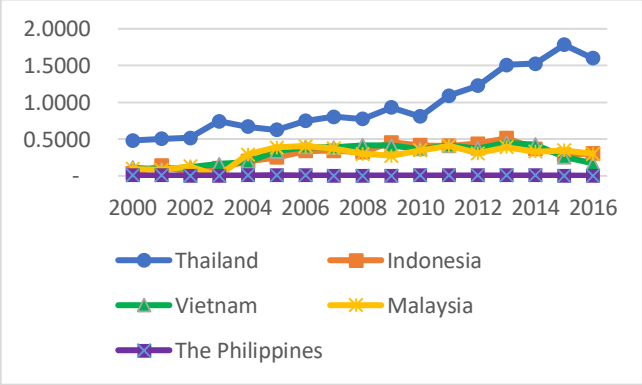
4. Results and Discussion

4.1. Natural Rubber Trade Flow to China Before and After China's Economic Slowdown

Natural rubber trade flow to China from five main countries in Southeast Asia tended to increase before the economic slowdown in China. The main importer was Thailand. From 2000 to 2016, exports from Thailand outperformed the other four Southeast Asia countries. In 2000, imports from Thailand were 0.4819 million tonnes, and in 2015 they reached 1.7822 million tonnes or grew by 269.81 percent over the last 16 years. But in 2016 exports from Thailand fell by 10.13 percent.

In contrast to Thailand, a total of natural rubber trade flow to China from four other countries tended to decrease, especially after 2007. The decline of Malaysia's in 2008 looked quite significant than the other countries, reached 18.89 percent. This condition made a change of the Malaysian natural rubber export pattern until the end of the research period. From 2000 to 2007, natural rubber trade flow from Malaysia to China was higher than Indonesia, as the main competitor, but after 2007 it was lower.

China's economic slowdown in 2008 also directly impacted to Thailand's and Indonesia's natural rubber exports, where Thailand's exports declined by 3.79 percent while Indonesia's was 6.72 percent. Although exports from the Philippines continued to grow in 2008, in 2009 the exports declined by 52.28 percent. Similar conditions also occurred in Vietnam. Although the decrease in 2009 only 0.61 percent, the impact of China's economic slowdown continued to affect exports decrease until the end of the research period. Vietnam's largest decrease occurred in 2015, reached 39.87 percent.



Source: FAOSTAT

Figure 2: Natural rubber export volume from Southeast Asia to China between 2000-2016 (million tonnes)

4.2. Panel Estimation Results

Table 2 displays the estimates of the impact of natural rubber production, natural rubber price, relative effective exchange rate, and China's economic growth on natural rubber trade flow to China. It is compared between fixed effect, random effect, MG and AMG estimator. The result shows that in the fixed effect model, natural rubber price

and *REER* significantly affects natural rubber trade flow to China. Random effect model shows that all variables significantly affect natural rubber trade flow to China. But both of estimations still have nonstationary and cross-sectional dependence problem and make inefficiency in estimation result, or it can produce a spurious result. Mean Group (MG) estimator provides only natural rubber price significantly affects natural rubber trade flow to China. But this estimator is weak because MG does not care about cross-sectional dependence (Atasoy, 2017). So, the AMG estimator is the preferred model; our main interpretations focus only on this model.

Based on Table 2, the coefficient of *Prod* is estimated at 0.6397, which indicates that one percent increase in production of Southeast Asia's natural rubber will increase natural rubber trade flow to China by 0.6397 percent. It can indicate an increasing number of production from natural rubber producers (Southeast Asia countries) also expanding the number of natural rubber trade flow to China. Rubber cultivation has overgrown since the mid-2000s. Its cultivation is related to the increase in rubber prices and demand from China (Fern, 2018). But in this research, Southeast Asia's natural rubber production does not affect natural rubber trade flow to China significantly and in line with the decline of China's demand for natural rubber due to its economic slowdown since 2008 despite abundant natural rubber production in exporting countries.

Table 2: The Fixed Effect, Random Effect, MG, and AMG Estimator

	Fixed Effect	Random Effect	MG	AMG
$Prod$	0.5130 (0.5025)	1.6265*** (0.1282)	0.2970 (0.8645)	0.6397 (0.6216)
$Price$	0.6781*** (0.1791)	0.4101*** (0.1879)	0.4951*** (0.1674)	0.4151*** (0.1474)
$REER$	-1.9556** (1.1330)	-0.1904*** (0.0355)	-2.4688 (1.8010)	-2.3842* (1.6315)
$ChnImp$	0.0416 (0.0811)	0.1999*** (0.0268)	0.1964 (0.1558)	0.1194** (0.0674)
$Constant$	-2.6161 (8.9087)	-11.5628 (1.7792)	6.8332 (13.2194)	1.9011 (9.1139)

*, **, *** indicates that statistics are significant at the 0.15, 0.10, and 0.05 level of significance.

The coefficient of *Price* is estimated at 0.4151 and significant. It indicates that if natural rubber price increases by one percent, natural rubber trade flow to China increases 0.4151 percent. Increasing natural rubber price could affect the motivation of natural rubber plantation farmers and also exporters. Price could be an indicator of farming decision to expand the quantity of their product into the market. This condition makes the farmers increase the number of productions, and then the exporters increase the number of exports. Inoue, Kaya, and Oshige (2008) mentioned that in global trade, China's economic slowdown also has an impact on international prices, including the price of agricultural products.

It was evidenced by the tendency of Southeast Asia's natural rubber prices continued to decline until 2016. Natural rubber prices from the five largest exporting countries in Southeast Asia tend to be volatile. Natural rubber prices peaked in 2011 but subsequently continued to decline. It linked to the world's economic slowdown, particularly China, and lower oil prices.

The coefficient of *REER* is estimated at -2.3842 and significant. It indicates that if the real effective exchange rate increases by one percent, natural rubber trade flow to China decreases 2.3842 percent. It means that the higher real effective exchange rate of the export destination country against the exporting countries will cause the commodity prices in the export destination country to be cheaper than the exporting countries. So the export volume of exporting countries will decline as consumers in export destination country prefer to consume domestic commodities than imported commodities.

ChnImp as the global linking variable is an interactive variable and shows China's economic growth diffusion (Dinda, 2017). From the result of Table 2, the impact of China's economic performance percolates into foreign variables for each Southeast Asia country is positively significant. It is clear that China's economic growth directly affects the number of natural rubber trade flow from Southeast Asia to China. It means when China faces an economic slowdown, it will decrease the demand for exported goods. This condition gives an impact to Southeast Asia countries that the number of natural rubber export to China will decline. This result is in line with findings of Dinda (2017), the impact of China's economic slowdown may impact the developing countries (such as Southeast Asia) through export.

It is also in line with Blagrave and Vesperoni (2016) that found China's economic transition has played a significant role in global exports slow down. That study also concluded the impact of China's slowdown is large enough in high trade exposure countries with China. Inoue, Kaya, and Oshige (2008) also found that the economic downturn in China had a significant impact on countries under China's trade structure. Indonesia is one of the biggest commodity exporters affected by economic shock in China, reflecting both demand and terms of trade shock. Malaysia and Thailand as export-dependent countries on the East Asian production cycle are also affected.

5. Conclusions

China became the second largest economy in the world since 2010. The manufacturing sector is the leading sector in China. China's economy is supported by the rapid growth of its automobile manufacturing industry. China is a major producer of natural rubber in the world. But the high total production has been unable to equalize its consumption. Southeast Asia countries are producers and suppliers of natural rubber needs in the world. Thailand, Indonesia, Vietnam, Malaysia, and the Philippines are the five main natural rubber supplier countries to China. Thus China and Southeast Asia are dependent on their economy in terms of availability of natural rubber as raw materials.

China's economic slowdown occurred since 2008. And it could impact the natural rubber trade flow to China. The study shows that natural rubber price, REER and China's economic slowdown significantly influence the natural rubber trade flow to China. It indicates that the number of natural rubber trade flow to China not only determined by the economic stability of exporter countries but also importer country.

Southeast Asia countries are the primary producers and exporters of natural rubber as raw materials in the world. The huge potential of natural rubber from Southeast Asia countries is consumed slightly, and most of it is exported abroad, especially to automotive-producing countries of the world, one of them is China. An increase in China's demand boosts domestic rubber investment. The growth and development of natural rubber companies also boost economic growth in Southeast Asia countries. This condition has resulted not only China needs Southeast Asia as a raw material supplier, but Southeast Asia also relies on China to spur its economic growth especially in natural rubber exports. It is important for Southeast Asia countries to wary the decreasing of natural rubber exports as the impact of China's economic slowdown.

China's long-term demand decline could have an impact on exporter rubber investment. From the results, we know that the number of domestic production is not significant to the natural rubber trade flow to China. This condition causes the excess supply that cannot be avoided. Reducing the amount of production is a short-term solution. But the policy that can be taken by Southeast Asia countries in the medium and long term is to increase economic cooperation with other automobile industrial countries such as South Korea and India. Encouraging domestic innovation and investment to increase the value added of natural rubber by converting raw materials into semi-finished or finished materials before being exported is also one of the best solutions. Southeast Asia countries need greater efforts to diversify natural rubber products to avoid dependence on China and other developed countries.

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