An Investigation of China’s Import Demand for Technically Specified Natural Rubber (TSR) from Thailand

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Abstract: Approximately 90 percent of rubbers produced in Thailand are for exporting and the major importer is China, which is accounted for 56.60 percent of exported rubbers from Thailand. A substantial exported rubber is in the form of Technically Specified Natural Rubber (TSR) or block rubbers to produce tires. This article aims to analyze China’s import demand for TSR from Thailand and other countries including Japan and South Korea. The investigation found that Chinese consumers’ behavior has considered TSR as normal goods. Furthermore, information from trading partners and this comparative study would be beneficial to stakeholders to implement policies when Chinese importing circumstance has been changed.

Key Words: Import demand, Technically Specified Natural Rubber (TSR), Thailand

INTRODUCTION

Rubber is one of major industrial crops in Thailand because rubber’s prices have been continuously increasing during the past decade. In addition, with the government’s policies to support and promote cropping rubber around Thailand, the production of rubber in 2015 has been raised around 34.3 percent, a million tons increase from 2004 to 2015. Furthermore, Thailand has been a leader in producing and exporting rubber of the world since 1991. However, the rubber production of Thailand in 2015 was only 4 million tons, a 3.2 percent decline from 2014, as a result of the drought and political instability (Bank of Thailand, 2015). The main production of Thai rubber industry is for exporting, as Thailand is a major producer and exporter of Rib Smoked Sheet (RSS) and concentrated latex in the world; and the world’s second largest producer and exporter of blocked rubber after Indonesia (Cherdchoongam & Rungreunganun, 2015).

In the world market, the first three exporting countries are Thailand (32.1 percent), with a production of approximately 276 kilogram per rai (6.25 rai = 1 ha), Indonesia (26.4 percent), and Malaysia (8.9 percent), respectively (table 1). These three countries are major producers because of their climates and demographical advantages to grow rubber trees, as well as lower labor costs and high capacity in producing rubber.

| Year | Thailand | Malaysia | Indonesia | China | India | Sri Lanka | Liberia | Nigeria |
|------|----------|----------|-----------|-------|-------|-----------|---------|---------|
| 2009 | 3,164.40 | 857      | 2,440.00  | 644   | 820.3 | 137       | 59.5    | 45      |
| 2010 | 3,252.10 | 939      | 2,736.00  | 687   | 850.8 | 153       | 62.1    | 54.2    |
| 2011 | 3,569.00 | 996.2    | 2,990.00  | 727   | 892.7 | 158.1     | 64.5    | 55.3    |
| 2012 | 3,778.00 | 922.8    | 3,012.00  | 802   | 919   | 152       | 64      | 57      |
| 2013 | 4,170.00 | 826.5    | 3,237.00  | 865   | 796   | 130.5     | 68.8    | 57      |
| 2014 | 4,324.00 | 668.1    | 3,153.20  | 840.1 | 704.5 | 98.7      | 59.9    | 57.5    |

Source: Statistics Rubber Thailand (2016)
Production reported in Unit: 1,000 Ton

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In terms of gross exporting among these top three exporters of the world (table 2), in 2014 the highest exporter was Thailand, accounting for 48.40 percent, followed by Indonesia and Malaysia, which were 35.64 and 15.96 percent, respectively. Thailand’s major exporting products are blocked rubber, RSS, and concentrated latex. The major importing countries are China and Japan for RSS and blocked rubber, whereas Malaysia is for concentrated latex. Indonesian’s major importers are USA, Japan and China, whereas Malaysia’s major importers are China and EU.

Table 2: Gross exports of natural rubber

| Year | Thailand | Malaysia | Indonesia |
|------|----------|----------|-----------|
| 2004 | 2,637.10 | 1,106.10 | 1,875.10  |
| 2005 | 2,632.40 | 1,143.30 | 2,025.10  |
| 2006 | 2,771.60 | 1,285.20 | 2,290.30  |
| 2007 | 2,703.80 | 1,212.90 | 2,415.70  |
| 2008 | 2,675.30 | 1,154.50 | 2,297.30  |
| 2009 | 2,726.20 | 1,087.70 | 2,061.30  |
| 2010 | 2,866.40 | 1,245.40 | 2,368.70  |
| 2011 | 2,890.00 | 1,239.50 | 2,565.80  |
| 2012 | 3,024.30 | 1,290.90 | 2,524.90  |
| 2013 | 3,648.70 | 1,331.60 | 2,770.20  |
| 2014 | 3,614.90 | 1,192.40 | 2,661.70  |

Source: Statistics Rubber Thailand (2016)
Production reported in Unit: 1,000 Ton

The world’s natural rubber consumption is highly related to the world’s economy, particularly highly correlated with the Chinese economy since China is the world’s highest consumer of natural rubber. Previously, Chinese economy had rapidly grown but it has been slowly grown in the recent years. The world’s rubber consumption in 2015 was only 12.4 million tons, a 2.2 percent increase from previous year, which was the lowest growth since 2013. This is due to a gradual decline in Chinese rubber consumption as a result of three factors: A downturn in automobile industry, an Anti-Dumping Duty (AD), and a substitution to use synthetic rubber since price of synthetic rubber is lower as a consequence of lower crude oil prices. Thailand is the world’s second largest producer of Technically Specified Natural Rubber (TSR), only after Indonesia (table 3), and the major importer is China. TSR is processed into variety of products including wheel tyres, retreading tyres, spare tyres, engineering materials and parts of many manufacturers. During 2009 to 2014 Thailand’s rubber exporting has been continuously rising, accounting for 37.83 percent, while the real price of rubber exporting has fluctuated depending on the world price of rubbers, as accounted for a dramatic increase of 62.33 percent (table 4).

Table 3: Gross export quantity of technically specified rubber by country

| Year | Thailand | Malaysia | Indonesia |
|------|----------|----------|-----------|
| 2004 | 998.00   | 1,008.10 | 1,707.40  |
| 2005 | 1,109.30 | 1,056.00 | 1,685.60  |
| 2006 | 1,069.30 | 1,064.10 | 1,953.30  |
| 2007 | 1,103.80 | 952.00   | 2,124.40  |
| 2008 | 1,132.10 | 861.80   | 2,148.50  |
| 2009 | 950.60   | 617.40   | 1,905.00  |
| 2010 | 1,106.40 | 838.50   | 2,278.80  |
| 2011 | 1,224.10 | 905.90   | 2,478.90  |
| 2012 | 1,286.90 | 726.80   | 2,374.50  |
| 2013 | 1,470.80 | 793.10   | 2,608.20  |
| 2014 | 1,529.00 | 675.10   | 2,549.80  |

Source: United Nations Commodity Trade Statistics Database (2014)
Production reported in Unit: 1,000 Ton
Table 4: Export value technically specified rubber by country

| Year | World   | Thailand | Indonesia | Malaysia |
|------|---------|----------|-----------|----------|
| 2009 | 6,683.91| 1,476.28 | 3,104.65  | 1,175.15 |
| 2010 | 15,155.25| 3,066.44 | 7,102.86  | 2,647.36 |
| 2011 | 24,070.04| 5,696.20 | 11,416.10 | 4,110.11 |
| 2012 | 27,778.56| 4,204.53 | 7,626.72  | 2,382.67 |
| 2013 | 18,966.02| 3,919.27 | 6,706.86  | 2,067.70 |

Source: United Nations Commodity Trade Statistics Database (2014)
Production reported in Unit: Billion baht

Blocked rubber produced in Thailand is mainly for exporting, and the major markets are China, Japan and South Korea (table 5). The total amount of exporting blocked rubber is fluctuated depending on the world’s rubber market price as well as Chinese economy, because China is the main rubber importer from Thailand. In addition, total value of exporting is affected by competitiveness between other players: Indonesia and Malaysia.

The study of import demand of blocked rubber from China would prove beneficial in terms of guiding policy makers and rubber producers, together with other stakeholders to cope with trend or changes in China’s import demand. Comparisons of TSR import demand with other major importers, Japan and South Korea, are also given.

Table 5: Major importer of TSR from Thailand

| Year | World   | Thailand | Indonesia | Malaysia |
|------|---------|----------|-----------|----------|
| 2009 | 6,683.91| 1,476.28 | 3,104.65  | 1,175.15 |
| 2010 | 15,155.25| 3,066.44 | 7,102.86  | 2,647.36 |
| 2011 | 24,070.04| 5,696.20 | 11,416.10 | 4,110.11 |
| 2012 | 27,778.56| 4,204.53 | 7,626.72  | 2,382.67 |
| 2013 | 18,966.02| 3,919.27 | 6,706.86  | 2,067.70 |

Source: Department of Foreign Trade (2016)
Production reported in Unit: Million baht

This paper is divided into 4 sections. First, brief literature review on structural import demand equations and China’s import demand is highlighted. Second, methodology is described. Third, results as well as their interpretations are presented. Last, conclusion is explained.

LITERATURE REVIEW

Many studies have attempted to explain the import demand of various countries and a variety of products. Lo, Sawyer and Sprinkle (2007) found the relationship between the income elasticity of import demand as a result of GDP. The study concludes that as the economy has grown, the income elasticity of import demand will also increase.

Zhang and Gan (2007) tested the factors impacting the China’s import demand for forest product from many regions and countries around the world such as Russia, Southeast Asia, Africa, the United States and the European Union using four simulation scenarios: world economic growth, the Yuan currency appreciation, logging restrictions under the Natural Forest Conservation Program (NFCP) in China and the combination of the currency and logging restriction. The results conclude that the world economic growth is a major impact on the import demand as well as the exports for forestry in China. Moreover, the logging restrictions in China and the Chinese Yuan appreciation directly affect the import demand.

Wang and Lee (2012) examined the import demand function for China using lag model. The results appear controversial to the theory that quantities of import for China will decline although there is a reduction in external competitiveness (appreciation). The reason may be due to the anti-dumping duties imposed on some products. However, these economic factors: Domestic economic activity, real
effective exchange rate and the perception of the global risk have directly and significantly affected the import demand of China.

Farinelli et al. (2009) estimated the economic factors affecting import demand for Brazilian ethanol of its major importers. The price elasticity for Brazilian ethanol is found in the Caribbean region, Mexico, Japan and Nigeria, whereas the price inelasticity is found in the United States and Europe.

Turner and Buongiorno (2004) studied the static and dynamic model in order to estimate price and income elasticity of import demand for forestry and its related products using panel data from 64 countries. Information was selected between 1970 and 1987. The demand for import products tended to be elastic to income, while the majority of the products were found to be inelastic to price.

Hamori and Matsubayashi (2001) analyzed the stability of Japan’s aggregate import demand function applying co-integration test using quarterly data from the first quarter of 1973 to the first quarter of 1998. The variables in the study are real import, real GDP and relative import price. It is concluded that a stable import demand function in Japan cannot be found. In contrast, the study of Tang (2003) which assessed the import demand function of Japan during 1973 to 1997 using bound test approach found the opposite result. It concludes that the import demand function is stable and the import demand in Japan is income elastic.

METHOD AND DATA

According to Goldstein and Khan (1985) quantity of imports depends on two factors: Real domestic income ($Y_i$) and price of the commodity ($P_i$), as presented in terms of a function as:

$$M_i = f(Y_i, P_i)$$

(1)

The linear equation can be written with some partial derivatives as:

$$M_i = \alpha_0 + \alpha_1 P_i + \alpha_2 Y_i + \varepsilon_i$$

(2)

Where:

$\alpha_1$ = import price elasticity
$\alpha_2$ = income elasticity of import demand

The parameter $\alpha_1$, import price elasticity, should move in different direction. This is, when the import price increases, the import quantity should decrease; while when the import price decreases, the import quantity should rise. In addition, the parameter $\alpha_2$ can be positive or negative. If import goods are normal goods, the income elasticity will be positive, while if import goods are inferior goods, the income elasticity will be negative Yimnak, (2016).

Wang and Lee (2012) studied the import demand model for China. Unlike the demand volume by Bahmani-Oskooee and Hajilee (2011), which assumes that the import demand of China is affected by income and real interest rate, Wang and Lee included a proxy called a VIX and real effective exchange rate in the equation as:

$$\ln M_t = \beta_0 + \beta_1 \ln IP_t + \beta_2 \ln REER_t + \beta_3 \ln VIX_t + \varepsilon_t$$

(3)

Where:

$M$ = Import volume
$IP$ = Domestic income
$REER$ = Real effective exchange rate
$VIX$ = Implied volatility of the US market
$\varepsilon_t$ = Error term

Khan and Ross (1977) found that the log-linear equation as shown in equation (4) was better since the regression coefficient can provide results about price and income elasticity.

$$\log M_i = \alpha_0 + \alpha_1 \log P_i + \alpha_2 \log Y_i + \omega_i$$

(4)

Farinelli, Carter, Lin and Sumner, (2009) analyzed the economic factors affecting the import demand for Brazilian ethanol by its major buyers. The authors include many factors: the world price of crude oil, real Gross Domestic Product (GDP), real exchange rate, and import tariff. As a result, the
estimated long-run import demand by using the multiple regression model as:

\[ Q_{\text{Meth}}_t = \beta_1 + \beta_2 P_{\text{eth}}_t + \beta_3 P_{\text{oil}}_t + \beta_4 \text{GDP}_t + \beta_5 \text{ExRt}_t + \beta_6 \text{Tariff}_t + \beta_7 \text{Trend}_t + \beta_8 \text{LagQ}_{\text{Meth}}(t-1) + \varepsilon_t \]  

Where:  
- \( Q_{\text{Meth}}_t \) = Quantity of ethanol imported, in billion liters, in quarter \( t \) and country \( i \)  
- \( P_{\text{eth}}_t \) = Import price of ethanol, in 2007 US dollars per liter  
- \( P_{\text{oil}}_t \) = World import crude oil price, in 2007 US dollars per liter  
- \( \text{GDP}_t \) = Real Gross Domestic Product (GDP), in 2007 billion US dollars  
- \( \text{ExRt}_t \) = Real exchange rates, 2007 = 100 US (USD per foreign currency and then indexed by GDP deflator)  
- \( \text{Tariff}_t \) = Import tariff, in 2007 US dollars per liter  
- \( \text{Trend}_t \) = Linear time trend, where \( t = 1 \) is equivalent to 1st quarter of 1997  
- \( \text{LagQ}_{\text{Meth}}(t-1) \) = Lagged quantity of ethanol imported, in billion liters  
- \( \varepsilon_t \) = Estimated residual  

From the previous studies, the Thailand’s import demand of TSR to China, Japan and South Korea in this paper can be written as:

\[ Q_i = f(RP, RP_{ssr}, \text{REER}_i, \text{RGDP}_i) \]  

Where definition of variable and data sources of each variable is presented in table 6. The data were collected from 2000 to 2015.

### Table 6: Definition of variables and data sources of each variable

| Variables | Definition | Data source |
|-----------|------------|-------------|
| \( Q_i \) | Quantities of imported TSR from Thailand to the importing countries \( i \) (China, Japan and South Korea) (ton) | Import amounts from Custom Department Product Code: 101090200 (Blocked rubber) (Department of Foreign Trade, 2016) |
| \( RP \) | Imported price of TSR from Thailand to foreign countries is (China, Japan and South Korea) (USD) | F.O.B price from Thailand (Statistics Rubber Thailand, 2016) |
| \( RP_{ssr} \) | Prices of rubber smoked sheet 3 (RSS 3) in the world market (USD) | International Rubber Study Group (IRSG), (International Rubber Study Group, 2015) |
| \( \text{REER}_i \) | Real effective exchange rate of the importers \( i \) (China, Japan and South Korea) | Global Economic monitor, World Bank |
| \( \text{RGDP}_i \) | Real GDP of foreign countries \( i \) (China, Japan and South Korea) per capita (USD) | Global Economic monitor, World Bank |

The Ordinary Least Square (OLS) using double log-linear is as follows:

\[ \ln Q_1 = a + b_1 \ln RP + b_2 \ln RP_{ssr} + b_3 \ln \text{REER}_1 + b_4 \ln \text{RGDP}_1 + \mu_1 \]  
\[ \ln Q_2 = a + b_5 \ln RP + b_6 \ln RP_{ssr} + b_7 \ln \text{REER}_2 + b_8 \ln \text{RGDP}_2 + \mu_2 \]  
\[ \ln Q_3 = a + b_9 \ln RP + b_{10} \ln RP_{ssr} + b_{11} \ln \text{REER}_3 + b_{12} \ln \text{RGDP}_3(3) + \mu_3 \]  

Where:  
- \( a \) = Constant  
- \( b_1 \) to \( b_{12} \) = Coefficient or elasticity  
- \( \mu_1, \mu_2, \mu_3 \) = Error term  
- \( \ln Q_1, \ln Q_2, \ln Q_3 \) = Quantities of imported TSR from Thailand to China, Japan, and South Korea, respectively  
- \( \ln RP \) = Imported value of TSR from China, Japan and South Korea  
- \( \ln RP_{ssr} \) = Prices of rubber smoked sheet 3 (RSS 3) in the world market (USD)  
- \( \ln \text{REER}_1, \ln \text{REER}_2, \ln \text{REER}_3 \) = The real effective exchange rate of China, Japan and South Korea  
- \( \ln \text{RGDP}_1, \ln \text{RGDP}_2, \ln \text{RGDP}_3 \) = Real Gross Domestic Products
Real GDP of China, Japan and South Korea

Note that the Rubber Estate Organization (2016) states that Standard Thai Rubber (STR) classifies RSS 3 as the same quality as TSR 20.

RESULTS

Table 7 demonstrates import demand of TSR from Thailand to the top three importing countries: China, Japan and South Korea in each aspect. Starting with China, which is the top importer of TSR from Thailand, we found that if the Real Price (RP) of TSR from Thailand has increased 1 percent, the TSR importing from Thailand will decrease less than 1 percent ($b_1 = -0.908**$). The price elasticity of demand is less than 1 implying that TSR is necessary good to Chinese customers (TSR is an essential material in manufacturing and a change in price is higher than a change in importing demand).

In addition, if the price of SSR has increased 1 percent, importing of TSR from Thailand will decrease 1.439 percent ($b_2 = -1.439*$). We can conclude that Chinese customers view TSR and SSR as substitution goods. In general, SSR is substituted for TSR in manufacturing medical products, footwear, automobile tyres, engineering works and in many manufacturing firms (Rubber Authority of Thailand, 2002 as cited in Phantamit and Limsombunchai, 2010). It is likely that China imports SRR as a substitute with TSR as materials in manufacturing variety of products. The result is consistent with the study of import demand of natural rubber from Thailand to Japan by Phantamit and Limsombunchai, (2010) that price of SSR affects Japanese TSR importing from Thailand.

The real effective exchange rate has significantly affected the China’s import demand for TSR from Thailand. The result shows that if the real effective exchange rate has increased 1 percent, the import demand will decline 0.027 percent ($b_3 = -0.027$) result. It may be in accordance with the study of Wang and Lee (2012) about estimating the import demand function from China, in which real effective exchange rate has negative coefficients. This can be implied that the appreciation in the Chinese currency will reduce the import amounts from China as a result of the anti-dumping duties on some imported items.

Real GDP of Chinese, however, has a significant effect on the Chinese’s TSR import demand, that is, if the real GDP has increased 1 percent, the import demand will also increase 0.747 percent ($0.747**$). This implies that Chinese customers view TSR as normal good. The result proved to be in consistent with Ziramba (2010) in which the real GDP has a positive correlation to the import demand.

Among these 3 countries: China, Japan and South Korea, a rising in the real price of TSR from Thailand will lead to a reduction in imported quantities of TSR from Thailand as found in the result of $b = -0.908**$, -0.681*, -0.247*, respectively.

A raise in real price of the SSR leads to changes in quantities of imported TSR in China, Japan and South Korea in two ways. If the price of SSR has increased, import quantities of TSR in China and

| Dependent Variables/ | lnQ<sub>CN</sub> | lnQ<sub>JN</sub> | lnQ<sub>KR</sub> |
|----------------------|----------------|----------------|----------------|
| Constant             | 266.643        | 70.012**       | 241.309***     |
| ln RP                | -0.908**       | -0.681*        | -0.247*        |
| ln RP<sub>S</sub>S<sub>R</sub> | -1.439*       | 1.765***       | -0.821**       |
| ln REER              | -0.027         | 0. 137*        | 0.052*         |
| ln RGDP              | 0.747**        | 0. 694**       | 1.314*         |
| R<sup>2</sup>        | 0.863          | 0.758          | 0.895          |
| Adjusted R<sup>2</sup> | 0.813         | 0.721          | 0.837          |
| Durbin-Watson        | 1.62           | 2.23           | 1.93           |

Note: *, **, *** are statistically significant at 0.10, 0.05, and 0.01, respectively.

CH, JN and KR denote China, Japan and South Korea respectively.
South Korea will conversely decrease \((b = -1.439^*, -0.821^{**}, \text{respectively})\). This can be interpreted as these two countries treat SSR and blocked rubber as complementary goods. In contrast, Japan gives a different result \((b = 1.765^{***})\), meaning that a rising price of the SSR will increase the import quantities of TSR in Japan. This means the Japanese customers view SSR and TSR as substitution goods.

Interestingly, the real effective exchange rate has a direct effect on the import quantities of Japan and South Korea as \(b = 0.137^*\) and \(0.052^*\), respectively, implying that if the importers currency (Japan and South Korea) appreciates, import quantities of TSR will also increase. On the other hand, import quantities of China will reduce \((b = -0.027)\), but not significantly if the Chinese Yuan appreciates.

An increase in Real GDP (RGDP) has significantly affected the import demand of these importing countries: China, Japan and South Korea. That is, quantities of TSR imported will increase as seen in table 7 with a statistically significant result \((b = 0.747^{**}, 0.694^{**} \text{ and } 1.314^*\), respectively). Customers from these countries treat TSR from Thailand as normal good in “necessary goods” categories: If a customer’s income has risen, products can be increasingly sold, however, that percentage change of quantities of products sold is less than an increase in percentage change of income.

CONCLUSION

The three major importing countries of TSR from Thailand: China, Japan and South Korea, consider TSR as major material in manufacturing rubber related products. These countries classify Thailand’s TSR as normal good: if income increases or economy grows, imported quantities will also be higher. In addition, TSR is considered to be necessary good, in which a change in price of TSR will affect the import quantities, less than the change in price. This can bring benefits to Thailand if the policy makers encourage the rubber producers to improve the rubber quality in order to sell it as premium quality, and not to compete with other countries in terms of prices. Also, the government would not support the croppers to expand the agricultural areas since the quantities of imported TSR from these countries have a slight effect.

Additionally, since Chinese and South Korean customers consider SSR as complementary good with TSR, the Thai government would implement the production and marketing policies and to these two countries in the same direction.

Lastly, the forecast quantities of TSR importing to China, Japan and South Korea have a result as in the same trend as GDP: As the country has higher GDP, the imported quantities of TSR will also be higher. Consequently, strategies to deal with an economic fluctuation can be extremely complicated. However, what Thailand government can take action now is to continuously develop and improve rubber’s quality in order to meet the customers’ need or new market in the future.

REFERENCES

Bahmani-Oskooee, M., & Hajilee, M. (2011). How fast wages adjust to prices: A multi country analysis. *Economics Bulletin, 31*(3), 2404-2413.

Bank of Thailand (2015). *Bank of Thailand*. Retrieved from [http://www.bot.or.th/](http://www.bot.or.th/)

Cherdchoongam, S., & Rungreunganun, V. (2015). An application of analytical hierarchy process for ranking factors affecting of Thai natural rubber ribbed smoked sheets no.3 (RSS3) price. *International Journal of Technology and Engineering Studies, 1*(2), 42-47.

Department of Foreign Trade. (2016). *Department of international trade promotion, Thailand*. Retrieved from [http://www2.ops3.moc.go.th/](http://www2.ops3.moc.go.th/)

Farinelli, B., Carter, C. A., Lin, C. Y. C., & Sumner, D. A. (2009). Import demand for Brazilian ethanol: A cross-country analysis. *Journal of Cleaner Production, 17*, S9-S17.

Goldstein, M., & Khan, M. S. (1985). Income and price effects in foreign trade. *Handbook of International Economics, (pp. 1041-1105)*. Amsterdam, Netherlands: Elsevier.

Hamori, S., & Matsubayashi, Y. (2001). An empirical analysis on the stability of Japan's aggregate import demand function. *Japan and the World Economy, 13*(2), 135-144.
International Rubber Study Group. (2015). *Statistical summary of world rubber situation*. Retrieved from [https://goo.gl/702knk](https://goo.gl/702knk)

Khan, M. S., & Ross, K. Z. (1977). The functional form of the aggregate import demand equation. *Journal of International Economics, 7*(2), 149-160.

Lo, M., Sawyer, W. C., & Sprinkle, R. L. (2007). The link between economic development and the income elasticity of import demand. *Journal of Policy Modeling, 29*(1), 133-140.

Phantamit, B., & Limsombunchai, V. (2010). An Analysis of Japan Import Demand for Natural Rubber from Thailand. *Songklanakarin Journal of Social Sciences and Humanities (Thailand), 16*(1), 141-150.

Rubber Authority of Thailand. (2002). *Thailand rubber price*. Retrieved from [https://goo.gl/UnwnRx](https://goo.gl/UnwnRx)

Rubber Estate Organization. (2016). *Standard Thai Rubber (STR) classifies RSS3 as the same quality as TSR20*. Retrieved from [https://goo.gl/5yGIIm](https://goo.gl/5yGIIm)

Statistics Rubber Thailand. (2016). *Rubber plantation in Thailand*. Retrieved from [https://goo.gl/7huUsK](https://goo.gl/7huUsK)

Tang, T. C. (2003). An empirical analysis of China’s aggregate import demand function. *China Economic Review, 14*(2), 142-163.

Turner, J. A., & Buongiorno, J. (2004). Estimating price and income elasticities of demand for imports of forest products from panel data. *Scandinavian Journal of Forest Research, 19*(4), 358-373.

United Nations Commodity Trade Statistics Database. (2014). *Statistics of natural rubber in smoked sheets of Thailand, Indonesia, and Malaysia exports 2009-2013*. Retrieved from [http://comtrade.un.org/data/](http://comtrade.un.org/data/)

Wang, Y. H., & Lee, J. D. (2012). Estimating the import demand function for China. *Economic Modelling, 29*(6), 2591-2596.

Yimnak, K. (2016). A comparison of the accuracy of an adjusted fuzzy time series forecasting method with the traditional method application to Thailand rubber price. *Journal of Applied and Physical Sciences, 2*(1), 25-33, 2016.

Zhang, J., & Gan, J. (2007). Who will meet China’s import demand for forest products? *World Development, 35*(12), 2150-2160.

Ziramba, E. (2010). Price and income elasticities of crude oil import demand in South Africa: A cointegration analysis. *Energy Policy, 38*(12), 7844-7849.

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