

THE RUBBER PRICE STRUCTURE OF THAILAND AND IMPULSE RESPONSE TO WORLD PRICE SHOCK

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ABSTRACT: The objectives of this research were to: 1) study market structure and price structure of rubber in different levels of Thailand, and 2) study the responses of domestic prices to the fluctuation of the world market price. The inferential statistic was employed to detect the long-run equilibrium and causal relationship among the variables. The impulse response function was considered to forecast future shocks. The data used for this research were monthly time series over the period of 2001 to 2019. The results showed that 1) rubber market structure that the stakeholders are in upstream, midstream, and downstream levels. There are many upstream farmers with lower bargaining power than midstream levels (e.g. middleman, central market, and collector). In the downstream level, there is usually the most bargaining power but has no bargaining power in the world market. 2) The responses of domestic prices to the world market prices in rubber markets that the price in different levels responds to the fluctuation of the world market in the same direction using 4-4.5 months before return to the equilibrium. This means that when the world market price changes, it causes domestic price changes as well 3) The factors affecting price and price structure of rubber that are demand and supply, future market, market structure, information, oil price, exchange rate, and government policy.

KEYWORDS: Price Analysis, Cointegration, Granger Causality

I. INTRODUCTION

Nowadays, the agricultural sector in Thailand, even with the value proportion of only 7% of the gross domestic product, is essential to the livelihood of many populations. In 2019, around 30% of the country's population was farmers [1]. Furthermore, the agricultural sector is significant in the aspect of food production to nurture the entire country population as well as creating food security and supporting renewable energy for the country, and all are on agriculture.

Most of the Thai agricultural products have excess supply comparing to domestic demand. Hence, the remaining products are exported for distribution outside of the country, making a large amount of revenue each year. These products include rice, rubber, and cassava. In 2019, rubber was the second-highest earned revenue from agricultural product export after rice. Thus, rubber is a relevant agricultural product toward Thailand's economy. Besides, rubber is one of the commodity products which based its pricing from the world market price. All of the countries, including Thailand, have to accept the price taker as the world market has a massive amount of both buyers and vendors, and there are no parties that can influence the market. Once the price in the world market has changed, it will significantly impact the price in-country and farmers. The recognitions of domestic price responses towards the world price change and time lag of the transmission along with. Whether the price at each level has an impact on the pricing on another level. It causes the domestic market price and farmers to better adapt and plan for production in the next phase. Besides, the results of this research study will let us know about the power of negotiation and pricing of various groups within the supply chain of rubber distribution from the upstream level to the downstream level.

More than 80% of produced rubber volume exported while a small amount is used in the country, making the rubber price in Thailand depended on the demand for rubber in the world market. The demand volume of rubber as a raw material in various industries depended on the vital factors that are the world economic expansion and rubber substitute products. Such export proportion generates high dependency on the outer market. Positively viewing, this means it can generate revenue for the country. In 2019, Thailand is the 1st highest rubber exporter with a market share of approximately 1 in 3 of the total world export volume. The exporting amount of rubber in Thailand tends to continuously increase since 2011. Since there has been an increase in a rubber plantation in several regions of Thailand, it has created the unavoidable outer fluctuation. Hence, it is fascinating to see that the agricultural sector, which is essential and related to people has to encounter such fluctuation and uncertainty of high agricultural product prices. The uncertainty of the price level is a very crucial problem to the Thai rubber

market, especially the decrease in the rubber price in the past, making the farmers unable to adapt to such changes. Furthermore, the fluctuation of the rubber price causes the revenue uncertainty for exporters, industrial entrepreneurs, along with rubber farmers. Moreover, the price fluctuation of agricultural products may lead to the difficulty and mistake in the purchasing and stock planning as well as the incurring cost of risk protection.

Therefore, understanding the movement behaviors of rubber price which is a commodity that traded widely in the world market is vital to all related sectors as the government sector can better determine the policy of overall farming domestically. The government can issue various measures to keep price stability in the case when the price is too inverted. For the farmers, they can plan their seasonal cropping more effectively as they take the price information into consideration during the decision-making phase. So, this study wants to answer the question of how much impact the global market price change has on domestic rubber prices. It will also analyze the domestic price structure and the price margin to reflect the negotiation power and the benefits which farmers, middleman, and exporters received. Then will lead to the policy creation regarding pricing in order to create stability and fairness for all parties involved. The objectives of this study are to: 1) study the market structure and rubber price structure at different levels, and 2) study the response of the domestic price towards the global market price change.

II. LITERATURE REVIEW

The empirical studies regarding the price structure of rubber and the response towards the shock in the global market price are quite diverse. For example, the study of [2], which was about the connection of the price in the rubber market of Thailand in different levels such as central rubber market price, export price (FOB price), and world market price (Tokyo and Singapore future exchange markets). They adopt monthly time series data starting from January 2003 to December 2010 with a total sample of 96 samples. The long-term equilibrium was analyzed by using the Johansen cointegration method. This study considered markets into two types: vertical markets such as the central market, export market, and the global market. In contrast, the Horizontal market divided into two sub-market such as internal central market group and global market group (Tokyo and Singapore future exchange market). It showed that the price of rubber in the central marker of the total of nine relationships such as Had Yai central market price-Nakhon Si Thammarat central market price, Had Yai central market price-Suratthani central market price, Nakhon Si Thammarat central market price-Suratthani central market price, Had Yai central market price-export price. In regards to the connection of the price between the rubber market using the Granger causality method, the result of this study revealed that Had Yai central market price had an impact on the price making of Nakhon Si Thammarat central market price and Suratthani central market price. In contrast, the export market price had a close connection with Tokyo's future market price and Nakhon Si Thammarat central market.

Moreover, [3] analyzed the efficiency of rubber price in commodity future exchange market by comparing with the rubber spot price of Thailand. They based the information on time series data from September 2004 to December 2010, the seasonal price index as well as error correction model (ECM) to measure the efficiency of rubber price in the commodity future exchange market. The results demonstrated that farmers and related agricultural parties were rubber vendors in the agricultural product future market with the highest proportion at 67.82%. The characteristic of future exchange contracts was approximately seven months in product delivery. Furthermore, it revealed that the agricultural product's future price had more stability to the rubber spot market price by comparing it to Bangkok pier central market and Had Yai central market. Regarding the analysis results from the ECM model, it concluded that the agricultural product's future exchange market was a market with semi-strong efficiency. As the price of the rubber market constantly adapted to new information basing on the electronic system. Through the internet network, it tended to have fast information spreading as well.

III. MATERIALS AND METHODS

The methodology of this study was divided into 2 parts, namely, descriptive analysis and quantitative analysis with the following details as follows.

3.1 Descriptive analysis: It describes the background and general information of the market structure and rubber price in Thailand to indicate the price in each level, the price movement, and the power of negotiation of each group in the supply chain which include farmers, purchasing group, processing factory, and exporter.

3.2 Quantitative analysis: It employs the vector autoregressive (VAR) model to investigate the rubber price response to the shock in the world market price. The analysis conducted using time series econometric tools. The tools consisted of the ADF unit root test [4-5], Johansen cointegration test [6-7], Granger causality test [8], and Impulse response function [9]. The models can be presented as follows:

The ADF unit root test [4-5] is modeled as Eq. (1).

$$\Delta Y_t = \mu_0 + \delta T + \beta_1 Y_{t-1} + \sum_{i=1}^p \beta_2 \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

Where Y is the variable, μ , δ and β are presented as the parameters to be estimated, Δ is the differencing order, T is the time trend, t is the time period, ε is the error term and p is the optimal lag selection.

The Johansen cointegration test [6-7] is modeled as Eq. (2).

$$\Delta Z_t = \mu_1 + \delta_1 T + \sum_{i=1}^{p-1} \Gamma_i \Delta Z_{t-i} + \alpha \begin{pmatrix} \beta \\ \mu_2 \\ \delta_2 \end{pmatrix} (Z_{t-1} \ 1 \ T) + \varepsilon_t \quad (2)$$

Where Z is the matrix of the variables.

The Granger causality test [8] is modeled as Eq. (3-4).

$$\Delta Y_t = \mu_1 + \sum_{i=1}^p \beta_1 \Delta Y_{t-i} + \sum_{i=1}^p \beta_2 \Delta X_{t-i} + \varepsilon_{1t} \quad (3)$$

$$\Delta X_t = \mu_2 + \sum_{i=1}^p \beta_3 \Delta X_{t-i} + \sum_{i=1}^p \beta_4 \Delta Y_{t-i} + \varepsilon_{2t} \quad (4)$$

Where Y and X are the variables to be estimated the causal relationship.

The Impulse response function [9] is modeled as Eq. (5).

$$Z_t = \mu + \sum_{i=0}^{\infty} \phi_i u_{t-i} \quad (5)$$

Where ϕ is presented as the parameters to be estimated.

To analyze the data, the monthly time series from January 2001 to December 2019 with a total of 228 samples are observed. The variables used in this study consisted of four rubber price levels in a horizontal market. The four levels included 1) farm gate price (FG), which is the price of raw rubber sheet in the local market extracting from Rubber Authority of Thailand. 2) Wholesale price (WS), which is the price of the 3rd class rib smoked rubber sheet at Had Yai district, Songkhla province with the information from rubber authority of Thailand. 3) Export price (EX), which is a FOB price of Bangkok according to the information from Thailand Rubber. 4) World price (WD) which is the 3rd class rib smoked rubber sheet price of SICOM market that has been used as a referring price in the world rubber market according to the World Bank information.

IV. RESULTS AND DISCUSSION

The results showed that the structure of the rubber marker in Thailand consisted of various sectors from upstream, midstream, and downstream. The upstream level includes rubber farmers who take the products to sell them to the purchasing group in the local area who classified in the midstream level. In this part, the purchasing group will have more negotiation power than the farmers and will be the price setter for purchasing price by mainly referred to the central market. After that, the purchasing group will take rubber for distribution in the central market. This group will receive profits from the differences between purchasing and selling prices. The processing factory, which is the rubber purchaser in the central market, is at the downstream level. The factory acts as the distributor for processing rubber to the rubber manufacturing factory. Furthermore, the processing factory also sells the products to the broker for export. For the factory with its network abroad, it may export the product itself. Hence, the rubber exporters are classified as at the downstream level as well. The downstream group has a lower number than the midstream group. Most of them are industrial factories and major traders who have strong connection abroad and have more power of negotiation than midstream group.

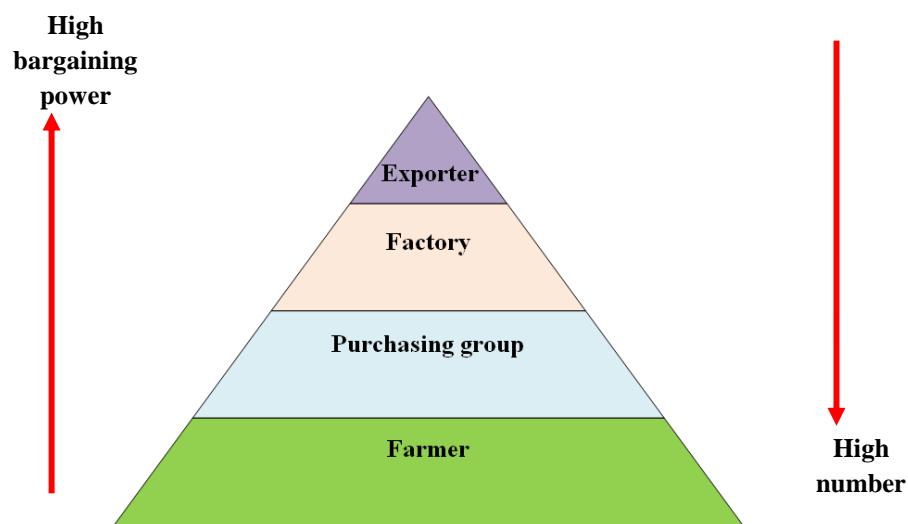


Figure 1. Negotiation power in the rubber market structure

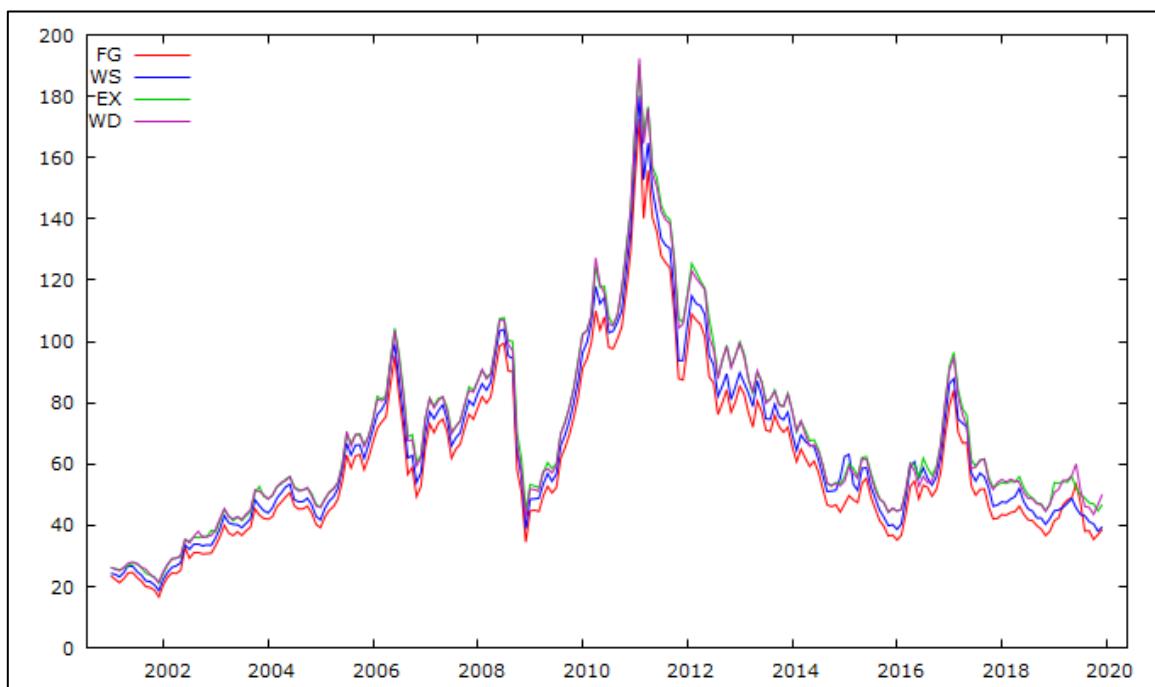


Figure 2. The rubber price movement at different levels

Source: Data from Rubber Authority of Thailand, Had Yai Central market and World Bank

In Figure 2, all of the four levels of rubber prices have the same direction of movement by continuing from the farm gate price, wholesale price. The export price and the global market price are similar to each other.

By studying the response of the local rubber price towards the world price shock, which in this part will result from quantitative analysis and the econometric measure as the analysis tool including:

The market structure overall, it shows that the exporters are the group on the top of the pyramid with the lowest number of players. In the meantime has the highest price suppression power towards the purchasing from midstream and upstream groups but has no negotiation power in the world market. The latter groups with the negotiation power are factories and purchasing groups, which considered being the midstream level. For rubber farmers, they are at the lowest level of the pyramid but with the largest number of people and the least negotiation power or no power at all.

There are four levels of rubber price structure: 1) Farmgate price (FG), which is the price of raw rubber sheet in the local market. 2) Wholesale price (WS) is the price of the 3rd class rib smoked rubber sheet at Had Yai district, Songkhla province. 3) Export price (EX) which is and FOB price of Bangkok and 4) World price (WD) which is the 3rd class rib smoked rubber sheet price of SICOM market that used as a referring price in the global rubber market. The references for the world market price are from the Tokyo market and Singapore market. The four levels of rubber price have a movement as the following Figure 2.

Unit Root Test and Johansen Cointegration Test

In this section, the rubber farm gate price (FG), the rubber wholesale price (WS) at the central rubber market. The rubber export price (EX) and the rubber world (WD) price brought in to test for stationery by using unit root test. The results are displayed in Table 1.

Table 1. The results from the unit root test of rubber prices by ADF method

Variable	Level I(0)		First difference		Result
	t-statistic	p	t-statistic	p	
FG	-2.134	1	-12.923*	0	I(1)
WS	-2.180	1	-11.836*	0	I(1)
EX	-2.158	1	-11.366*	0	I(1)
WD	-2.188	1	-11.952*	0	I(1)

* means the 0.05 level of statistical significance and p means the appropriate past period in the estimation of Autoregressive (p) model by considering picking the lowest value of the Bayesian Information Criterion (BIC).

Table 2. Cointegration test from Trace statistic and Maximum Eigenvalue

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.433	219.920	<0.001	128.89	<0.001
1	0.204	91.033	<0.001	52.072	<0.001
2	0.138	38.961	<0.001	33.953	<0.001
3	0.021	5.007	0.602	5.007	0.603

The stationary test of data by using the ADF test revealed that the rubber price in all different levels could not reject the null hypothesis (H_0). It shows that the entire data are non-stationary property at the level. I(0) or level will later use the data as mentioned above to find the 1st difference and to test for the stationary property of the data again. The results of the test demonstrated that all the data had first different at the 0.05 level of significance or stationary. Then this study will use the data to find the relationship among these variables.

In the study of the long-term equilibrium relationship of the market price at different levels by using the structure of the Vector Autoregressive (VAR) model and the time series used should have to be I(1) which means it has the stationary level at the first different. The time series that will use at the level stage [10] and statistic model is Trace statistic and Maximum eigenvalue (Lmax) statistic with such statistic as the estimator with Maximum Likelihood (ML) method.

The results from the test, according to Trace statistic and Maximum Eigen statistic of rubber prices in Table 2, showed that both statistical values identified in this study had a long-run equilibrium relationship with three cointegration vectors. The price in the rubber market at the different levels had a long-run equilibrium relationship occurred. However, the analytic results only explained the relationship between the pair but did not explain the connection whether which market was the determinator/influencer of the price. Hence, this research studied the analysis to find the causal relationship (the connection in the price of the market at different levels) by using the Granger causality method in a further section.

Granger Causality Test

This study employed the causality test to investigate the pairwise relationship between variables. That was to study whether there was any relationship among all 4 variables and in what way in order to explain the pairwise

relationship between rubber price including Farm Gate price (FG), Whole Sale price (WS), Export price (EX) and World price (WD). The results were as follow:

Table 3. The causality test of the price in the rubber market

(H ₀)	F-tests (p-value)	(H ₀)	F-tests (p-value)
$\Delta WS =/=> \Delta FG$	16.430* (<0.001)	$\Delta WS <=/= \Delta FG$	20.169* (<0.001)
$\Delta EX =/=> \Delta FG$	1.865 (0.173)	$\Delta EX <=/= \Delta FG$	22.505* (<0.001)
$\Delta WD =/=> \Delta FG$	6.273* (0.013)	$\Delta WD <=/= \Delta FG$	19.784* (<0.001)
$\Delta EX =/=> \Delta WS$	2.917 (0.089)	$\Delta EX <=/= \Delta WS$	18.406* (<0.001)
$\Delta WD =/=> \Delta WS$	7.707* (0.006)	$\Delta WD <=/= \Delta WS$	14.933* (<0.001)
$\Delta EX =/=> \Delta WD$	1.299 (0.255)	$\Delta EX <=/= \Delta WD$	10.111* (0.001)

Null Hypothesis (H₀) is that the independent variable has no causal relationship (connect) with the dependent variable(X=/ \Rightarrow Y) and * at the 0.05 level of significance.

The results of the causal relationship analysis of the rubber price in the market stated that it had a causal relationship in almost every market when considering at the 0.05 level of significance. In other words, the Farm Gate (FG) price influenced the Whole Sale (WS) price, Export (EX) price, and World (WD) price. The wholesale price itself also has an impact on the farm gate price, export price, and world market price. While the world price also influences the wholesale price, export price, and the farm gate price. However, the export price has no impact on any other price levels but the receiver of all the influences from all three levels which means the referring export price with the FOB price had no impact on the movement of the price in the market. However, it will receive the influence from other markets in a one-way direction. On the contrary, in determining the price, the exporters will bring the price at different levels (farm gate price, wholesale price, and world price) into consideration.

Impulse Response Analysis

The analysis of the impulse response of rubber prices shows the impulse response of rubber prices in the market at different levels once there is an abrupt change in the global market can be shown in Figure 3.

According to Figure 3, it represents the impulse response of domestic rubber prices such as Farm Gate (FG) price, Whole Sale (WS) price, and Export (EX) price from the effect of shock price change of World(WD) price. It divides into three parts: Part (1) the response to the stimulation of Farm Gate (FG) price. It found out that the price at the Farm Gate (FG) responded to the change of the price in the World (WD) market and will adapt to the equilibrium in the first two month period which will be the same responding direction. The response in such a way will go into the new equilibrium in 4 months. Part (2) the response to the stimulation of the Whole Sale (WS) price which found out that the Whole Sale (WS) responded the price in the World (WD) market and will adapt to the equilibrium in the first two month period which will be the same responding direction. The response in such a way will go into the new equilibrium in 4 months. Part (3) the response to the stimulation of the Export (EX) price found out that the Export (EX) price responded to the price in the World (WD) market and will adapt to the equilibrium in the first two month period which will be the same responding direction. The response in such a way will go into the new equilibrium in 4 months. According to the impulse response results, they revealed that there were similarities amount the three markets with both size and direction of impact. The causes stemmed from the effective price transfer in the rubber market but domestically and internationally, which coincide with the causal relationship test.

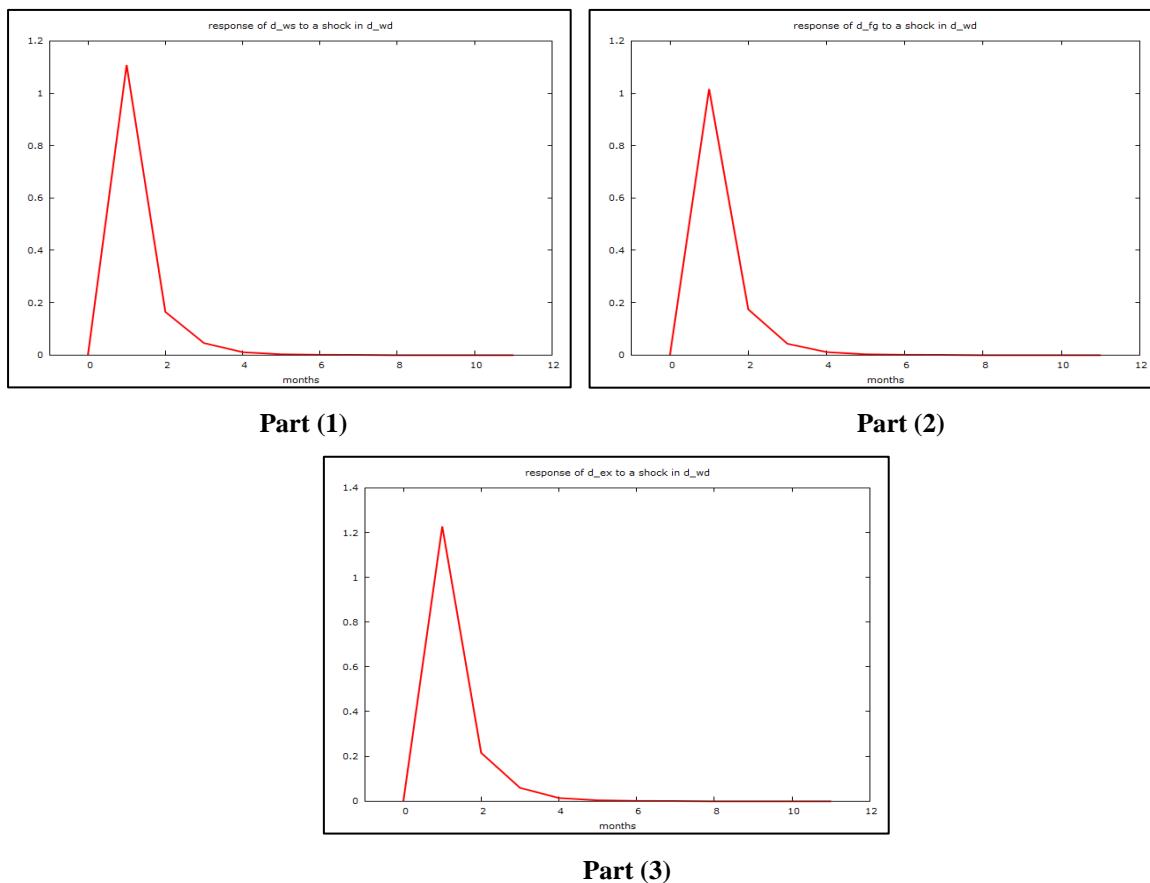


Figure 3. The analysis of the impulse response of rubber price

The price of the rubber will use approximately 2-4 months in order to adapt to the equilibrium. For Thailand, it does not use that much time as the rubber purchasing has the central market, which used the distribution system scattered in various locations, especially in the southern region of Thailand. The central market will announce the daily buying price to let the producer, whole seller, and exporters can be able to follow the news and information easier than in the case of other agricultural product prices. It will also enable the parties to look at the referring prices from the movement of the rubber price in the future exchange market. The Thai entrepreneurs utilize the rubber price in the international future exchange price as the referring price in the rubber purchase in the actual delivery market, causing the price to have connected relationship with each other. Hence, the abrupt change in the world price, which is the international future exchange world price, will affect the response of the price in-country such as farm gate price, wholesale price, and export price in the same direction. It is consistent with the study of the [11] that indicated that the world price impacted domestic rubber pricing [2] which revealed that the export price connects with the price in the Tokyo Commodity Exchange and Thailand central market.

V. CONCLUSION

The study of the rubber price structure and the response towards the world price change with the objectives to 1) study the market structure and rubber price structure at the different levels 2) study the response of domestic price towards the global market price. The results of the study stated that the rubber market structure in Thailand consisted of various sectors from upstream, midstream, and downstream groups. The upstream group was such as farmers with a large amount and scattered in several areas. The midstream group was the purchasing group who had the negotiation power more than farmers and who are the buying price maker by mainly referring to the central market price. Afterward, the purchasing group will bring the rubber and sell them at the central market and make a profit from the price difference of the buying price and the selling price. The buyers of the rubber in the central market are processing factories and exporters. They are in the downstream group with a low number of players in this market. Most of them are large industrial factories and large-size exporters. Therefore, this group has the highest negotiation power. In the price making, they will mostly use the reference from the world price, especially in the Tokyo Commodity Exchange and Singapore Commodity Exchange as well as considering the domestic central market price.

The rubber price structure in Thailand has four levels such as farm gate price, wholesale price, export price, and world price which based on the world price from the price in the Tokyo commodity exchange market and Singapore commodity exchange market. All of the four rubber price levels had the same direction of movement. In general, the entrepreneurs at the downstream usually have a high margin than the midstream because of more power of monopoly. There are not many entrepreneurs and have positive advantages of having an international network. When considering the relationship of the price at different levels, it showed that farm gate price, wholesale price, and world price influenced other prices except for the export price. The export price did not have any impact on the other levels of price but influenced by the farm gate price, wholesale price, and world price. The price making of exporters will use all the price levels to take into consideration whole the daily rubber price announcement of the central market will also use the reference price from the international future commodity exchange market.

The response of the price in-country towards the change in the world price, once there is a shock with the world price, showed that the rubber price in the country classifies into three levels: farm gate price, wholesale price, and export price with the same direction of the response and similar traits. The same direction response lasted for approximately the first two months and would return to the new equilibrium within four months.

Because the rubber price in the country received the impact of the movement of the price in the global market, causing the related parties in the domestic rubber market to become the price taker. Hence, one of the approaches is to increase domestic consumption. Regarding the guideline in policy determination and rubber price solving may divide into short term and long term periods. In the short-term, the focus should place on the relief to farmers from all the burdens. The measures are such as buffer stock buying, subsidy, factors of production gives. However, in the long term, there should be problem-solving in the production and market structure level. For example:

- (1) The increase in the proportion of domestic use of natural rubber in substitution to export to increase domestic demand by supporting the establishment of rubber product industries such as rubber gloves factories, tire making industry, the road made by rubber, as well as sports stadium floor which block rubber and smoked rubber sheets as the primary materials. Apart from the increase in domestic demand, it will decrease the import from abroad as well. The increase in the proportion of using natural rubber in this country will be lower the impact of the price from external factors such as the movement of the oil price, rubber price in the future commodity exchange market. It includes the promotion of processing products that used rubber as the raw material to add more value.
- (2) The extension of the research and development (R&D) to add more value to rubber products by strengthening the downstream industry with technology capability. The conduct of research and development will lead to discovering new products that consumers can use in their daily life and will increase the use of rubber as a raw material in the production process as well.
- (3) Supply management planning is a problem-solving method, in the long run, to ease the problem of oversupply. Like the past, several countries in the Southeast Asia region and China have expanded their rubber plantation more and more, causing the rubber product to flow more into the market. Meanwhile, the rubber demand has a lower increasing rate than the supply leading it to the oversupply state and causing the price to be lower. Hence, in order to ease such a problem, the government must focus on supply management planning such as limit the rubber plantation expansion, increase productivity per Rai, and manage rubber stock at an appropriate level.

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