



**EE489: Seminar in Industrial Economics**

**Is there any predictor to rubber price in case of Thailand?**

Present

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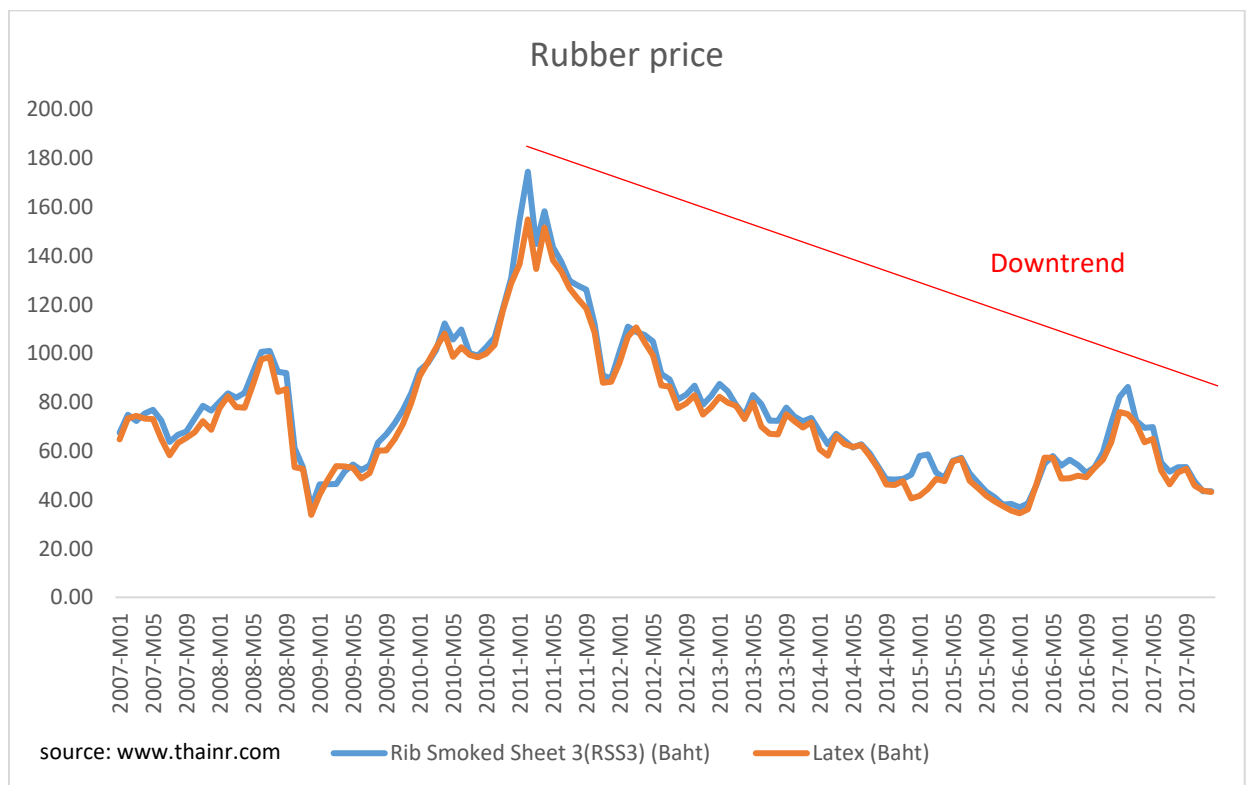
Abstract

This paper find the variable factor that can predict the rubber price in Thailand by collecting the time-series data through as monthly data from January 2007 to December 2017. The result reveals that there are four variables can highly explain the movement of rubber price which is the future rubber price in the Shanghai Futures Exchange (SHFE) in month  $t$  and  $t-1$ , the import quantity amount of China from Thailand in month  $t-4$  and the export quantity amount for Indonesia in month  $t-3$ .

## Introduction

Nowadays rubber production relates to many products or activities that we use it in everyday. The rubber is not only important in the primary products but also the secondary products for other category goods which need the rubber as one of their components. However most people still do not know much about how important they are for Thailand, some of them misunderstand that rice is the most valuable in Thai agriculture export but actually it is the natural rubber is the most valuable export product of Thailand. Besides that Thailand is the biggest rubber exporter for the rest of the world (กฤษฎิณี พิสิษฐสุภากุล, 2014). They are produced either for domestically or mainly export to other countries especially China, Japan or Malaysia which are the top three most import the rubber productions from Thailand.

Figure1: rubber price graph from 2007 to 2017



In the recent years, it can be observed that there are a lot of news and reports about the continuous decreasing in natural rubber price or some groups of rubber planters protested to the Thai government to solve this problem. It was an essential problem that Thai government cannot avoid to help rubber planters of continuous decreasing natural rubber price because rubber plantation is one of the most popular for Thai farmers because they very suffer from the lower rubber price which means that their revenue was dropping down while the cost of agriculture or cost of living are increasing.

According to Figure 1, it is a graph showing the two type of rubber price which are Rib Smoke Sheet 3 (RSS3) which is the main rubber production from Thailand and Latex from 2007 to 2017. The rubber price sharply increased from the beginning of year 2009 to the late year 2010. However, after that boom, it has been facing to the downward trend for a long time since 2011. The price continuously decreased since that time even though in 2016 the rubber price was increasing until the beginning of 2017 but it did not help so much for the whole big picture. Therefore this problem raise up a question of “Is there any easy but powerful predictor to the rubber price”, because the faster the prediction is, the faster the Thai rubber planters can prepare and adjust for the impact. In order to answer this question, this paper aims to collect the possible variable factors that might affect to the rubber price as times series data to see the relationship among those independent variable whether it can predict the rubber price.

The next part of this paper will be the literature review to find some related studies and following by the research methodology part to clarify the econometric model method and procedure of analysis. Then the result of regression will be showed in the result and discussion part and it follows by the conclusion and finally it ends with the limitation.

## Literature review

This paper tried to find for any possible variable factors that might significantly affect to the rubber price from some similar or related studies to collect those variable factors as one of possible factors which might explain the movement for predicting it. From the old research, there are some paper that question about what is the determinant of Thai rubber price (Chayapa tungkaset Siri, 2016) and its result show that R-square is equal to 0.85 and adjust R-square is 0.86 but it focuses on the impact to the rubber price while this paper concentrates on the predicting factor.

Since the rubber is the commodity product that Thailand export to the rest of the world, so the exchange rate is an unavoidable factor that affect to the rubber price. Besides that Thailand is not the monopoly supplier of the rubber source in this world market, it also has Indonesia and Malaysia as the second and third biggest exported rubber production for the world market respectively. Therefore the exchange rate come to play an important role not only in rubber production but also in the bigger part as the agriculture sectors. There are many studies supporting that in the 1970s in USA, the agriculture price was low and their export were up but then the situation was worse when the dollars currency began to appreciate and caused their export to fell down in the 1980s (David Orden, 2002) or another study by Kees Burge et al (2002) also supported that the exchange rate should have an inverse effect on agriculture price. Moving to the case of Thailand, it also has a study that find some significant factors to the rubber price.

According to Wei Chang Sang et al (2012), they did the research on the volatility and determinants to rubber price in Thailand which have a climatic factor, exchange rate and crude

oil market as the independent variable factors. This study collects the data from 28 May 2004 to 31 December 2010 as the daily data, and also collect the natural rubber price by using Rib Smoked Sheet 3 (RSS3) as the dependent variable which is the main rubber sheet of Rib Smoked Sheet in Thailand. It explains that the dollar exchange rate and crude oil price are significant to the volatility in the rubber price in Thailand from VARMA-AGARCH model. Another study, it is the study in the determinants of the volatility of natural rubber price in Malaysia (Nur Hidayah binti Sadali,2013) and the result also show that shows that crude oil price, inflation and export can significantly describe the volatility of natural rubber price in Malaysia.

Due to the World War II, It can be said that this is the beginning of the age of synthetic rubber to dominate the natural rubber industry because there is a huge usage on rubber to operate in War activities. The US government faced with the shortage in the natural rubber stock in that time. Hence, they decided to spend their budget to build more fifty-one plants to boost the synthetic rubber production in order to reach the rubber demand. During 1959 domestic consumption of synthetic rubber reached 64.5 percent of the new rubber market (Charles F. Phillips, Jr.,1960). When the World War II was ended, it seemed that the synthetic rubber production might not be able to compete cost-wise with the natural rubber.

However, the natural rubber production also has many difficulties. The plantation had to be rehabilitated. Besides that the post-war natural rubber production did not give the satisfied return to the externality (Robert Solo, 1955). The profit from selling the natural rubber was quite low, the average natural rubber price was 8-12 cents per pound which was very low. Then in 1950, the price dropped at 14 cents (Robert Solo, 1955). Until the age of technological

advance and subsidy policy on synthetic rubber production came to the society. It can imply that the natural rubber producing industry is now faced with a strong and technologically progressive synthetic rubber industry (Charles F. Phillips, Jr.,1960).

According to Kritsanee Pisitsupakul's paper (2014), it suggested more that synthetic rubber is the substitute goods to the natural rubber such as the type production but it does not the perfect substitute goods because the natural rubber has the unique characteristic which it is more flexible than the synthetic rubber, so the demand for natural rubber still exists.

Due to crude oil is the main component of synthetic rubber production that is a substitute goods to natural rubber price. Therefore, the movement in crude oil price might have a significant effect on the natural rubber industry because it will cause the cost of synthetic production to be high or low. There is a study from Aye Aye Khin et al (2012), they found that the crude oil can determine the natural rubber price in Malaysia by Vector Error Correction Method model (VECM). Besides that another study also support that the Diesel price is one of the statistical significance to predict the natural rubber price in Thailand by Multiple Regression model. (Chayapa tungkaset Siri, 2016).

After reviewing the previous related paper, this paper can collect some possible significant variable factors to the model and might generate more variable into model as well in order to cover the possible factors that may affect to the rubber price which will be explained in the research methodology part.

### **Research Methodology**

Upon reviewing some of literature review and theories which are related to the rubber price, this paper found that exchange rate, crude oil price and synthetic rubber were

mentioned from many studies that have the effect to the natural rubber industry. However, this paper also add more possible factor to the model in order to complete the model to get better R-square result as possible as it could be. Thereby natural rubber quantity amount of Indonesia export, natural rubber quantity amount of Malaysia export, rubber stockpiles in Shanghai Futures Exchange (SHFE) were added as the supply side for rubber production because Indonesia and Malaysia are the main rubber exporter to the world market and they are the main competitors to Thailand rubber industry (กฤษฎิ์ พิสิษฐสุภากุล,2014).

The total Thai natural rubber export amount which including China, Japan and Malaysia were added as the demand side for rubber production because they are the three main importer from Thailand and the last one is rubber futures price in Shanghai Futures Exchange (SHFE) were added as the external factor that rubber production are traded in the future market, so it might have some possible effects to the natural rubber price (กฤษฎิ์ พิสิษฐสุภากุล,2014).

The data were collected as monthly periods from January 2007 to December 2017. The data of quantity amount for export and import for China, Malaysia, Japan, Indonesia and synthetic rubber export from Thailand were collected from the Trademap official website. The data of Rib Smoke Sheet 3 (RSS3) price as the dependent variable for this paper was collected from Thainr.com website as the official Thai rubber association. The crude oil price were collected from indexmundi website which is the crude oil price database website. The exchange rate which this paper used as the real effective exchange rate (REER) in order to eliminate the inflation problem was collected from the Bank of Thailand (BOT) official website. The data of rubber stockpile in China and rubber future price were collected from the website which is called Bloomberg.

## Econometric model

This paper applied the Autoregressive Distribution Lag model (ARDL) to estimate the value of coefficients.

## Procedure of analysis

### 1. Econometric specification

Since the data is the Time-series data, so the variance is not constant then it is needed to rearrange the data to be in the natural logarithm form in order to reduce variability and distribution of the data which has the equation below. Moreover this paper also applied the Akaike Information Criteria (AIC) in the eview9 program to choose the best and suitable lag for each variable factor for this model. The ARDL regression model is estimated in the following form

$$\begin{aligned} d\ln(RUBBER_t) = & \alpha + \beta_1 \ln(INDOEX_{t-3}) + \beta_2 \ln(MALAYSIAEX_t) + \beta_3 \ln(STOCK_{t-2}) + \\ & \beta_4 \ln(CHINAIM_{t-4}) + \beta_5 \ln(JAPANIM_t) + \beta_6 \ln(MALAYSIAIM_t) + \\ & \beta_7 d\ln(REER_t) + \beta_8 d\ln(SYNEX_t) + \beta_9 d\ln(FUTURE_{t-2}) + \\ & \beta_{10} d\ln(BRENT_{t-1}) + \varepsilon_t \end{aligned}$$

Where subscript t indicates monthly time-period.

$RUBBER_t$  is the Rib Smoked Sheet 3 price (RSS3).

$INDOEX_t$  is the natural rubber quantity amount of Indonesia export.

$MALAYSIAEX_t$  is the natural rubber quantity amount of Malaysia export.

$STOCK_t$  is rubber stockpiles in Shanghai Futures Exchange(SHFE).

$CHINAIM_t$  is the natural rubber quantity amount of China import from Thailand.

$JAPANIM_t$	is the natural rubber quantity amount of Japan import from Thailand.
$MALAYSIAIM_t$	is the natural rubber quantity amount of Malaysia import from Thailand.
$REER_t$	is the real effective exchange rate.
$SYNEX_t$	is the quantity amount of synthetic rubber export from Thailand.
$FUTURE_t$	is rubber futures price in Shanghai Futures Exchange(SHFE).
$BRENT_t$	is Brent crude oil price.

## 2. Unit Root test

Time-series data is usually the Non-stationary. It means that the Mean, Variance and Covariance are not constant which depends on time or the collected data which is called unit root. If it has this problem without taking the solution, even though we find some variable that is significant but it might not have a reliability in the result which is called spurious regression. Hence it need to be tested to find whether it has unit root problem or not by Augmented Dicky-Fuller (ADF) test.

## 3. Multicollinearity, Heteroscedasticity and Autocorrelation test

Multicollinearity is the situation in which two or more independent variables in a multiple regression model are highly related, so this paper plan to test Multicollinearity by the correlation test. If the result shows that there are some variable which has the correlation between them higher or equal to 0.8, it can reply that the variables have the Multicollinearity problem and it needs to cancel some variables which has the Multicollinearity problem out of model.

Heteroscedasticity problem will be tested by the RVF plot graph which is the relationship between residual and fitted value under the null hypothesis that there is no Heteroscedasticity problem.

Autocorrelation problem will be tested by Durbin-Watson test under the Null hypothesis that there is no autocorrelation problem.

#### 4. Problem solution

If there is Multicollinearity problem, this paper plan to cancel out one of the high correlation between variables and if there are Heteroscedasticity and Autocorrelation problem, it will be solved by the robust standard error.

### Result and discussion

After these collected monthly time series data were collected covering the period from January 2007 to December 2017 in the past eleven years which have 132 observation to each variable factors. Table 1 shows the summary statistic including of variable name, number of observation, Mean value, standard deviation value, Min value and Max value.

Table 1: Summary statistic

Variable	unit	Obs	Mean	Std. Dev.	Min	Max
Rubber	Baht/kg	132	79.55477	28.43213	38.66	180.18
Indoex	tons	132	208960.8	28633.52	118131.9	281938.9
Malaysiaex	tons	132	66568.09	14269.38	40512.45	111021.6
Stock	tons	132	136258.4	112442.8	10291	478168
Chinaim	tons	132	104909.7	41138.04	36131.66	210822.1
Japanim	tons	132	23948.14	6737.821	12111.46	49008.73
Malaysiaim	tons	132	38285	7190.974	9475.887	61619.44
REER	-	132	100.8191	3.823188	91.4	111.7

Synex	tons	132	28472.24	34670.05	3526.722	151522.1
Future	Yuan/tons	132	19479.47	7214.7	9540	41000
Brent	Dollar/barrel	132	81.21288	27.25447	30.8	133.87

### Result of stationary test (unit root)

Since this paper mentions from the previous chapter that the data of this paper is time series data which needs to be tested a stationary for the data to see whether there are some problems of variable factor. This is because non-stationary data could lead to a counterfeit result from the regression. Thus the Augmented Dicky-Fuller method is applied to test a stationary problem and give the result as the table below.

Table 2: Augmented Dicky-Fuller method for unit root

	Inrubber	dlnrubber	lnindoex	lnmalaysiaex	lnstock	dlnstock
p-value	0.6121	0.0000	0.0000	0.0001	0.7516	0.0000

	Inchinaim	Injapanim	Inmalaysiaaim	lnreer	dlnreer	lnsynex	dlnsynex
p-value	0.0010	0.0002	0.0000	0.2348	0.0000	0.8230	0.0000

	lnfuture	dlnfuture	lnbrent	dlnbrent
p-value	0.5413	0.0000	0.5156	0.0000

Regarding the table above, it disclosed that the null hypothesis of unit root is rejected for five variables which are lnindoex, lnmalaysiaex, Inchinaim, Injapanim and lnmalaysiaaim at significant level (MacKinnon P-value for  $Z(t) < 0.05$ ). This implies that these five variable factors do not have the unit root problem and stationary at level form  $I(0)$ . While other six variable

factors including of Inrss3, Instock, Inreer, Insynex, Infuture and Inbrent fail to reject the null hypothesis (MacKinnon P-value for  $Z(t) < 0.05$ ). To solve this problem, they need to be solved by first difference, which show the result that these six variable factors are stationary at order  $I(1)$ . After solving the unit root problem, this implies that it does not have spurious problem occurs in this model.

### **Result of multicollinearity test**

Due to the many variable factors in this paper, it is important to do multicollinearity test to see that there are some correlation between factors or not because if the variable factors are related to each other (correlation value  $> 0.8$ ), the regression result might not perform well enough as it should be. Hence the solution if this problem occur is that this study will cancel out one of them from the regression equation. However after testing multicollinearity test, this study found that it does not have any correlation among those variable factors (correlation value  $> 0.8$ ), which means that it does not have a multicollinearity problem in this regression equation.

### **Result of Heteroscedasticity test**

As it was mentioned in the methodology, heteroscedasticity problem will be tested by RVF plot graph to find that there is any trend of RVF graph or not. If the graph shows some trend even it will be positive trend or negative trend, it can imply that it has heteroscedasticity problem on this equation but if it does not have a trend, this equation is fine to progress. If the problem occurs, the robust standard error will be applied to solve it. However the result

revealed that the RVF graph does not show any trend. Hence it can be concluded that there is no Heteroscedasticity problem in this equation.

### Result of autocorrelation test

This paper test autocorrelation problem by using Durbin-Watson test. However the result shows that the Durbin-Watson d-statistic equals to 2.447595. It is in the range from 1.5 to 2.5 which does not have autocorrelation problem range. Hence this equation does not occur the autocorrelation problem.

### ARDL regression result

The main interest of this study is to find that there is any easy predictor to rubber price in Thailand to help the rubber planters or speculators to forecast the rubber price and prepare themselves for any consequence. With this purpose, this study generates four different models in order to answer this question. Model 1 and Model 2 was created to help the rubber planters in case of they cannot reach so much of information and assuming that they only collect rubber price data, Brent crude oil price data and real effective exchange rate (REER) data. However this study also create a full model as Model 3 and Model 4 to find out to answer the main question.

Table 3: Regression result

VARIABLES	Model 1	Model 2	VARIABLES	Model3	Model4 Full model
L.dlnrubber	0.1400	0.1460	dlnfuture	0.355***	0.386***
	-0.0927	-0.0947		-0.0681	-0.0712
L2.dlnrubber	-0.0475	-0.0198	L.dlnfuture	0.433***	0.441***
	-0.0952	-0.0988		-0.0683	-0.0728
L3.dlnrubber	-0.0314	-0.0333	L2.dlnfuture	0.0950	0.1100

	-0.0948	-0.0981		-0.0695	-0.0746
L4.dlnrubber	-0.0021	-0.0309	dlnreer	-0.5430	-0.7250
	-0.0940	-0.0978		-0.4430	-0.4640
dlnbrent	0.422***	0.451***	dlnbrent	0.194**	0.149*
	-0.0979	-0.1040		-0.0795	-0.0816
L.dlnbrent	-0.0120	0.0057	L.dlnbrent	-0.148*	-0.154*
	-0.1100	-0.1150		-0.0818	-0.0819
L2.dlnbrent	0.1260	0.0915	Inchinaim	-0.0378	-0.0526**
	-0.1110	-0.1140		-0.0246	-0.0265
L3.dlnbrent	-0.0387	-0.0575	L.Inchinaim	0.0596**	0.0593**
	-0.1100	-0.1140		-0.0293	-0.0297
L4.dlnbrent	-0.0376	-0.0058	L2.Inchinaim	0.0153	0.0281
	-0.1060	-0.1100		-0.0286	-0.0295
dlnreer		-0.6370	L3.Inchinaim	-0.0548*	-0.0451
		-0.6150		-0.0290	-0.0297
L.dlnreer		0.0142	L4.Inchinaim	0.0468**	0.0742***
		-0.6250		-0.0231	-0.0251
L2.dlnreer		0.7320	Inindoex	0.0206	0.0077
		-0.6030		-0.0665	-0.0698
L3.dlnreer		-0.5950	L.Inindoex	0.0357	0.0469
		-0.6190		-0.0669	-0.0708
L4.dlnreer		-0.2400	L2.Inindoex	-0.0035	0.0118
		-0.6190		-0.0673	-0.0676
Constant	-0.0036	-0.0031	L3.Inindoex	-0.171***	-0.224***
	-0.0079	-0.0080		-0.0645	-0.0675
			dlnstock		0.0064
Observations	127	127			-0.0362
R-squared	0.2240	0.2440	L.dlnstock		0.0179
					-0.0410
			L2.dlnstock		0.0453
					-0.0368
			Injanim		0.0003
					-0.0348
			Inmalaysiaex		0.0900**
					-0.0436
			Inmalaysiaim		-0.0336
					-0.0323
			dlnsynex		0.0210
					-0.0247
			Constant	1.113*	0.5530

	-0.6230	-0.8370
Observations	128	128
R-squared	0.5910	0.6290
<hr/>		
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Due to using the Autoregressive Distributed Lag (ARDL) model to run an Ordinary Least Square (OLS) regression analysis for four models. The result from table 3 of model 1 and model 2 which are easy model show their R-square are equal to 0.224 and 0.244 respectively. It implies that these independent variables from model 1 and model 2 are not well-explained to dependent variable. The result also disclosed that the Brent crude oil price (*dlnbrent*) in month t has a positive relationship and statistically highly significant at 0.01 level or 99% confidence interval. it means that the Brent crude oil price could be used to explain the change in rubber price in Thailand and also it can be interpreted that if the Brent crude oil price increase for 1%, the rubber price will also increase by 42.2% for model 1 and 45.1% for model 2 and vice versa. The interpreted results are in the percentage form because this paper also take the natural logarithm form to both sides for independent and dependent variables.

Moving on to the next model, for model 4, it is the full model which this study conduct to find out and answer the topic question, the table 4 revealed that R-square for model 4 is equal to 0.629 (it is lower than the previous literature) which can be interpreted that the independent variables for model 4 can explain the dependent variable by 62.9% which improve from model 1 and model 2 due to adding more independent variable to the model. The result turns out that there are many variable factor that can explain the dependent variable with different in confidence interval.

It has four independent variable factors which are able to predict the dependent variable at 99% confidence interval or significant at 0.01 level which are future rubber price in the Shanghai Futures Exchange (SHFE) in month  $t$  and  $t-1$  ( $dlfuture$ ,  $l.dlfuture$ ), the import quantity amount of China from Thailand in month  $t-4$  ( $l4.dlnchinaim$ ) and the export quantity amount for Indonesia in month  $t-3$  ( $l3.dlnindoex$ ) and their coefficients are equal to 0.386, 0.441, 0.0742 and -0.224 respectively. It means that  $dlfuture$ ,  $l.dlfuture$ ,  $l4.dlnchiim$  have a positive relationship to the rubber price in Thailand but the  $l3.dlnindoex$  has a negative relationship.

It can be interpreted that if the future rubber price in the Shanghai Futures Exchange (SHFE) in month  $t$  increase by 1%, the rubber price will increase by 38.6%. While if the export quantity amount of Indonesia at month  $t-3$  increase by 1%, the rubber price in Thailand will decrease by 22.4% vice versa due to the negative coefficient result. This result has confirmed that when the future price at non-lag and lag 1 and import quantity amount of China at lag 4 from Thailand are performing well, it can highly predict the rubber price in Thailand as a positive way, it might result from when the China import more rubber from Thailand or the future rubber price increase, it means that there are increasing of demand for rubber production which generate the rubber price in Thailand to increase related to demand and supply theory. On the other hands when Indonesia, the main competitor of rubber production against Thailand, can export more on rubber production, it might be because the decreasing in rubber price in Indonesia or they have a competitive advantage on this product which create the increasing on their export. This effect will make the rubber price in Thailand to decrease.

Since the price and quantity relationship is estimated in a model, there is usually an endogeneity problem (this will make the value of  $\hat{\beta}$  biased). However this paper focuses more on finding a predictor of price (not the impact of quantity on price), we can ignore the endogeneity problem for this case.

### **Conclusion**

It is interesting, important and useful to find what could be the leading indicator to the rubber price in Thailand even though it is not easy to find out because the commodity products price change too fast to predict its fluctuation which sometimes the possible variable factor data cannot be collected as the daily or weekly data and it might be many related variable that might affect them. However it is a good starting point to question which can inspire other researchers to improve and conduct more effective model to answer this question in order to help rubber planters or any speculators in the future.

For the model 1 and model 2 this paper conducted an easy model to predict the rubber price but it is not well-explained with only 0.224 and 0.244 of R-square value although the Brent crude oil price in month  $t$  can describe it at 99% confidence interval. With low R-square value, therefore these models are not a good model to forecast the rubber price.

Nonetheless this study found that many variables could predict the rubber price in Thailand in model 4 as full model for this paper. Both future rubber price in the Shanghai Futures Exchange (SHFE) in month  $t$  and  $t-1$ , China's import quantity from Thailand in month  $t-4$  and Indonesia's export quantity can highly explain it with 99% confidence interval with 62.9% of R-square by using Autoregressive Distributed Lag (ARDL) model. However the real effective

exchange rate (REER) which this paper conducted to this model and expected that it might give some signals to the rubber price in Thailand. Unfortunately the result shows that it cannot explain the rubber price at any confidence interval under this model.

### **Limitation and suggestion**

As it was mentioned in the previous chapter, there are some limitations to collect the data because this paper collected the monthly data in the past eleven years, however the total observation amount is only 132 which is quite low for running the Stata because the low observation might affect to the significance for the variable factors. If the observation is too low, the result is not accurate as possible as it could be and might lead to a false analysis. This first paper's intention is to collect the data as weekly data because it could be better than daily data since the daily data may not be able to predict price that far in the future but unfortunately, some data are not collected in everyday such as import and export quantity amount which are the possible factors that can affect to the rubber price in Thailand. Besides that, the rubber product is one of the commodity product which is sensitive to the many variable factors, so this paper may not cover all possible factor that impact to the rubber price. However the researcher hopes that this paper will be useful or inspire for other people who is interested in this kind of topic and adapt it for further study in the future in order to find the possibly exact variable that can predict the rubber price in Thailand.

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