Modeling Thai Concentrated Latex Sector

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Abstrac:- This study aims to identify the factors that influence the dynamics of key variables, particularly output, price, and employment, in the concentrated latex sector. To this end, a Dynamic Stochastic General Equilibrium (DSGE) approach is utilized and a Bayesian estimation method is employed using monthly data from the Office of Industrial Economics database for domestic price, demand, and export of concentrate latex from January 2016 to January 2022, with a total of 61 observations. The results suggest that a technological shock increases output and employment while reducing output price. The cost related shocks, on the other hand, decrease output and employment while increasing output price. Furthermore, external shocks cause a shift in imports and exports and domestic final prices of concentrated latex. Therefore, it is strongly recommended to enhance technology, labor skills, and the domestic concentrated latex industry's capacity.

Key-Words: - Concentrated Latex, Technology shock, DSGE, Bayesian estimation, Thailand

Received: May 9, 2022. Revised: May 11, 2023. Accepted: June 15, 2023. Published: July 13, 2023.

1. Introduction

Since 2003, Thailand has been the world's leading producer of natural rubber (NR), with production peaking at 3.4 million tons of fresh latex in 2011 with an average yield of 1.6 tons per hectare. This output is mainly exported, particularly to European countries, China, India and Malaysia [1]. In comparison to Malaysia, the traditional leader in NR production in the 1980s, Thailand's success can be attributed to a number of factors, such as falling yields in Malaysia as a decrease in land dedicated to rubber cultivation, and an ageing population of rubber farmers [2].

Rubber provides a positive contribution to Thai economy because it generates foreign exchange for the country. Moreover, rubber industry links other sectors together through a backward linkage and forward linkage. The groups of backward linkage include, e.g., raw materials, machinery and equipment, business supporter, and infrastructure. In the same way, the groups of forward linkage include, e.g., automotive, housewares, services, transport, and others. Therefore, rubber industry has a crucial role to play in promoting domestic industry development [3].

Thai rubber production chain has three main components: 1) upstream industries involving the growing and harvesting of rubber on plantations by growers and tappers; 2) intermediate or midstream rubber industries, or rubber processors, taking rubber produced on plantations and convert it into semi-finished products; and 3) downstream producers including manufacturers of automobile tires, latex gloves, condoms, elastics, and so on. Most of Thailand's intermediate rubber goods are sold on overseas markets for processing into downstream products. The most important end-

use is for the production of tires (60.9% of all domestic demand for intermediate rubber products), followed by elastics (16.2%) and then other products such as hosing and condoms.

The outlook of Thailand's rubber industry is expected to remain positive throughout 2022, with output levels predicted to rise due to an expansion in the area under cultivation and more favorable climatic conditions. It is projected that the industry will enjoy an average annual growth rate of 4.5-5.5% over the next five years [5].

Concentrated latex is an essential intermediate product in the rubber industry, produced from field latex using high-speed centrifuges. This process separates out water and other impurities, resulting in a concentrated latex that is at least 60% rubber and is ready for further processing. In 2021, the total value of concentrated latex distributed by Thai players to the market was estimated at THB 68 billion. Of this, 72.6% was exported, with the remaining 27.4% consumed domestically. In 2021, concentrated latex exports from Thailand edged up 3.4% to 1.19 million tonnes, with revenues from these sales increasing 22.6% to USD 1.56 billion. While sales to the primary market of Malaysia declined -0.8% to 0.57 million tonnes due to a lockdown imposed in the country, this was offset by increased sales in smaller markets such as Brazil and China [5]. Nonetheless, this concentrated latex industry is anticipated to expand and play a potential role in boosting national income [6].

Motivated by the economic importance of the concentrate latex industry, this study employs a Dynamic Stochastic General Equilibrium (DSGE) method to identify strategies for improving this sector. To achieve this objective, the remaining works will be organized as follows. In the next section, we will present the variables that affect the model's dynamics. Section 3 will describe the construction of the models and Section 4 will present the results, along with a brief discussion.

2. Literature Reviews

Following are the most pertinent research findings that revealed the factors anticipated to influence the dynamics of the model to be developed in this study.

Researchers have discovered that a lack of financial credit can have a detrimental impact on rubber production. This can lead to difficulties in maintaining rubber farms, resulting in inadequate latex yields, as well as a disincentive to export due to an increase in domestic consumption. Moreover, both output and producer prices have a positive effect on the export of natural rubber [7]. Further research has identified government policies on agriculture, synthetic rubber production, ecological factors, and socio-economic issues as influential factors in rubber production [8]. Additionally, the price of synthetic and natural rubber is linked to the price of oil, while no significant relationship was found between exchange rate (local currency/USD) and NR price, production, and exports [4].

The number of households, years of experience of the farmer, and frequency of the extension agent's visit are all critical factors that can greatly influence the productivity and technical efficiency of rubber production [9]. In particular, a higher number of households, more years of experience of the farmer, and a more frequent visit from the extension agent to impart knowledge on improved technology are all associated with greater productivity and technical efficiency. Moreover, the price of natural rubber (NR) is positively related to NR production and is cointegrated with it in the long run. This is because when NR prices increase, farmers will be more inclined to produce more NR for the market, leading to an increase in production. However, when NR prices rise, users will turn to substitute products such as synthetic rubber (SR) since they become more affordable. Exchange rate and NR price are also negatively related and cointegrated in the long

run, as when the local currency appreciates the product will become more expensive, which in turn will lower consumption. These findings emphasize the fact that NR prices are not solely determined by world supply-demand trends, i.e., it is driven largely by non-fundamental factors , e.g., crude oil price [10].

In addition to the variables such as input cost, credit facility, fertilizer subsidy, land size, experience, hours spent on rubber activities, intercropping, and family member age, which are positively correlated with output, international rubber prices, exchange rate, and domestic consumption also have an influence on the price of natural rubber exports [11]. This positive relationship between inputs and output level suggests that when more inputs are utilized, there will be an increase in the total production level [12].

Other studies have shown that capital-labor ratios, wage rates, and firm size all play critical roles in promoting efficiency in the rubber manufacturing industry [13]. To further reduce inefficiencies, consider investing in technology and research, collaborating with the global industry, and increasing Foreign Direct Investment (FDI). These strategies are likely to improve production efficiency and diminish inefficiencies [14].

These findings offer a valuable insight into how rubber manufacturing processes can be optimized and improved, providing a basis for explaining the dynamics of the variables included in the model formulated in the following section.

3. Model Formulation

The following formulated model is based on the concepts from the works of [15-17]. In this model, there are three principal agents involved in the production of concentrate latex: the competitive final concentrate latex producer, the farmer, and the domestic concentrate latex manufacturer. Their production specifications are as follows:

The competitive final concentrate latex producer pages for domestic and foreign intermediate concentrate latex use the following CES technology:

$$X_{H,t} = \left(\varpi_{HD}^{\frac{1}{\eta_H}} X_{D,t}^{\frac{\eta_H - 1}{\eta_H}} + \left(1 - \varpi_{HD}\right)^{\frac{1}{\eta_H}} X_{M,t}^{\frac{\eta_H - 1}{\eta_H}} \right)^{\frac{\eta_H}{\eta_H - 1}}, \quad (1)$$

where ϖ_{HD} denotes the proportion of the domestically manufactured concentrate latex in the final concentrate latex product. η_H is the elasticity of substitution between the domestically manufactured concentrate latex and the imported concentrate latex in the final concentrate latex product.

The farmer produces the latex, $X_{A,t}$, by using the Cobb-Douglas production technology written by:

$$X_{A,t} = A_{A,t} \left(F_{A,t}\right)^{\alpha_1} \left(N_{A,t}\right)^{1-\alpha_1}, \quad (2)$$

where $A_{A,t}$ is a labor productivity specific to the agricultural sector. $F_{A,t}$ and $N_{A,t}$ denote the quantity of fertilizer and the number of workers, respectively. α_1 express the proportion of fertilizer used in the production of latex.

The domestic concentrate latex manufacturer produces its product, $X_{B,t}$, by using the Cobb-Douglas production technology written by:

$$X_{B,t} = A_{B,t} \left(K_{B,t}\right)^{\alpha_2} \left(N_{B,t}\right)^{\alpha_3} \left(X_{A,t}\right)^{1-\alpha_2-\alpha_3}, \quad (3)$$

where $A_{B,t}$ is a technology unique to the concentrate latex manufacturing industry. $K_{B,t}$ and $N_{B,t}$ denote the quantity of capital and labor, respectively. α_2 and α_3 express the proportions

of capital and labor used in the production of concentrated latex, respectively.

The export is written by:

$$X_{E,t} = X_{f,t}\varpi_{HD}\frac{eP_{f,t}^{\eta_H}}{P_{D,t}^{\eta_H}}. \quad (4)$$

Assuming that $A_{B,t}$, $W_{B,t}$, $R_{KB,t}$, $W_{A,t}$, $R_{KA,t}$, $P_{F,t}$, $P_{f,t}$, e_t, and $X_{f,t}$ evolve according to AR (1) process. Finally, market clearing condition is specified by $X_{B,t} = X_{D,t} + X_{E,t}$.

The log-linear forms of the solutions from the above equations are as follows:

$$\tilde{X}_{D,t} = \eta_H\left(\tilde{P}_{H,t} - \tilde{P}_{D,t}\right) + \tilde{X}_{H,t}, \quad (5)$$

$$\tilde{X}_{M,t} = \eta_H\left(\tilde{P}_{H,t} - \tilde{P}_{f,t} - \tilde{e}_t\right) + \tilde{X}_{H,t}, \quad (6)$$

$$\tilde{P}_{H,t} = \frac{(\varpi_{HD}-1)\left(\tilde{e}_t + \tilde{P}_{f,t}\right)P_{fss}^{1-\eta_H}e_{ss}^{1-\eta_H} - \varpi_{HD}\tilde{P}_{D,t}P_{Dss}^{1-\eta_H}}{(\varpi_{HD}-1)P_{fss}^{1-\eta_H}e_{ss}^{1-\eta_H} - \varpi_{HD}P_{Dss}^{1-\eta_H}}, \quad (7)$$

$$\tilde{N}_{A,t} = \tilde{P}_{A,t} + \tilde{X}_{A,t} - \tilde{W}_{A,t}, \quad (8)$$

$$\tilde{F}_{A,t} = \tilde{X}_{A,t} - \tilde{P}_{F,t} + \tilde{P}_{A,t}, \quad (9)$$

$$\tilde{P}_{A,t} = (1-\alpha_1)\tilde{W}_{A,t} + \alpha_1\tilde{P}_{F,t} - \tilde{A}_{A,t}. \quad (10)$$

$$\tilde{N}_{B,t} = \tilde{P}_{D,t} + \tilde{X}_{B,t} - \tilde{W}_{B,t}, \quad (11)$$

$$\tilde{K}_{B,t} = \tilde{P}_{D,t} + \tilde{X}_{B,t} - \tilde{R}_{KB,t}, \quad (12)$$

$$\tilde{X}_{A,t} = \tilde{X}_{B,t} + \tilde{P}_{D,t} - \tilde{P}_{A,t}, \quad (13)$$

$$\tilde{P}_{D,t} = (1-\alpha_2-\alpha_3)\tilde{P}_{A,t} + R_{KB,t}\alpha_2 + \tilde{W}_{B,t}\alpha_3 - \tilde{A}_{B,t}, \quad (14)$$

$$\tilde{X}_{E,t} = \tilde{X}_{f,t} + \eta_H\left(\tilde{P}_{f,t} + \tilde{e}_t - \tilde{P}_{D,t}\right), \quad (15)$$

This model will be estimated using a Bayesian estimation method with monthly data from the Office of Industrial Economics database for domestic price, demand, and export of concentrate latex from January 2016 to January 2022, including 61 observations.

4. Result and Discussion

The model is estimated using the initial values of the following parameters: η_H =5.4, ϖ_{HD} =0.7, α_1 =0.6, α_2 =0.3, and α_3 =0.3. The estimation results are as follows:

Table 1: Estimated parameters

Par.	Prior		Posterior		
	Distr.	Mean	Mean	HPD inf	HPD sup
ρ_{AB}	beta	0.5	0.4372	0.1726	0.6758
ρ_{WB}	beta	0.5	0.6377	0.5574	0.7214
ρ_{RKB}	beta	0.5	0.4941	0.1731	0.7505
ρ_e	beta	0.5	0.5345	0.1513	0.9384
ρ_{Pf}	beta	0.5	0.3439	0.2398	0.4534
ρ_{Xf}	beta	0.5	0.3391	0.1143	0.5358
ρ_{XH}	beta	0.5	0.2912	0.1733	0.393
ρ_{AA}	beta	0.5	0.3876	0.0877	0.6603
ρ_{PF}	beta	0.5	0.4235	0.086	0.8007
ρ_{WA}	beta	0.5	0.5486	0.2959	0.8758

In the following, the effects of shocks will be discussed.

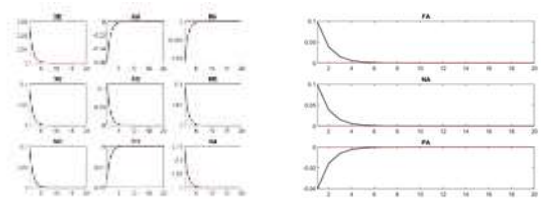

Figure 1: Effect of labour productivity shock in agricultural sector

Figure 1 demonstrates that labor productivity shock in the agriculture sector leads to an increase in agricultural outputs (XA), agricultural employment (NA), fertilizer use (FA), and manufacturing outputs (XB). However, it decreases the output price (PA) of agriculture and the output price of manufacturing (PD). The explanations are that with the improvement in labor productivity, farmers are able to produce more output with less input. This increased output allows farmers

to generate higher profits and create additional employment opportunities (NA). As a result, the agricultural sector has seen an increased demand for labor. The increased fertilizer usage (FA) is a result of the increased output of agricultural products. Fertilizer is essential for ensuring optimal crop yields, and with the increased output, farmers need to use larger amounts of fertilizer than before. For the increased manufacturing output (XB), it is a result of increased agricultural output. By producing more agricultural products, farmers are able to supply manufacturers with more raw materials. The decreased agriculture output prices (PA) and decreased manufacturing output prices (PD) are a result of increased productivity in the agricultural sector. As farmers are able to produce more output with less input, the prices of agriculture and manufactured goods have decreased.

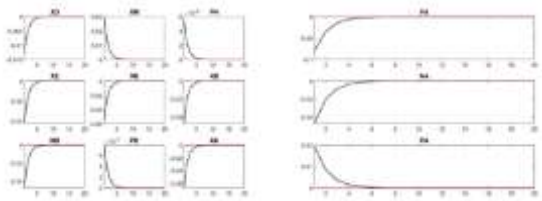

Figure 2. Effect of fertilizer price shock

In Figure 2 it shows that fertilizer price shocks in the agriculture sector lead to a decrease in agricultural outputs (XA), agricultural employment (NA), fertilizer consumption (FA), and manufacturing outputs (XB). However, it raises the prices of agricultural (PA) and industrial output (PD). This is due to the fact that a rise in fertilizer prices can cause an increase in production costs, resulting in a decline in agricultural output. In addition, high fertilizer prices can lead to a reduction in the amount of fertilizer used (FA), thereby reducing agricultural output. Increasing fertilizer costs may also have an effect on manufacturing outputs (XB). Since agricultural production is a significant source of raw materials for manufacturing, a rise in fertilizer prices can reduce the output of manufactured goods. In addition, the rising cost of fertilizer can have a positive effect on the cost and, consequently, the price of agricultural output (PA) and manufacturing output (PD).

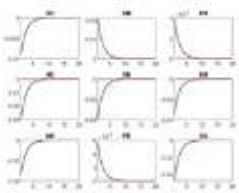

Figure 3: Effect of wage shock in agricultural sector

Figure 3 illustrates that wage shock in the agriculture sector leads to a decline in agriculture outputs (XA), agriculture employment (NA), fertilizer usage (FA), and manufacturing outputs (XB). However, it raises both the agriculture output price (PA) and the manufacturing output price (PD). This is because when wage increases in the agricultural sector, the cost of production rises, making it more expensive to produce agricultural goods. This increased cost of production leads to a decrease in agricultural output (XA), as producers are unable to produce as much as they would have prior to the wage increase. As a result, there is a decrease in agricultural employment (NA) and fertilizer usage (FA). Moreover, the increased cost of production can leads to an increase in agricultural output prices (PA) and an increase in manufacturing output prices (PB). This is due to a basic economic principle known as the law of supply and demand. As the cost of production of agricultural goods increases, the supply of agricultural goods decreases, driving up the price of agricultural goods. Similarly, as the cost of production of the manufacturing goods increases, the supply of the manufacturing goods decreases (XB) which driving up the price of the manufacturing goods.

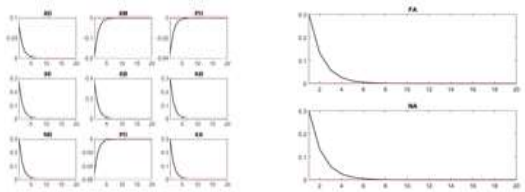

Figure 4: Effect of Tech. shock in Latex manufacturing sector

Figure 4 demonstrates that a manufacturing technology shock increases manufacturing outputs (XB), manufacturing employment (NB), and demand for agricultural outputs (XA) while decreasing manufacturing prices (PD) and the domestic final concentrate latex price (PH). Due to the introduction of efficient methods and machines, technological advancement in the manufacturing sector has resulted in higher outputs (XB). In a short period of time, highly efficient and automated machines can produce vast quantities of goods. This, in turn, leads to greater productivity and output, which can reduce manufacturing prices (PD). In addition, technological advancements have resulted in an increase in manufacturing sector employment (NB) due to the expansion of manufacturing businesses. Increased technological advancement in the manufacturing sector has also led to an increase in demand for agricultural products (XA), as automated machines enable the production of more manufactured goods, which necessitate an increase in agricultural product consumption. Because there are more manufactured goods on the market, domestic final concentrate latex prices (PH) may decline.

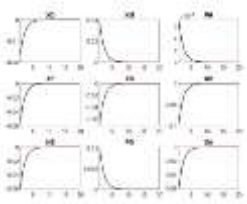

Figure 5: Effect of Capital rental rate shock in Latex manufacturing sector

Figure 5 depicts that a shock to the capital rental rate in the manufacturing sector reduces manufacturing outputs (XB), manufacturing employment (NB), and demand for agricultural outputs (XA) while increasing manufacturing prices (PD) and domestic final concentrate latex prices (PH). A rise in the capital rental rate can reduce manufacturing output because firms are forced to pay more to obtain the necessary capital for production. This is due to the fact that higher capital rental rates result in higher costs that must be passed on to businesses, resulting in lower profits. Consequently, firms are less able to finance their operations, and as a result, they produce less output (XB). Additionally, a rise in the capital rental rate leads to a decline in manufacturing employment (NB), as firms become less likely to hire employees due to the increased costs of capital. Since this product's demand is derived from the manufacturing sector, agricultural outputs (XA) also experience a decline in demand. A rise in the capital rental rate results in an increase in the manufacturing price (PD), as firms are compelled to pass on the higher capital costs to consumers. This increased cost leads to higher consumer prices for the manufactured goods, resulting in a decline in demand for them as a whole. Simultaneously, the increased cost of capital can lead to an increase in the price of domestic final concentrate latex (PH), as the producer is forced to pay higher prices for manufacturing inputs.

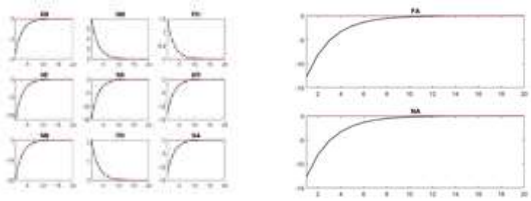

Figure 6: Effect of wage shock in Latex manufacturing sector

Figure 6 reveals that a wage shock in the manufacturing sector reduces manufacturing outputs (XB), manufacturing employment (NB),

and demand for agricultural outputs (XA) while increasing manufacturing prices (PD) and the domestic final concentrate latex price (PH). This is primarily due to the substitution effect. In order to reduce labor costs, firms in the manufacturing sector are likely to substitute labor (NB) with capital when wages increase. This increase in the cost of labor results in an increase in the price of manufactured goods (PD), as firms are now able to pass along the cost of capital equipment to consumers. Additionally, the increase in the price of manufactured goods reduces the demand for agricultural outputs (XA). This is because, as the price of manufactured goods rises, consumers are less likely to buy them (XB) because they can no longer afford them. This decrease in manufacturing output demand results in a decline in agricultural input demand (XA). Due to the fact that the price of manufactured goods has an effect on this price, the domestic final concentrate latex price increase is a result of rising wages in the manufacturing sector.

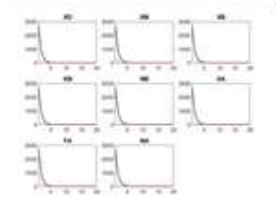

Figure 7: Effect of domestic demand shock

Figure 7 indicates that the domestic demand shock for final concentrate latex increases agricultural output, manufacturing output, and concentrate latex imports (XM). Since domestic final concentrate latex originates from the manufacturing sector and is imported, the increase in demand will lead to an increase in agricultural production, manufacturing output, and concentrate latex imports.

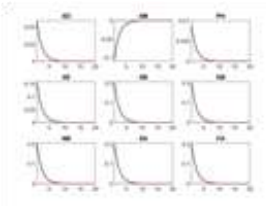

Figure 8: Effect of exchange rate shock

Figure 8 demonstrates that an exchange rate shock or baht depreciation increases concentrate latex export (XE), but decreases concentrate latex import (XM). As exchange rates change significantly, so do the relative costs of exporting and importing goods, leading to proportional changes in the volume of international trade. When the exchange rate increases or the baht depreciates, purchasing concentrate latex from abroad becomes more expensive. Consequently, the price of importing concentrated latex is now greater than it was previously. This results in a decrease in the importation of concentrate latex (XM). However, a rise in the exchange rate or depreciation of the baht results in a reduction in the price of concentrate latex for foreign buyers. Therefore, it is more likely that foreign buyers will purchase concentrated latex from Thai producers. This causes an increase in the export quantity of concentrate latex (XE).

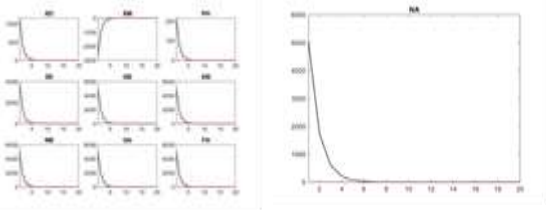

Figure 9: Effect of foreign price shock

Figure 9 shows that the foreign concentrate latex price shock causes an increase in concentrate latex exports (EX), a decrease in concentrate latex imports (XM), and an increase in the domestic price of concentrate latex (PH). A rise in foreign prices increases the relative desirability of exports of Thai concentrate latex.

This is due to the fact that, as foreign prices rise, Thai concentrated latex exports (XE) become relatively less expensive for foreign buyers. Therefore, foreign buyers are more likely to purchase concentrate latex at a lower price from Thailand. However, a rise in foreign prices also reduces imports of concentrate latex (XM). This is due to the likelihood that domestic buyers will purchase concentrate latex within countries with lower prices. As the foreign price of concentrate latex is included in the domestic final price of concentrate latex (PH), when the foreign price increases, so does the domestic final price.

5. Recommendations

Based on the results of the analysis, the following recommendations are suggested: 1) Investing in production technology in the manufacturing sector to improve production efficiency and productivity; 2) Implementing practices to minimize the negative effects of increasing fertilizer price, wage, and capital rental rate, such as supporting domestic fertilizer production, increasing labor productivity through equipping workers with new knowledge and skills, and utilizing as much of the capital capacity as possible; 3) Encouraging domestic concentrate latex demand by supporting the growth of downstream producers through credit support and building proper infrastructure. Furthermore, the government should leverage external shocks that are out of its control by strengthening the domestic concentrate latex industry, which is less reliant on foreign countries in the event of a concentrate latex global crisis.

6. Conclusion

Concentrated latex is an intermediate rubber product that serves a unique purpose in the rubber industry as the primary raw material for a variety of rubber manufacturing processes. This industry contributes positively to the economy by facilitating the growth of other industries and generating foreign currency. Due to the economic significance of the concentrated latex industry, this study employs the DSGE method to describe the factors that influence the dynamics of key variables, including output, price, and employment, in the upstream and midstream of the industry. The model is estimated using a Bayesian estimation method with monthly data from the Office of Industrial Economics database for domestic price, demand, and export of concentrate latex from January 2016 to January 2022. The results indicate that a technological shock increases output and employment while reducing output price. The cost related shocks decrease output and employment while increasing output price. As anticipated, external shocks cause a shift in imports and exports and domestic prices. Therefore, enhancing technology, labour skills, and the domestic concentrated latex sector is strongly recommended.

Acknowledgement

This research is supported by School of Economics, Sukhothai Thammathirat Open University, Thailand.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

The author contributed in the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

This research is supported by School of Economics, Sukhothai Thammathirat Open University, Thailand.

Conflict of Interest

The author has no conflict of interest to declare that is relevant to the content of this article.