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AGRICULTURAL POLICY OPTIONS TO BOOST THE PRODUCER SURPLUS: THAILAND'S NATURAL RUBBER MARKET EQUILIBRIUM

Özlem TURAN, Serkan GURLUK, Abdulhakim MADIYOH

University of Uludag, Faculty of Agriculture, Department of Agriculture Economics Nilufer, Bursa, Turkey. Emails: ozturan@uludag.edu.tr, serkan.gurluk@gmail.com, chul987@gmail.com

Corresponding author: serkan.gurluk@gmail.com

Abstract

For Thai farmers natural rubber is a significant product and an economic crop. It has also some social benefits of rubber cultivation in this country. Yet, rubber producers of Thailand have not been receiving intended revenues in spite of expanding planted areas and increasing production. Current paper focuses on Thailand's natural rubber market equilibrium which is influenced by global and local impacts. The paper uses two-stage least squares methodology in order to estimate demand and supply response of Thailand. Input costs, planted area, agricultural credit amount dedicated to agriculture, palm oil prices are explanatory variables of supply. Indonesia production, per capita income of the world, car production of the world, exchange rate and rubber production of Indonesia are explanatory variables of demand. Rubber price is endogenous variable while resuming variables are exogenous. The econometric analysis will present opportunities to understand how to increase the producer surplus by simulating abovementioned variables. Producer's surplus is calculated 10,719,174,750 USD/Year in the equilibrium conditions. When financial supports are increased, it caused about 9.5 percent decreases in producer's surplus. The impacts of bilateral agreements was simulated with 10% and the 5% decreases of production amount. There was almost no difference on producer's surplus in case of a production decrease of 5% or 10%.

Key words**:** *rubber, Thailand, two-stage least squares approach, market equilibrium*

INTRODUCTION

World's rubber consumption is primarily concentrated in China, European Union, India, and the USA. Those countries' consumption is over one million tons annually. Those countries are accepted top four countries of natural rubber consumption in the last years. Yet, there are only two countries which are respectful of the world's production with the share of 60 percent: Thailand and Indonesia. Although current study focuses on Thailand producers, simulations concern producer-countries.

Thailand, with 47 percent of rural population, is an agricultural country, and the rubber is important export production with the contribution to gross agricultural value of the country [4]. Yet, Thai producers' surplus has fluctuations due to changing world price that are tending to decline. The main aims of this study are to develop a demand and supply model to predict the world natural rubber prices, to make simulations to increase Thai producer's surplus and to suggest policy recommendations to policy-makers. In addition, two important hypotheses are analyzed at the paper. One of them is to investigate whether financial resources transferred to agriculture of Thailand have impacts on increasing producer surplus and it is analyzed changes in price and producer surplus in the case of two major producer countries reducing rubber processing. The results give insights to producer countries at the region such as Thailand, Indonesia, Vietnam, and Malaysia.

Several researches were carried out on rubber supply-demand model. Jaitung [7] studied the rubber demand of Thailand by using "natural rubber price, oil price, exchange rate, nominal effective exchange rate, GDP of China, U.S. and Japan" as factors. The GDP of China may have on rubber demand. Yet, the China use the rubber for all the world. Therefore current study considers per capita GDP of the world instead of the GDP of China. In addition, we think that oil prices and rubber supply-demand are uncorrelated because oil prices are influenced by many exogenous factors. In

some studies labor factors and planted areas variables were used in the econometric analysis. These results shows that land area used in rubber production and the price of rubber affects the supply of rubber. Also the land area used in rubber production is affected by rubber price and labor factors. These analysis show that prices have an effect on the rubber supply [3;8]. The results of these studies can be used as a model in supply trends that affects prices globally. Therefore we used the input costs including labor factors by looking at micro-level studies. Input costs were obtained by [11] by dividing planted area at related year. Some studies stated the important of substitution of the rubber production [2] while some studies emphasizes the importance of supply-demand equilibrium rather than individual estimations [10]. Current study considers all suggestions at the literature, and put some new variables such as financial resource to agriculture sector and local input costs, and investigates producer's surplus in order to understand policy implementations.

MATERIALS AND METHODS

The paper considers many demand and supply variables depending on microeconomic theory with macroeconomic data. Factors affecting the rubber demand are considered as rubber price (USD/tonnes), per capita GDP of the world (USD), car production of the world (number), Indonesia's rubber production amount and exchange rate (USD/Baht). Factors affecting the rubber supply are also considered as rubber price (USD/tonnes), input costs coming from five production regions of Thailand (USD/Ha), planted area (Ha), financial support to agriculture sector (USD/year), palm oil price (USD/tonnes). Rubber price is endogenous variable while resuming variables are exogenous. In this study, the two-stage least squares method is used for solving the demand and supply equations [1]. We jointly determined the one or more explanatory variable with dependent variable in order to carry out the simultaneous equation model. Therefore the simultaneously determined variables had an equilibrium equation. According to theory, such variables can be explained when the model is in equilibrium [12]. At this study, reduced form equations are employed to jointly determine the price. Reduced form equations are as following:

$$Q_t = \pi_{11} + \pi_{21} Pin_t + \pi_{31} ar_t + \pi_{41} r_t + \pi_{51} Ps_t + \pi_{61} pci_t + \pi_{71} cpw_t + \pi_{81} indpr_t + \pi_{91} excr_t + v_{t1} \quad (1)$$

$$P_t = \pi_{12} + \pi_{22} Pin_t + \pi_{32} ar_t + \pi_{42} r_t + \pi_{52} Ps_t + \pi_{62} pci_t + \pi_{72} cpw_t + \pi_{82} indpr_t + \pi_{92} excr_t + v_{t2} \quad (2)$$

At the first stage, these equations are estimated by least squares since the right-hand-side variables are exogenous and uncorrelated with the random errors v_{t1} and v_{t2} [6]. The reduced form equations were used to obtain p_t (estimated P_t, P_{est}) which will be used in place of P_t on the right hand side of the supply and demand equations in the second stage of two-stage least squares [9].
In the second stage, the structural models are estimated separately by using the estimated rubber price variable (P_{est}). The structural models are as follows:

Supply equation:

$$Q_{ts} = \alpha + \beta_1 Pin_t + \beta_2 ar_t + \beta_3 r_t + \beta_4 Ps_t + \beta_5 Pest \quad (3)$$

Demand equation:

$$Q_{td} = \alpha + \beta_1 pci_t + \beta_2 cpw_t + \beta_3 indprt + \beta_4 excr_t + \beta_5 Pest \quad (4)$$

$$Q_{ts} = Q_{td} \quad (5)$$

RESULTS AND DISCUSSIONS

The estimated supply and demand curve results are in Table 1 and 2, respectively. Note that the coefficient of price is positive in supply estimation, and negative in demand estimation. These values indicate that as the market price rises the quantity demanded of rubber declines as predicted by the law of demand. One may state the reverse for supply. Financial support to agriculture and cultivated rubber area has positive impacts on rubber supply while palm oil price has negative impact. Increases in the price of substitutes for rubber decreases the supply for rubber.

The standard errors that are reported are obtained from 2SLS estimation. They and *t*-values are valid in large samples, and indicate that the estimated slope of the supply and demand curves are significantly different from zero.

Table 1. 2SLS Estimations for Rubber Supply

Variable	Estimate	Std. Error	*t*-value
Constant	2,474,234	289,033.1	8.560
Pin_t	-4,446.56	441.88	-10.063
ar_t	0,255	0.168	1.518
r_t	0.000136	0.000	3.865
Ps_t	-413.72	299.95	-1.379
P*est*	366.53	38.35	9,557

Pin_t: Input cost per hectares (USD)
ar_t: Cultivated rubber area (Ha)
r_t: Financial support to agriculture
Ps_t: Palm oil price (USD/Tonnes)
P*est*: Estimated price (USD)
Source: Own results.

Table 2. 2SLS Estimations for Rubber Demand

Variable	Estimate	Std. Error	*t*-value
Constant	-1,335,559	172,957.1	-7.722
pci_t	695.28	92.176	7.543
cpw_t	0.031	0.009	3.444
$indpr_t$	0.039	0.265	0.147
$excr_t$	10,348.53	8,081.572	1.281
P*est*	-625.828	146.42	-4.274

pci_t: Per capita income of the world (USD)
cpw_t: Car production of the world (number)
(USD/Year) $indpr_t$: Indonesia rubber production
$excr_t$: Exchange rate (Baht/USD)
P*est*: Estimated price (USD)
Source: Own results.

Calculations of the producer's surplus of the supply-demand equilibrium model are possible after finding solution in balance, and therefore it may be attempted to make many simulations. First of all, we give the producer's surplus at the equilibrium. Commonly estimated price variable is employed to find supply and demand equations including related variables. Therefore these two equations can be confronted in the same analytical plane. After calculating the price at the equilibrium, it is calculated the volume of transaction in order to find the producer's surplus. We consider ten-years-average of all variables apart from P*est* variable while using supply and demand equations. According to estimated equilibrium price is 7,046 USD while the amount of volume is 3,493,864 tones. Therefore producer's surplus is calculated 10,719,174,750 USD/Year in the equilibrium conditions (Table 3.).

Financial supports supplied to agriculture may not always be an enhancement of agricultural productivity [5]. It is very important to generate effective policies including well defined target groups. In addition to find right policies and target population, finding a policy that is purified of political influence on the world is desired. Consequently, every policy put into practice has a political cost. In this study, the financial support variable was found statistically significant. However, interestingly, this variable does not positively affect the rubber manufacturer. Because the sign of the variable is negative. This can be explained in various ways. Firstly, an agriculture policy support diverged from the efficiency may be on the agenda. On the other hand, resources transferred to agriculture provide more benefits to other agricultural production varieties. Finally, it is observed that subsidies to agriculture contribute to the consumer surplus; or this subsidies increase analytically deadweight losses. We can infer from the results that a 10% increase in the financial support caused a 9.5% decrease in the producer surplus (Table 3).

The impact of changes in the price of palm oil variable is remarkable. Rubber supply and palm oil price have a negative relationship meaning that when the price of palm oil decreases, the quantity of rubber produced increases. It reflects the importance of producers to switch to an alternative crop.

If bilateral agreements in the field of agriculture have a disruptive effect on world trade, international competition is not welcomed by regulatory agencies. However, the advantages supplied to establisher countries (the first 12 countries) of the European are indisputable facts since the 1950s. Therefore investigation of the impacts of possible bilateral agreements between Thailand and Indonesia countries would be remarkable. We used the model in a

simulation where Thailand and Indonesia reduced their rubber production capacity by 5 percent and ten percent in order to see their effects on producer surplus.

We observed that the producer' surplus are not being increased by further reducing production. In other words, in preference between 5% and 10% reduction in production capacity there is a favored advantage in reducing 5% of production. We can infer from this simulation that decreasing the output capacity may affect other parameters and adversely affect the producer's surplus. Using such policies continuously and increasingly can cause economic losses to Thai rubber producer sector.

Table 3. Simulations results of changing producer's surplus

Simulations	USD/Year	Change to equilibrium PS (%)
Increase of agricultural support (%10)	9,785,036,845	-9.5
Bilateral agreement (%10 decrease of production)	15,447,034,620	30.6
Bilateral agreement (%5 decrease of production)	15,656,508,360	31.5
Equilibrium PS	10,719,174,750	

Source: Own results.

CONCLUSIONS

Current study seeks demand and supply models to predict equilibrium in amount and price on rubber market by using Thailand-sided data from 1980 to 2016. Its methodology depends on two-stage least square technique and simultaneous equations. The paper uses two-stage least squares methodology in order to estimate demand and supply response of Thailand. Input costs, planted area, agricultural credit amount dedicated to agriculture, palm oil prices are explanatory variables of supply. Indonesia production, per capita income of the world, car production of the world, exchange rate and rubber production of Indonesia are explanatory variables of demand. After making estimations of reduced form equations complying with two-stage least square technique structural equations are reached in order to make simulations by taking considerations of producer's surplus for changing policy recommendations. The paper focused on two hypothesis. One of them was related with the efficiency of financial support to agriculture sector in Thailand. Another was related with possible bilateral agreements between the countries Thailand and Indonesia. The econometric analysis will present opportunities to understand how to increase the producer surplus by simulating abovementioned variables. Producer's surplus is calculated 10,719,174,750 USD/Year in the equilibrium conditions. When financial supports are increased, it caused about 9.5 percent decreases in producer's surplus. The impacts of bilateral agreements was simulated with 10% and the 5% decreases of production amount. There was almost no difference on producer's surplus in reduction the production with the amount of 5% and 10%. The results give insights to producer countries at the region such as Thailand, Indonesia, Vietnam, and Malaysia at the same geographical area and similar socio-economic background.

Results indicates that rubber demand is nearly perfectly inelastic in terms of price. Countries are willing to pay almost any amount to purchase rubber, because its substitute is not observable. Consequently, producer countries should try to favor the international market conditions. Switching the alternative productions may provide benefits to producers. In conditions where the market is fluctuating this may create opportunities to save revenues. It is recommended to use several of the different resources used in rubber production to some other uses. It will diversify the agricultural economy of Thailand and decrease its dependency on rubber. Yet, in this diversification a consideration should be given to exports and the feasibility of production. Production of products that will increase export earnings of the country should be prioritize. Therefore the policy options on productions would not damage to agricultural contribution to Thailand's economy.

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