INCREASING STABILITY IN NATURAL RUBBER SUPPLY CHAIN

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ยางธรรมชาติในตลาดโลกมีปริมาณของอุปสงค์เพิ่มขึ้นเล็กน้อย ในขณะที่การปริมาณของอุปทานเพิ่มขึ้นในระดับที่มาก ดังนั้นปริมาณของอุปสงค์และอุปทานเกิดความไม่สมดุลย์ขึ้น จึงส่งผลให้ราคายางธรรมชาติในตลาดโลกลดลง การศึกษานี้จึงมีวัตถุประสงค์คือ (1) เพื่อพัฒนาแบบจำลองอุปสงค์และอุปทานในการพยากรณ์ปริมาณยางธรรมชาติในตลาดโลก โดยใช้ข้อมูลรายเดือน ปี 2547 ถึง 2558 ด้วยสมการหลายชั้น (2) เพื่อพยากรณ์ค่าของตัวแปรอธิบายในแบบจำลองอุปสงค์และอุปทาน โดยใช้ข้อมูลรายเดือน ปี 2554 ถึง 2558 ด้วยเทคนิควิธีเส้นค่าเฉลี่ยเคลื่อนที่แบบธรรมดา และ (3) เพื่อประมาณปริมาณและราคา ณ จุดดุลยภาพ ของยางธรรมชาติในตลาดโลก โดยใช้แบบจำลองอุปสงค์ แบบจำลองอุปทาน และค่าพยากรณ์ของตัวแปรอธิบาย

การศึกษาแรกพบว่า แบบจำลองอุปสงค์มีความสัมพันธ์ทางบวกกับปริมาณผลผลิตยางธรรมชาติในตลาดโลก ราคายางสังเคราะห์ ค่าของ GDP เมื่อเปรียบเทียบกับปีก่อนหน้า และอัตราแลกเปลี่ยนจากเงินหยวนของจีนเป็นเงินบาทของไทย ในขณะที่มีความสัมพันธ์เชิงลบกับราคายางธรรมชาติ สำหรับแบบจำลองอุปทานมีความสัมพันธ์เชิงบวกกับราคายางธรรมชาติ ปริมาณพื้นที่ให้ผลผลิตได้ในประเทศไทย ปริมาณน้ำฝนในประเทศไทย และราคาน้ำมันดิบปิโตรเลียม ในขณะที่มีความสัมพันธ์เชิงลบกับปริมาณสต๊อกยางธรรมชาติในตลาดโลก และราคายูเรีย

การศึกษาที่สอง พบว่า ค่าพยากรณ์ของปริมาณผลผลิต ค่าของ GDP เมื่อเปรียบเทียบกับปีก่อนหน้า อัตราแลกเปลี่ยน ปริมาณสต๊อก และปริมาณพื้นที่ให้ผลผลิตได้ในประเทศไทย มีแนวโน้มเพิ่มขึ้นเล็กน้อย ในขณะที่ราคายางสังเคราะห์ ราคายูเรีย ปริมาณน้ำฝน และราคาน้ำมันดิบ มีแนวโน้มลดลงจากปี 2560 ถึง 2569

การศึกษาสุดท้าย พบว่า ค่าพยากรณ์ของปริมาณยางธรรมชาติ ณ จุดดุลยภาพ มีแนวโน้มเพิ่มขึ้นเล็กน้อยจาก 953.75 เป็น 957.15 พันตัน และราคายางธรรมชาติ ณ จุดดุลยภาพ มีแนวโน้มผันผวนและลดลง จาก 169.78 เป็น 162.05 พันเยน จากปี 2560 ถึง 2569 จากผลการศึกษานี้สามารถช่วยรัฐบาลของประเทศผู้ผลิตยางธรรมชาติที่สำคัญของโลกในการวางแผนนโยบายในการลดต้นทุนการผลิตยางธรรมชาติและสร้างเสถียรภาพราคายางธรรมชาติในอนาคต ตัวอย่างเช่น การกำหนดปริมาณที่เหมาะสมในการปลูกยางในแต่ละประเทศ

สาขาวิชา การจัดการด้านโลจิสติกส์ ลายมือชื่อนิสิต .....

ปีการศึกษา 2559 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

ลายมือชื่อ อ.ที่ปรึกษาร่วม .....

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KEYWORDS: EQUILIBRIUM PRICE / EQUILIBRIUM QUANTITY / NATURAL RUBBER / SIMULTANEOUS EQUATION

SURATWADEE ARUNWARAKORN: INCREASING STABILITY IN NATURAL RUBBER SUPPLY CHAIN. ADVISOR: PROF. KAMONCHANOK SUTHIWARTNARUEPUT, Ph.D., CO-ADVISOR: ASSOC. PROF. PONGSA PORNCHAIWISESKUL, Ph.D., 200 pp.

The natural rubber in the world market has small increase in demand and big increase in supply. Therefore, the demand and supply are imbalance and impact the natural rubber price of the world market to decline. This study is set to (1) to develop demand and supply model for predicting the world natural rubber quantity by using monthly data from 2004 to 2015 with simultaneous equation; (2) to predict all explanatory variables in demand and supply model by using monthly data from 2011 to 2015 with simple moving average technique; and (3) to estimate equilibrium quantity and price in world natural rubber by using demand model, supply model, and predicted explanatory variables.

Firstly, in the demand model, the positive relationship of explanatory variables are world natural rubber production quantity, synthetic rubber price, %YOY of GDP, and exchange rate from Chinese Yuan to Thai Baht, while negative relationship variable is natural rubber price. In the supply model, the positive relationship variables are natural rubber price, size of mature area in Thailand, rainfall in Thailand, and crude oil price, while negative relationship variables are world natural rubber stock and urea price.

Secondly, the predicted variables show that number of production, %YOY of GDP, exchange rate, number of stock and size of mature area in Thailand tend to gradually increase, while synthetic rubber price, urea price, rainfall, and crude oil price tend to slowly decrease from 2017 to 2026.

Finally, the forecasting of equilibrium quantity tends to gradually increase from 953.75 to 957.15 thousand tons, and equilibrium price tend to fluctuate and decrease from 169.78 to 162.05 thousand yens from 2017 to 2026. As a consequence, this study may be helpful to the government of the important natural rubber producing countries to plan the policies for reducing natural rubber production costs and stabilizing natural rubber price in the future, as well as setting the suitable size of world natural rubber plantation in each country.

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CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER I
INTRODUCTION

1.1 Statement of problem

Natural rubber market of the world was primarily concentrated in China, Europe, India, USA and Japan respectively, which are the top five countries of natural rubber consumption in 2015 (International Rubber Study Group, 2016b). China was the world's largest consumer of natural rubber, which consumed 4,820 thousand tons in 2015, with 1.26 percent increase from the previous year, making up 39.03 percent of the world's total consumption, an increased by 33.84 percent from 2011 (International Rubber Study Group, 2016b; Reportlinker, 2015). However, the weather condition was the main factor to impact the output of natural rubber market in China that was rather low, only 794 thousand tons in 2015, or 6.47 percent of the total in the world market, and percentage change is decreased by 5.49 percent of previous year (International Rubber Study Group, 2016b). China had to import a large number of natural rubber from Thailand, Indonesia and Malaysia to meet demand and supply gap, with imports obtaining 3,803.2 thousand tons in 2015, 78.9 percent of total consumption that year (International Rubber Study Group, 2016b; Reportlinker, 2015).

The demand rise was from automotive and tire industries in China, natural rubber consumption would continue to grow and was expected to reach 6,791 thousand tons by 2018 (Pitakpaibulkij, Jarurungsipong, & Suntornpagasit, 2015; Reportlinker, 2015). While the continuous decreasing in price of natural rubber over the last three years convinced producers to reduce production, the stock of natural rubber of the world market decreased to 3.16 million tons in 2015 (International Rubber Study Group, 2016b). Although the gap between production and usage reduced, natural rubber is still above three million tons, which is a high level. The high inventory levels will keep a limit on natural rubber prices (Pitakpaibulkij et al., 2015).

The International Rubber Study Group (IRSG) expected that the oversupply situation would continue for the next few years and then gradually decline because of a slow growth in natural rubber (Pitakpaibulkij et al., 2015). Production growth would

be slow due to the EI Nino effect and the continuing drop in natural rubber prices, while the automotive sector is forecast to increase the usage of natural rubber (Pitakpaibulkij et al., 2015).

Natural rubber forecasts were necessary to help in decision making and long term investment decision, while the simultaneous equation was more of efficient measures in terms of statistical criteria for supply, demand and price system model (Khin, Zainalabidin, Nasir, Chong, & Mohamed, 2011).

Due to the important to balance the demand and supply in the world natural rubber, the government, experts and natural rubber's stakeholders should apply the supply chain management (SCM) for the whole chain of natural rubber production in order to improve the cost effectiveness and performance. However, the solution that can help everyone in the entire natural rubber chain is the appropriate policy from the main countries which export the natural rubber.

1.2 Research Objectives

(1) To develop demand and supply model for predicting the world natural rubber quantity

(2) To predict all explanatory variables in demand and supply model

(3) To estimate equilibrium quantity and price in world natural rubber

1.3 Scope of the Study

This study focuses on the natural rubber of the world market that includes world natural rubber consumption quantity, world natural rubber production quantity, natural rubber price in physical market price of RSS3 at Tokyo market, synthetic rubber price at USA market, %YOY of GDP of the world, exchange rate from Chinese Yuan to Thai Baht, world natural rubber stock, size of mature area of natural rubber plantation in Thailand, urea f.o.b. price at Eastern Europe, number of rainfall in Thailand, palm oil future price at Malaysia market, and crude oil price in petroleum.

1.4 Research Methodology

The first of objectives is to develop demand and supply model for predicting the world natural rubber quantity, which is identified by using monthly data from 2004 to 2015 with simultaneous equation. The next objective is to predict all explanatory variables in demand and supply model, which are forecasted by using monthly data from 2011 to 2015 with simple moving average technique. The last objective is to estimate equilibrium quantity and price in world natural rubber, which are examined by using demand model, supply model and predicted explanatory variables.

1.5 Expected Contribution

The most of natural rubber studies in the past focused on (1) forecasting natural rubber price and number of natural rubber production, and (2) finding the determinants of demand, supply and price for developing model. However, the studies were investigated in each country such as (1) important exporters' countries; Thailand, Malaysia, India, and Nigeria, and (2) essential importers' countries; Japan, USA, and China. For the gap of the studies in the past, there are no studies in natural rubber of the world market about developing the demand and supply model for forecasting the number of production and price, and no studies about finding the equilibrium of natural rubber quantity and price of the world market.

Therefore, this study would fill the information gap in developing the natural rubber demand and supply model with appropriate explanatory variables by focusing on the natural rubber of the world market. Moreover, this study would estimate the equilibrium of natural rubber quantity and price in natural rubber of the world market in the period from 2017 to 2026.

Moreover, this study would estimate the equilibrium of natural rubber quantity and price by using demand and supply model that would be developed by simultaneous equations with three-stage least square. This technique has never been used to predict natural rubber of the world market before. The simultaneous equations is a popular and reliable approach to forecast the demand and supply in several commodities. Therefore, the results from the analysis in this study would be accurate and consistent in the economic theory.

As a consequent, this study is an important contribution to plan and develop the natural rubber policies for the world important natural rubber producer countries' government to plan the natural rubber policies for reduction in natural rubber production costs and stabilization in natural rubber price in the future, such as setting the suitable number of world natural rubber plantation in each country, and defining the appropriate alternative crop with area in each country. For setting the suitable number of world natural rubber plantation in each country, it can help to balance supply and demand in the world market that impact to natural rubber price stabilization in the future. For defining the appropriate alternative crop with area in each country, it can help to increase alternative income for farmers. The appropriate alternative crop should be considered based on topography, weather and soil in each country, especially sustainable alternative crop in the future.

1.6 Terminology and Definition

In this study, it is essential to define central ideas and concepts according to the Rubber Statistical Bulletin, International Rubber Study Group (International Rubber Study Group, 2005, 2006, 2007, 2008, 2009a, 2010, 2011, 2012, 2013, 2014, 2015a, 2015b, 2016a, 2016b) as seen below:

Natural rubber – in this study, means natural rubber and natural rubber content in compound rubber.

The natural rubber is classified in four types as follows:

(1) Natural rubber latex, whether or not pre-vulcanized

(2) Natural rubber in ribbed smoked sheets (RSS)

(3) Technically specified natural rubber (TSR)

(4) Other natural rubber

The natural rubber content in compound rubber is classified in three types as follows:

(1) Rubber solutions, dispersions n.e.s.

(2) Compounded unvulcanized rubber in plates, sheets or strip

(3) Compounded unvulcanized rubber in primary form n.e.s.

Synthetic rubber – in this study, it is divided into fifteen types as follows:

(1) Latex of styrene-butadiene rubber (SBR)/ carboxylated styrene-butadiene rubber (SBR)
(2) Styrene-butadiene rubber (SBR)
(3) Poly-butadiene rubber (BR)
(4) Isobutene-isoprene (buty1) rubber (IIR)
(5) Halo-buty1 rubber (HIIR)
(6) Latex of chloroprene (chloro-butadiene) rubber (CR)
(7) Chloroprene (chloro-butadiene) rubber (CR)
(8) Latex of Acrylo-nitrile rubber (NBR)
(9) Acrylo-nitrile rubber (NBR)
(10) Poly-isoprene rubber (IR)
(11) Ethylene-propylene-nonconjugated diene rubber (EPDM)
(12) Mixtures of natural rubber
(13) Other latex of synthetic rubber
(14) Other synthetic rubber
(15) Compound rubber, un-vulcanised, in primary forms, or in plates, sheets and strips, with carbon-block or silica

CHAPTER II
LITERATURE REVIEW

The main purposes of this study are (1) to develop demand and supply model for predicting the world natural rubber quantity, (2) to predict all explanatory variables in demand and supply model, and (3) to estimate equilibrium quantity and price in world natural rubber. Therefore this chapter will propose a literature review which includes overview and principle that will be applied to this study as follows:

2.1 Overview of natural rubber

Para rubber tree (*Hevea Brasiliensis*) or rubber tree is a perennial plant. It can be older than 100 years and grow to heights of 100 to 130 feet (Rainforest Aliliance, 2012). However, the rubber tree plantation normally grows to 20-30 meters (or about 65-100 feet) and rubber tree is replanted after 25 years when latex yields reach unprofitable levels. The rubber research institute of Thailand advises that the suitable environment to plant rubber tree has (1) yearly rainfall at least 1,250 mm., (2) the number of rainfall day between 120 and 150 days per year, (3) appropriate temperature between 26 and 30 degree Celsius, and (4) suitable height of area about 600 meters (or around 2,000 feet) above sea level. The rubber tree can grow on a variety of soil types

provided that there is sufficient drainage, but highly productive soils can give higher yields (Rubber research institute of Thailand, 2012). The growing areas for rubber trees are within the 10° latitudes north and south of the equator although cultivation occurs further North, e.g., Guatemala, Mexico and China, and further South, e.g. Sao Paulo region of Brazil (Soontaranurak, 2011). Therefore, Southeast Asia is a suitable area to plant the rubber tree.

Nowadays, rubber trees are mainly cultivated in Southeast Asia, especially Indonesia, Thailand, Malaysia, and Vietnam. International Rubber Study Group (2016a) reported that in 2015 the top four countries in mature plantation area of rubber are in Indonesia (28.6%), Thailand (27.6%), Malaysia (6.2%), and Vietnam (5.7%), respectively. In the years of 2006-2015, the growth rate of mature area in rubber plantation of the world has increased by 24.49 percent. The detail of mature area of rubber tree plantation in each country and the world market are shown in the Table 1.

The full production of rubber tree starts with planting the rubber tree for about six years, after that farmer can tap the rubber. Rubber tapping is a process by which the latex is collected from a rubber tree. An incision is made in the tree's bark, which cuts through the latex vessels, from which the product then flows. Timing of the incision must be planned within the planting cycle to optimize the latex yield (Wikipedia, 2016).

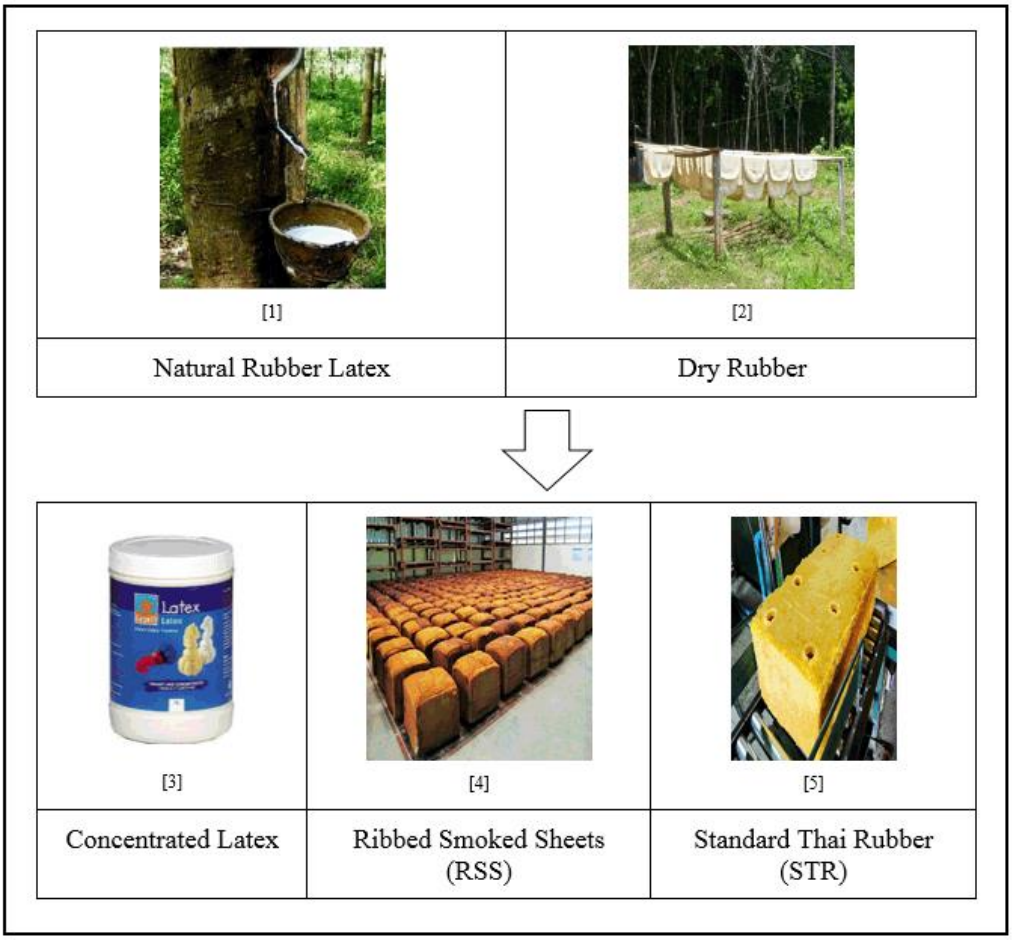
The field latex is used to be the raw material for making natural rubber products, such as concentrated latex, ribbed smoked sheets (RSS), and technically specified natural rubber (TSR) as shown in the Figure 1.

Table 1 The size of mature Area in rubber tree plantation (000 hectares)

	Indonesia	Thailand	Malaysia	Vietnam	World
2006	2,725.9	1,742.9	1,251.0	522.2	8,484.0
	32.1%	20.5%	14.7%	6.2%	100.0%
2007	2,775.5	1,766.9	1,248.0	556.3	8,633.8
	32.1%	20.5%	14.5%	6.4%	100.0%
2008	2,897.6	1,819.5	1,247.0	399.0	8,703.5
	33.3%	20.9%	14.3%	4.6%	100.0%
2009	3,435.2	1,856.0	1,058.0	419.0	9,285.0
	37.0%	20.0%	11.4%	4.5%	100.0%
2010	3,445.1	1,929.3	1,112.0	438.6	9,864.0
	34.9%	19.6%	11.3%	4.4%	100.0%
2011	3,456.2	2,042.6	1,136.0	460.0	9,687.7
	35.7%	21.1%	11.7%	4.7%	100.0%
2012	3,484.2	2,209.1	1,200.0	505.8	9,451.0
	36.9%	23.4%	12.7%	5.4%	100.0%
2013	2,770.0	2562.5*	906.0*	565.4*	9939.1*
	27.9%	25.8%	9.1%	5.7%	100.0%
2014	2893.0*	2739.1*	612.0	625.0	10592.2*
	27.3%	25.9%	5.8%	5.9%	100.0%
2015	3,016.0	2,915.8	650.0	600.0	10561.7*
	28.6%	27.6%	6.2%	5.7%	100.0%

** The value is estimated by using simple moving average technique*

Source: (International Rubber Study Group, 2005, 2006, 2007, 2008, 2009a, 2010, 2011, 2012, 2013, 2014, 2015a, 2015b, 2016a, 2016b)



Source: [1] from Patra Product (2000), [2] from Wikimedia commons (2014), [3] from Pebco SAS (-), [4] from Tong Thai (2015a), [5] from Tong Thai (2015b)

Figure 1: The example of natural rubber production

There are many products that are made from the natural rubber. For example, latex is produced to be latex products such as surgical and examination gloves, household gloves, catheters, breathing bags, balloons and other relatively high-value products. The mid-range, which comes from the Technically Specified Natural Rubber material ends up largely in tires and also in conveyor belts, marine products, windshield wipers and miscellaneous rubber goods (Wikipedia, 2017). In 2015, the IRSG reported that the main of countries where produces the natural rubber production in the top four countries of the world market are Thailand (36.8%), Indonesia (25.9%), Vietnam (8.4%), and Malaysia (5.9%), respectively. The sum of number in natural rubber production from four countries is around 77.0 percent of the world market. The detail of number of natural rubber production from their countries are shown in Table 2.

Table 2 The number of natural rubber production (000 tons)

	Thailand	Indonesia	Vietnam	Malaysia	Total (4 countries)	World
2006	3,137.0	2,637.0	555.4	1,283.6	7,613.0	9,791.0
	32.0%	26.9%	5.7%	13.1%	77.8%	100.0%
2007	3,056.0	2,755.2	605.8	1,199.6	7,616.6	10,057.0
	30.4%	27.4%	6.0%	11.9%	75.7%	100.0%
2008	3,089.8	2,751.0	660.0	1,072.4	7,573.2	10,098.0
	30.6%	27.2%	6.5%	10.6%	75.0%	100.0%
2009	3,164.4	2,440.0	711.3	857.0	7,172.7	9,723.0
	32.5%	25.1%	7.3%	8.8%	73.8%	100.0%
2010	3,252.1	2,736.0	751.7	939.0	7,678.8	10,393.0
	31.3%	26.3%	7.2%	9.0%	73.9%	100.0%
2011	3,569.0	2,990.0	789.3	996.2	8,344.5	11,034.0
	32.3%	27.1%	7.2%	9.0%	75.6%	100.0%
2012	3,778.0	3,012.0	877.1	922.8	8,589.9	11,046.0
	34.2%	27.3%	7.9%	8.4%	77.8%	100.0%
2013	4,170.0	3,237.0	949.1	826.5	9,182.6	11,430.0
	36.5%	28.3%	8.3%	7.2%	80.3%	100.0%
2014	4,324.0	3,153.2	953.7	668.1	9,099.0	12,181.0
	35.5%	25.9%	7.8%	5.5%	74.7%	100.0%
2015	4,473.3	3,145.4	1,017.0	721.5	9,357.2	12,146.0
	36.8%	25.9%	8.4%	5.9%	77.0%	100.0%

Source: 2006-2009 are from International Rubber Study Group (2012)
2010-2015 are from International Rubber Study Group (2016a)

Natural rubber offers good elasticity, while synthetic materials tend to offer better resistance to environmental factors such as oils, temperature, chemicals or ultraviolet light. “Cured rubber” is a rubber which has been compounded and subjected to the vulcanization process which creates cross-links within the rubber matrix (Wikipedia, 2017). The natural rubber is the basic component of many products used in the transportation, industrial, consumer, hygienic and medical sectors. For major end-use markets for rubber, transportation is the largest single sector, with tires and tire products taking over 50% of natural rubber consumption. Truck and bus tires would represent the largest single consumer for natural rubber, followed by automobile tires (Indolatex Jaya Abadi, 2011).

IRSG reported that the top five countries of consumption in natural rubber and synthetic rubber of the world market are China (33.0%), European Union (13.6%), USA (10.9%), Japan (5.9%) and India (5.7%), respectively. The sum of consumption in natural rubber and synthetic rubber of the world market is about 26,708 thousand tons. The detail of number of natural rubber production from their countries are shown in Table 3.

Table 3 The number of consumption in natural rubber and synthetic rubber (000 tons)

	China	EU	USA	Japan	India	World
2006	5,807.2	3,878.3	3,003.9	2,044.5	1,079.4	22,365.0
	26.0%	17.3%	13.4%	9.1%	4.8%	100.0%
2007	6,379.7	3,902.4	2,908.8	2,049.6	1,140.8	23,474.0
	27.2%	16.6%	12.4%	8.7%	4.9%	100.0%
2008	6,376.8	3,674.5	2,735.9	2,015.5	1,174.8	22,923.0
	27.8%	16.0%	11.9%	8.8%	5.1%	100.0%
2009	7,613.6	2,743.5	2,134.8	1,467.5	1,226.2	21,578.0
	35.3%	12.7%	9.9%	6.8%	5.7%	100.0%
2010	7,247.6	3,416.4	2,657.5	1,738.4	1,350.1	23,984.0
	30.2%	14.2%	11.1%	7.2%	5.6%	100.0%
2011	7,314.2	3,789.0	2,895.8	1,750.7	1,380.8	24,890.0
	29.4%	15.2%	11.6%	7.0%	5.5%	100.0%
2012	7,845.2	3,457.5	2,715.8	1,690.0	1,426.9	25,008.0
	31.4%	13.8%	10.9%	6.8%	5.7%	100.0%
2013	8,498.5	3,416.5	2,611.2	1,664.2	1,433.1	25,591.0
	33.2%	13.4%	10.2%	6.5%	5.6%	100.0%
2014	9,031.2	3,486.1	2,787.2	1,660.0	1,538.3	26,447.0
	34.1%	13.2%	10.5%	6.3%	5.8%	100.0%
2015	8,805.2	3,629.4	2,905.2	1,587.4	1,535.6	26,708.0
	33.0%	13.6%	10.9%	5.9%	5.7%	100.0%

Source: 2006-2009 are from International Rubber Study Group (2012)
2010-2015 are from International Rubber Study Group (2016a)

Indolatex Jaya Abadi (2011) told that general rubber products for commercial and industrial use account for the balance. These non-tire rubber items include industrial products (for example, transmission and elevator belts, hoses and tubes,

industrial lining, and bridge bearings); consumer products (like golf or football balls and other recreational and sports goods, erasers, footwear and other apparel); and items for use in the medical and health sector (mainly, condoms, catheters and surgical gloves) as well as seismic materials (for instance, over 500 and 2,500 building are fitted with seismic rubber bearings in China and Japan). Latex products (typically condoms, gloves, threads, adhesives, and molded foams) could be included in different categories in terms of end-use.

2.2 Overview of Demand, Supply and Price

Demand and supply are the two basic components of a market economy to understand the determination of quantity of a good sold on the market. Demand and supply shows that consumers and producers are willing to buy and sell. A product is exchanged when buyers and sellers can agree on a price.

In economic principle, demand is used to explain a consumer requirement and willingness to pay for a good or service. There are a lot of factors that impact on demand change, especially the price of good or service. Supply represents how much the market can offer. The supplied is the amount of a certain good that a producer is willing to supply when receiving a certain price. The correlation between price and how much of a good or service is supplied to the market is known as the supply relationship. Therefore, the reflection of demand and supply is price. (Hayes, 2017)

Hameed et al. (2009) refer to Labys (1973) that the basic structure of models in the agricultural product markets are formed from the factors of the market model approach which includes supply, demand, price, and stock.

According to Labys (1973) and Pollak (1984), in the equation system, price adjusts to clear the market. The supply depends on the lagged supply, lagged price, and policy variables. The demand depends on the lagged demand, price of good or service, price of substitute product, level of economic activity, and technical factors. Lagged price and stock can be used to explain the price. Since the supply process normally uses the general class of distributed lag functions, the lagged price variables are included. The market model is closed using an identity which are quantity supplied minus quantity demanded.

The factors of demand and supply can be used to define price, by correlating the amount of a given commodity that a producer hopes to sell at a certain price (supply), and the amount of that commodity that a consumer is willing to buy (demand). Supply refers to the varying amounts of a good that producers will supply at different prices. If the price increases, the supply increases. It is normal forces of the market. Demand is the quantity of a good that is demanded by consumers at any given price. The law of demand, if demand increases, price increases. While if demand decreases, price decreases. In a perfect economy, the combination of the upward-sloping supply curve and the downward-sloping demand curve yields a supply and demand schedule that, at the intersection of the two curves, shows the equilibrium price of an item. (Cuthbertson, 1985; Klein, 1983).

2.2.1 Definitions of demand, supply and equilibrium price

According from Stephen (2009), demand, supply and equilibrium price definitions are as follows:

Demand is defined as *"the schedule of quantities of a good or service that people are willing and able to buy at different prices"*.

Supply is defined as *"the schedule of quantities of a good or service that people are willing and able to sell at different prices"*.

Equilibrium price is *"the price at which quantity demanded equals quantity supplied"*.

2.2.2 The law of demand and supply

According from Robin and Michael (2007), the law of demand and supply definitions are as follows:

The law of demand states that;

"When other things remaining the same, if the price of a good increases, the demand of that good decreases; and if the price of a good decreases, the demand of that good increases".

The law of supply states;

"When other things remaining the same, if the price of a good rises, the supply of that good increases; and if the price of a good falls, the supply of that good decreases".

2.2.3 Demand determinants

This part shows the demand determinants, and there are several studies about the factors that impact to the number of natural rubber consumption of natural rubber demand in the market. They are (1) number of natural rubber production, (2) natural rubber price, (3) synthetic rubber price, (4) gross domestic product (GDP) - which is represented the gross national product (GNP), world economy, and income, and (5) exchange rate. The results of literature review are as follows, and the summary of demand determinants are shown in Table 4.

(1) Number of natural rubber production

At present, the natural rubber production quantity tends to increase because of (1) increasing size of mature area in natural rubber plantation and (2) development of natural rubber transform process. Since 2009, mature area in natural rubber plantation has been increased because the natural rubber price was the highest price in 2009 and continued for another few years. As a consequence, the farmers had motivation in natural rubber plantation, and the mature area increased obviously in 2014 and 2015. Thus the number of natural rubber production tends to increase in few years from now. For development of natural rubber transform process, the technology in transform process had been being developed continuously which made high productivity in transform from latex to natural rubber production. As a result, the number of natural rubber production tends to increase in the future (International Rubber Study Group, 2005, 2006, 2007, 2008, 2009a, 2010, 2011, 2012, 2013, 2014, 2015a, 2015b, 2016a, 2016b).

However, the natural rubber price tended to decrease continuously since 2011 because some countries, such as Malaysia and Indonesia, had policy in rubber tree reduction by cutting the rubber tree before twenty-five years of productive phase. Therefore, the number of natural rubber production decreases faster than it should be.

Additionally, the Association of Natural Rubber Producing Countries (ANRPC) reported that the natural rubber supply of ANRPC member countries have declined with a negative annual growth at 8.4 percent from 2016 to 2020 (Lind, Marchal, & Wathen, 2015).

There are several studies that reported that the number of natural rubber production have affected the natural rubber demand. Roselina, Siti, Siti, and Suarni (2006) studied about Malaysia natural rubber prediction price framework and found that number of natural rubber production directly impact on number of natural rubber consumption in Malaysia. Mesike, Okoh, and Inoni (2010) showed that number of production directly force on price and indirectly impact on number of consumption in Nigeria, while Burger and Smit (1989) and Khin, Chong, Mohamed, and Shamsudin (2008) supported this result with their study in the world market.

Therefore, this study uses the number of natural rubber production as a factor that impacts on natural rubber consumption of the world market.

(2) Natural rubber price

Natural rubber price is the main factor that impacts the natural rubber demand and supply. For the demand, if natural rubber price decreases, the demand of the natural rubber increases. Since there is an adverse relationship between natural rubber price and demand, it is similar to the normal market forces.

The natural rubber price was the highest in 2009 and after that tended to decrease continuously until today. The factors that impact on the natural rubber price are a lot of determinants. Khin et al. (2008) studied about price forecasting of natural rubber in the world market with Box and Jenkins approach, and the results showed that (a) number of natural rubber production, (b) number of natural rubber consumption, (c) number of natural rubber stock, (d) crude oil price, (e) number of passenger cars' and commercial vehicle cars' tires, and (f) exchange rate from RM to USD were the important explanatory variables in the Standard Malaysia Rubber price forecasting.

Therefore, the natural price is the essential factor which several research studied on. Maya (2003) studied about supply response and cost of production of natural rubber with econometric model, and said that natural rubber price is the major factor for motivated buying. It means, if the natural rubber price decreases, the demand in natural

rubber will increase. Bussabarporn and Visit (2010), and Rosada (1994) studied about natural rubber demand determinants for Thailand in both, and they found that real import and real export natural rubber price are directly impact the number of natural rubber demand. There are several studies, which support that the expected price of natural rubber directly affect the number of natural rubber demand (Bank of Thailand, 2004-2015; MdLudin, Applanaidu, & Abdullah, 2016; Robin & Michael, 2007; Roselina et al., 2006).

As a consequence, the natural rubber price is the main determinant in demand model of this study.

(3) Synthetic rubber price

Synthetic rubber price is the perfect substitute product of natural rubber (Romprasert, 2012). In 2004-2013, the situation of synthetic rubber price increased constantly, since the natural rubber price tended to increase continuously, which was followed by the increasing in natural rubber demand of the world market. In contrast, the synthetic rubber price declined continuously since 2014 until today, because the main industries, especially automotive and tire industries, used the natural rubber more than synthetic rubber to be raw material. When natural rubber price decreases, it relates to the falling share of synthetic rubber in total rubber consumption (Khin et al., 2008). Similarly with Akron (2017) which reported that synthetic rubber price, especially butadiene price, was starting to fall, since Asia change from using synthetic rubber to natural rubber.

However, the synthetic rubber price is to be the perfect substitute product of natural rubber, the changing of synthetic rubber price impacts the number of natural rubber consumption or demand. There are many studies that support this idea. Robin and Michael (2007) told that the synthetic rubber is the substitute natural rubber product, so the synthetic rubber price directly impacts the natural rubber price and natural rubber demand. Khin et al. (2008) studied about price forecasting of natural rubber in the world market, and the result showed that the synthetic rubber price directly affects the number of consumption or demand in the world market. Moreover, Romprasert (2012) and Roselina et al. (2006) reported that the synthetic rubber price directly impact on the demand of natural rubber in the market. If synthetic rubber price

increases, the demand in synthetic rubber will decrease and the demand in natural rubber will increase.

Therefore, this study uses the synthetic rubber price to be the demand determinant. In this study, the synthetic rubber price at USA market represented the world market since USA is in the top three of the world the natural rubber importers, which uses the natural rubber in several products, especially in automotive and tire industries.

(4) Gross Domestic Product (GDP)

Romprasert (2012) and Khin et al. (2008) reported that the world economy growth directly impact the demand of natural rubber in the market. Robin and Michael (2007) and Roselina et al. (2006) told that when income of the population increases, the number of consumption in natural rubber rises. It means that the income directly affects to the number of natural rubber demand. While Chawananon (2014), Bussabarporn and Visit (2010) and Rosada (1994) showed that when gross domestic product (GDP) increases, the natural rubber demand of the market increases.

Thus this study would use GDP for reporting the economic growth and income of the population (Barnes, 2017). For this study, the percent year of year (%YOY) in gross domestic product (GDP) represents GDP of the world. The GDP of the world is reported in the annual data, while the percent year of year in GDP is reported in quarter data. After that the quarter of percent year of year in GDP is transformed to monthly of percent year of year in GDP with the simple moving average technique.

The percent year of year in GDP fluctuated by the economic growth and income of the population. However, the percent year of year in GDP has been being increased continuously since 2013, which has the positive impact on the number of natural rubber demand of the world market.

(5) Exchange rate

Exchange rate is the main factor of natural rubber demand. There are many researches that studied the relationship between exchange rate and the number of natural rubber consumption. And the results showed that exchange rate had direct and indirect relation with natural rubber demand.

Khin et al. (2008) and MdLudin et al. (2016) reported that the exchange rate from Malaysian RM to US dollar directly affects the number of natural rubber demand. While Romprasert (2012) and Burger and Smit (1989) studied about future price of natural rubber, and showed that the exchange rate impacts on future price of natural rubber. Thus it means that the exchange rate indirectly impacts the number of demand in natural rubber of the market.

Therefore, this study will use the exchange rate as an explanatory variable of natural rubber demand. Since China is the number one natural rubber consumer in the world and Thailand is the number one natural rubber producer in the world (International Rubber Study Group, 2016b), this study will use exchange rate from Chinese Yuan to Thai Baht that to represent the exchange rate of the world.

Trend of exchange rate from Chinese Yuan to Thai Baht (CNY) has been being increased continuously since 2010, thus one yuan can increase value in baht, which impacts the increase in the natural rubber demand. It is similar to the normal market forces.

Table 4 Summary of determinants used in demand model from the past literature

Author(s)	Year	Method	Data collection		Area of study
1. Number of natural rubber production					
Mesike, Okoh and Inoni	2010	Co-integration and vector error correction model	Annual data	1970-2008	Nigeria
Khin et al.	2008	Autoregressive integrated moving average	Monthly data	2007-2010	World market
Roselina et al.	2006	Granular neural network	N/A		Malaysia
Burger and Smit	1989	Time series model and descriptive statistics	Annual data	1955-1988	World market
2. Natural rubber price					
MdLudin, Applanaidu, & Abdullah	2016	Simultaneous equations	Annual data	1980-2012	Malaysia
Bank of Thailand	2014	Descriptive statistics	Government Report		Thailand
Bussabarporn and Visit	2010	Seemingly unrelated regression (SUR)	Annual data	1994-2006	Thailand
Robin and Michael	2007	Descriptive statistics	Book		General situations
Roselina et al.	2006	Granula neural network	N/A		Malaysia
Rosada	1994	Ordinary least squares	Annual data	1975-1991	Thailand
3. Synthetic rubber price					
Romprasert	2012	Econometrics model	Monthly data	2004-2009	Thailand
Khin et al.	2008	Autoregressive integrated moving average	Monthly data	2007–2010	World market
Robin and Michael	2007	Descriptive statistics	Book		General situations
Roselina et al.	2006	Granula neural network	N/A		Malaysia

Table 4 Summary of determinants used in demand model from the past literature (cont.)

Author(s)	Year	Method	Data collection		Area of study
4. Gross Domestic Product (GDP)/ Gross national product (GNP)/ World economy/ Income					
Chawananon	2014	Two-stage least squares approach	Annual data	1977-2012	Thailand
Romprasert	2012	Econometrics model	Monthly data	2004-2009	Thailand
Bussabarporn and Visit	2010	Seemingly unrelated regression (SUR)	Annual data	1994-2006	Thailand
Khin et al.	2008	Autoregressive integrated moving average	Monthly data	2007–2010	World market
Robin and Michael	2007	Descriptive statistics	Book		General situations
Roselina et al.	2006	Granula neural network	N/A		Malaysia
Rosada	1994	Ordinary least squares	Annual data	1975-1991	Thailand
5. Exchange rate					
MdLudin, Applanaidu, & Abdullah	2016	Simultaneous equations	Annual data	1980-2012	Malaysia
Romprasert	2012	Econometrics model	Monthly data	2004-2009	Thailand
Khin et al.	2008	Autoregressive integrated moving average	Monthly data	2007–2010	World market
Burger and Smit	1989	Time series model and descriptive statistics	Annual data	1955-1988	World market

2.2.4 Supply Determinants

The purpose of this part is to find the supply determinants, and there are several studies about the factors that impact the number of natural rubber production or natural rubber supply in the market. They are (1) natural rubber price, (2) number of natural rubber stock, (3) size of mature area which is tappable area in natural rubber plantations, (4) urea price which is represented to fertilizer price in this study, (5) number of rainfall, (6) crude oil price, and (7) alternative crop. The results of literature review are as follows, and the summary of supply determinants are shown in Table 5.

(1) Natural rubber price

Natural rubber price is the main factor that impacts on the natural rubber demand and supply. For the supply, the natural rubber price increase affects the motivation in natural rubber plantation of farmers. If natural rubber price increases, the supply of the natural rubber increases. It is similar to the normal market forces. Maya (2003), who studied about the supply response and cost of production of natural rubber with econometrics, supported this idea that the natural rubber price is the main factor when deciding the natural rubber tapping of farmers for sale in the market.

There are a lot of researches in the past that studied about relationship between natural rubber price and natural rubber supply. They are separated into three natural rubber prices that are domestic price, world price, and future price.

For the domestic price, the several studies focus on the natural rubber price in each country, which upon the area of study; includes Thailand (Chawananon, 2014; Rosada, 1994; Soontaranurak, 2011), India (Kannan, 2013; Maya, 2003), Cambodia (Much, Tongpan, & Sirisupluxana, 2011), Cote d'Ivoire (Amoro & Shen, 2013), Malaysia ((Purcell, 1993), and Nigeria (Abolagba, Onyekewere, & Umar, 2010). The results showed that in each country, the natural rubber price is related to the natural rubber supply.

For the world price, there are only one study of Khin et al. (2008) that reported about the world natural rubber price influencing the number of natural rubber production.

For the future price, there are researches which show that the future natural rubber price directly impacts the number of natural rubber production in the market

(Robin & Michael, 2007; Roselina et al., 2006). Some studies told that the future natural rubber price directly impacts the current natural rubber price and indirectly impacts the number of natural rubber production (Bank of Thailand, 2014; Mesike et al., 2010; Romprasert, 2012; Roselina et al., 2006).

The past studies show that the natural rubber price is essential explanatory variable in supply model for forecasting the number of natural rubber production in the future. Therefore, the natural rubber price is an important explanatory variable of supply model in this study.

(2) Number of natural rubber stock

The number of natural rubber stock had fluctuated values in the past ten years. In 2009-2011, the number of stock declined slightly because it was used to produce the natural rubber products in the market for supporting the increasing demand of the world market, especially in China. Therefore, when the natural rubber demand and price increase, the number of natural rubber stock decreases. It has negative relation with the natural rubber demand and price, and number of natural rubber stock.

At present, the number of natural rubber stock has been being highly continuously increased since 2011, due to world economic depression. The natural rubber demand, especially in automotive and tire industries in China, tends to reduce, which impacts to the decrease in natural rubber demand in the world market. Moreover, the number of natural rubber production tends to increase, while the number of stock will increase in a normal situation.

The number of natural rubber stock is an important factor to predict the natural rubber demand, supply and price of the world market. There are a lot of papers that studied relationship between the number of natural rubber stock and supply. Kannan (2013), who studied the determinants of production and export of natural rubber in India, Khin et al. (2008), who studied the price forecasting of natural rubber in the world market, and Maya (2003), who studied the supply response and cost of production of natural rubber with econometrics, reported that the changing of the world natural rubber stock also directly affects the number of natural rubber production in the market.

While some studies shows that the number of stock directly impacts the natural rubber price – which means that if the number of stock decreases, the natural rubber

price increases - so it is farmers' motivation to produce the natural rubber production into the market (Bank of Thailand, 2004-2015; Burger & Smit, 1989; Romprasert, 2012; Roselina et al., 2006). Moreover, Romprasert (2012) told that the number of stock at sellers boom should be pressure to increase the natural rubber price in the market, and force farmers tapping the natural rubber latex for sale in the market.

Therefore, this study will use the number of natural rubber stock to be a supply determinant for supply model development.

(3) Size of mature area in natural rubber plantation

The size of mature area in rubber tree plantation tends to increase since 2009, because the natural rubber price was the highest price and the price was increased continuously for another few years. Therefore, the farmers had motivation to plant the rubber tree in 2009, the mature area increased obviously in 2014 and 2015. As a consequence, the size of mature area of the world market tends to increase in a normal situation.

However, some countries, such as Malaysia and Indonesia, had policy in rubber tree reduction by cutting the rubber tree before the productive phase, which directly impacts the size of mature area of rubber tree plantation decrease in the future.

There are several studies that reported that the size of mature area in rubber tree plantation have affected the natural rubber supply. Number of natural rubber is directly influenced on tappable area in natural rubber plantations and yield per hectare (Maya, 2003). Many studies reported that the major of factor in natural rubber supply model is mature area in natural rubber plantation (Maya, 2003; MdLudin et al., 2016; Purcell, 1993; Rosada, 1994; Roselina et al., 2006; Soontaranurak, 2011; Suwanakul & Wailes, 1987). It is obviously factor that impacts the natural rubber production, since if there are large mature areas of natural rubber plantation in the world that means we have a lot of natural rubber resources for producing into the market.

Therefore, this study uses the size of mature area in rubber tree plantation as a factor that impacts on natural rubber production of the world market. In this study, the mature area in rubber tree plantation in Thailand will be used to represent the mature area of the world. Thailand is the number one of the world, which produces the natural rubber for 36.8 percent of the world in 2015, and it has size of mature area in rubber

tree plantation for 27.6 percent of the world in 2015 (International Rubber Study Group, 2016b).

(4) Rainfall

Most agricultural plants need water in suitable amount for growth, and rubber tree is one of plants, which needs water for good growth and high yield. The rainfall is an uncertain factor, which is difficult to predict. Khin et al. (2008) told that the uncertain weather, especially rainfall, has also affected natural rubber production.

There are several studies, which support that rainfall is an important explanatory variable for predicting the number of the natural rubber production. Chawananon (2014) studied the factors that affect the equilibrium of Thailand natural rubber market, and the results showed that rainfall had a significant effect on quantity of rubber production in Thailand. Mesike and Esekhade (2014) studied the rainfall variability and rubber production in Nigeria, and reported that rainfall effect on rubber production in Nigeria. There are research that support that the rainfall directly forces to the growing of rubber trees as well as affects the determining of the season of natural rubber tapping.

Therefore, the rainfall is a factor in supply model for forecasting the number of natural rubber production of the world market in this study.

(5) Crude oil price

The crude oil price tended to decrease dramatically since 2013, because of economic depression, imbalance between demand and supply, renewable energy, and so on. The economic depression directly impacts the crude oil price, since if economic growth slows, the demand of consumer decreases. It has a negative impact on crude oil price movement (Baush, 2011; Investopedia, 2015; Kristopher, 2015).. The imbalance between demand and supply is an important reason that affects the crude oil price. Kristopher (2015) told that the key driver of oil price drop was the oil oversupply. Moreover, the group of crude oil producers, especially the Organization of Petroleum Exporting Countries (OPEC), violated their agreement in the number of output, which made the crude oil price decrease (Berman, 2017; Molchanov, 2003). The recent fall in crude oil price was occurred from energy alternative, such as solar, wind and biomass energy sources. The consumers had a lot of selected renewable energy technologies,

which directly affected crude oil price (Bonaire, 2015; Ernesto, Matthew, & Kevin, 1989; Hayes, 2015).

The crude oil price is an important supply determinant which affects the quantity of natural rubber production in the market, since the crude oil is the important raw material to produce the natural rubber product, especially in the automotive tires manufacturing. There are many studies that support that the crude oil price impacts the number of natural rubber production in the market. Maya (2003) studied the Supply response and cost of production of natural rubber with econometrics, and the results showed that the crude oil price had relation with number of natural rubber production. The studies of , Robin and Michael (2007), and Roselina et al. (2006) were support that the crude oil price affected natural rubber of quantity in the market.

Moreover, some researches showed that the crude oil price is the leading indicator for the future natural rubber price (Bank of Thailand, 2014; Khin et al., 2008; MdLudin et al., 2016; Romprasert, 2012), which indirectly influences the number of natural rubber production in the market.

Therefore, the crude oil price will be used as determinant in the supply model for forecasting in number of natural rubber production of the world market.

(6) Fertilizer price

Maya (2003) told that the number of natural rubber production is directly governed the inputs' factor, such as labor, irrigation, and fertilizer. In addition, there are many researches which reported that the fertilizer is the main inputs' factor for rubber tree growth (Maya, 2003; Robin & Michael, 2007; Rosada, 1994; Roselina et al., 2006; Soontaranurak, 2011), so the price of fertilizer that directly impacts the number of natural rubber production in the market.

Rubber board (2002) showed that the main component of fertilizer application in rubber tree is urea, thus this study would use the urea to represent the rubber fertilizer.

(7) Alternative crop price

The variety of economic alternative crops were studied and recommended in many researches. Much et al. (2011) suggested that maize, soybean, and cassava are the good choices for rubber replanting and their price affected the number of natural rubber

production. Chawananon (2014) and Soontaranurak (2011) found that the paddy rice price is the factor of natural rubber production quantity in Thailand. Soontaranurak (2011), Jipun, Yusoff, and Mulok (2007) and Rosada (1994) examined that palm oil price affected the number of natural rubber production in Thailand.

However, this study would study on palm oil because (1) palm oil tree and rubber tree are suitable plantation in the same weather (Malaysian Palm Oil Council, 2012), (2) the adult palm oil tree and rubber tree can produce the production around 20 to 25 years (Agriculture and consumer protection department, 1990), and (3) some countries (e.g. Indonesia, Malaysia, and Thailand) have policy about represented cultivating from rubber tree to palm oil tree (Schwarze et al., 2015).

Table 5 Summary of determinants used in supply model from the past literature

Author(s)	Year	Method	Data collection		Area of study
1. Natural rubber (NR) price					
1.1 Domestic NR price					
Chawananon	2014	Two-stage least squares approach	Annual data	1977-2012	Thailand
Amoro and Shen	2013	Ordinary least squares	Annual data	1970-2005	Cote d'Ivoire
Kannan	2013	Ordinary least squares	Annual data	1991/92–2010/11	India
Much, Tongpan and Sirisupluxana	2011	Ordinary least squares	Annual data	1990-2008	Cambodia
Soontaranurak	2011	Co-integration approach	Annual data	1962-2008	Thailand
Abolagba, Onyekewere and Umar	2010	Ordinary least squares	Annual data	1970-2005	Nigeria
Maya	2003	Multiple regression	Annual data	1976/77–2001/02	India
Rosada	1994	Ordinary least squares	Annual data	1975-1991	Thailand
Purcell	1993	Co-integration method and causality tests	Annual data	1900 - 1990	Malaysia
1.2 World NR price					
Khin et al.	2008	Autoregressive integrated moving average	Monthly data	2007–2010	World market
1.3 Future/expected NR price					
MdLudin, Applanaidu, & Abdullah	2016	Simultaneous equations	Annual data	1980-2012	Malaysia
Bank of Thailand	2014	Descriptive statistics	Government Report		Thailand
Romprasert	2012	Econometrics model	Monthly data	2004-2009	Thailand
Mesike, Okoh and Inoni	2010	Co-integration and vector error correction model	Annual data	1970-2008	Nigeria
Robin and Michael	2007	Descriptive statistics	Book		General situations
Roselina et al.	2006	Granula neural network	N/A		Malaysia

Table 5 Summary of determinants used in supply model from the past literature (cont.)

Author(s)	Year	Method	Data collection		Area of study
2. Number of natural rubber stock					
Bank of Thailand	2014	Descriptive statistics	Government Report		Thailand
Kannan	2013	Ordinary least squares	Annual data	1991/92–2010/11	India
Romprasert	2012	Econometrics model	Monthly data	2004-2009	Thailand
Khin et al.	2008	Autoregressive integrated moving average	Monthly data	2007-2010	World market
Roselina et al.	2006	Granular neural network	N/A		Malaysia
Maya	2003	Multiple regression	Annual data	1976/77-2001/02	India
Burger and Smit	1989	Time series model and descriptive statistics	Annual data	1955-1988	World market
3. Number of mature area in natural rubber plantations					
MdLudin, Applanaidu, & Abdullah	2016	Simultaneous equations	Annual data	1980-2012	Malaysia
Soontaranurak	2011	Co-integration approach	Annual data	1962-2008	Thailand
Roselina et al.	2006	Granular neural network	N/A		Malaysia
Maya	2003	Multiple regression	Annual data	1976/77–2001/02	India
Rosada	1994	Ordinary least squares	Annual data	1975-1991	Thailand
Purcell	1993	Co-integration method and causality tests	Annual data	1900-1990	Malaysia
Suwanakul and Wailes	1987	Simulation technique	Annual data	1954-1983	Thailand
4. Rainfall					
Chawananon	2014	Two-stage least squares approach	Annual data	1977-2012	Thailand
Mesike and Esekhade	2014	Time series and descriptive statistics	Annual data	1971-2009	Nigeria
Romprasert	2012	Econometrics model	Monthly data	2004-2009	Thailand

Table 5 Summary of determinants used in supply model from the past literature (cont.)

Author(s)	Year	Method	Data collection		Area of study
4. Rainfall (cont.)					
Much, Tongpan and Sirisupluxana	2011	Ordinary least squares	Annual data	1990-2008	Cambodia
Khin et al.	2008	Autoregressive integrated moving average	Monthly data	2007-2010	World market
Maya	2003	Multiple regression	Annual data	1976/77–2001/02	India
5. Crude oil price					
MdLudin, Applanaidu, & Abdullah	2016	Simultaneous equations	Annual data	1980-2012	Malaysia
Bank of Thailand	2014	Descriptive statistics	Government Report		Thailand
Weerathamrongsak and Wongsurawat	2013	Depth interviews	N/A		Thailand
Romprasert	2012	Econometrics model	Monthly data	2004-2009	Thailand
Khin et al.	2008	Autoregressive integrated moving average	Monthly data	2007–2010	World market
Robin and Michael	2007	Descriptive statistics	Book		General situations
Roselina et al.	2006	Granula neural network	N/A		Malaysia
Maya	2003	Multiple regression	Annual data	1976/77–2001/02	India
6. Fertilizer price					
Soontaranurak	2011	Co-integration approach	Annual data	1962-2008	Thailand
Robin and Michael	2007	Descriptive statistics	Book		General situations
Roselina et al.	2006	Granula neural network	N/A		Malaysia
Maya	2003	Multiple regression	Annual data	1976/77–2001/02	India
Rosada	1994	Ordinary least squares	Annual data	1975-1991	Thailand

Table 5 Summary of determinants used in supply model from the past literature (cont.)

Author(s)	Year	Method	Data collection		Area of study
7. Alternative crop					
Chawananon	2014	Two-stage least squares approach	Annual data	1977-2012	Thailand
Much, Tongpan and Sirisupluxana	2011	Ordinary least squares	Annual data	1990-2008	Cambodia
Soontaranurak	2011	Co-integration approach	Annual data	1962-2008	Thailand
Jipun, Yusoff, and Mulok	2007	Ordinary least squares approach	Annual data	1971-2004	Malaysia
Rosada	1994	Ordinary least squares	Annual data	1975-1991	Thailand

2.2.5 Price determinants

The determinants that affect the price are applied from related researches, and this literature review focuses on natural rubber as the follows:

Bank of Thailand (2014) reported that the price determinants are current natural rubber price, world natural rubber demand, number of producing vehicles in China, crude oil price, natural rubber stock, and future rubber price in Tokyo commodity exchange (TOCOM).

Romprasert (2012) studied about agricultural futures: case of natural rubber ribbed smoked sheets no.3 with econometrics model by using monthly data during the period 2004-2009. The author told that the crude oil price is the main indicator for the trend in future rubber prices in Thailand. The variables used include the exchange rates between the Thai baht and US dollar, the exchange rate between the Japanese yen and US dollar, the price of crude oil, TOCOM, net imports of natural and synthetic rubber in Japan, net imports of natural and synthetic rubber in China, and the world consumption of natural and synthetic rubber.

Mesike et al. (2010) studied about supply response of rubber farmers in Nigeria with co-integration and vector error correction model by using annual data between 1970 and 2008. The results showed that rubber price was affected from number of rubber production, time trend, and structural breaks.

Khin et al. (2008) studied about price forecasting of natural rubber in the world market with normal autoregressive integrated moving average (ARIMA) and econometric model by using monthly data from January 2007 to December 2010. The results showed that the independent variables that impact to price of standard Malaysia rubber (SMR20) which include number of world natural rubber production, number of world natural rubber consumption, number of world natural rubber stock, crude oil price, number of production in passenger car, number of tires in commercial vehicle cars, and exchange rate from RM to USD.

Roselina et al. (2006) studied about framework of Malaysia natural rubber prediction price using granular neural network. The framework is based on the theoretical framework by Barlow et al. (1994), the price are determined by the

intersection of supply and demand. The expected rubber prices in the market, production capacity of natural rubber, input costs of natural rubber, and technological progress are the determining factors for natural rubber supply, while income level in the overall economy, prices of rubber substitutes, price of final goods, technology, consumer preferences, stocks and manufacturing capacity utilizing are the determining factors for natural rubber demand. Both demand and supply actively correlate in setting natural rubber price in market. Moreover, there are other factors that may affect natural rubber price such as petroleum and palm oil price, and shortage of natural rubber supply.

Burger and Smit (1989) studied about long-term and short-term analysis of the natural rubber market with time series model and descriptive statistics. The study was analyzed in long term and short term by using annual data from 1955 to 1960s and from 1982 to 1988, respectively. The authors told that the factors of natural rubber price include total world rubber consumption (both natural rubber and synthetic rubber), opening stocks, and expected production, changing rates of inflation, interest and exchange rate.

2.3 Overview of approach

2.3.1 Simultaneous equation

Wooldridege (2010) told that simultaneous equations is the most familiar application of system instrumental variable (SIV) estimation, which is an estimated approach based on the principle of generalized method of moments (GMM). The system estimation procedures have more applications than the classical simultaneous equations method (SEMs).

Khin and Thambiah (2015) refer to Ferris (1998), Pindyck and Rubinfeld (1998), and Gujarati (2003) that the simultaneous equations model is a two-equation model based on the market demand and supply where price and quantity are both endogenous variables. The model deals directly with the interaction of supply and demand in setting prices without separately using the single-equations of supply, demand and price. Price and supply are endogenous also; jointly determined price and

demand are endogenous variables. Others are exogenous variables (Khin & Thambiah, 2015).

Wooldridege (2010) explained about two stage least square (2SLS) and Generalized method of moments (GMM) or three stage least square (3SLS) for a general linear system. Applying that discussion to linear SEMs, we can immediately draw the following conclusions. First, if each equation is just identified, 2SLS equation by equation and 3SLS are identical; in fact, each is identical to the system IV estimator. Basically, there is only one consistent estimator, the IV estimator on each equation. Second, regardless of the degree of overidentification, 2SLS equation by equation and 3SLS are identical when expected of sum is diagonal.

Tajdini, Ghajebeigloo, and Roohnia (2013), studied about veneer supply and demand estimation with simultaneous equations, told that the demand and supply relations can be estimated using a traditional 2SLS method, but only a few have focused on simultaneous estimation of supply and demand model. However, there is a study in natural rubber demand with using simultaneous equation by MdLudin. MdLudin et al. (2016) analyzed the natural rubber market in Malaysia with simultaneous equations by using annual data between 1980 and 2012. The results were that time trend, hectare natural rubber and production with lagged one year are important in production natural rubber equation. While, import depends on world price and exchange rate.

2.3.2 A moving average technique

The Moving Average is one of the most popular technical analysis tools used by traders. It does not predict the price direction, but defines the current direction with a lag, which is sometimes called a “lagging” indicator. Moving Average works well when prices are in trend. However, it is possible to give false signal when prices are not trending. Simple Moving Average (SMA) and the Exponential Moving Average (EMA) are among the most popular types of moving averages. These moving averages can be used to spot the direction of the trend or to identify potential support and resistance levels.

Lind et al. (2015) explained about a moving average that

“A moving average is useful in smoothing a time series to see its trend. It is also the basic method used in measuring the seasonal fluctuation. While the least squares method expresses the trend in terms of a mathematical equation ($\hat{y} = a + bt$), the moving average method simply smooths the fluctuations in the data. This happens by “moving” the arithmetic mean values through the time series. To apply the moving average to a time series, the data should follow a quite linear trend and have a certain rhythmic fluctuation pattern".

The first step of computing the n-period moving average is to determine the n-period moving total. Then divide the total by n to find the mean of this total. This first mean is positioned opposite to the middle of n for the group of data. Then determine the total of next n periods and find its mean. The second mean is positioned opposite to the middle period and becomes the second value of moving average. Finally, total and mean calculations are repeated until reaching the last n numbers.

The number of data values to include in a moving average depends on the data collected. If the data are quarterly, then four values is typical because there are four quarters in a year. If the data are daily, then seven values is appropriate because there are seven days in a week. Therefore, the number of data values should match the frequency of data collection to determine a number that gives the best level out of the chance fluctuations.

2.3.3 Box and Jenkins Approach

The Box and Jenkin approach adjusts the time series to make it stationary by using the differences between data points. This allows the model to spot trends, typically by using autoregression, moving averages, and seasonal differencing in the calculations.

The Box and Jenkin approach has a large class of models to choose from and a systematic approach for identifying the correct model form. There are both statistical test to verify model validity and statistical measures to forecast uncertainty. In contrast, traditional forecasting models have a limited number of models relative to the complex

behavior of many time series with some guidelines and statistical tests for verifying the validity of the selected model (Cherdchoongam & Rungreunganun, 2016).

Box and Jenkin modeling step involves a five-stage process as follows:

(1) *Data preparation* involves transformations and differencing. Transformations of the data can help stabilize the variance in a series where the variation changes with the level. This often happens with business and economic data. Then the data are differenced until there are no obvious patterns such as trend or seasonality left in the data. "Differencing" means taking the difference between consecutive observations, or between observations a year apart. The differenced data are often easier to model than the original data.

(2) *Model selection* uses various graphs based on the transformed and differenced data to try to identify potential ARIMA processes which might provide a good fit to the data. Later developments have led to other model selection tools such as Akaike's Information Criterion.

(3) *Parameter estimation* means finding the values of the model coefficients which provide the best fit to the data. There are complex computational algorithms designed to do this.

(4) *Model checking* tests the assumptions of the model to identify any areas where the model is inadequate. If the model is found to be inadequate, it is necessary to go back to Step 2 and try to identify a better model.

(5) *Forecasting* is the main goal to accomplish. Once the model has been selected, estimated and checked, then the computer will do the forecasts.

Box and Jenkins Autoregressive Integrated Moving Average (ARIMA) time-series methodology have been used by a number of researchers to forecast demands in terms of internal production, consumption, imports and exports. The forecasting studies on natural rubber using Box-Jenkins ARIMA model are available by Mesike (2012) whose studies present various econometric models to forecast the short-run export of natural rubber in Nigeria. The result showed that ARIMA (2,1,1) was the best stochastic model for rubber exports. Among the deterministic models, the quadratic model was the best choice for rubber exports. Kahforoushan, Zarif, and Mashahir (2010) applied

the performance of artificial neural network, Box-Jenkins and Holt-Winters-no-seasonal models in forecasting added value of agricultural sub-sectors in Iran. Results showed that Box-Jenkins and artificial neural network are appropriate and artificial neural network indicated good result relatively in learn stage, but Box-Jenkins approach gave better results in forecasting of unseen data. Rahman et al. (2016) forecast Aus rice area and production in Bangladesh and found that Aus rice area and production both had a decreasing trend.

CHAPTER III
RESEARCH METHODOLOGY

The objectives of this study are (1) to develop demand and supply model for predicting the world natural rubber quantity, (2) to predict all explanatory variables in demand and supply model, and (3) to estimate equilibrium quantity and price in world natural rubber. Therefore, this chapter describes the method of the study and covers the data collection and data analysis.

3.1 Data Collection

The main objective of this study is to estimate the equilibrium quantity and price in the world natural rubber market. At first, the study also considers the demand and supply in the natural rubber of the world market as endogenous variables, which can be viewed as a function of several explanatory variables. The procedure that was used in selecting the variables was based on the theoretical background of demand and supply theories and influential macroeconomic data. The equilibrium quantity and price in the natural rubber of the world market were estimated by using the monthly time series data for the period of 2004 to 2015. The explanatory variables of this study are shown in Table 6.

Table 6 Measurement, frequency, symbol and source of explanatory variables

Data	Measurement	Frequency	Symbol	Source
1 quantity of world natural rubber consumption	thousand tons	monthly	Q	International Rubber Study Group (IRSG)
2 quantity of world natural rubber production	thousand tons	monthly	Qs	International Rubber Study Group (IRSG)
3 physical natural rubber price of RSS3 (cif) at Tokyo market	thousand yens	monthly	NRPRICE	International Rubber Study Group (IRSG)
4 synthetic rubber price at USA market	US dollars per ton	monthly	SRPRICE	International Rubber Study Group (IRSG)
5 %YOY of GDP of the world	percent	quarterly*	YGDP	Thomson Reuters
6 exchange rate from Chinese Yuan to Thai Baht	baht	monthly	CNY	Bank of Thailand
7 number of world natural rubber stock	thousand tons	monthly	STOCK	International Rubber Study Group (IRSG)
8 number of mature area of natural rubber plantation in Thailand	hectare	yearly**	MAREA_TH	International Rubber Study Group (IRSG)
9 urea f.o.b. price at Eastern Europe	US dollars per metric ton	monthly	UPRICE	IndexMundi website
10 number of rainfall in Thailand	millimeter	monthly	RAINFALL_TH	Meteorological Department of Thailand
11 oil palm future price at Malaysia market	US dollars per metric ton	monthly	OPPRICE	IndexMundi website
12 crude oil price in petroleum from three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh with simple average	US dollars per barrel	monthly	CPETRO	IndexMundi website

** YGDP is transformed from quarterly data to monthly data by using the simple moving average technique*

*** MAREA_TH is transformed from yearly data to monthly data by using the simple moving average technique*

From Table 6, there are several explanatory variables in this study which include quantity of natural rubber consumption of the world market in the unit of thousand tons (Q), quantity of natural rubber production of the world market in the unit of thousand tons (Qs), natural rubber price in physical market price of RSS3 (cif) at Tokyo market in the unit of thousand yens (NRPRICE), synthetic rubber price at USA market - where represented the world market in this study – in the unit of US dollars per ton (SRPRICE), %YOY of GDP of the world in the unit of percent (YGDP), exchange rate from Chinese Yuan to Thai Baht that is represented the exchange rate of the world in this study – since China is the number one natural rubber consumer in the world and Thailand is the number one natural rubber producer in the world (International Rubber Study Group, 2016b) - in the unit of baht (CNY), number of natural rubber stock of the world market in the unit of thousand tons (STOCK), size of mature area of natural rubber plantation in Thailand in the unit of hectare (MAREA_TH), urea f.o.b. price at Eastern Europe in the unit of US dollars per metric ton (UPRICE), number of rainfall in Thailand in the unit of millimeter (RAINFALL_TH), palm oil future price at Malaysia market in the unit of US dollars per metric ton (OPPRICE), and crude oil price in petroleum - which calculate from three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh with simple average – in the unit of US dollars per barrel (CPETRO).

There are five main sources of the data including (1) International Rubber Study Group (IRSG) that reported world natural rubber consumption (Q), world natural rubber production (Qs), natural rubber price (NRPRICE), synthetic price (SRPRICE), number of natural rubber stock (STOCK), and size of mature area of natural rubber plantation in Thailand (MAREA_TH) (International Rubber Study Group, 2005, 2006, 2007, 2008, 2009a, 2010, 2011, 2012, 2013, 2014, 2015a, 2015b, 2016a, 2016b), (2) IndexMundi website that showed urea price (UPRICE), crude oil price (CPETRO) and palm oil future price (OPPRICE) (IndexMundi, 1987-2015), (3) Thomson Reuters (2000-2021) reported %YOY of GDP of the world (YGDP), (4) Bank of Thailand presented exchange rate from Chinese Yuan to Thai Baht (CNY) (Bank of Thailand, 2004-2015), and (5) Meteorological Department of Thailand reported number of

rainfall in Thailand (RAINFALL_TH) (Meteorological Department of Thailand, 2004-2015). For quarterly of YGDP and yearly of MAREA_TH, the data are transformed to monthly data by using the simple moving average technique. All of monthly data that were used in this study are shown in Appendix A.

3.2 Data Analysis

At the first part of analysis, the initial equations are developed by using the variables from above. There are two equations for estimating the quantity of natural rubber consumption at the world market in demand model and supply model by applying simultaneous equations according to the three-stage least square (3SLS) technique and the monthly data from 2004 to 2015. The equations of natural rubber consumption quantity at the world market in this study are as follows:

Demand model

$$Q_t = \alpha_0 + \alpha_1 Q_{st} + \alpha_2 NRPRICE_t + \alpha_3 SRPRICE_t + \alpha_4 YGDP_t + \alpha_5 CNY_t + \varepsilon_{1t} \quad \ldots(1)$$

where

Q_t = quantity of world natural rubber consumption (thousand tons)

Q_{st} = quantity of world natural rubber production (thousand tons)

$NRPRICE_t$ = natural rubber price at Tokyo market (thousand yens)

$SRPRICE_t$ = synthetic rubber price at USA market (US dollars per ton)

$YGDP_t$ = %YOY of GDP of the world (percent)

CNY_t = exchange rate from Yuan to Baht (baht)

ε_{1t} = residual term

Supply model

$$Q_t = \beta_0 + \beta_1 NRPRICE_t + \beta_2 STOCK_t + \beta_3 MAREA\_TH_t + \beta_4 UPRICE_t + \beta_5 RAINFALL\_TH_t + \beta_6 OPPRICE_t + \beta_7 CPETRO_t + \varepsilon_{2t} \quad \ldots(2)$$

where

Q_t = quantity of world natural rubber consumption (thousand tons)

$NRPRICE_t$	=	natural rubber price at Tokyo market (thousand yens)
$STOCK_t$	=	number of world natural rubber stock (thousand tons)
$MAREA\_TH_t$	=	size of mature area of natural rubber plantation in Thailand (hectare)
$UPRICE_t$	=	urea f.o.b. price at Eastern Europe (US dollars per metric ton)
$RAINFALL\_TH_t$	=	number of rainfall in Thailand (millimeter)
$OPPRICE_t$	=	palm oil future price at Malaysia market (US dollars per metric ton)
$CPETRO_t$	=	crude oil price in petroleum (US dollars per barrel)
ε_{2t}	=	residual term

According to equation (1) above, the signs of the coefficients of variables is expected as follows:

$\alpha 1 > 0, \alpha 2 < 0, \alpha 3 > 0, \alpha 4 > 0, \alpha 5 > 0$

The coefficients of number of world natural rubber production (Qs), synthetic rubber price (SRPRICE), %YOY of world GDP (YGDP) and exchange rate from Chinese Yuan to Thai Baht (CNY) are expected to be positive. The coefficient of Qs is expected to be positive because the increase in natural rubber production results in natural rubber price drops, so the natural rubber demand increases. The price of synthetic rubber — the substitute for natural rubber — increases which helps reduce the demand of synthetic rubber, while it affects the increase in the demand of nature rubber. Therefore, the coefficient of SRPRICE is expected to be positive. The %YOY of GDP represents the income of people which means that if the %YOY increase, the natural rubber demand increase. The CNY increase means that one yuan can increase value in baht, which impacts the increase in the natural rubber demand. The coefficients of world natural rubber price (NRPRICE) is expected to be negative because there is an adverse relationship between natural rubber price and demand. If the natural rubber price increases, the demand of the natural rubber decreases. It is similar to the normal market forces.

The signs of the coefficients of variables in equation (2) is expected to be as follows:

$\beta 1 > 0, \beta 2 < 0, \beta 3 > 0, \beta 4 < 0, \beta 5 > 0, \beta 6 < 0, \beta 7 > 0$

The coefficients of world natural rubber price (NRPRICE), size of mature area of natural rubber plantation in Thailand (MAREA_TH), number of rainfall in Thailand (RAINFALL_TH) and crude oil price in petroleum (CPETRO) are expected to be positive. The natural rubber price increase affects the motivation in natural rubber plantation of farmers. The mature area of natural rubber plantation in Thailand, which is the number one of producer of the world (International Rubber Study Group, 2016b), directly impacts the number of natural rubber supply of the world market. If mature area of natural rubber plantation in Thailand increases, the number of supply increases. If the rainfall, which is an important input factor of growing of rubber tree and amount of natural rubber latex, increases, the supply of the natural rubber increases. If the crude oil price in petroleum, which is the main raw material of synthetic rubber, increases, the synthetic rubber price increases. Therefore, demand and supply in natural rubber will be increased in the normal market forces. The coefficients of number of world natural rubber stock (STOCK), urea price (UPRICE), palm oil future price (OPPRICE) and crude oil price in petroleum (CPETRO) are expected to be negative. If the number of stock increases, the natural rubber price reduces, which makes the natural rubber production decreases and the national rubber supply decreases. If the price of urea, which is an important fertilizer of natural rubber, increases, the use of fertilizer reduces and the production of natural rubber decreases. If the price of palm oil, which is an important alternative crop of natural rubber (Office of agricultural economics of Thailand, 2012a, 2012b), increases, natural rubber plantation and natural rubber production reduces. If the petroleum crude oil price, which is the main raw material of natural rubber production, increases, the number of natural rubber production decreases.

At the second part of analysis, all explanatory variables in demand and supply model will be predicted by (1) Box and Jenkins approach and (2) simple moving

average technique. For Box and Jenkins approach, this study uses several techniques such as autoregressive and moving average (ARMA) model, autoregressive integrated moving average (ARIMA) model, seasonal autoregressive integrated moving average (SARIMA), and monthly data in two periods that are (1) from 2004 to 2015 and (2) from 2011 to 2015. For simple moving average technique, this study uses monthly time series data in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015,. After that the study compares the results by mean absolute percent error (MAPE) – the technique which gets the lowest in the average MAPE of all explanatory variables.

For the last part of the analysis, the estimated variables, demand model and supply model will predict the equilibrium of quantity and price in natural rubber of the world market from 2017 to 2026. The result can help the government plan the policy of natural rubber plantation in the countries which are important natural rubber exporters.

CHAPTER IV
RESULTS

This chapter describes the results of demand model and supply model by using simultaneous equation, predicted explanatory variables in demand and supply model by using simple moving average technique, and estimated equilibrium quantity and price in natural rubber of the world market. Results are divided into five parts; (1) demand and supply model developing, (2) explanatory variables forecasting, (3) world natural rubber consumption quantity predicting, (4) world natural rubber price foretelling, (5) and equilibrium quantity and price estimating.

4.1 Results of demand and supply model developing

This study identified two initial equations for developing the demand and supply models that are shown as equation (1) and (2). All variables are examined in the unit root test with Augmented Dickey-Fuller (ADF) test. The results of the unit root test indicate that NRPRICE, SRPRICE, CNY, STOCK, MAREA_TH, UPRICE, CPETRO and OPPRICE are non-stationary at the 5% significant level, and at the first difference of their log-transformation, will be stationary. Then their variables are set as I(1) or integrated of order 1 for estimating the model. The Qs and RAINFALL_TH are already stationary at the 5% significant level, while YGDP is stationary at the 10% significant level. Therefore, all variables are tested for developing the demand and supply model. In this study, three-stage least square of simultaneous equation is used to estimate the coefficients. The fitted models are considered based on (1) higher R-square, that means the explanatory variables in model have high relationship with number of demand and supply, and (2) the sign of NRPRICE in demand and supply model should follow the economic theory. The sign in NRPRICE should be minus for demand and should be plus for supply model. The results are reported in Table 7 and the models are estimated as follows:

Demand Model

$$\ln Q_t = 2.86 + 0.11\ln Q_{st} - 0.02\ln NRPRICE_{t-6} + 0.23\ln SRPRICE_t + 0.04\ln YGDP_{t-6} + 0.77\ln CNY_t \quad \ldots(3)$$

Supply Model

$$\ln Q_t = 1.92 + 0.05\ln NRPRICE_{t-6} - 0.05\ln STOCK_t + 0.65\ln MAREA\_TH_t - 0.04\ln UPRICE_{t-6} + 0.02\ln RAINFALL\_TH_t + 0.05\ln CPETRO_t \quad \ldots(4)$$

Table 7 Coefficients of demand and supply by 3SLS (number of observations = 128)

Variables	Coefficients	P-value
Demand Equation		
Constant	2.86**	0.00
$\ln Q_{st}$	0.11**	0.04
$\ln NRPRICE_{t-6}$	-0.02	0.68
$\ln SRPRICE_t$	0.26**	0.00
$\ln YGDP_{t-6}$	0.04**	0.01
$\ln CNY_t$	0.77**	0.00
Root Mean Square Error (RMSE) = 0.09, R-square = 0.54, P-value = 0.00		
Supply Equation		
Constant	1.92**	0.00
$\ln NRPRICE_{t-6}$	0.05*	0.06
$\ln STOCK_t$	-0.05**	0.01
$\ln MAREA\_TH_t$	0.65**	0.00
$\ln UPRICE_{t-6}$	-0.04**	0.05
$\ln RAINFALL\_TH_t$	0.02**	0.00
$\ln CPETRO_t$	0.05**	0.00
Root Mean Square Error (RMSE) = 0.06, R-square = 0.79, P-value = 0.00		

Endogenous variables: $\ln Q_t$

Exogenous variables: $\ln Q_{st}$, $\ln NRPRICE_{t-6}$, $\ln SRPRICE_t$, $\ln YGDP_{t-6}$, $\ln CNY_t$, $\ln STOCK_t$, $\ln MAREA\_TH_t$, $\ln UPRICE_{t-6}$, $\ln RAINFALL\_TH_t$, $\ln CPETRO_t$

** indicates signification of 10%, ** indicates signification of 5%*

As the coefficients in the demand model, the intercept was estimated at 2.86, which is significant at 5% level. The coefficient of Qs was estimated at 0.11, which is significant at the 5% level, which indicates that any one percent increase in the Qs will increase the Q by 0.11 percent. The coefficient of NRPRICE in the past six months was estimated at -0.02, which is not significant. As the price is an important explanatory variable to predict the demand model, this study still holds the price to be independent variable for forecasting the demand model. The coefficient of SRPRICE was estimated

at 0.26, which is significant at 5% level, which indicates that SRPRICE increases by one percent, while the Q increases by 0.26 percent. The coefficient of YGDP in the past six months was estimated at 0.04, which is significant at 5% level, which indicates that if YGDP increases by one percent, the Q increases by 0.04 percent. The coefficient of CNY was estimated at 0.77, which is significant at 5% level, which indicates that if CNY increases by one percent, the Q increases 0.77 percent. The explanatory variables in demand model with positive relationship include Qs, SRPRICE, YGDP in the past six months and CNY, while negative relationship is NRPRICE in the past six months. The root mean square error, which showed the accuracy of demand equation, was calculated as 0.09. The R-square was calculated as 0.54, which showed the goodness of fit of the demand model. This demand model was significant at 5% level. From the results above, the rank of coefficient in explanatory variables that impact the number of natural rubber demand of the world market are CNY at the present (0.77), SRPRICE at the present (0.26), Qs at the present (0.11), YGDP in the past six months (0.44) and NRPRICE in the past six months (-0.02), respectively. The result of ranking is shown in Figure 2.

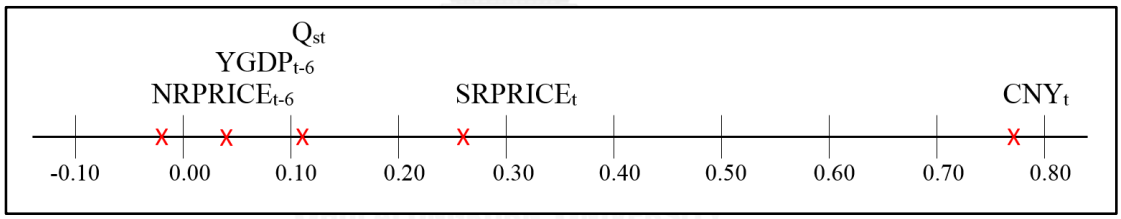


Figure 2: The ranking of coefficient in explanatory variables in demand model

For the coefficients in the supply model, the intercept was estimated at 1.92, which is significant at 5% level. The coefficient of NRPRICE in the past six months was estimated at 0.05, which is significant at 1% level, which indicates that if NRPRICE in the past six months increases by one percent, the Q increases 0.05 percent. The coefficient of STOCK was estimated at -0.05, which is significant at 5% level, which indicates that if STOCK increases by one percent, the Q decreases 0.05 percent. The coefficient of MAREA_TH was estimated as 0.65, which is significant at 5% level, which indicates that if MAREA_TH increases one percent, the Q increases 0.65

percent. The coefficient of UPRICE in the past six months was estimated at -0.04, which is significant at 5% level, which indicates that if UPRICE increases by one percent, the Q decreases 0.04 percent. The coefficient of RAINFALL_TH was estimated as 0.02, which is significant at 5% level, which indicates that if RAINFALL_TH increases by one percent, the Q increases 0.02 percent. The coefficient of CPETRO was estimated as 0.05, which is significant at 5% level, which indicates that if CPETRO increases by one percent, the Q increases 0.05 percent. The explanatory variables in supply model with positive relationship include NRPRICE in the past six months, MAREA_TH, RAINFALL_TH and CPETRO, while negative relationship are STOCK and UPRICE in the past six months. The root mean square error was calculated as 0.06, which showed the accuracy of supply equation. The R-square was calculated as 0.79, which showed the goodness of fit of supply model. This supply model was significant at 5% level. From the results above, the rank of coefficient in explanatory variables that impact the number of natural rubber supply of the world market are MAREA_TH at the present (0.65), RAINFALL_TH at the present (0.20), NRPRICE in the past six months and CPETRO at the present (0.05), UPRICE in the past six months (-0.40) and STOCK at the present (-0.05), respectively. The result of ranking is shown in Figure 3.

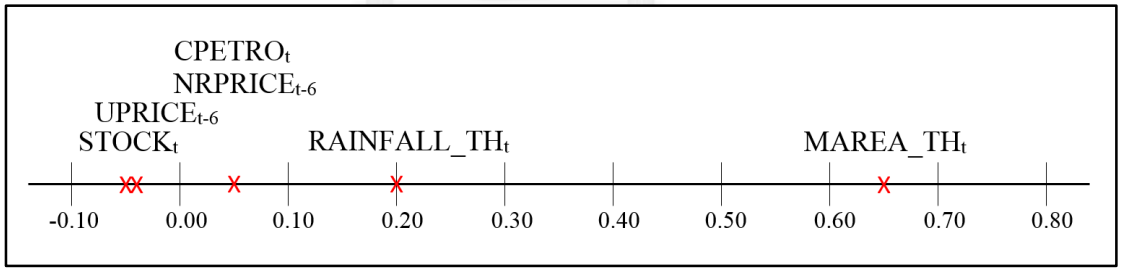


Figure 3: The ranking of coefficient in explanatory variables in supply model

After that this study predicted the quantity of natural rubber consumption and residuals of the monthly data from January 2015 to June 2016 in the actual data by using (1) actual data terms and (2) percentage change in independent variables term for testing the fitted model. The results are shown in Table 8.

Table 8 The predicted data of quantity of natural rubber consumption (Q) and residuals from January 2015 to June 2016 by using actual data terms and percentage change in the actual data of explanatory variables term

		Quantity of Consumption	Actual Data				Percentage Change			
			Demand Model		Supply Model		Demand Model		Supply Model	
			Q Forecast	Residual	Q Forecast	Residual	Q Forecast	Residual	Q Forecast	Residual
2015	Jan	1019	963.49	-55.51	945.84	-73.16	999.62	-19.38	995.57	-23.43
	Feb	858	914.98	56.98	942.21	84.21	1041.65	183.65	1038.36	180.36
	Mar	1064	897.81	-166.19	956.87	-107.13	879.51	-184.49	875.72	-188.28
	Apr	1048	871.71	-176.29	978.71	-69.29	1088.20	40.20	1086.29	38.29
	May	1068	902.28	-165.72	995.46	-72.54	1077.78	9.78	1069.18	1.18
	Jun	1083	917.19	-165.81	1001.70	-81.30	1100.59	17.59	1089.20	6.20
	Jul	1079	931.79	-147.21	1003.43	-75.57	1113.35	34.35	1103.99	24.99
	Aug	1072	964.56	-107.44	1003.44	-68.56	1114.89	42.89	1099.55	27.55
	Sep	1057	982.67	-74.33	1008.15	-48.85	1104.64	47.64	1092.25	35.25
	Oct	1023	981.96	-41.04	996.60	-26.40	1087.41	64.41	1076.39	53.39
	Nov	1006	962.65	-43.35	983.40	-22.60	1047.96	41.96	1041.63	35.63
	Dec	970	952.74	-17.26	955.02	-14.98	1034.41	64.41	1024.28	54.28
			Average	-91.93	Average	-48.01	Average	28.58	Average	20.45
2016	Jan	1016	938.26	-77.74	1003.30	-12.70	997.07	-18.93	1004.37	-11.63
	Feb	896	910.39	14.39	977.51	81.51	1042.59	146.59	1035.28	139.28
	Mar	1130	897.24	-232.76	981.84	-148.16	920.25	-209.75	914.58	-215.42
	Apr	1076	873.05	-202.95	1011.39	-64.61	1157.69	81.69	1153.51	77.51
	May	1085	884.61	-200.39	1047.37	-37.63	1107.54	22.54	1097.91	12.91
	Jun	1070	912.55	-157.45	1065.99	-4.01	1123.96	53.96	1106.55	36.55
			Average	-142.82	Average	-30.93	Average	12.68	Average	6.53
Total			Average	-108.89	Average	-42.32	Average	23.28	Average	15.81

From Table 8, the average of residuals were separated into three periods: (1) in 2015, (2) the first half of the year in 2016, and (3) from January 2015 to June 2016. The residuals in predicted Q with demand and supply model by using actual data terms in explanatory variables term were underestimated trend together similarly. In demand model, the average of residuals were -91.93, -142.82 and -108.89, respectively. In supply model, they were -48.01, -30.93 and -42.32, respectively. In case of using percentage change of explanatory variables term with demand and supply model were overestimated trend together similarly. In demand model, the average of residuals were 28.58, 12.68 and 23.28, respectively. In supply model, they were 20.45, 6.53 and 15.81, respectively.

4.2 Results of explanatory variables forecasting

In the next step, this study found the values of all explanatory variables in monthly data from January 2017 to December 2026 with (1) Box and Jenkins approach by using monthly data in two periods that are from 2004 to 2015 and 2011 to 2015 and (2) simple moving average technique by using the monthly data in four periods that are from (a) 2013 to 2015, (b) 2011 to 2015, (c) 2008 to 2015, and (d) 2006 to 2015.

4.2.1 Results of Box and Jenkins approach

For Box and Jenkins approach, there are three phases for finding the fitted model. The first phase is identification that includes (1) data preparation – transform data to stabilize variance and difference data to obtain stationary series – and (2) model selection – examine data, autocorrelation function (ACF), and partial autocorrelation function (PACF) to identify potential models. This study will check by using the unit root test. The second phase is estimation and testing that includes (1) estimation – estimate parameters in potential models, and select best model using suitable criterion – and (2) Diagnostics – check ACF/PACF of residuals, do portmanteau test of residuals by using Q-statistics. For this phase, the residuals have to be white noise, if it is not white noise, it will go back to the first phase, but if it is white noise, it will go forward

to the last phase. The last phase is application that uses model to forecast the future data.

4.2.1.1 By using the monthly data from 2004 to 2015

At the first phase of Box and Jenkins approach, the identification step includes data preparation and model selection by checking stationary of the time series data with Auto-correlation Function (AFC) and Augmented Dickey-Fuller (ADF) test. The results of stationary test with the unit root indicate YGDP and UPRICE are stationary at the signification of 5% level. The Qs, SRPRICE, CNY, STOCK, MAREA_TH, RAINFALL_TH and CPETRO are non-stationary at the signification of 5%, and they will be stationary at the first differentiation. The results are reported in Table 9.

Table 9 Test for stationary with Augmented Dickey-Fuller test (Method: Least Squares)

	At level		At 1st difference	
	t-Statistic	Prob	t-Statistic	Prob
Demand Model				
Qs	-0.6886	0.8449	-10.0285	0.0000*
SRPRICE	-1.9402	0.3132	-12.7567	0.0000*
YGDP	-4.3478	0.0005*	-2.8282	0.0049*
CNY	-1.7189	0.4196	-7.6464	0.0000*
Supply Model				
STOCK	-1.7823	0.3880	-8.3503	0.0000*
MAREA_TH	0.5876	0.9890	-12.3186	0.0000*
UPRICE	-4.1432	0.0011*	-8.2852	0.0000*
RAINFALL_TH	-2.0397	0.2697	-11.9339	0.0000*
CPETRO	-2.4753	0.1237	-7.1627	0.0000*

** At 10% level of signification*

*** At 5% level of signification*

At the second phase, the time series data was used to estimate the parameters in potential models, and then the least squares method was used to estimate the tentative models at a significance of 5% level. There were a few tentative models that passed the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) checking, and Q-statistic testing of residuals. Then the model was selected by the goodness of fit statistics that were used to test the accuracy of the candidate models. And then the fitted model was chosen by selecting the minimum of mean absolute

percent error (MAPE). Therefore, the coefficients, standard error, t-statistics and probability of fitted model in Qs, SRPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH and CPETRO are shown in the Table 10. For this study, all of probability value of t-statistics are less than 0.05 or the models are fitted model. The results of Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) checking, and Q-statistic testing of residuals of fitted model is reported in Table 11. For this study, all of probability of Q-statistic are larger than 0.05 or the all of residuals are white noise. The Accuracy of the fitted models of Qs, SRPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH and CPETRO are shown in Table 12.

Table 10 The coefficients, standard error, t-statistics and probability of explanatory variable in demand and supply model by Box and Jenkins approach with monthly data from 2004-2015

	Demand Model															
	Qs				SPRICE				YGDP				CNY			
	Coef.	S.E.	t-stat	Prob.	Coef.	S.E.	t-stat	Prob.	Coef.	S.E.	t-stat	Prob.	Coef.	S.E.	t-stat	Prob.
Constant	0.0002	0.0013	0.1352	0.8927	-0.0028	0.0016	-1.7921	0.0755	1.1317	0.1205	9.3882	0.0000	0.0004	0.0004	0.9101	0.3646
AR(1)	-	-	-	-	-	-	-	-	1.8834	0.0363	51.9541	0.0000**	0.1686	0.0653	2.5822	0.0111**
AR(2)	-	-	-	-	-	-	-	-	-0.8976	0.0360	-24.9273	0.0000**	-	-	-	-
AR(3)	-0.3327	0.0562	-5.9164	0.0000**	-	-	-	-	-	-	-	-	-	-	-	-
AR(7)	-0.122	0.0541	-2.2545	0.0261**	-	-	-	-	-	-	-	-	-	-	-	-
AR(9)	0.6085	0.0539	11.2945	0.0000**	-	-	-	-	-	-	-	-	-0.6463	0.0835	-7.7369	0.0000**
MA(3)	0.2331	0.0395	5.9011	0.0000**	-	-	-	-	-	-	-	-	-	-	-	-
MA(6)	-	-	-	-	-0.2428	0.0810	-2.9976	0.0033**	-	-	-	-	-	-	-	-
MA(7)	-	-	-	-	-0.2093	0.0810	-2.5839	0.0109**	-	-	-	-	-	-	-	-
MA(9)	-0.8605	0.0217	-39.7133	0.0000**	-	-	-	-	-	-	-	-	0.7188	0.0946	7.6001	0.0000**
MA(11)	-	-	-	-	0.2463	0.0827	2.9779	0.0035**	-	-	-	-	-	-	-	-
SMA(12)	-0.8764	0.0267	-32.8526	0.0000**	-0.9310	0.0268	-34.7771	0.0000**	-0.9700	0.0209	-46.3917	0.0000**	-0.8653	0.0401	-21.5917	0.0000**
R-squared	0.6282	-	-	-	0.5806	-	-	-	0.9979	-	-	-	0.6157	-	-	-
D.W.stat	2.5565	-	-	-	2.0931	-	-	-	2.0425	-	-	-	1.5896	-	-	-
F-statistic	32.3848	-	-	-	43.6038	-	-	-	22043.84	-	-	-	46.8665	-	-	-
Prob(F-stat)	0.0000	-	-	-	0.0000	-	-	-	0.0000	-	-	-	0.0000	-	-	-

* *At 10% level of signification*

** *At 5% level of signification*

*** *S.E. refers to Standard Error, D.W. stat refers to Dubin Watson statistics*

Table 10 The coefficients, standard error, t-statistics and probability of explanatory variable in demand and supply model by Box and Jenkins approach with monthly data from 2004-2015 (cont.)

	Supply Model											
	STOCK				MAREA_TH				UPRICE			
	Coefficient	S.E.	t-stat	Prob.	Coefficient	S.E.	t-stat	Prob.	Coefficient	S.E.	t-stat	Prob.
Constant	0.0039	0.0163	0.2375	0.8126	0.0005	0.0003	1.6102	0.1101	-0.0033	0.0013	-2.5643	0.0116
AR(1)	0.7154	0.1798	3.9785	0.0001	-	-	-	-	0.4905	0.0859	5.7080	0.0000**
AR(3)	-	-	-	-	-	-	-	-	0.3544	0.1446	2.4503	0.0157**
AR(4)	-	-	-	-	-	-	-	-	-0.2221	0.0998	-2.2260	0.0279**
AR(12)	-	-	-	-	-0.7225	0.1047	-6.8987	0.0000**	-	-	-	-
MA(1)	-0.6415	0.1873	-3.4256	0.0008	-	-	-	-	-	-	-	-
MA(2)	-	-	-	-	-	-	-	-	-0.1523	0.0708	-2.1513	0.0335**
MA(3)	-	-	-	-	-	-	-	-	-0.6954	0.1077	-6.4536	0.0000**
MA(4)	0.1602	0.0826	1.9389	0.0548	-	-	-	-	-	-	-	-
MA(12)	-	-	-	-	-0.3715	0.1501	-2.4753	0.0148	-	-	-	-
SMA(12)	-	-	-	-	-	-	-	-	-0.9090	0.0253	-35.9100	0.0000**
R-squared	0.0645	-	-	-	0.6810	-	-	-	0.6921	-	-	-
D.W.stat	1.8975	-	-	-	2.0459	-	-	-	1.9355	-	-	-
F-statistic	2.8978	-	-	-	123.8223	-	-	-	44.9549	-	-	-
Prob(F-stat)	0.0377	-	-	-	0.0000	-	-	-	0.0000	-	-	-
	RAINFALL_TH				CPETRO							
	Coefficient	S.E.	t-stat	Prob.	Coefficient	S.E.	t-stat	Prob.				
Constant	-0.0032	0.0015	-2.0365	0.0438	-0.0050	0.0031	-1.6187	0.1081				
AR(1)	0.2052	0.0949	2.1625	0.0325**	-	-	-	-				
AR(6)	-	-	-	-	-0.2175	0.0894	-2.4319	0.0165				
MA(1)	-0.9070	0.0433	-20.9433	0.0000**	0.3480	0.0901	3.8622	0.0002				
MA(2)	-	-	-	-	0.1992	0.0883	2.2552	0.0259				
SMA(12)	-0.8920	0.0328	-27.2233	0.0000**	-0.8835	0.0212	-41.6880	0.0000				
R-squared	0.7276	-	-	-	0.5432	-	-	-				
D.W.stat	1.8507	-	-	-	2.0094	-	-	-				
F-statistic	112.1814	-	-	-	35.6798	-	-	-				
Prob(F-stat)	0.0000	-	-	-	0.00000	-	-	-				

* *At 10% level of signification*

** *At 5% level of signification*

*** *S.E. refers to Standard Error, D.W. stat refers to Dubin Watson statistics*

Table 11 The results of Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) checking, and Q-statistic testing of residuals by Box and Jenkins approach with monthly data from 2004 to 2015

	Demand Model															
	Qs				SRPRICE				YGDP				CNY			
	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.
1	-0.293	-0.293	10.761		-0.048	-0.048	0.3140		-0.023	-0.023	0.0754		0.202	0.202	5.0870	
2	0.018	-0.075	10.801		0.049	0.047	0.6399		-0.009	-0.009	0.0862		0.006	-0.037	5.0909	
3	-0.126	-0.156	12.813		0.040	0.045	0.8598		0.050	0.050	0.4600		-0.050	-0.046	5.4111	
4	-0.128	-0.241	14.926		-0.091	-0.090	1.9970		-0.022	-0.020	0.5308	0.466	0.035	0.058	5.5716	
5	0.075	-0.069	15.659		0.016	0.004	2.0327	0.154	0.044	0.044	0.8142	0.666	-0.024	-0.046	5.6434	0.059
6	0.021	-0.022	15.718		0.004	0.012	2.0345	0.362	-0.060	-0.061	1.3527	0.717	-0.013	-0.001	5.6663	0.118
7	-0.015	-0.078	15.748	0.050	0.042	0.049	2.2775	0.517	0.033	0.034	1.5155	0.824	0.039	0.050	5.8674	0.198
8	-0.118	-0.206	17.602	0.066	0.089	0.085	3.3995	0.493	0.018	0.013	1.5638	0.906	0.034	0.010	6.0199	0.228
9	0.112	0.008	19.292	0.087	-0.122	-0.121	5.5419	0.353	-0.109	-0.100	3.3752	0.760	-0.081	-0.093	6.9069	0.084
10	-0.010	0.002	19.305	0.091	-0.160	-0.189	9.2206	0.162	0.011	0.001	3.3954	0.846	0.177	0.233	11.141	0.125
11	-0.026	-0.105	19.394	0.081	-0.042	-0.048	9.4720	0.221	0.038	0.042	3.6252	0.889	-0.037	-0.145	11.329	0.066
12	-0.009	-0.097	19.405	0.061	-0.075	-0.035	10.287	0.245	-0.089	-0.085	4.8836	0.844	-0.156	-0.141	14.656	0.056

	Supply Model																			
	STOCK				MAREA_TH				UPRICE				RAINFALL_TH				CPETRO			
	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.
1	0.050	0.050	0.3387		-0.023	-0.023	0.0650		0.014	0.014	0.0261		0.025	0.025	0.0810		-0.011	-0.011	0.0152	
2	-0.134	-0.137	2.7325		-0.023	-0.024	0.1314		-0.009	-0.010	0.0376		0.037	0.037	0.2690		-0.004	-0.004	0.0167	
3	0.116	0.134	4.5598		-0.023	-0.024	0.1991	0.655	-0.023	-0.023	0.1076		-0.015	-0.017	0.3000		-0.004	-0.004	0.0192	
4	-0.045	-0.083	4.8404	0.062	-0.023	-0.025	0.2682	0.874	-0.046	-0.045	0.3866		-0.008	-0.009	0.3093	0.578	0.075	0.075	0.7625	
5	0.055	0.105	5.2617	0.072	-0.024	-0.026	0.3388	0.953	0.063	0.064	0.9177		0.036	0.037	0.4827	0.786	-0.034	-0.033	0.9172	0.338
6	0.060	0.012	5.7591	0.124	-0.024	-0.027	0.4109	0.982	0.039	0.036	1.1215		-0.087	-0.089	1.5265	0.676	-0.038	-0.038	1.1093	0.574
7	-0.129	-0.100	8.0655	0.089	-0.024	-0.028	0.4844	0.993	-0.078	-0.081	1.9604	0.161	-0.032	-0.031	1.6666	0.797	0.013	0.012	1.1306	0.770
8	-0.010	-0.003	8.0809	0.152	-0.024	-0.029	0.5595	0.997	0.042	0.047	2.2080	0.332	-0.076	-0.067	2.4787	0.780	-0.033	-0.039	1.2753	0.866
9	-0.012	-0.051	8.1020	0.231	-0.024	-0.030	0.6362	0.999	0.126	0.133	4.3975	0.222	-0.013	-0.009	2.5014	0.868	-0.148	-0.146	4.2837	0.509
10	0.048	0.088	8.4281	0.296	-0.024	-0.031	0.7144	0.999	0.103	0.098	5.8961	0.207	0.094	0.097	3.7543	0.808	-0.022	-0.021	4.3512	0.629
11	0.100	0.064	9.8791	0.274	-0.024	-0.032	0.7943	1.000	-0.008	-0.021	5.9048	0.316	-0.027	-0.028	3.8610	0.869	0.062	0.058	4.8916	0.673
12	-0.456	-0.465	40.074	0.196	-0.065	-0.074	1.3634	0.999	-0.082	-0.066	6.8682	0.333	-0.137	-0.153	6.5819	0.681	-0.035	-0.032	5.0633	0.751

** At 10% level of signification* *** At 5% level of signification*

Table 12 The Accuracy of the fitted models of Qs, SRPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH and CPETRO

	Dynamic Forecasting				Static Forecasting			
	RMSE	MAE	MAPE	U	RMSE	MAE	MAPE	U
Demand Model								
Qs AR(3) AR(7) AR(9) MA(3) MA(9) SMA(12)	221.874	172.717	18.757	0.111	58.902	47.587	5.331	0.032
SRPRICE MA(6) MA(7) MA(11) SMA(12)	759.116	598.884	22.080	0.166	186.245	130.565	5.252	0.037
YGDP AR(1) AR(2) SMA(12)	1.844	1.278	68.904	0.446	0.087	0.046	2.847	0.018
CNY AR(1) AR(9) MA(9) SMA(12)	0.451	0.398	8.089	0.044	0.060	0.048	0.966	0.006
Supply Model								
STOCK AR(1) MA(1) MA(4)	1485.785	1276.924	61.797	0.531	168.391	106.427	5.857	0.041
MAREA_TH AR(12) MA(12)	129.742	103.104	4.686	0.030	21.360	7.218	3.262	0.005
UPRICE AR(1) AR(3) AR(4) MA(2) MA(3) SMA(12)	123.804	96.941	27.740	0.203	36.828	23.524	6.768	0.054
RAINFALL_TH AR(1) MA(1) SMA(12)	105.245	84.111	58.774	0.435	37.928	27.910	28.832	0.118
CPETRO AR(6) MA(1) MA(2) SMA(12)	26.829	22.405	28.038	0.165	5.868	4.597	6.120	0.034

From Box-Jenkins approach, the fitted model is chosen by selecting the lowest of mean absolute percent error (MAPE). The model of Qs is AR(3) AR(7) AR(9) MA(3) MA(9) SMA(12) or ARIMA(9,9)$(0,1)_{12}$ that has MAPE dynamic forecasting and static forecasting equal to 18.757 and 5.331, respectively. The fitted model of SRPRICE is MA(6) MA(7) MA(11) SMA(12) or ARIMA(0,11)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 22.080 and 5.252, respectively. The fitted model of YGDP is AR(1) AR(2) SMA(12) or ARMA(2,0)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 68.904 and 2.847, respectively. The fitted model of CNY is AR(1) AR(9) MA(9) SMA(12) or ARIMA(9,9)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 8.089 and 0.966, respectively. The fitted model of STOCK is AR(1) MA(1) MA(4) or ARIMA(1,4)$(0,0)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 67.797 and 5.857, respectively. The fitted model of MAREA_TH is AR(12) MA(12) or ARIMA(12,0)$(0,0)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 4.686 and 3.262, respectively. The fitted model of UPRICE is

AR(1) AR(3) AR(4) MA(2) MA(3) SMA(12) or ARMA(4,3)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 27.740 and 6.768, respectively. The fitted model of RAINFALL_TH is AR(1) MA(1) SMA(12) or ARIMA(1,1)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 58.774 and 28.832, respectively. The fitted model of CPETRO is AR(6) MA(1) MA(2) SMA(12) or ARIMA(2,0)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 28.038 and 6.120, respectively. In the last phase, the fitted models with Box and Jenkins approach in second phase are used to predict the future data of Qs, SRPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH and CPETRO from January 2017 to December 2026 are reported in Appendix B. After that this study calculated the average of yearly for all explanatory variables, and the results are shown in the Table 13.

Table 13 The average of yearly predicted future data of all explanatory variables with Box and Jenkins approach and monthly data from 2004 to 2015

	Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2017	1730.25	965.25	1.1309	6.71	622.46	3439.06	89.98	6.41	17.20
2018	1889.83	743.46	1.1316	7.11	776.89	3806.32	64.34	4.03	10.62
2019	2067.18	553.80	1.1319	7.57	1015.99	4238.79	44.23	2.43	6.18
2020	2266.60	398.96	1.1318	8.10	1392.23	4752.85	29.22	1.42	3.39
2021	2490.25	277.96	1.1317	8.70	1999.04	5363.17	18.56	0.79	1.75
2022	2741.22	187.28	1.1317	9.40	3007.57	6092.62	11.33	0.43	0.85
2023	3024.44	122.04	1.1317	10.21	4741.31	6966.05	6.65	0.22	0.39
2024	3343.02	76.91	1.1317	11.13	7831.90	8017.74	3.75	0.11	0.17
2025	3703.44	46.87	1.1317	12.20	13555.68	9288.39	2.03	0.05	0.07
2026	4110.81	27.63	1.1317	13.44	24584.49	10831.66	1.06	0.02	0.03
Average of total	2736.70	340.02	1.1316	9.46	5952.76	6279.67	27.12	1.59	4.07

The Table 13 shows the average of yearly predicted future data for ten years from 2017 to 2026 of Qs, SRPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH and CPETRO. The trend of Qs tends to increase highly changing from 1,730.25 in 2017 to 4,110.81 in 2026, or tends to increase by 137.58 percent. The SRPRICE tends to suddenly decrease from 965.25 in 2017 to 27.63 in 2026m, or tends to decrease by 97.14 percent. The YGD is stationary changing from 1.1309 in 2017 to 1.1317 in 2026, or tends to gradually increase by 0.07 percent. The CNY tends to increase from 6.71 in 2017 to 13.44 in 2026, or tends to increase by 100.30 percent. The STOCK tends to highly increase from 622.46 in 2017 to 24,584.49 in 2026, or tends to increase by 3,849.57 percent. The MAREA_TH suddenly increases from 3,439.06 in 2017 to 10,831.66 in 2026, or tends to increase by 214.96 percent. The UPRICE tends to highly decrease from 89.98 in 2017 to 1.06 in 2026, or tends to decrease by 98.82 percent. The RAINFALL_TH tends to decrease from 6.41 in 2017 to 0.02 in 2026, or tends to 99.69 percent. The CPETRO tends to reduce from 17.20 in 2017 to 0.03 in 2026, or tends to decrease by 99.83 percent. The average of total in predicted data for ten years are 2,736.70 thousand tons, USD 340.02 per ton, 1.1316 percent, 9.46 baht, 5,952.76 thousand tons, 6,279.67 hectare, USD 27.12 per metric, 1.59 millimeter and USD 4.07 per barrel, respectively.

4.2.1.2 By using the monthly data from 2011 to 2015

At the first phase of Box and Jenkins approach, the identification step includes data preparation and model selection by checking stationary of the time series data with Auto-correlation Function (AFC) and Augmented Dickey-Fuller (ADF) test. The results of stationary test with the unit root indicate Qs and RAINFALL_TH are stationary at the signification of 5% level, while YGDP is stationary at the signification of 10% level. The SRPRICE, CNY, STOCK, MAREA_TH, UPRICE and CPETRO are non-stationary at the signification of 5%, and they will be stationary at the first differentiation. The results are reported in Table 14.

Table 14 Test for stationary with Augmented Dickey-Fuller test (Method: Least Squares)

	At level		At 1st difference	
	t-Statistic	Prob	t-Statistic	Prob
Demand Model				
Qs	-5.6309	0.0000*	-6.3391	0.0000*
SRPRICE	-0.6674	0.8466	-6.5022	0.0000*
YGDP	-2.7947	0.0652**	-2.6454	0.0900*
CNY	-1.2045	0.6669	-5.1316	0.0001*
Supply Model				
STOCK	-1.3493	0.6006	-5.0435	0.0001*
MAREA_TH	-0.6800	0.8435	-7.8420	0.0000*
UPRICE	-0.2868	0.9194	-5.4344	0.0000*
RAINFALL_TH	-6.7722	0.0000*	-6.1456	0.0000*
CPETRO	-0.2499	0.9254	-5.0626	0.0001*

** At 10% level of signification*

*** At 5% level of signification*

At the second phase, the time series data was used to estimate the parameters in potential models, and then the least squares method was used to estimate the tentative models at a significance of 5% level. There were a few tentative models that passed the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) checking, and Q-statistic testing of residuals. Then the model was selected by the goodness of fit statistics that were used to test the accuracy of the candidate models. And then the fitted model was chosen by selecting the minimum of mean absolute percent error (MAPE). Therefore, the coefficients, standard error, t-statistics and probability of fitted model in Qs, SRPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH and CPETRO are shown in the Table 15. For this study, all probability value of t-statistics are less than 0.05 or the models are fitted model. The results of Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) checking, and Q-statistic testing of residuals of fitted model is reported in Table 16. For this study all of probability of Q-statistic are larger than 0.05 or the all of residuals are white noise. The Accuracy of the fitted models of Qs, SRPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH and CPETRO are shown in Table 17.

Table 15 The coefficients, standard error, t-statistics and probability of explanatory variable in demand and supply model by Box and Jenkins approach with monthly data from 2011-2015

	Demand Model															
	Qs				SPRICE				YGDP				CNY			
	Coef.	S.E.	t-stat	Prob.	Coef.	S.E.	t-stat	Prob.	Coef.	S.E.	t-stat	Prob.	Coef.	S.E.	t-stat	Prob.
Constant	0.0105	0.0032	3.3168	0.0022	-0.0057	0.0010	-5.4686	0.0000	0.0009	0.0214	0.0431	0.9659	0.0011	0.0007	1.6872	0.0996
AR(1)	-	-	-	-	-	-	-	-	1.0637	0.0919	11.5774	0.0000**	0.9942	0.1761	5.6461	0.0000**
AR(2)	-	-	-	-	0.3471	0.1793	1.9359	0.0605*	-	-	-	-	-0.5234	0.1437	-3.6410	0.0008**
AR(4)	-	-	-	-	-0.4374	0.1434	-3.0509	0.0042**	-0.2666	0.0716	-3.7237	0.0006**	-	-	-	-
AR(10)	-0.4318	0.1230	-3.5123	0.0013**	-	-	-	-	-	-	-	-	-	-	-	-
MA(1)	-	-	-	-	-	-	-	-	-0.5297	0.1891	-2.8017	0.0080**	-0.6749	0.1712	-3.9412	0.0003**
MA(2)	-	-	-	-	-0.6472	0.2124	-3.0467	0.0043**	-	-	-	-	-	-	-	-
MA(3)	-	-	-	-	-0.3451	0.1481	-2.3299	0.0254**	-	-	-	-	-	-	-	-
MA(4)	0.3294	0.1143	2.8814	0.0069**	-	-	-	-	-	-	-	-	-	-	-	-
MA(7)	-0.6852	0.1061	-6.4596	0.0000**	-	-	-	-	-	-	-	-	-	-	-	-
MA(9)	-	-	-	-	-	-	-	-	-	-	-	-	-0.3150	0.1434	-2.1959	0.0341**
SMA(12)	-0.9534	0.0266	-35.8023	0.0000**	-0.8867	0.0512	-17.3176	0.0000**	-0.9422	0.0811	-11.6235	0.0000**	-0.8720	0.0476	-18.3285	0.0000**
R-squared	0.7835	-	-	-	0.6435	-	-	-	0.8675	-	-	-	0.7394	-	-	-
D.W.stat	1.6224	-	-	-	2.2745	-	-	-	1.8200	-	-	-	1.9502	-	-	-
F-statistic	29.8494	-	-	-	13.3545	-	-	-	62.1954	-	-	-	22.1308	-	-	-
Prob(F-stat)	0.0000	-	-	-	0.0000	-	-	-	0.0000	-	-	-	0.0000	-	-	-

* *At 10% level of signification*

** *At 5% level of signification*

*** *S.E. refers to Standard Error, D.W. stat refers to Dubin Watson statistics*

Table 15 The coefficients, standard error, t-statistics and probability of explanatory variable in demand and supply model by Box and Jenkins approach with monthly data from 2011-2015 (cont.)

	Supply Model											
	STOCK				MAREA_TH				UPRICE			
	Coefficient	S.E.	t-stat	Prob.	Coefficient	S.E.	t-stat	Prob.	Coefficient	S.E.	t-stat	Prob.
Constant	-0.0051	0.0053	-0.9580	0.3435	0.0000	0.0002	0.1346	0.8937	-0.0090	0.0072	-1.2545	0.2168
AR(12)	-	-	-	-	-0.6004	0.0104	-57.7914	0.0000**	-	-	-	-
MA(1)	0.8228	0.0812	10.1285	0.0000**	-	-	-	-	-	-	-	-
MA(3)	-	-	-	-	-	-	-	-	-0.3486	0.0995	-3.5027	0.0011**
MA(4)	0.1007	0.0867	1.1606	0.2524	-	-	-	-	-0.2998	0.0572	-5.2373	0.0000**
MA(8)	-0.2713	0.0799	-3.3969	0.0015**	-	-	-	-	-	-	-	-
MA(10)	-	-	-	-	-	-	-	-	0.5114	0.0781	6.5473	0.0000**
MA(12)	-	-	-	-	0.9703	0.0049	199.8540	0.0000**	-	-	-	-
MA(13)	-	-	-	-	-	-	-	-	0.2069	0.1000	2.0694	0.0449**
SMA(12)	-0.8424	0.0546	-15.4381	0.0000**	-	-	-	-	-0.8878	0.0363	-24.4639	0.0000**
R-squared	0.7493	-	-	-	0.9988	-	-	-	0.7362	-	-	-
D.W.stat	2.0771	-	-	-	1.9865	-	-	-	1.7311	-	-	-
F-statistic	31.3878	-	-	-	13276.44	-	-	-	22.8877	-	-	-
Prob(F-stat)	0.0000	-	-	-	0.0000	-	-	-	0.0000	-	-	-
	RAINFALL_TH				CPETRO							
	Coefficient	S.E.	t-stat	Prob.	Coefficient	S.E.	t-stat	Prob.				
Constant	-0.0061	0.0115	-0.5335	0.5967	-0.0148	0.0080	-1.8530	0.0713				
AR(1)	0.4005	0.1903	2.1050	0.0418**	0.8653	0.2660	3.2535	0.0023**				
AR(2)	-	-	-	-	-0.4800	0.1442	-3.3279	0.0019**				
AR(3)	-0.3004	0.1484	-2.0242	0.0498**	-	-	-	-				
MA(1)	-0.7104	0.1619	-4.3889	0.0001**	-0.4705	0.2853	-1.6491	0.1070				
SMA(12)	-0.9665	0.0421	-22.9648	0.0000**	-0.8441	0.0403	-20.9243	0.0000**				
R-squared	0.6996	-	-	-	0.3768	-	-	-				
D.W.stat	1.8174	-	-	-	1.8755	-	-	-				
F-statistic	22.7037	-	-	-	6.0465	-	-	-				
Prob(F-stat)	0.0000	-	-	-	0.0000	-	-	-				

* *At 10% level of signification*

** *At 5% level of signification*

*** *S.E. refers to Standard Error, D.W. stat refers to Dubin Watson statistics*

Table 16 The results of Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) checking, and Q-statistic testing of residuals by Box and Jenkins approach with monthly data from 2011 to 2015

	Demand Model															
	Qs				SRPRICE				YGDP				CNY			
	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.
1	0.152	0.152	0.952		-0.157	-0.157	1.140		0.083	0.083	0.320		0.010	0.010	0.005	
2	-0.045	-0.070	1.038		0.043	0.018	1.226		-0.150	-0.158	1.387		0.026	0.026	0.039	
3	0.098	0.119	1.454		0.159	0.172	2.444		-0.056	-0.030	1.541		-0.021	-0.021	0.061	
4	-0.160	-0.208	2.604		-0.010	0.043	2.448		-0.157	-0.179	2.765		0.000	0.000	0.061	
5	-0.156	-0.082	3.730	0.053	-0.076	-0.091	2.743		-0.066	-0.054	2.988	0.084	-0.097	-0.096	0.561	
6	-0.161	-0.174	4.961	0.084	-0.068	-0.132	2.984	0.084	0.128	0.087	3.844	0.146	0.082	0.084	0.925	0.336
7	0.134	0.241	5.841	0.120	-0.181	-0.226	4.742	0.093	0.140	0.097	4.891	0.180	-0.109	-0.109	1.592	0.451
8	-0.001	-0.117	5.841	0.211	0.047	0.020	4.866	0.182	0.050	0.040	5.029	0.284	-0.070	-0.075	1.874	0.599
9	-0.152	-0.108	7.056	0.217	-0.312	-0.270	10.411	0.034	-0.303	-0.310	10.257	0.068	0.000	0.011	1.874	0.759
10	0.161	0.093	8.468	0.206	-0.143	-0.225	11.603	0.041	-0.040	0.065	10.353	0.111	0.073	0.064	2.193	0.822
11	0.075	0.063	8.787	0.268	0.218	0.183	14.474	0.025	-0.007	-0.058	10.356	0.169	0.046	0.058	2.324	0.888
12	-0.075	-0.058	9.114	0.333	-0.198	-0.078	16.912	0.018	-0.048	-0.034	10.501	0.232	-0.286	-0.333	7.565	0.373

	Supply Model																			
	STOCK				MAREA_TH				UPRICE				RAINFALL_TH				CPETRO			
	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.	AC	PAC	Q-Stat	Prob.
1	-0.065	-0.065	0.211		-0.016	-0.016	0.010		0.130	0.130	0.845		0.056	0.056	0.149		0.040	0.040	0.075	
2	0.119	0.115	0.931		-0.017	-0.017	0.021		0.117	0.102	1.542		-0.100	-0.103	0.629		-0.005	-0.007	0.077	
3	-0.077	-0.064	1.244		-0.017	-0.018	0.033	0.856	-0.067	-0.097	1.780		-0.009	0.003	0.633		0.048	0.048	0.191	
4	-0.077	-0.101	1.564		-0.018	-0.019	0.047	0.977	-0.218	-0.218	4.323		-0.022	-0.033	0.658		-0.097	-0.101	0.672	
5	0.010	0.018	1.570	0.210	-0.019	-0.020	0.062	0.996	0.022	0.099	4.350		0.090	0.095	1.082	0.298	0.140	0.152	1.716	0.190
6	-0.205	-0.194	3.939	0.140	-0.019	-0.021	0.079	0.999	-0.108	-0.078	5.002	0.025	-0.077	-0.097	1.401	0.496	-0.157	-0.183	3.059	0.217
7	0.026	-0.013	3.977	0.264	-0.020	-0.022	0.097	1.000	-0.047	-0.080	5.129	0.077	-0.194	-0.168	3.462	0.326	-0.141	-0.110	4.162	0.245
8	0.040	0.087	4.072	0.396	-0.021	-0.023	0.117	1.000	-0.214	-0.238	7.845	0.049	-0.021	-0.018	3.486	0.480	0.067	0.057	4.419	0.352
9	-0.017	-0.047	4.091	0.536	-0.021	-0.024	0.140	1.000	0.080	0.190	8.230	0.083	0.035	0.009	3.559	0.615	-0.149	-0.124	5.717	0.335
10	-0.071	-0.127	4.401	0.623	-0.022	-0.026	0.165	1.000	0.022	-0.006	8.261	0.142	-0.088	-0.114	4.021	0.674	0.054	0.036	5.890	0.436
11	0.141	0.171	5.674	0.578	-0.023	-0.027	0.192	1.000	0.108	0.032	9.006	0.173	0.019	0.038	4.043	0.775	0.100	0.120	6.509	0.482
12	0.030	0.032	5.734	0.677	-0.208	-0.214	2.637	0.989	0.157	0.047	10.621	0.156	-0.270	-0.291	8.663	0.372	0.013	0.032	6.520	0.589

** At 10% level of signification* *** At 5% level of signification*

Table 17 The Accuracy of the fitted models of Qs, SRPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH and CPETRO

	Dynamic Forecasting				Static Forecasting			
	RMSE	MAE	MAPE	U	RMSE	MAE	MAPE	U
Demand Model								
Qs AR(10) MA(4) MA(7) SMA(12)	45.387	36.466	3.705	0.022	36.849	26.864	2.762	0.018
SRPRICE AR(2) AR(4) MA(2) MA(3) SMA(12)	225.525	166.008	5.720	0.040	141.527	104.587	3.701	0.025
YGDP AR(1) AR(4) MA(1) SMA(12)	0.676	0.606	47.664	0.264	0.073	0.046	3.994	0.024
CNY AR(1) AR(2) MA(1) MA(9) SMA(12)	0.110	0.076	1.456	0.011	0.049	0.039	0.759	0.005
Supply Model								
STOCK MA(1) MA(4) MA(8) SMA(12)	509.231	448.729	16.644	0.108	60.562	46.108	1.882	0.012
MAREA_TH AR(12) MA(12)	5.722	3.972	0.152	0.001	2.415	0.514	0.020	0.000
UPRICE MA(3) MA(4) MA(10) MA(13) SMA(12)	61.035	47.400	14.223	0.085	21.389	13.553	3.851	0.032
RAINFALL_TH AR(1) AR(3) MA(1) SMA(12)	56.344	43.170	39.707	0.174	37.203	24.364	24.600	0.113
CPETRO AR(1) AR(2) MA(1) SMA(12)	13.552	11.026	11.873	0.075	5.680	4.716	5.634	0.031

From Box-Jenkins approach, the fitted model is chosen by selecting the lowest of mean absolute percent error (MAPE). The model of Qs is AR(10) MA(4) MA(7) SMA(12) or ARMA(10,7)$(0,1)_{12}$ that has MAPE dynamic forecasting and static forecasting equal to 3.705 and 2.762, respectively. The fitted model of SRPRICE is AR(2) AR(4) MA(2) MA(3) SMA(12) or ARIMA(4,3)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 5.720 and 3.701, respectively. The fitted model of YGDP is AR(1) AR(4) MA(1) SMA(12) or ARMA(4,1)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 47.664 and 3.994, respectively. The fitted model of CNY is AR(1) AR(2) MA(1) MA(9) SMA(12) or ARIMA(2,9)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 1.456 and 0.759, respectively. The fitted model of STOCK is MA(1) MA(4) MA(8) SMA(12) or ARIMA(0,8)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 16.644 and 1.882, respectively. The fitted model of MAREA_TH is AR(12) MA(12) or ARIMA(12,0)$(0,1)_{12}$ that has MAPE in dynamic forecasting and

static forecasting equal to 0.152 and 0.020, respectively. The fitted model of UPRICE is MA(3) MA(4) MA(10) MA(13) SMA(12) or ARIMA(0,13)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 14.223 and 3.851, respectively. The fitted model of RAINFALL_TH is AR(1) AR(3) MA(1) SMA(12) or ARMA(3,1)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 39.707 and 24.600, respectively. The fitted model of CPETRO is AR(1) AR(2) MA(1) SMA(12) or ARIMA(2,1)$(0,1)_{12}$ that has MAPE in dynamic forecasting and static forecasting equal to 11.873 and 5.634, respectively.

In the last phase, the fitted models with Box and Jenkins approach in second phase are used to predict the future data of Qs, SRPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH and CPETRO from January 2017 to December 2026 are reported in Appendix C. After that this study calculated the average of yearly for all explanatory variables, and the results are shown in the Table 18.

Table 18 The average of yearly predicted future data of all explanatory variables with Box and Jenkins approach and monthly data from 2011 to 2015

	Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2017	1030.35	1132.47	0.93	6.38	2276.30	3154.02	137.73	24.16	12.22
2018	1041.36	740.46	0.92	7.02	2022.68	3449.34	81.10	13.04	4.60
2019	1052.24	452.12	0.93	7.83	1691.73	3735.28	42.91	6.54	1.45
2020	1063.40	257.79	0.94	8.85	1331.81	4070.99	20.41	3.05	0.38
2021	1074.61	137.27	0.97	10.14	986.87	4422.01	8.72	1.32	0.09
2022	1085.95	68.26	1.01	11.78	688.30	4815.40	3.35	0.53	0.02
2023	1097.41	31.69	1.06	13.87	451.86	5238.49	1.16	0.20	0.00
2024	1108.99	13.74	1.12	16.56	279.21	5705.07	0.36	0.07	0.00
2025	1120.69	5.57	1.21	20.03	162.39	6212.19	0.10	0.02	0.00
2026	1132.52	2.10	1.31	24.57	88.90	6768.44	0.03	0.01	0.00
Average of total	1080.75	284.15	1.04	12.70	998.01	4757.12	29.59	4.89	1.88

The Table 18 shows the average of yearly predicted future data for ten years from 2017 to 2026 of Qs, SRPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH and CPETRO. The trend of Qs increases in small change from 1,030.35 in 2017 to 1,132.52 in 2026, or tends to increase by 9.92 percent. The SRPRICE tends to highly decrease from 1,132.47 in 2017 to 2.10 in 2026, or tends to decrease by 99.81 percent. The YGD tends to increase from 0.93 in 2017 to 1.31 in 2026, or tends to increase by 151.46 percent. The CNY tends to rises from 6.38 in 2017 to 24.57 in 2026, or tends to increase by 285.11 percent. The STOCK tends to decrease from 2,276.30 in 2017 to 88.90 in 2026, or tends to decrease by 96.09 percent. The MAREA_TH increases from 3,154.02 in 2017 to 6,768.44 in 2026, or tends to increase by 114.60 percent. The UPRICE tends to decrease from 137.73 in 2017 to 0.03 in 2026, or tends to decrease by 99.98 percent. The RAINFALL_TH tends to decrease from 24.16 in 2017 to 0.01 in 2026, or tends to decrease by 99.96 percent. The CPETRO tends to reduce from 12.22 in 2017 to 0.00 in 2023, or tends to decrease by 100.00 percent. The average of total in predicted data for ten years are 1,080.75 thousand tons, USD 284.15 per ton, 1.04 percent, 12.70 baht, 998.01 thousand tons, 4,757.12 hectare, USD 29.59 per metric, 4.89 millimeter and USD 1.88 per barrel, respectively.

4.2.2 Results of simple moving average technique

The results from simple moving average technique in monthly data in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015. The results of Qs, SRPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH and CPETRO are shown in Appendix D, Appendix E, Appendix F, Appendix G, Appendix H, Appendix I, Appendix J, Appendix K, and Appendix L, respectively.

After that this study calculated the average of predicted of yearly future data for all explanatory variables between 2017 and 2026, and the results of Qs are shown in Table 19.

Table 19 The average of yearly predicted future data and mean absolute percent error of Qs with simple moving average

	Qs			
	2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	1014.92	998.70	949.81	918.50
2018	1025.96	1005.37	963.88	928.37
2019	1019.61	1003.60	972.47	941.83
2020	1021.69	1007.26	976.79	952.10
2021	1022.24	1002.11	977.90	957.65
2022	1021.48	1003.99	973.21	959.50
2023	1021.89	1004.50	971.37	958.57
2024	1021.75	1004.54	966.77	952.84
2025	1021.77	1004.28	970.40	949.24
2026	1021.79	1004.11	972.22	944.41
Average of total	1021.31	1003.85	969.48	946.30
% of changing	0.68	0.54	2.36	2.82
MAPE	11.91	6.99	91.44	14.22

The Table 19 shows the average of yearly predicted future data for ten years from 2017 to 2026 of Qs in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015. From the data between 2013 and 2015, the trend of Qs increases in small change from 1,014.92 in 2017 to 1,021.79 in 2026, and the percent of changing increases by 0.68 percent. The average of Qs total equals to 1,021.31 and mean absolute percent error equals to 11.91. From the data between 2011 and 2015, the Qs tends to gradually rises from 998.70 in 2017 to 1,004.11 in 2026, and the percent of changing increases by 0.54 percent. The average of total is 1,003.85 and mean absolute percent error equals to 6.99. From the data between 2008 and 2015, the trend of Qs increase from 949.81 in 2017 to 972.22 in 2026, and the percent of changing increases by 2.36 percent. The average of total is 969.48, and mean absolute

percent error equals to 91.44. From the data between 2006 and 2015, the Qs tends to increase from 918.50 in 2017 to 944.41 in 2026, and the percent of changing increases by 2.82 percent. The average of total is 946.30 and mean absolute percent error equals to 14.22.

Next, the results of SRPRICE in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015, are shown in Table 20.

Table 20 The average of yearly predicted future data and mean absolute percent error of SRPRICE with simple moving average

	SRPRICE			
	2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	2423.41	2795.73	2780.67	2653.91
2018	2411.42	2694.04	2862.38	2705.36
2019	2443.40	2639.75	2866.00	2743.93
2020	2424.01	2681.70	2786.62	2804.55
2021	2431.59	2727.10	2724.04	2801.15
2022	2429.82	2697.21	2695.78	2731.62
2023	2429.18	2685.10	2728.95	2676.37
2024	2430.24	2690.58	2774.48	2649.18
2025	2429.58	2699.69	2778.46	2670.64
2026	2429.81	2696.59	2772.50	2708.07
Average of total	2428.24	2700.75	2776.99	2714.48
% of changing	0.26	-3.55	-0.29	2.04
MAPE	21.46	23.16	23.81	22.36

The Table 20 shows the average of yearly predicted future data for ten years from 2017 to 2026 of SRPRICE in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015. From the data between 2013 and 2015, the trend of SRPRICE increases in small change from 2,423.41 in 2017 to 2,429.81 in

2026, and the percent of changing increases by 0.26 percent. The average of total in SRPRICE equals to 2,428.24 and mean absolute percent error equals to 21.46. From the data between 2011 and 2015, the SRPRICE tends to decrease from 2,795.73 in 2017 to 2,696.59 in 2026, and the percent of changing decreases by 3.55 percent. The average of total is 2,700.75 and mean absolute percent error equal to 23.16. From the data between 2008 and 2015, the trend of SRPRICE declines from 2,780.67 in 2017 to 2,772.50 in 2026, and the percent of changing decreases by 0.29 percent. The average of total is 2,776.99, and mean absolute percent error equals to 23.81. From the data between 2006 and 2015, the SRPRICE tends to increase from 2,653.91 in 2017 to 2,708.07 in 2026, and the percent of changing increases by 2.04 percent. The average of total is 2,714.48 and mean absolute percent error equals to 22.36.

Next, the results of YGDP in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015, are shown in Table 21. The average of yearly predicted future data for ten years from 2017 to 2026 of YGDP in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015. From the data between 2013 and 2015, the trend of YGDP gradually decreases from 1.76 in 2017 to 1.75 in 2026, and the percent of changing decreases by 0.57 percent. The average of total in YGDP equals to 1.75 and mean absolute percent error equals to 70.07. From the data between 2011 and 2015, the YGDP tends to increase from 1.45 in 2017 to 1.56 in 2026, and the percent of changing increases by 7.59 percent. The average of total is 1.55 and mean absolute percent error equals to 37.12. From the data between 2008 and 2015, the trend of YGDP is increase from 1.21 in 2017 to 1.35 in 2026, and the percent of changing rises by 11.57 percent. The average of total is 1.35, and mean absolute percent error equals to 121.45. From the data between 2006 and 2015, the YGDP tends to increase from 0.99 in 2017 to 1.20 in 2026, and the percent of changing highly increase by 21.21 percent. The average of total is 1.20 and mean absolute percent error equals to 98.52.

Table 21 The average of yearly predicted future data and mean absolute percent error of YGDP with simple moving average

	YGDP			
	2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	1.76	1.45	1.21	0.99
2018	1.74	1.58	1.48	0.88
2019	1.74	1.60	1.34	1.19
2020	1.75	1.56	1.33	1.40
2021	1.74	1.54	1.39	1.28
2022	1.75	1.56	1.38	1.26
2023	1.75	1.57	1.32	1.30
2024	1.75	1.56	1.31	1.29
2025	1.75	1.55	1.36	1.23
2026	1.75	1.56	1.35	1.20
Average of total	1.75	1.55	1.35	1.20
% of changing	-0.57	7.59	11.57	21.21
MAPE	70.07	37.12	121.45	98.52

Next, the results of CNY in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015, are shown in Table 22.

Table 22 The average of yearly predicted future data and mean absolute percent error of CNY with simple moving average

	CNY			
	2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	5.35	5.18	5.01	4.95
2018	5.37	5.24	5.03	4.99
2019	5.35	5.25	5.08	4.99
2020	5.36	5.24	5.11	5.01
2021	5.36	5.21	5.13	5.04
2022	5.36	5.23	5.13	5.06
2023	5.36	5.23	5.10	5.08
2024	5.36	5.23	5.08	5.07
2025	5.36	5.23	5.09	5.04
2026	5.36	5.23	5.10	5.02
Average of total	5.36	5.23	5.08	5.03
% of changing	0.19	0.97	1.80	1.41
MAPE	5.17	4.93	5.01	4.87

The Table 22 shows the average of yearly predicted future data for ten years from 2017 to 2026 of CNY in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015,. From the data between 2013 and 2015, the trend of CNY increase from 5.35 in 2017 to 5.36 in 2026, and the percent of changing gradually increase by 0.19 percent. The average of total in CNY equals to 5.36 and mean absolute percent error equals to 5.17. From the data between 2011 and 2015, the CNY tends to increase from 5.18 in 2017 to 5.23 in 2026, and the percent of changing increases by 0.97 percent. The average of total is 5.23 and mean absolute percent error equals to 4.93. From the data between 2008 and 2015, the trend of CNY is increase from 5.01 in 2017 to 5.10 in 2026, and the percent of changing increases by 1.80 percent. The average of total is 5.08, and mean absolute percent error is equal 5.01.

From the data between 2006 and 2015, the CNY tends to increase from 4.95 in 2017 to 5.02 in 2026, and the percent of changing rises by 1.41 percent. The average of total is 5.03 and mean absolute percent error equals to 4.87.

Next, the results of STOCK in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015, are shown in Table 23.

Table 23 The average of yearly predicted future data and mean absolute percent error of STOCK with simple moving average

	STOCK			
	2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	2886.38	2557.75	2092.60	1966.44
2018	2858.18	2670.26	2154.86	1995.78
2019	2869.81	2663.97	2252.89	2066.83
2020	2868.19	2599.60	2355.24	2113.37
2021	2866.96	2594.97	2395.95	2186.59
2022	2868.57	2626.03	2355.22	2260.49
2023	2867.69	2628.82	2275.60	2282.66
2024	2868.01	2617.63	2250.61	2238.42
2025	2867.99	2613.96	2277.75	2163.26
2026	2867.92	2619.22	2298.66	2132.23
Average of total	2868.97	2619.22	2270.94	2140.61
% of changing	-0.64	2.40	9.85	8.43
MAPE	23.06	27.01	31.07	26.14

The Table 23 shows the average of yearly predicted future data for ten years from 2017 to 2026 of STOCK in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015,. From the data between 2013 and 2015, the trend of STOCK decreases from 2,886.38 in 2017 to 2,867.92 in 2026, and the percent of changing gradually reduce by 0.64 percent. The average of total in STOCK

equals to 2,868.97 and mean absolute percent error equals to 23.06. From the data between 2011 and 2015, the STOCK tends to increase from 2,557.75 in 2017 to 2,619.22 in 2026, and the percent of changing increases by 2.40 percent. The average of total is 2,619.22 and mean absolute percent error equals to 27.01. From the data between 2008 and 2015, the trend of STOCK increase from 2,092.60 in 2017 to 2,298.66 in 2026, and the percent of changing increases by 9.85 percent. The average of total is 2,270.94, and mean absolute percent error equals to 31.07. From the data between 2006 and 2015, the STOCK tends to increase from 1,966.44 in 2017 to 2,132.23 in 2026, and the percent of changing rises by 8.43 percent. The average of total is 2,140.61 and mean absolute percent error equals to 26.14.

Next, the results of MAREA_TH in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015, are shown in Table 24. The average of yearly predicted future data for ten years from 2017 to 2026 of MAREA_TH in four periods are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015. From the data between 2013 and 2015, the trend of MAREA_TH decreases from 2,560.80 in 2017 to 2,552.26 in 2026, and the percent of changing slightly decreases by 0.33 percent. The average of total in MAREA_TH equals to 2,553.22 and mean absolute percent error equals to 8.83. From the data between 2011 and 2015, the MAREA_TH tends to increase from 2,404.41 in 2017 to 2,443.85 in 2026, and the percent of changing increases by 1.64 percent. The average of total is 2,442.37 and mean absolute percent error equals to 12.56. From the data between 2008 and 2015, the trend of MAREA_TH is increase from 2,218.39 in 2017 to 2,310.35 in 2026, and the percent of changing increases by 4.15 percent. The average of total is 2,298.65, and mean absolute percent error equals to 12.75. From the data between 2006 and 2015, the MAREA_TH tends to increase from 2,124.82 in 2017 to 2,213.36 in 2026, and the percent of changing rises by 4.17 percent. The average of total is 2,219.88 and mean absolute percent error equals to 11.43.

Table 24 The average of yearly predicted future data and mean absolute percent error of MAREA_TH with simple moving average

	MAREA_TH			
	2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	2560.80	2404.41	2218.39	2124.82
2018	2555.71	2447.26	2262.03	2159.82
2019	2548.34	2469.37	2299.37	2193.74
2020	2554.39	2446.15	2323.49	2225.65
2021	2551.40	2431.98	2338.63	2251.34
2022	2552.44	2443.97	2337.34	2265.36
2023	2552.41	2448.64	2305.74	2271.25
2024	2552.14	2445.77	2289.26	2263.10
2025	2552.36	2442.31	2301.92	2230.31
2026	2552.26	2443.85	2310.35	2213.36
Average of total	2553.22	2442.37	2298.65	2219.88
% of changing	-0.33	1.64	4.15	4.17
MAPE	8.83	12.56	12.75	11.43

Next, the results of UPRICE in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015, are shown in Table 25. The average of yearly predicted future data for ten years from 2017 to 2026 of UPRICE in four periods are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015. From the data between 2013 and 2015, the trend of UPRICE decreases from 291.59 in 2017 to 290.69 in 2026, and the percent of changing decreases by 0.31 percent. The average of total in UPRICE equals to 290.66 and mean absolute percent error equals to 20.28. From the data between 2011 and 2015, the UPRICE tends to reduce from 328.22 in 2017 to 319.44 in 2026, and the percent of changing decreases by 2.68 percent. The average of total is 319.67 and mean absolute percent error equals to 16.37. From the data between 2008 and 2015, the trend of UPRICE decreases from

333.34 in 2017 to 332.70 in 2026, and the percent of changing decreases by 0.19 percent. The average of total is 333.17, and mean absolute percent error equals to 21.77. From the data between 2006 and 2015, the UPRICE tends to decline from 345.38 in 2017 to 336.99 in 2026, and the percent of changing reduce by 2.43 percent. The average of total is 336.90 and mean absolute percent error equals to 19.99.

Table 25 The average of yearly predicted future data and mean absolute percent error of UPRICE with simple moving average

	UPRICE			
	2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	291.59	328.22	333.34	345.38
2018	288.56	316.34	343.52	339.70
2019	291.91	315.09	343.13	335.02
2020	290.32	318.63	331.93	343.25
2021	290.73	322.53	325.31	342.88
2022	290.75	319.06	325.77	334.00
2023	290.63	318.44	329.35	329.00
2024	290.72	319.11	333.34	329.75
2025	290.68	319.81	333.32	333.01
2026	290.69	319.44	332.70	336.99
Average of total	290.66	319.67	333.17	336.90
% of changing	-0.31	-2.68	-0.19	-2.43
MAPE	20.28	16.37	21.77	19.99

Next, the results of RAINFALL_TH in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015, are shown in Table 26.

Table 26 The average of yearly predicted future data and mean absolute percent error of RAINFALL_TH with simple moving average

	RAINFALL			
	2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	131.44	135.09	139.41	139.85
2018	133.75	134.71	141.02	139.94
2019	132.40	134.05	139.03	139.47
2020	132.58	135.94	137.16	140.75
2021	132.76	135.18	137.20	139.14
2022	132.57	134.90	137.15	137.69
2023	132.64	134.86	138.71	137.77
2024	132.61	135.03	138.60	137.79
2025	132.62	135.11	138.45	139.10
2026	132.62	134.98	138.25	139.06
Average of total	132.60	134.98	138.50	139.06
% of changing	0.90	-0.08	-0.83	-0.56
MAPE	281.34	208.72	193.82	189.78

The Table 26 shows the average of yearly predicted future data for ten years from 2017 to 2026 of RAINFALL_TH in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015. From the data between 2013 and 2015, the trend of RAINFALL_TH gradually increase from 131.44 in 2017 to 132.62 in 2026, and the percent of changing rises by 0.90 percent. The average of total in RAINFALL_TH equals to 132.60 and mean absolute percent error equals to 281.34. From the data between 2011 and 2015, the RAINFALL_TH tends to reduce from 135.09 in 2017 to 134.98 in 2026, and the percent of changing slightly decreases by 0.08 percent. The average of total is 134.98 and mean absolute percent error equals to 208.72. From the data between 2008 and 2015, the trend of RAINFALL_TH decreases from 139.41 in 2017 to 138.25 in 2026, and the percent of changing decreases by 0.83

percent. The average of total is 138.50, and mean absolute percent error equals to 193.82. From the data between 2006 and 2015, the RAINFALL_TH tends to decline from 139.85 in 2017 to 139.06 in 2026, and the percent of changing reduce by 0.56 percent. The average of total is 139.06 and mean absolute percent error equals to 189.78.

Next, the results of CPETRO in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015, are shown in Table 27.

Table 27 The average of yearly predicted future data and mean absolute percent error of CPETRO with simple moving average

	CPETRO			
	2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	71.21	87.66	87.76	86.34
2018	69.77	84.22	89.83	85.95
2019	72.43	79.91	89.70	87.23
2020	70.81	81.12	87.59	88.80
2021	71.38	84.12	85.50	88.59
2022	71.30	82.93	83.07	86.80
2023	71.21	82.22	84.26	85.07
2024	71.30	82.19	86.74	83.10
2025	71.25	82.75	86.79	84.06
2026	71.27	82.69	86.51	86.11
Average of total	71.19	82.98	86.77	86.20
% of changing	0.08	-5.67	-1.42	-0.27
MAPE	34.58	32.63	32.26	30.60

From the Table 27 shows the average of yearly predicted future data for ten years from 2017 to 2026 of CPETRO in four periods that are from (1) 2013 to 2015, (2) 2011 to 2015, (3) 2008 to 2015, and (4) 2006 to 2015. From the data between 2013

and 2015, the trend of CPETRO gradually increase from 71.21 in 2017 to 71.27 in 2026, and the percent of changing rises by 0.08 percent. The average of total in CPETRO equals to 71.19 and mean absolute percent error equals to 34.58. From the data between 2011 and 2015, the CPETRO tends to reduce from 87.66 in 2017 to 82.69 in 2026, and the percent of changing decreases by 5.67 percent. The average of total is 82.98 and mean absolute percent error equals to 32.63. From the data between 2008 and 2015, the trend of CPETRO decreases from 87.76 in 2017 to 86.51 in 2026, and the percent of changing decreases by 1.42 percent. The average of total is as 86.77, and mean absolute percent error is equal 32.26. From the data between 2006 and 2015, the CPETRO tends to decline from 86.34 in 2017 to 86.11 in 2026, and the percent of changing reduce by 0.27 percent. The average of total is 86.20 and mean absolute percent error equals to 30.60.

4.2.3 Results of comparison between Box and Jenkins approach and simple moving average technique

After that the study compares the results of Box and Jenkins technique and simple moving average approach by mean absolute percent error (MAPE). The technique which gets the lowest in the average MAPE of all explanatory variables is used in the next part. The results of average MAPE from the all explanatory variables are shown in Table 28.

Table 28 The comparison of average MAPE from the all explanatory variables between Box and Jenkins approach and simple moving average technique

	MAPE of Box and Jenkins approach		MAPE of simple moving average technique			
	2004-2015	2011-2015	2013-2015	2011-2015	2008-2015	2006-2015
Qs	18.76	3.71	11.91	6.99	91.44	14.22
SRPRICE	22.08	5.72	21.46	23.16	23.81	22.36
YGDP	68.90	47.66	70.07	37.12	121.45	98.52
CNY	8.09	1.46	5.17	4.93	5.01	4.87
STOCK	61.80	16.64	23.06	27.01	31.07	26.14
MAREA_TH	4.69	0.15	8.83	12.56	12.75	11.43
UPRICE	27.74	14.22	20.28	16.37	21.77	19.99
RAINFALL_TH	58.77	39.71	281.34	208.72	193.82	189.78
CPETRO	28.04	11.87	34.58	32.63	32.26	30.60
Average of MAPE	33.21	15.68	52.97	41.05	59.26	46.43

The averages of mean absolute percent error (MAPE) from all explanatory variables with Box and Jenkins approach by using monthly data from 2004 to 2015 and from 2011 to 2015 are 33.21 and 15.68 respectively. While the average of mean absolute percent error (MAPE) from all explanatory variables with simple moving average technique by using monthly data in 2013-2015, 2011-2015, 2008-2015 and 2006-2015 are 52.97, 41.05, 59.26 and 46.43, respectively. Therefore the rank of lowest of average MAPE of all explanatory variables, the lowest is Box and Jenkins approach by using monthly data from 2011 to 2015. The second lowest is Box and Jenkins approach by using monthly data from 2004 to 2015. The third one is simple moving average technique by using monthly data from 2011 to 2015. The fourth one is simple moving average technique by using monthly data from 2006 to 2015. The fifth one is simple moving average technique by using monthly data from 2013 to 2015. And the last one is simple moving average technique by using monthly data from 2008 to 2015.

As a consequence, this study finds the equilibrium of quantity and price of the world natural rubber from 2017 to 2026 by using the expected of all explanatory variables from monthly data in 2011-2015 with Box and Jenkins approach. The results of expected of equilibrium natural rubber price in natural rubber at the world market is in an unacceptable range. Since the value of equilibrium natural rubber price in 2016 is a wide gap between the actual data in June at 157.40 thousand yens and the predicted data in July at 37.4325 thousand yens, or 76.22 percent difference. Moreover, the value of expected equilibrium natural rubber price tends to decrease and converge into zero in 2023 in the thousand yens unit. The results are shown in Appendix N.

After that this study tries to find the equilibrium of natural rubber quantity and price by using the expected of all explanatory variables from monthly data in 2004-2015 with Box and Jenkins approach. The results are similar with the monthly data in 2011-2015 with Box and Jenkins approach. The results of expected of equilibrium natural rubber price is in an unacceptable range. Since the value of equilibrium natural rubber price in 2016 is a wide gap between the actual data in June at 157.40 thousand yens and the predicted data in July at 14.5929 thousand yens, or 90.73 percent difference. In addition, the value of expected equilibrium natural rubber price tends to

decrease and converge into zero in 2022 in the thousand yens unit. The results are shown in Appendix M.

Therefore this study finds the equilibrium of natural rubber quantity and price of the world market by using the monthly data from 2011 to 2015 with simple moving technique. And the results are shown in the next part.

4.3 Results of world natural rubber consumption quantity predicting

The number of natural rubber consumption from January 2015 to June 2016 are estimated by using the actual predicted and percentage change in predicted explanatory variables. The results are shown in the Table 29.

From Table 29, the average of residuals in predicted Q from January 2015 to June 2016 were separated into three periods; (1) in 2015, (2) the first half of the year in 2016, and (3) from January 2015 to June 2016. All of residuals average were underestimated trend together similarly. The predicted data used actual data terms in explanatory variables terms. In demand model, the average of residuals were -91.93, -81.71 and -88.52, respectively. In supply model, they were -48.01, -95.80 and -63.94, respectively. In case of using percentage change, the average of residuals were -99.04, -89.26 and -95.78, respectively in demand model, and were -46.81, -95.40 and -63.01, respectively in supply model.

Table 29 The predicted data of quantity of natural rubber consumption (Q) and residuals from January 2015 to June 2016 by using predicted independent variables from simple moving average technique

		Quantity of Consumption	Actual Predicted Data				Percentage Change			
			Demand Model		Supply Model		Demand Model		Supply Model	
			Q Forecast	Residual	Q Forecast	Residual	Q Forecast	Residual	Q Forecast	Residual
2015	Jan	1019	963.49	-55.51	945.84	-73.16	970.23	-48.77	968.41	-50.59
	Feb	858	914.98	56.98	942.21	84.21	953.28	95.28	945.45	87.45
	Mar	1064	897.81	-166.19	956.87	-107.13	919.62	-144.38	943.76	-120.24
	Apr	1048	871.71	-176.29	978.71	-69.29	879.74	-168.26	959.15	-88.85
	May	1068	902.28	-165.72	995.46	-72.54	857.81	-210.19	980.42	-87.58
	Jun	1083	917.19	-165.81	1001.70	-81.30	888.16	-194.84	996.09	-86.91
	Jul	1079	931.79	-147.21	1003.43	-75.57	903.23	-175.77	1001.87	-77.13
	Aug	1072	964.56	-107.44	1003.44	-68.56	921.19	-150.81	1003.43	-68.57
	Sep	1057	982.67	-74.33	1008.15	-48.85	956.23	-100.77	1003.91	-53.09
	Oct	1023	981.96	-41.04	996.60	-26.40	975.57	-47.43	1007.01	-15.99
	Nov	1006	962.65	-43.35	983.40	-22.60	976.06	-29.94	995.28	-10.72
	Dec	970	952.74	-17.26	955.02	-14.98	957.35	-12.65	980.51	10.51
			Average	-91.93	Average	-48.01	Average	-99.04	Average	-46.81
2016	Jan	1016	960.65	-55.35	953.76	-62.24	951.78	-64.22	954.89	-61.11
	Feb	896	962.67	66.67	950.03	54.03	955.40	59.40	953.37	57.37
	Mar	1130	964.64	-165.36	948.63	-181.37	970.33	-159.67	949.88	-180.12
	Apr	1076	964.89	-111.11	948.88	-127.12	950.03	-125.97	948.65	-127.35
	May	1085	966.36	-118.64	944.58	-140.42	954.71	-130.29	948.42	-136.58
	Jun	1070	963.52	-106.48	952.32	-117.68	955.17	-114.83	945.40	-124.60
			Average	-81.71	Average	-95.80	Average	-89.26	Average	-95.40
Total			Average	-88.52	Average	-63.94	Average	-95.78	Average	-63.01

From the prediction of explanatory variables in the future, this study used them to forecast the Q in monthly data from January 2017 to December 2026 by using actual predicted data and percentage change in explanatory variables. The results are shown in Appendix O. After that this study calculated the average of yearly quantity of natural rubber consumption (Q), and the results are shown in the Table 30.

Table 30 The average of yearly quantity natural rubber consumption (Q) from 2017 to 2026 by using predicted actual data and percentage change in explanatory variables

	Actual Predicted Data		Percentage Change	
	Demand model	Supply model	Demand model	Supply model
2017	948.26	968.89	948.33	968.29
2018	949.50	977.77	949.39	977.06
2019	949.00	981.83	949.06	981.97
2020	950.74	978.04	950.58	978.43
2021	949.91	975.21	950.00	975.09
2022	949.65	977.21	949.63	977.08
2023	949.84	978.21	949.84	978.19
2024	949.94	977.68	949.93	977.74
2025	950.02	977.08	950.03	977.10
2026	949.85	977.29	949.86	977.26
Average of total	949.67	976.92	949.66	976.82

From the results of actual predicted data in the Table 12, the average of predicted natural rubber quantity in demand model tends to increase from 948.26 thousand tons in 2017 to 949.85 thousand tons in 2026, and the average of ten years is 949.67 thousand tons. For the supply model, the average of predicted natural rubber quantity tends to gradually increase from 968.89 thousand tons in 2017 to 977.29 thousand tons in 2026, and the average of ten years is 976.92 thousand tons. In the case of percentage change, the average of predicted natural rubber quantity in demand model tends to increase from 948.33 thousand tons in 2017 to 949.86 thousand tons in 2026, and the average of ten years is 949.66 thousand tons. For supply model, the results increase from 968.29 thousand tons in 2017 to 977.26 thousand tons in 2026, and the average of ten years is 976.82 thousand tons.

The result of comparison of the number of demand and the number of supply shows that the trend of supply quantity is more than that of the demand quantity in

2017-2026 both in actual predicted data and percentage change techniques. In case of actual predicted data, the average of gap between supply and demand quantities is 27.25 thousand tons per year, and the accumulated number of difference is 272.5 thousand tons in the next ten years. The number shows that the number of natural rubber stock will continuously increase every year from 2017 to 2026. Similarly with the case of percentage change, the average of gap between supply and demand quantities is 27.12 thousand tons per year, and the accumulated number of difference is 271.2 thousand tons in 2026. The number shows that natural rubber stock will steadily increase in the next ten years.

4.4 Results of world natural rubber price forecasting

And then, the natural rubber price of the world market from January 2015 to June 2016 are estimated by using the actual predicted and percentage change in predicted explanatory variables. The results are shown in the Table 31.

From Table 31, the average of residuals in predicted NRPRICE from January 2015 to June 2016 were separated into three periods; (1) in 2015, (2) the first half of the year in 2016, and (3) from January 2015 to June 2016. All of residuals average were overestimated trend together similarly. The predicted data used actual data terms in explanatory variables terms. In demand model, the average of residuals were 576.39, 11.57 and 388.12, respectively. In supply model, they were 574.72, 62.09 and 403.84, respectively. In case of using percentage change, the average of residuals were 231.47, 0.25 and 154.40, respectively in demand model, and were 481.22, 67.76 and 343.40, respectively in supply model.

Table 31 The predicted data of world natural rubber price (NRPRICE) and residuals from January 2015 to June 2016 by using predicted independent variables from simple moving average technique

		Natural Rubber Price	Actual Predicted Data				Percentage Change			
			Demand Model		Supply Model		Demand Model		Supply Model	
			NRPRICE Forecast	Residual	NRPRICE Forecast	Residual	NRPRICE Forecast	Residual	NRPRICE Forecast	Residual
2015	Jan	190.10	6.64	-183.46	1005.41	815.31	1360.48	1170.38	907.77	717.67
	Feb	213.60	9040.14	8826.54	23.75	-189.85	89.40	-124.20	770.56	556.96
	Mar	215.80	0.01	-215.79	1848.17	1632.37	57.55	-158.25	179.19	-36.61
	Apr	204.80	0.00	-204.80	808.60	603.80	171.05	-33.75	819.42	614.62
	May	214.70	0.01	-214.69	896.05	681.35	13.77	-200.93	912.48	697.78
	Jun	219.60	0.01	-219.59	1043.30	823.70	230.99	11.39	1034.04	814.44
	Jul	198.10	0.03	-198.07	946.71	748.61	1233.00	1034.90	943.99	745.89
	Aug	176.70	0.37	-176.33	920.88	744.18	623.83	447.13	887.59	710.89
	Sep	158.80	2.67	-156.13	614.29	455.49	553.66	394.86	573.72	414.92
	Oct	155.00	17.40	-137.60	365.05	210.05	4.34	-150.66	362.25	207.25
	Nov	138.70	15.13	-123.57	354.81	216.11	407.63	268.93	342.13	203.43
	Dec	154.30	74.50	-79.80	309.83	155.53	272.11	117.81	281.75	127.45
			Average	576.39	Average	574.72	Average	231.47	Average	481.22
2016	Jan	143.40	221.72	78.32	222.85	79.45	213.36	69.96	223.75	80.35
	Feb	145.20	203.18	57.98	224.86	79.66	182.98	37.78	226.34	81.14
	Mar	162.70	162.13	-0.57	228.20	65.50	162.28	-0.42	224.88	62.18
	Apr	184.00	162.37	-21.63	220.63	36.63	153.64	-30.36	222.21	38.21
	May	167.20	148.19	-19.01	224.11	56.91	137.07	-30.13	218.61	51.41
	Jun	157.40	131.71	-25.69	211.78	54.38	112.08	-45.32	250.66	93.26
			Average	11.57	Average	62.09	Average	0.25	Average	67.76
Total			Average	388.12	Average	403.84	Average	154.40	Average	343.40

From the prediction of explanatory variables in the future, this study used them to forecast the NRPRICE in monthly data from January 2017 to December 2026 by using actual predicted data and percentage change in explanatory variables. The results are shown in Appendix P. After that this study calculated the average of yearly world natural rubber price (NRPRICE), and the results are shown in the Table 32.

Table 32 The average of yearly world natural rubber price (NRPRICE) from 2017 to 2026 by using predicted actual data and percentage change in explanatory variables

	Actual Predicted Data		Percentage Change	
	Demand model	Supply model	Demand model	Supply model
2017	49.60	293.81	46.97	292.48
2018	27.82	304.00	25.55	304.48
2019	20.67	307.20	20.13	306.01
2020	31.19	304.23	35.41	305.58
2021	35.67	297.32	34.26	296.71
2022	29.58	302.30	28.93	302.18
2023	28.16	302.55	28.13	302.57
2024	29.33	302.49	29.73	302.52
2025	31.00	300.81	31.10	300.86
2026	30.04	301.63	29.82	301.57
Average of total	31.31	301.63	31.00	301.50

From the results of actual predicted data in the Table 32, the average of predicted world natural rubber price in demand model highly fluctuates and tends to decrease from 49.60 thousand yens in 2017 to 30.04 thousand yens in 2026, and the average of ten years is 31.31 thousand yens. For the supply model, the average of predicted world natural rubber price fluctuates and tends to gradually increase from 293.81 thousand yens in 2017 to 301.63 thousand yens in 2026, and the average of ten years is 301.63 thousand yens. In the case of percentage change, the average of predicted natural rubber quantity in demand model highly fluctuates and tends to reduce from 46.97 thousand yens in 2017 to 29.82 thousand yens in 2026, and the average of ten years is 31.00 thousand yens. For supply model, the results gradually increase from 292.48 thousand yens in 2017 to 301.57 thousand yens in 2026, and the average of ten years is 301.50 thousand yens.

4.5 Results of estimated equilibrium quantity and price of world natural rubber

At the last, this study estimates the equilibrium of quantity and price in world natural rubber market between January 2017 and December 2026 in monthly data by using demand and supply model in simultaneous equation and predicted explanatory variables from simple moving average technique. The results are shown in Appendix Q. After that this study calculated the average of yearly equilibrium of quantity and price in world natural rubber market from 2017 to 2026, and the results are shown in Table 33.

Table 33 The average of yearly equilibrium of quantity and price in world natural rubber market from 2017 to 2026

	Equilibrium Quantity		Equilibrium Price	
	Actual Predicted Data (thousand tons)	Percentage Change (thousand tons)	Actual Predicted Data (thousand yens)	Percentage Change (thousand yens)
2017	953.75	953.65	169.78	170.49
2018	957.01	956.74	150.13	150.54
2019	957.71	957.79	153.97	153.51
2020	957.99	957.98	170.35	170.19
2021	956.64	956.67	164.52	164.74
2022	956.97	956.93	160.47	160.53
2023	957.38	957.37	160.40	160.34
2024	957.31	957.32	162.85	162.79
2025	957.21	957.23	163.04	163.09
2026	957.15	957.14	162.05	162.08
Average	956.91	956.88	161.76	161.83

The results from actual predicted explanatory variables show that the average of equilibrium of natural rubber quantity tends to gradually increase for ten years that are from 953.75 thousand tons in 2017 to 957.15 thousand tons in 2026, and the average of ten years is 956.91 thousand tons. While the results from percentage change show that the average of equilibrium of natural rubber quantity tends to increase from 953.65 thousand tons in 2017 to 957.14 in 2026, and the average of ten years is 956.88 thousand tons.

The equilibrium of world natural rubber price tends to decrease for ten years from 169.78 thousand yens in 2017 to 162.05 thousand yens in 2026 for actual predicted

data, and reduce from 170.49 thousand yens in 2017 to 162.08 thousand yens in 2026 for percentage change. The average of total for ten years are 161.76 thousand yens and 161.83 thousand yens, respectively.

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APPENDIX

Appendix A

The monthly data of Q, Qs, NRPRICE, SPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH, OPPRICE, and CPETRO from 2004 to 2015

Appendix A. The monthly data of Q, Qs, NRPRICE, SPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH, OPPRICE, and CPETRO from 2004 to 2015

		Q	Qs	NRPRICE	SPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	OPPRICE	CPETRO
2004	Jan	675.00	829.00	143.40	1267.20	3.16	4.72	2395	1691.0	153.88	23.8	467.69	31.40
	Feb	655.00	721.00	147.00	1321.02	3.33	4.72	2373	1693.2	128.25	38.0	501.61	31.32
	Mar	723.00	693.00	157.70	1300.55	3.51	4.76	2247	1695.3	129.13	20.5	520.57	33.67
	Apr	684.00	605.00	156.90	1311.17	3.53	4.76	2119	1697.5	130.80	65.9	516.34	33.71
	May	665.00	638.00	153.60	1257.45	3.56	4.89	2144	1699.7	135.67	207.8	481.14	37.63
	Jun	651.00	672.00	151.30	1284.27	3.58	4.92	2213	1701.8	161.88	231.0	408.98	35.54
	Jul	667.00	738.00	140.00	1351.35	3.39	4.94	2334	1704.0	199.50	238.7	386.63	37.93
	Aug	672.00	725.00	139.90	1359.30	3.19	5.01	2369	1706.1	204.75	206.4	393.71	42.08
	Sep	716.00	779.00	140.00	1338.76	3.00	5.00	2442	1708.3	226.80	242.5	401.64	41.65
	Oct	758.00	751.00	144.20	1364.37	2.84	4.98	2365	1710.5	243.13	100.4	381.61	46.87
	Nov	705.00	714.00	132.50	1480.27	2.69	4.87	2390	1712.6	205.63	49.8	386.67	42.23
	Dec	749.00	780.00	124.70	1436.46	2.53	4.73	2444	1714.8	184.00	16.9	370.09	39.09
2005	Jan	759.00	846.00	120.30	1553.00	2.50	4.68	1900	1717.0	189.50	12.6	346.63	42.89
	Feb	727.00	727.00	131.20	1601.00	2.46	4.64	1813	1719.1	184.88	3.5	347.57	44.56
	Mar	787.00	675.00	135.50	1687.00	2.43	4.66	1589	1721.3	219.90	39.8	374.83	50.93
	Apr	779.00	668.00	142.60	1643.00	2.52	4.77	1479	1723.4	246.25	73.4	375.84	50.64
	May	718.00	673.00	149.10	1659.00	2.61	4.81	1500	1725.6	257.25	156.0	370.16	47.81
	Jun	754.00	689.00	160.40	1612.00	2.70	4.94	1415	1727.8	221.30	194.5	369.64	53.89

Appendix A. The monthly data of Q, Qs, NRPRICE, SPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH, OPPRICE, and CPETRO from 2004 to 2015 (cont.)

		Q	Qs	NRPRICE	SPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	OPPRICE	CPETRO
2005	Jul	725.00	742.00	193.80	1626.00	2.75	5.06	1514	1729.9	216.00	217.8	369.60	56.37
	Aug	733.00	727.00	183.10	1573.00	2.80	5.06	1485	1732.1	209.25	194.4	360.30	61.87
	Sep	792.00	772.00	185.90	1544.00	2.85	5.05	1451	1734.3	209.90	305.9	369.98	61.65
	Oct	738.00	824.00	198.00	1657.00	2.89	5.04	1643	1736.4	225.50	152.3	382.82	58.19
	Nov	748.00	655.00	185.70	1559.00	2.94	5.06	1371	1738.6	232.75	132.0	375.97	54.98
	Dec	734.00	778.00	198.60	1565.00	2.98	5.05	1553	1740.7	215.75	109.4	368.90	56.47
2006	Jan	748.00	852.00	215.20	1617.79	3.09	4.90	1826	1742.9	197.75	14.5	377.92	62.36
	Feb	704.00	804.00	248.60	1698.19	3.20	4.88	1922	1744.9	215.75	40.1	390.63	59.71
	Mar	812.00	779.00	237.90	1629.24	3.31	4.84	1756	1746.9	244.10	72.1	383.36	60.93
	Apr	754.00	648.00	248.90	1640.32	3.22	4.72	1577	1748.9	248.38	117.3	386.41	68.00
	May	777.00	766.00	267.50	1609.00	3.13	4.74	1661	1750.9	227.75	217.8	394.52	68.61
	Jun	754.00	800.00	310.20	1697.00	3.04	4.78	1764	1752.9	208.20	189.9	386.18	68.29
	Jul	779.00	915.00	302.80	1675.00	2.89	4.75	1990	1754.9	202.25	251.9	404.02	72.51
	Aug	816.00	833.00	261.20	1670.00	2.73	4.72	1888	1756.9	213.70	249.6	434.48	71.81
	Sep	795.00	817.00	212.00	1764.00	2.58	4.71	1915	1758.9	215.25	254.3	416.94	61.97
	Oct	784.00	829.00	218.50	1748.00	2.68	4.72	1983	1760.9	211.75	209.3	422.32	57.95
	Nov	775.00	788.00	194.40	1798.00	2.77	4.64	1964	1762.9	235.60	46.8	476.74	58.13
	Dec	708.00	979.00	196.40	1968.00	2.87	4.58	2359	1764.9	254.67	28.9	528.24	61.00

Appendix A. The monthly data of Q, Qs, NRPRICE, SPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH, OPPRICE, and CPETRO from 2004 to 2015 (cont.)

		Q	Qs	NRPRICE	SPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	OPPRICE	CPETRO
2007	Jan	827.00	977.00	249.50	1830.00	2.73	4.61	2484	1766.9	269.80	22.8	550.78	53.40
	Feb	729.00	793.00	272.70	1901.00	2.60	4.60	2548	1771.3	304.25	11.1	553.75	57.58
	Mar	839.00	683.00	254.40	2177.00	2.46	4.53	2392	1775.7	318.00	40.3	566.39	60.60
	Apr	823.00	617.00	276.60	1904.00	2.50	4.51	2186	1780.1	288.50	114.6	645.41	65.10
	May	794.00	668.00	280.30	1837.00	2.54	4.51	2060	1784.4	296.25	280.8	740.63	65.10
	Jun	830.00	787.00	273.90	1878.00	2.58	4.53	2017	1788.8	289.00	181.2	748.43	68.19
	Jul	849.00	764.00	252.80	1941.00	2.66	4.45	1932	1793.2	267.88	198.8	764.47	73.67
	Aug	841.00	924.00	245.80	2860.00	2.73	4.51	2015	1797.6	269.00	212.7	729.56	70.13
	Sep	846.00	837.00	249.10	1967.00	2.81	4.55	2006	1802.0	314.00	261.9	745.18	76.91
	Oct	872.00	889.00	261.70	1960.00	2.67	4.55	2023	1806.4	333.70	224.7	824.07	82.15
	Nov	844.00	893.00	272.60	1982.00	2.52	4.56	2072	1810.7	377.13	65.8	877.34	91.27
	Dec	788.00	893.00	267.20	1903.00	2.38	4.57	2177	1815.1	385.25	27.0	883.45	89.43
2008	Jan	865.00	903.00	278.60	1887.00	2.21	4.58	1470	1819.5	369.70	27.1	987.02	90.82
	Feb	843.00	798.00	292.10	1915.00	2.03	4.55	1425	1822.5	325.25	38.1	1109.50	93.75
	Mar	875.00	728.00	279.20	2251.00	1.86	4.44	1278	1825.6	377.75	48.0	1146.86	101.84
	Apr	892.00	699.00	278.70	2367.00	1.60	4.51	1085	1828.6	471.25	135.3	1083.48	109.05
	May	857.00	746.00	312.40	2331.00	1.35	4.60	974	1831.7	627.50	215.6	1086.83	122.77
	Jun	822.00	774.00	336.60	2425.00	1.09	4.81	926	1834.7	628.38	203.6	1096.39	131.52

Appendix A. The monthly data of Q, Qs, NRPRICE, SPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH, OPPRICE, and CPETRO from 2004 to 2015 (cont.)

		Q	Qs	NRPRICE	SPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	OPPRICE	CPETRO
2008	Jul	893.00	944.00	337.80	3064.00	0.70	4.90	977	1837.8	760.00	204.1	1026.25	132.55
	Aug	870.00	917.00	329.30	2762.00	0.31	4.94	1024	1840.8	770.00	193.9	791.77	114.57
	Sep	887.00	981.00	336.70	2811.00	-0.08	5.01	1118	1843.8	706.25	296.1	667.04	99.29
	Oct	868.00	930.00	203.90	2904.00	-0.97	5.03	1180	1846.9	405.50	198.8	486.40	72.69
	Nov	770.00	787.00	160.50	2771.00	-1.86	5.13	1197	1849.9	245.75	143.8	433.10	54.04
	Dec	712.00	824.00	103.80	2647.00	-2.75	5.11	1309	1853.0	225.38	46.9	440.38	41.53
2009	Jan	620.00	810.00	145.10	2512.00	-3.47	5.10	1715	1856.0	263.38	20.6	522.15	43.91
	Feb	632.00	654.00	139.20	2170.00	-4.18	5.16	1737	1862.1	273.25	7.7	529.40	41.76
	Mar	786.00	521.00	141.70	1822.00	-4.90	5.23	1472	1868.2	265.38	89.9	557.21	46.95
	Apr	731.00	604.00	165.80	1630.00	-4.83	5.19	1345	1874.3	245.20	132.0	693.21	50.28
	May	729.00	715.00	166.90	1604.00	-4.77	5.06	1331	1880.4	240.75	227.5	772.39	58.10
	Jun	792.00	911.00	163.80	1559.00	-4.70	4.99	1450	1886.5	237.38	163.9	690.82	69.13
	Jul	868.00	917.00	168.90	1670.00	-4.39	4.98	1499	1892.7	243.70	227.7	601.95	64.65
	Aug	823.00	836.00	200.10	1803.00	-4.09	4.98	1512	1898.8	247.13	213.2	686.79	71.63
	Sep	788.00	817.00	203.90	2042.00	-3.78	4.95	1541	1904.9	233.89	263.2	636.42	68.38
	Oct	825.00	930.00	218.20	2111.00	-2.76	4.89	1646	1911.0	239.00	158.2	636.56	74.08
	Nov	874.00	971.00	237.80	2163.00	-1.75	4.88	1743	1917.1	244.75	84.6	674.33	77.56
	Dec	857.00	1016.00	262.80	2142.00	-0.73	4.87	1902	1923.2	261.10	21.3	727.60	74.88

Appendix A. The monthly data of Q, Qs, NRPRICE, SPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH, OPPRICE, and CPETRO from 2004 to 2015 (cont.)

		Q	Qs	NRPRICE	SPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	OPPRICE	CPETRO
2010	Jan	799.00	913.00	290.80	2268.00	0.24	4.83	1994	1929.3	275.75	44.9	742.00	77.12
	Feb	734.00	783.00	286.70	2314.00	1.20	4.85	2043	1938.7	288.63	12.6	754.32	74.72
	Mar	963.00	665.00	293.30	2382.00	2.17	4.75	1745	1948.2	278.75	28.0	793.90	79.30
	Apr	913.00	652.00	320.60	2499.00	2.48	4.72	1484	1957.6	252.70	58.3	798.53	84.14
	May	856.00	741.00	269.80	2500.00	2.79	4.73	1369	1967.1	229.63	119.0	775.57	75.54
	Jun	908.00	878.00	273.60	2519.00	3.10	4.75	1339	1976.5	229.30	190.1	764.91	74.73
	Jul	926.00	913.00	266.50	2613.00	3.20	4.75	1326	1986.0	249.50	213.8	774.50	74.52
	Aug	915.00	966.00	285.90	2601.00	3.29	4.66	1377	1995.4	273.00	315.4	865.23	75.88
	Sep	965.00	1025.00	301.10	2638.00	3.39	4.55	1437	2004.8	315.00	218.1	884.89	76.11
	Oct	888.00	897.00	330.80	2607.00	3.24	4.49	1446	2014.3	329.38	254.8	935.22	81.72
	Nov	944.00	966.00	358.00	2540.00	3.08	4.50	1468	2023.7	366.38	111.5	1059.01	84.53
	Dec	967.00	1000.00	394.40	2573.00	2.93	4.53	1501	2033.2	375.10	83.9	1171.22	90.07
2011	Jan	864.00	1031.00	455.40	2667.00	2.70	4.64	1540	2042.6	374.13	34.9	1238.57	92.66
	Feb	728.00	833.00	499.10	2800.00	2.47	4.67	1645	2056.5	358.13	19.3	1248.55	97.73
	Mar	974.00	738.00	424.30	2900.00	2.24	4.63	1409	2070.4	327.80	191.0	1142.23	108.65
	Apr	895.00	685.00	430.90	3083.00	1.99	4.61	1199	2084.2	340.38	103.6	1123.79	116.32
	May	920.00	823.00	378.30	3354.00	1.75	4.67	1102	2098.1	397.38	206.1	1143.44	108.18
	Jun	931.00	996.00	376.10	3575.00	1.50	4.72	1167	2112.0	485.90	199.7	1075.91	105.85

Appendix A. The monthly data of Q, Qs, NRPRICE, SPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH, OPPRICE, and CPETRO from 2004 to 2015 (cont.)

		Q	Qs	NRPRICE	SPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	OPPRICE	CPETRO
2011	Jul	931.00	1004.00	380.10	3769.00	1.47	4.67	1240	2125.9	474.75	259.0	1033.57	107.88
	Aug	1032.00	1045.00	368.30	3842.00	1.43	4.67	1253	2139.7	477.50	287.3	1047.51	100.45
	Sep	945.00	962.00	348.60	3933.00	1.40	4.77	1270	2153.6	503.80	319.7	995.18	100.83
	Oct	928.00	988.00	305.80	3772.00	1.35	4.86	1330	2167.5	487.13	201.9	914.44	99.92
	Nov	952.00	956.00	273.40	3663.00	1.29	4.88	1334	2181.4	470.90	67.9	985.77	105.36
	Dec	881.00	970.00	276.40	3299.00	1.24	4.93	1423	2195.2	353.75	57.5	969.07	104.26
2012	Jan	849.19	993.48	275.87	3290.00	1.39	5.01	1769	2209.1	368.38	86.1	1020.54	106.89
	Feb	883.05	877.79	308.80	3200.00	1.54	4.89	1764	2222.1	382.90	25.0	1047.69	112.70
	Mar	961.96	800.53	316.03	3399.00	1.69	4.87	1602	2235.0	410.63	58.5	1105.74	117.79
	Apr	880.89	800.88	299.13	3571.00	1.61	4.91	1522	2248.0	493.38	102.7	1157.45	113.75
	May	954.41	937.70	273.69	3623.00	1.53	4.96	1506	2260.9	496.70	231.6	1031.12	104.16
	Jun	897.20	995.82	247.00	3552.00	1.45	4.98	1604	2273.9	420.00	159.9	927.63	90.73
	Jul	929.49	1049.28	233.34	3344.00	1.29	4.97	1724	2286.8	384.50	207.7	952.54	96.75
	Aug	909.42	1033.83	211.30	3055.00	1.14	4.95	1848	2299.8	374.90	214.1	930.61	105.28
	Sep	923.47	1074.29	235.62	3138.00	0.98	4.91	1999	2312.7	384.50	302.0	879.53	106.32
	Oct	950.87	1039.45	253.51	2992.00	0.82	4.91	2088	2325.7	396.00	112.3	768.09	103.39
	Nov	957.61	1063.08	240.67	2859.00	0.65	4.93	2193	2338.6	374.20	118.0	743.13	101.17
	Dec	929.14	936.58	264.04	3088.00	0.49	4.92	2201	2351.6	378.75	63.8	713.94	101.17

Appendix A. The monthly data of Q, Qs, NRPRICE, SPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH, OPPRICE, and CPETRO from 2004 to 2015 (cont.)

		Q	Qs	NRPRICE	SPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	OPPRICE	CPETRO
2013	Jan	912.26	1046.12	293.69	3290.00	0.44	4.84	2335	2364.6	393.40	38.9	776.54	105.04
	Feb	807.29	780.31	297.78	3200.00	0.40	4.79	2308	2377.5	411.50	27.4	792.38	107.66
	Mar	944.43	860.44	267.61	3399.00	0.35	4.76	2224	2390.5	385.00	29.1	771.87	102.61
	Apr	953.18	810.12	249.04	3571.00	0.48	4.71	2080	2403.4	361.50	87.9	756.46	98.85
	May	953.90	874.89	263.96	3623.00	0.61	4.86	2001	2416.4	344.40	148.6	763.38	99.35
	Jun	962.29	986.33	235.06	3552.00	0.74	5.03	2025	2429.3	321.38	214.8	763.04	99.74
	Jul	952.32	1056.09	240.35	3344.00	0.91	5.08	2129	2442.3	321.50	283.9	729.86	105.21
	Aug	940.44	1080.76	255.77	3055.00	1.07	5.17	2270	2455.2	303.25	223.6	722.84	108.06
	Sep	997.49	1077.53	264.24	3138.00	1.24	5.19	2350	2468.2	297.75	313.0	725.80	108.78
	Oct	991.79	1120.30	249.33	2992.00	1.47	5.12	2478	2481.1	299.30	216.3	762.62	105.46
	Nov	977.71	1178.86	249.20	2859.00	1.69	5.20	2679	2494.1	312.38	131.8	810.30	102.58
	Dec	928.62	1163.90	276.97	3088.00	1.92	5.33	2915	2507.0	330.13	49.1	795.27	105.49
2014	Jan	944.00	1135.00	255.90	2507.00	1.88	5.45	3286	2520.0	352.60	8.4	769.34	102.25
	Feb	848.00	985.00	219.60	2499.00	1.85	5.38	3424	2525.4	344.13	3.6	811.20	104.82
	Mar	1025.00	826.00	241.50	2697.00	1.81	5.26	3225	2530.9	315.75	24.7	860.52	104.04
	Apr	1025.00	788.00	221.70	2665.00	1.79	5.20	2989	2536.3	291.13	84.1	825.32	104.94
	May	1007.00	872.00	196.00	2801.00	1.77	5.22	2854	2541.7	299.10	133.4	800.29	105.73
	Jun	986.00	950.00	193.00	2738.00	1.75	5.22	2818	2547.2	297.88	192.2	758.47	108.37

Appendix A. The monthly data of Q, Qs, NRPRICE, SPRICE, YGDP, CNY, STOCK, MAREA_TH, UPRICE, RAINFALL_TH, OPPRICE, and CPETRO from 2004 to 2015 (cont.)

		Q	Qs	NRPRICE	SPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	OPPRICE	CPETRO
2014	Jul	1017.00	1043.00	193.60	2664.00	1.75	5.18	2844	2552.6	301.70	229.0	752.89	105.22
	Aug	1019.00	1002.00	188.20	2744.00	1.76	5.21	2826	2558.0	321.88	251.7	677.86	100.05
	Sep	999.00	1004.00	176.90	2551.00	1.76	5.25	2832	2563.5	325.63	229.4	656.98	95.89
	Oct	1021.00	1026.00	178.20	2587.00	1.73	5.30	2838	2568.9	321.13	180.9	673.09	86.13
	Nov	993.00	1132.00	189.20	2572.00	1.70	5.36	2976	2574.3	311.25	108.0	662.40	76.96
	Dec	971.00	1044.00	185.80	2533.00	1.67	5.32	3049	2579.8	312.38	75.0	624.54	60.55
2015	Jan	1019.00	1166.00	190.10	2514.00	1.75	5.27	3388	2585.2	319.20	23.9	641.60	47.45
	Feb	858.00	884.00	213.60	2387.00	1.83	5.21	3413	2590.7	297.00	16.4	634.38	54.93
	Mar	1064.00	792.00	215.80	2288.00	1.91	5.23	3141	2596.1	271.00	39.5	607.65	52.83
	Apr	1048.00	749.00	204.80	2078.00	1.95	5.25	2842	2601.5	259.00	76.4	591.79	57.42
	May	1068.00	914.00	214.70	1999.00	1.99	5.41	2688	2607.0	253.00	104.7	601.40	62.50
	Jun	1083.00	974.00	219.60	2047.00	2.03	5.44	2579	2612.4	292.00	144.6	606.40	61.30
	Jul	1079.00	1064.00	198.10	1985.00	1.97	5.53	2563	2617.8	273.00	213.2	575.68	54.43
	Aug	1072.00	1137.00	176.70	2136.00	1.92	5.59	2629	2623.3	273.00	237.4	484.68	45.72
	Sep	1057.00	1147.00	158.80	2203.00	1.86	5.65	2718	2628.7	259.00	262.0	483.49	46.29
	Oct	1023.00	1148.00	155.00	2208.00	1.78	5.63	2843	2634.1	255.00	158.6	530.25	46.96
	Nov	1006.00	1179.00	138.70	2031.00	1.70	5.61	3015	2639.6	257.00	97.3	503.16	43.13
	Dec	970.00	1114.00	154.30	2045.00	1.62	5.57	3159	2645.0	239.83	45.6	520.60	36.56

Appendix B

The values of explanatory variables in monthly data
from January 2017 to December 2026 with Box and Jenkins approach
by using the monthly data for the period of 2004 to 2015

Appendix B. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2004 to 2015

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2017	Jan	1853.24	1095.57	1.1306	6.53	545.62	3314.47	101.64	1.31	18.50
	Feb	1616.06	1060.82	1.1307	6.50	544.92	3336.62	98.02	0.89	18.91
	Mar	1452.98	1042.14	1.1307	6.49	522.36	3358.92	95.14	2.21	19.06
	Apr	1368.82	980.31	1.1307	6.48	503.91	3381.37	91.36	4.70	19.19
	May	1600.05	944.46	1.1307	6.58	524.76	3403.97	91.32	9.05	18.73
	Jun	1666.28	942.14	1.1308	6.69	561.82	3426.72	92.74	9.69	18.71
	Jul	1814.53	931.46	1.1308	6.81	617.04	3449.62	90.92	11.58	17.96
	Aug	1864.56	956.80	1.1309	6.84	654.03	3472.68	90.09	11.35	16.99
	Sep	1861.17	939.61	1.1310	6.88	705.46	3495.89	88.60	12.98	16.05
	Oct	1902.25	929.95	1.1311	6.89	715.94	3519.26	85.00	7.57	15.51
	Nov	1839.16	886.10	1.1311	6.91	758.94	3542.78	80.38	3.85	14.16
	Dec	1923.94	873.66	1.1312	6.89	814.70	3566.46	74.51	1.76	12.58
2018	Jan	2025.87	856.35	1.1313	6.90	665.23	3657.18	73.95	0.84	11.72
	Feb	1766.97	826.88	1.1314	6.88	666.95	3683.65	71.08	0.57	11.92
	Mar	1583.29	810.05	1.1314	6.87	641.82	3710.31	68.77	1.40	11.96
	Apr	1489.81	759.86	1.1315	6.86	621.56	3737.16	65.82	2.98	11.98
	May	1745.60	730.03	1.1316	6.98	649.79	3764.21	65.57	5.72	11.63
	Jun	1823.07	726.21	1.1316	7.09	698.39	3791.45	66.37	6.10	11.56

Appendix B. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2004 to 2015 (cont.)

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2018	Jul	1983.57	715.97	1.1317	7.22	770.01	3818.89	64.85	7.28	11.05
	Aug	2033.32	733.40	1.1317	7.26	819.34	3846.53	64.05	7.11	10.40
	Sep	2030.09	718.21	1.1318	7.30	887.20	3874.37	62.78	8.11	9.77
	Oct	2080.44	708.84	1.1318	7.31	903.88	3902.41	60.03	4.71	9.39
	Nov	2013.91	673.54	1.1318	7.33	961.89	3930.65	56.58	2.39	8.54
	Dec	2101.95	662.22	1.1319	7.32	1036.58	3959.10	52.28	1.09	7.54
2019	Jan	2209.30	647.30	1.1319	7.33	849.68	4060.34	51.71	0.52	7.00
	Feb	1929.43	623.27	1.1319	7.31	855.19	4091.95	49.54	0.35	7.08
	Mar	1733.96	608.88	1.1319	7.30	826.17	4123.81	47.77	0.86	7.07
	Apr	1631.91	569.56	1.1319	7.29	803.19	4155.91	45.57	1.82	7.04
	May	1908.11	545.68	1.1319	7.42	842.93	4188.26	45.25	3.48	6.81
	Jun	1991.12	541.30	1.1319	7.55	909.50	4220.87	45.65	3.70	6.73
	Jul	2170.71	532.18	1.1319	7.69	1006.67	4253.73	44.46	4.40	6.40
	Aug	2229.17	543.62	1.1319	7.73	1075.32	4286.84	43.76	4.29	5.99
	Sep	2223.14	530.88	1.1319	7.78	1168.90	4320.22	42.76	4.87	5.61
	Oct	2273.78	522.49	1.1319	7.80	1195.50	4353.85	40.75	2.82	5.36
	Nov	2201.73	495.08	1.1319	7.82	1277.18	4387.74	38.28	1.43	4.85
	Dec	2303.88	485.40	1.1319	7.81	1381.69	4421.90	35.25	0.65	4.26

Appendix B. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2004 to 2015 (cont.)

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2020	Jan	2424.02	473.14	1.1319	7.83	1136.97	4538.82	34.75	0.31	3.93
	Feb	2113.85	454.31	1.1319	7.80	1148.79	4576.66	33.19	0.21	3.96
	Mar	1896.97	442.58	1.1318	7.80	1114.11	4614.82	31.89	0.51	3.93
	Apr	1787.37	412.84	1.1318	7.79	1087.33	4653.30	30.32	1.07	3.90
	May	2094.01	394.43	1.1318	7.93	1145.57	4692.09	30.01	2.04	3.75
	Jun	2184.90	390.17	1.1318	8.07	1240.84	4731.21	30.18	2.17	3.69
	Jul	2377.80	382.53	1.1318	8.23	1378.74	4770.66	29.29	2.56	3.49
	Aug	2440.74	389.66	1.1318	8.27	1478.49	4810.44	28.74	2.49	3.25
	Sep	2438.80	379.46	1.1318	8.33	1613.41	4850.54	27.98	2.82	3.03
	Oct	2498.17	372.42	1.1317	8.35	1656.54	4890.99	26.58	1.63	2.88
	Nov	2417.23	351.90	1.1317	8.38	1776.59	4931.76	24.89	0.82	2.59
	Dec	2525.31	344.06	1.1317	8.37	1929.43	4972.88	22.84	0.37	2.27
2021	Jan	2657.92	334.43	1.1317	8.40	1593.86	5106.05	22.45	0.18	2.08
	Feb	2322.01	320.23	1.1317	8.37	1616.69	5151.43	21.36	0.12	2.09
	Mar	2085.18	311.09	1.1317	8.38	1573.98	5197.21	20.46	0.29	2.06
	Apr	1962.22	289.38	1.1317	8.37	1542.12	5243.40	19.39	0.61	2.04
	May	2296.75	275.70	1.1317	8.52	1631.02	5289.99	19.13	1.15	1.95
	Jun	2399.26	271.96	1.1317	8.67	1773.53	5337.01	19.17	1.22	1.91

Appendix B. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2004 to 2015 (cont.)

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2021	Jul	2615.51	265.89	1.1317	8.85	1978.29	5384.44	18.55	1.44	1.80
	Aug	2684.63	270.09	1.1317	8.90	2129.65	5432.29	18.14	1.39	1.67
	Sep	2678.64	262.29	1.1317	8.96	2333.02	5480.56	17.60	1.57	1.54
	Oct	2743.04	256.70	1.1317	8.99	2404.69	5529.27	16.67	0.91	1.46
	Nov	2657.91	241.88	1.1317	9.02	2588.98	5578.41	15.55	0.46	1.31
	Dec	2779.96	235.83	1.1317	9.02	2822.64	5627.98	14.23	0.21	1.14
2022	Jan	2923.97	228.59	1.1317	9.05	2340.78	5782.76	13.94	0.10	1.04
	Feb	2551.66	218.27	1.1317	9.03	2383.53	5837.34	13.22	0.06	1.04
	Mar	2292.51	211.45	1.1317	9.03	2329.58	5892.44	12.62	0.16	1.02
	Apr	2160.72	196.15	1.1317	9.03	2291.28	5948.06	11.92	0.33	1.00
	May	2530.42	186.35	1.1317	9.20	2432.80	6004.21	11.72	0.63	0.95
	Jun	2640.53	183.31	1.1317	9.37	2655.64	6060.88	11.71	0.66	0.93
	Jul	2876.53	178.72	1.1317	9.56	2973.74	6118.09	11.29	0.78	0.87
	Aug	2955.25	181.04	1.1317	9.62	3213.70	6175.84	11.00	0.75	0.80
	Sep	2952.58	175.32	1.1317	9.69	3534.27	6234.14	10.64	0.84	0.74
	Oct	3023.29	171.11	1.1317	9.73	3657.00	6292.98	10.04	0.48	0.70
	Nov	2926.50	160.78	1.1317	9.76	3952.56	6352.39	9.34	0.24	0.62
	Dec	3060.67	156.32	1.1317	9.76	4326.02	6412.35	8.52	0.11	0.54

Appendix B. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2004 to 2015 (cont.)

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2023	Jan	3223.30	151.10	1.1317	9.80	3601.45	6591.54	8.31	0.05	0.49
	Feb	2815.36	143.87	1.1317	9.78	3681.48	6657.39	7.86	0.03	0.49
	Mar	2527.94	138.99	1.1317	9.79	3612.13	6723.90	7.48	0.08	0.47
	Apr	2380.56	128.57	1.1317	9.79	3566.55	6791.07	7.04	0.17	0.46
	May	2789.04	121.81	1.1317	9.98	3801.55	6858.91	6.90	0.33	0.44
	Jun	2914.13	119.49	1.1317	10.17	4165.88	6927.44	6.87	0.34	0.43
	Jul	3175.80	116.17	1.1317	10.37	4683.01	6996.64	6.60	0.40	0.40
	Aug	3260.21	117.34	1.1317	10.45	5080.57	7066.54	6.41	0.39	0.36
	Sep	3255.87	113.32	1.1317	10.53	5609.06	7137.13	6.18	0.44	0.33
	Oct	3336.72	110.29	1.1317	10.57	5826.38	7208.43	5.82	0.25	0.31
	Nov	3233.27	103.34	1.1317	10.62	6321.74	7280.44	5.39	0.12	0.28
	Dec	3381.08	100.20	1.1317	10.62	6945.94	7353.18	4.90	0.06	0.24
2024	Jan	3557.82	96.58	1.1317	10.66	5805.02	7563.41	4.77	0.03	0.22
	Feb	3107.56	91.70	1.1317	10.65	5957.07	7643.15	4.49	0.02	0.21
	Mar	2793.25	88.34	1.1317	10.66	5867.57	7723.72	4.26	0.04	0.21
	Apr	2632.27	81.49	1.1317	10.67	5816.04	7805.15	4.00	0.09	0.20
	May	3082.61	76.99	1.1317	10.88	6223.33	7887.44	3.90	0.17	0.19
	Jun	3218.96	75.31	1.1317	11.09	6846.25	7970.59	3.87	0.17	0.18

Appendix B. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2004 to 2015 (cont.)

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2024	Jul	3509.58	73.02	1.1317	11.32	7726.02	8054.62	3.71	0.20	0.17
	Aug	3606.55	73.55	1.1317	11.40	8414.46	8139.53	3.59	0.19	0.16
	Sep	3602.71	70.83	1.1317	11.50	9325.85	8225.34	3.45	0.22	0.14
	Oct	3689.83	68.74	1.1317	11.55	9724.81	8312.06	3.24	0.12	0.13
	Nov	3574.44	64.23	1.1317	11.60	10592.61	8399.69	2.99	0.06	0.12
	Dec	3740.66	62.11	1.1317	11.61	11683.73	8488.24	2.71	0.03	0.10
2025	Jan	3939.57	59.70	1.1317	11.66	9802.54	8735.18	2.63	0.01	0.09
	Feb	3440.74	56.52	1.1317	11.65	10098.36	8832.09	2.47	0.01	0.09
	Mar	3090.91	54.30	1.1317	11.67	9985.29	8930.07	2.33	0.02	0.09
	Apr	2913.06	49.95	1.1317	11.68	9936.05	9029.14	2.18	0.04	0.08
	May	3414.42	47.06	1.1317	11.91	10673.16	9129.31	2.12	0.08	0.08
	Jun	3567.36	45.91	1.1317	12.15	11787.11	9230.60	2.10	0.08	0.07
	Jul	3888.01	44.38	1.1317	12.41	13353.47	9333.00	2.01	0.10	0.07
	Aug	3993.77	44.58	1.1317	12.51	14599.87	9436.54	1.93	0.09	0.06
	Sep	3991.25	42.81	1.1317	12.61	16244.07	9541.23	1.85	0.10	0.06
	Oct	4091.29	41.44	1.1317	12.67	17004.81	9647.08	1.73	0.06	0.05
	Nov	3964.24	38.61	1.1317	12.74	18594.20	9754.11	1.59	0.03	0.05
	Dec	4146.66	37.23	1.1317	12.75	20589.23	9862.32	1.44	0.01	0.04

Appendix B. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2004 to 2015 (cont.)

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2026	Jan	4366.52	35.68	1.1317	12.81	17341.27	10155.22	1.39	0.01	0.04
	Feb	3816.08	33.69	1.1317	12.81	17934.02	10273.49	1.30	0.00	0.03
	Mar	3430.42	32.28	1.1317	12.84	17802.09	10393.15	1.23	0.01	0.03
	Apr	3232.78	29.61	1.1317	12.85	17783.13	10514.19	1.14	0.02	0.03
	May	3787.54	27.82	1.1317	13.11	19176.61	10636.65	1.11	0.04	0.03
	Jun	3957.81	27.06	1.1317	13.37	21260.33	10760.53	1.09	0.04	0.03
	Jul	4316.81	26.09	1.1317	13.67	24179.14	10885.86	1.04	0.05	0.03
	Aug	4436.19	26.13	1.1317	13.78	26538.70	11012.64	1.00	0.04	0.02
	Sep	4432.21	25.02	1.1317	13.91	29642.14	11140.91	0.96	0.05	0.02
	Oct	4542.04	24.15	1.1317	13.98	31150.89	11270.66	0.89	0.03	0.02
	Nov	4402.76	22.44	1.1317	14.05	34194.81	11401.93	0.82	0.01	0.02
	Dec	4608.58	21.58	1.1317	14.08	38010.79	11534.72	0.74	0.01	0.01

Appendix C

The values of explanatory variables in monthly data
from January 2017 to December 2026 with Box and Jenkins approach
by using the monthly data for the period of 2011 to 2015

Appendix C. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2011 to 2015

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2017	Jan	1198.47	1329.53	0.88	6.13	2817.34	3152.02	169.53	5.13	15.51
	Feb	913.15	1261.06	0.91	6.08	2830.87	3152.38	156.98	3.12	16.32
	Mar	799.44	1240.92	0.93	6.09	2515.35	3152.74	142.33	8.08	15.52
	Apr	791.97	1156.52	0.95	6.12	2220.05	3153.11	142.03	16.20	15.07
	May	959.23	1138.62	0.97	6.29	2059.30	3153.47	139.50	24.20	14.13
	Jun	982.58	1132.84	0.98	6.38	2024.66	3153.83	148.70	32.31	12.97
	Jul	1039.12	1086.63	0.98	6.43	2055.23	3154.20	140.72	44.87	11.90
	Aug	1108.18	1104.95	0.97	6.49	2075.06	3154.56	137.25	47.40	10.37
	Sep	1147.71	1104.99	0.95	6.58	2106.04	3154.92	130.71	51.17	9.89
	Oct	1145.00	1073.44	0.92	6.62	2151.69	3155.29	122.43	30.50	9.24
	Nov	1167.86	992.94	0.89	6.65	2198.93	3155.65	116.77	18.13	8.43
	Dec	1111.55	967.16	0.85	6.67	2261.04	3156.02	105.82	8.85	7.28
2018	Jan	1210.90	895.49	0.87	6.70	2570.31	3446.63	104.46	2.88	6.24
	Feb	921.26	844.51	0.89	6.66	2569.58	3447.12	95.87	1.74	6.47
	Mar	807.22	826.27	0.92	6.67	2271.63	3447.62	86.14	4.48	6.07
	Apr	799.97	765.67	0.94	6.72	1994.79	3448.11	85.19	8.93	5.81
	May	970.50	749.50	0.96	6.91	1840.99	3448.60	82.93	13.26	5.36
	Jun	993.89	741.44	0.98	7.01	1800.87	3449.10	87.61	17.59	4.85

Appendix C. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2011 to 2015 (cont.)

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2018	Jul	1050.59	707.12	0.97	7.08	1818.81	3449.59	82.16	24.29	4.38
	Aug	1120.14	714.93	0.96	7.16	1827.07	3450.08	79.42	25.50	3.77
	Sep	1159.85	710.86	0.95	7.26	1844.96	3450.58	74.96	27.36	3.54
	Oct	1157.69	686.62	0.92	7.31	1875.42	3451.07	69.58	16.21	3.26
	Nov	1180.27	631.49	0.89	7.36	1906.89	3451.57	65.77	9.58	2.93
	Dec	1124.08	611.58	0.85	7.38	1950.84	3452.06	59.07	4.65	2.49
2019	Jan	1224.10	563.02	0.87	7.43	2206.45	3731.83	57.79	1.50	2.10
	Feb	931.16	527.93	0.89	7.38	2194.67	3732.45	52.56	0.90	2.15
	Mar	815.32	513.57	0.92	7.41	1930.37	3733.08	46.81	2.31	1.99
	Apr	808.08	473.19	0.94	7.47	1686.55	3733.71	45.88	4.58	1.87
	May	980.54	460.55	0.96	7.70	1548.64	3734.34	44.26	6.75	1.70
	Jun	1004.28	452.98	0.98	7.81	1507.22	3734.96	46.34	8.90	1.52
	Jul	1061.66	429.55	0.97	7.89	1514.53	3735.59	43.07	12.21	1.35
	Aug	1131.70	431.81	0.97	7.99	1513.71	3736.22	41.26	12.74	1.14
	Sep	1172.05	426.90	0.95	8.12	1520.80	3736.85	38.60	13.59	1.06
	Oct	1169.55	409.98	0.93	8.18	1538.09	3737.48	35.51	8.00	0.96
	Nov	1192.55	374.91	0.89	8.25	1555.99	3738.11	33.26	4.70	0.85
	Dec	1135.85	361.01	0.85	8.28	1583.79	3738.74	29.61	2.27	0.71

Appendix C. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2011 to 2015 (cont.)

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2020	Jan	1237.29	330.44	0.88	8.34	1782.25	4066.63	28.71	0.73	0.59
	Feb	941.15	308.08	0.91	8.30	1763.76	4067.42	25.88	0.44	0.60
	Mar	824.00	297.98	0.93	8.35	1543.51	4068.22	22.84	1.11	0.54
	Apr	816.64	272.98	0.95	8.42	1341.72	4069.01	22.18	2.18	0.51
	May	990.89	264.17	0.98	8.68	1225.78	4069.80	21.21	3.19	0.45
	Jun	1014.97	258.34	1.00	8.82	1186.96	4070.60	22.01	4.19	0.40
	Jul	1072.88	243.58	0.99	8.93	1186.68	4071.39	20.27	5.71	0.35
	Aug	1143.79	243.46	0.99	9.05	1180.04	4072.18	19.25	5.92	0.29
	Sep	1184.49	239.31	0.97	9.20	1179.57	4072.98	17.84	6.27	0.27
	Oct	1181.93	228.51	0.95	9.29	1186.94	4073.77	16.27	3.67	0.24
	Nov	1205.01	207.77	0.91	9.37	1194.67	4074.57	15.10	2.14	0.21
	Dec	1147.74	198.92	0.87	9.42	1209.87	4075.36	13.32	1.03	0.17
2021	Jan	1250.30	181.04	0.90	9.50	1354.58	4416.65	12.80	0.33	0.14
	Feb	951.06	167.82	0.93	9.47	1333.75	4417.62	11.44	0.19	0.14
	Mar	832.69	161.39	0.95	9.52	1161.29	4418.60	10.00	0.49	0.12
	Apr	825.23	147.00	0.98	9.62	1004.36	4419.57	9.63	0.96	0.11
	May	1001.34	141.44	1.00	9.93	912.93	4420.55	9.12	1.40	0.10
	Jun	1025.63	137.54	1.02	10.10	879.54	4421.52	9.38	1.83	0.09

Appendix C. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2011 to 2015 (cont.)

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2021	Jul	1084.17	128.93	1.02	10.24	874.89	4422.50	8.57	2.48	0.08
	Aug	1155.85	128.13	1.01	10.39	865.59	4423.48	8.06	2.55	0.06
	Sep	1197.04	125.23	1.00	10.57	860.87	4424.45	7.40	2.69	0.06
	Oct	1194.44	118.89	0.97	10.68	861.86	4425.43	6.69	1.56	0.05
	Nov	1217.75	107.48	0.94	10.79	863.09	4426.40	6.16	0.91	0.04
	Dec	1159.86	102.32	0.90	10.86	869.65	4427.38	5.38	0.43	0.03
2022	Jan	1263.49	92.59	0.93	10.97	968.74	4808.86	5.13	0.14	0.03
	Feb	961.12	85.34	0.96	10.94	949.01	4810.05	4.54	0.08	0.03
	Mar	841.48	81.60	0.99	11.02	822.12	4811.24	3.93	0.20	0.02
	Apr	833.95	73.90	1.01	11.14	707.43	4812.43	3.75	0.40	0.02
	May	1011.92	70.70	1.04	11.52	639.77	4813.62	3.52	0.57	0.02
	Jun	1036.45	68.35	1.06	11.73	613.26	4814.80	3.59	0.74	0.02
	Jul	1095.59	63.71	1.06	11.89	606.93	4815.99	3.25	1.00	0.01
	Aug	1168.03	62.95	1.05	12.08	597.44	4817.18	3.03	1.02	0.01
	Sep	1209.66	61.17	1.04	12.31	591.17	4818.37	2.76	1.07	0.01
	Oct	1207.04	57.75	1.02	12.46	588.86	4819.56	2.47	0.62	0.01
	Nov	1230.60	51.90	0.98	12.59	586.72	4820.75	2.25	0.36	0.01
	Dec	1172.09	49.13	0.94	12.69	588.18	4821.94	1.95	0.17	0.01

Appendix C. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2011 to 2015 (cont.)

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2023	Jan	1276.82	44.20	0.97	12.83	651.89	5230.63	1.84	0.05	0.00
	Feb	971.25	40.51	1.00	12.81	635.38	5232.06	1.62	0.03	0.00
	Mar	850.36	38.51	1.03	12.92	547.64	5233.49	1.39	0.08	0.00
	Apr	842.75	34.68	1.06	13.08	468.86	5234.92	1.31	0.15	0.00
	May	1022.60	32.99	1.09	13.54	421.87	5236.35	1.22	0.22	0.00
	Jun	1047.40	31.71	1.11	13.80	402.34	5237.78	1.23	0.28	0.00
	Jul	1107.15	29.39	1.11	14.01	396.17	5239.21	1.11	0.37	0.00
	Aug	1180.35	28.87	1.11	14.25	388.01	5240.63	1.02	0.38	0.00
	Sep	1222.43	27.89	1.10	14.54	381.99	5242.07	0.92	0.40	0.00
	Oct	1219.78	26.18	1.07	14.72	378.57	5243.50	0.82	0.23	0.00
	Nov	1243.58	23.40	1.03	14.90	375.29	5244.93	0.74	0.13	0.00
	Dec	1184.46	22.02	0.99	15.04	374.32	5246.36	0.64	0.06	0.00
2024	Jan	1290.30	19.70	1.03	15.22	412.76	5695.69	0.59	0.02	0.00
	Feb	981.50	17.95	1.06	15.21	400.28	5697.40	0.52	0.01	0.00
	Mar	859.32	16.97	1.09	15.36	343.26	5699.10	0.44	0.03	0.00
	Apr	851.64	15.19	1.12	15.56	292.39	5700.81	0.41	0.05	0.00
	May	1033.39	14.37	1.16	16.12	261.76	5702.51	0.38	0.08	0.00
	Jun	1058.45	13.73	1.18	16.46	248.38	5704.22	0.38	0.10	0.00

Appendix C. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2011 to 2015 (cont.)

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2024	Jul	1118.84	12.65	1.18	16.73	243.33	5705.92	0.34	0.13	0.00
	Aug	1192.80	12.36	1.18	17.03	237.11	5707.63	0.31	0.13	0.00
	Sep	1235.33	11.87	1.17	17.40	232.25	5709.34	0.28	0.14	0.00
	Oct	1232.65	11.08	1.14	17.64	229.01	5711.04	0.24	0.08	0.00
	Nov	1256.70	9.85	1.10	17.88	225.87	5712.75	0.22	0.04	0.00
	Dec	1196.96	9.21	1.06	18.06	224.15	5714.46	0.19	0.02	0.00
2025	Jan	1303.91	8.19	1.09	18.29	245.92	6201.09	0.17	0.01	0.00
	Feb	991.85	7.42	1.13	18.31	237.27	6203.11	0.15	0.00	0.00
	Mar	868.39	6.98	1.17	18.51	202.44	6205.12	0.13	0.01	0.00
	Apr	860.63	6.21	1.20	18.77	171.57	6207.14	0.12	0.02	0.00
	May	1044.30	5.84	1.24	19.47	152.82	6209.16	0.11	0.03	0.00
	Jun	1069.62	5.55	1.27	19.90	144.27	6211.18	0.11	0.03	0.00
	Jul	1130.64	5.09	1.27	20.25	140.63	6213.20	0.09	0.04	0.00
	Aug	1205.39	4.94	1.27	20.64	136.34	6215.22	0.08	0.04	0.00
	Sep	1248.36	4.72	1.26	21.11	132.87	6217.24	0.07	0.04	0.00
	Oct	1245.66	4.38	1.23	21.43	130.35	6219.26	0.07	0.02	0.00
	Nov	1269.96	3.87	1.19	21.73	127.92	6221.28	0.06	0.01	0.00
	Dec	1209.59	3.60	1.14	21.98	126.30	6223.30	0.05	0.01	0.00

Appendix C. The values of explanatory variables in monthly data from January 2017 to December 2026 with Box and Jenkins approach by using the monthly data for the period of 2011 to 2015 (cont.)

		Qs	SRPRICE	YGDP	CNY	STOCK	MAREA_TH	UPRICE	RAINFALL_TH	CPETRO
2026	Jan	1317.67	3.18	1.18	22.29	137.86	6755.38	0.04	0.00	0.00
	Feb	1002.32	2.87	1.22	22.34	132.34	6757.75	0.04	0.00	0.00
	Mar	877.56	2.68	1.27	22.60	112.35	6760.12	0.03	0.00	0.00
	Apr	869.71	2.37	1.30	22.96	94.73	6762.50	0.03	0.01	0.00
	May	1055.31	2.22	1.34	23.84	83.95	6764.87	0.03	0.01	0.00
	Jun	1080.90	2.09	1.38	24.39	78.86	6767.25	0.03	0.01	0.00
	Jul	1142.57	1.91	1.38	24.84	76.47	6769.63	0.02	0.01	0.00
	Aug	1218.11	1.84	1.38	25.35	73.77	6772.01	0.02	0.01	0.00
	Sep	1261.53	1.75	1.37	25.95	71.53	6774.38	0.02	0.01	0.00
	Oct	1258.80	1.61	1.34	26.38	69.82	6776.76	0.02	0.01	0.00
	Nov	1283.36	1.42	1.30	26.79	68.16	6779.14	0.01	0.00	0.00
	Dec	1222.35	1.31	1.25	27.12	66.96	6781.53	0.01	0.00	0.00

Appendix D

The values of Qs in monthly data
from January 2017 to December 2026 with simple moving average technique

Appendix D. The value of Qs in monthly data from January 2017 to December 2026 with simple moving average technique

		Qs			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	Jan	1006.93	992.83	937.84	912.52
	Feb	1003.38	992.82	939.17	911.99
	Mar	1003.89	994.74	942.14	912.98
	Apr	1008.83	997.98	946.53	914.90
	May	1014.96	1001.26	950.10	917.38
	Jun	1018.93	1002.32	952.55	919.46
	Jul	1020.85	1002.43	952.98	920.56
	Aug	1020.23	1001.65	953.36	921.86
	Sep	1020.74	1001.11	954.58	921.85
	Oct	1021.20	999.89	956.01	922.55
	Nov	1021.07	999.23	956.28	922.83
	Dec	1017.99	998.17	956.13	923.08
2018	Jan	1017.27	999.20	955.50	923.33
	Feb	1013.13	998.41	955.95	923.50
	Mar	1016.72	1002.05	957.75	924.55
	Apr	1022.96	1004.41	960.80	926.19
	May	1030.57	1007.65	964.02	928.08
	Jun	1033.81	1009.86	966.34	929.60
	Jul	1035.47	1010.25	967.26	930.89
	Aug	1034.68	1009.49	967.82	930.78
	Sep	1031.84	1008.30	967.84	930.90
	Oct	1028.64	1007.15	967.25	930.48
	Nov	1025.32	1005.26	967.98	930.49
	Dec	1021.06	1002.37	968.00	931.68

Appendix D. The value of Qs in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		Qs			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2019	Jan	1018.47	999.68	967.67	932.58
	Feb	1018.90	997.42	967.01	933.60
	Mar	1019.37	997.63	968.40	935.93
	Apr	1019.69	1000.49	970.80	939.39
	May	1019.90	1004.03	973.78	942.18
	Jun	1019.96	1006.23	975.35	944.08
	Jul	1019.91	1007.17	975.14	944.35
	Aug	1019.83	1006.57	974.83	944.58
	Sep	1019.78	1006.65	974.10	945.48
	Oct	1019.77	1006.69	974.23	946.55
	Nov	1019.80	1006.37	974.09	946.69
	Dec	1019.92	1004.27	974.27	946.49
2020	Jan	1020.16	1003.61	974.32	945.91
	Feb	1020.53	1000.91	974.12	946.18
	Mar	1021.00	1002.85	975.12	947.54
	Apr	1021.48	1006.37	976.94	949.90
	May	1021.83	1010.66	978.78	952.38
	Jun	1022.02	1012.27	979.20	954.14
	Jul	1022.11	1012.91	979.03	954.78
	Aug	1022.14	1012.05	978.30	955.13
	Sep	1022.20	1009.97	977.72	955.04
	Oct	1022.24	1007.69	976.71	954.45
	Nov	1022.27	1005.35	976.06	954.93
	Dec	1022.30	1002.46	975.15	954.84

Appendix D. The value of Qs in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		Qs			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2021	Jan	1022.42	1000.60	975.56	954.46
	Feb	1022.56	1000.96	974.82	953.82
	Mar	1022.82	1001.33	976.85	954.83
	Apr	1022.99	1001.68	978.06	956.64
	May	1022.99	1001.96	979.81	958.90
	Jun	1022.78	1002.17	980.90	960.03
	Jul	1022.48	1002.33	980.85	959.73
	Aug	1022.12	1002.50	980.06	959.37
	Sep	1021.77	1002.67	979.01	958.65
	Oct	1021.49	1002.86	977.99	958.62
	Nov	1021.29	1003.04	976.50	958.38
	Dec	1021.18	1003.23	974.40	958.40
2022	Jan	1021.18	1003.41	972.42	958.30
	Feb	1021.26	1003.58	970.73	958.01
	Mar	1021.32	1003.76	970.58	958.68
	Apr	1021.37	1003.91	972.09	960.00
	May	1021.42	1004.01	974.00	961.32
	Jun	1021.46	1004.06	975.07	961.52
	Jul	1021.51	1004.09	975.33	961.23
	Aug	1021.55	1004.11	974.62	960.50
	Sep	1021.60	1004.16	974.34	959.89
	Oct	1021.65	1004.21	974.03	958.94
	Nov	1021.70	1004.28	973.49	958.26
	Dec	1021.75	1004.36	971.84	957.39

Appendix D. The value of Qs in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		Qs			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2023	Jan	1021.80	1004.47	971.08	957.56
	Feb	1021.85	1004.55	969.05	956.83
	Mar	1021.89	1004.66	969.94	958.30
	Apr	1021.91	1004.70	971.79	959.11
	May	1021.92	1004.70	974.11	960.35
	Jun	1021.93	1004.65	974.74	961.07
	Jul	1021.92	1004.57	974.75	960.86
	Aug	1021.92	1004.47	973.82	960.06
	Sep	1021.91	1004.39	972.12	959.06
	Oct	1021.90	1004.32	970.30	958.07
	Nov	1021.89	1004.28	968.45	956.72
	Dec	1021.88	1004.26	966.25	954.87
2024	Jan	1021.87	1004.29	964.71	953.12
	Feb	1021.86	1004.37	965.12	951.61
	Mar	1021.84	1004.49	965.53	951.33
	Apr	1021.81	1004.60	965.92	952.37
	May	1021.78	1004.67	966.30	953.74
	Jun	1021.74	1004.68	966.66	954.43
	Jul	1021.71	1004.65	967.01	954.46
	Aug	1021.69	1004.61	967.33	953.72
	Sep	1021.68	1004.58	967.67	953.32
	Oct	1021.68	1004.54	968.00	952.90
	Nov	1021.68	1004.51	968.35	952.29
	Dec	1021.69	1004.48	968.69	950.79

Appendix D. The value of Qs in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		Qs			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2025	Jan	1021.71	1004.48	969.02	950.02
	Feb	1021.72	1004.50	969.35	948.22
	Mar	1021.74	1004.56	969.66	948.75
	Apr	1021.75	1004.58	969.95	950.06
	May	1021.76	1004.55	970.19	951.73
	Jun	1021.77	1004.45	970.40	952.05
	Jul	1021.78	1004.32	970.59	951.87
	Aug	1021.78	1004.18	970.77	950.93
	Sep	1021.79	1004.05	970.95	949.38
	Oct	1021.80	1003.95	971.13	947.73
	Nov	1021.80	1003.89	971.28	946.06
	Dec	1021.80	1003.86	971.44	944.12
2026	Jan	1021.80	1003.89	971.60	942.71
	Feb	1021.80	1003.94	971.77	943.04
	Mar	1021.80	1003.99	971.93	943.36
	Apr	1021.80	1004.03	972.08	943.68
	May	1021.80	1004.07	972.20	944.00
	Jun	1021.79	1004.11	972.28	944.30
	Jul	1021.79	1004.14	972.34	944.59
	Aug	1021.79	1004.17	972.40	944.88
	Sep	1021.78	1004.20	972.44	945.17
	Oct	1021.78	1004.22	972.49	945.46
	Nov	1021.78	1004.25	972.55	945.75
	Dec	1021.77	1004.27	972.59	946.03

Appendix E

The values of SRPRICE in monthly data from January 2017 to December 2026 with simple moving average technique

Appendix E. The value of SRPRICE in monthly data from January 2017 to December 2026 with simple moving average technique

		SRPRICE			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	Jan	2453.50	2844.95	2733.20	2623.78
	Feb	2452.02	2837.53	2735.51	2630.39
	Mar	2450.71	2831.49	2741.40	2636.47
	Apr	2443.87	2822.03	2750.98	2640.30
	May	2437.73	2809.55	2762.65	2646.44
	Jun	2427.64	2795.99	2774.72	2653.18
	Jul	2419.01	2783.39	2787.39	2659.64
	Aug	2412.21	2774.05	2799.03	2665.63
	Sep	2402.99	2769.37	2809.40	2664.01
	Oct	2398.88	2763.22	2817.39	2669.82
	Nov	2393.66	2759.41	2824.75	2675.73
	Dec	2388.70	2757.75	2831.65	2681.51
2018	Jan	2384.69	2752.25	2838.83	2688.00
	Feb	2381.10	2743.28	2844.78	2694.68
	Mar	2380.94	2735.67	2850.30	2701.17
	Apr	2383.52	2724.62	2855.18	2704.93
	May	2392.01	2710.51	2858.89	2707.74
	Jun	2402.92	2695.30	2862.63	2710.88
	Jul	2412.81	2681.02	2866.21	2713.26
	Aug	2424.69	2669.97	2868.85	2710.34
	Sep	2432.71	2663.56	2871.64	2709.91
	Oct	2439.09	2655.65	2874.07	2709.07
	Nov	2445.51	2650.04	2876.85	2707.44
	Dec	2457.03	2646.56	2880.36	2706.91

Appendix E. The value of SRPRICE in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		SRPRICE			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2019	Jan	2468.47	2639.20	2883.57	2707.41
	Feb	2462.51	2641.41	2885.82	2709.04
	Mar	2456.85	2643.78	2886.72	2713.53
	Apr	2451.45	2642.89	2886.58	2720.96
	May	2446.47	2642.52	2884.53	2730.05
	Jun	2442.08	2639.88	2879.64	2739.44
	Jul	2438.36	2638.25	2872.40	2749.28
	Aug	2435.28	2637.82	2863.06	2758.27
	Sep	2432.74	2636.05	2852.86	2766.23
	Oct	2430.53	2637.47	2841.61	2772.26
	Nov	2428.74	2638.31	2831.92	2777.78
	Dec	2427.28	2639.41	2823.26	2782.90
2020	Jan	2426.07	2641.19	2818.30	2788.24
	Feb	2425.31	2643.31	2813.39	2792.57
	Mar	2424.57	2647.58	2809.36	2796.56
	Apr	2423.85	2653.57	2803.22	2800.02
	May	2423.29	2663.16	2795.22	2802.53
	Jun	2422.89	2674.23	2786.60	2805.05
	Jul	2422.76	2684.69	2778.63	2807.43
	Aug	2422.86	2696.35	2772.74	2809.05
	Sep	2423.16	2705.69	2769.80	2810.78
	Oct	2423.72	2714.07	2765.96	2812.22
	Nov	2424.41	2722.50	2763.61	2813.93
	Dec	2425.26	2734.03	2762.62	2816.22

Appendix E. The value of SRPRICE in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		SRPRICE			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2021	Jan	2426.28	2745.51	2759.23	2818.24
	Feb	2427.43	2742.28	2753.70	2819.50
	Mar	2428.72	2738.92	2749.05	2819.67
	Apr	2430.04	2735.46	2742.28	2819.00
	May	2431.34	2731.94	2733.65	2816.80
	Jun	2432.43	2728.39	2724.38	2812.32
	Jul	2433.25	2724.90	2715.76	2805.97
	Aug	2433.82	2721.53	2709.22	2797.94
	Sep	2434.07	2718.33	2705.61	2789.24
	Oct	2434.11	2715.34	2701.11	2779.71
	Nov	2433.97	2712.59	2698.08	2771.44
	Dec	2433.65	2710.04	2696.40	2764.01
2022	Jan	2433.00	2707.66	2692.32	2759.55
	Feb	2432.01	2705.37	2694.25	2755.13
	Mar	2431.17	2703.17	2696.29	2751.42
	Apr	2430.45	2701.03	2696.28	2746.03
	May	2429.87	2699.02	2696.61	2739.15
	Jun	2429.41	2697.17	2695.52	2731.79
	Jul	2429.06	2695.53	2695.08	2724.95
	Aug	2428.80	2694.06	2695.40	2719.79
	Sep	2428.62	2692.73	2694.89	2717.00
	Oct	2428.50	2691.45	2696.39	2713.49
	Nov	2428.45	2690.26	2697.53	2711.17
	Dec	2428.44	2689.10	2698.84	2709.94

Appendix E. The value of SRPRICE in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		SRPRICE			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2023	Jan	2428.47	2687.96	2700.57	2706.79
	Feb	2428.54	2686.89	2702.51	2701.93
	Mar	2428.63	2685.95	2705.80	2697.78
	Apr	2428.74	2685.12	2710.15	2691.93
	May	2428.88	2684.46	2716.74	2684.61
	Jun	2429.03	2684.03	2724.21	2676.79
	Jul	2429.20	2683.84	2731.27	2669.50
	Aug	2429.38	2683.89	2739.04	2663.87
	Sep	2429.56	2684.12	2745.32	2660.61
	Oct	2429.74	2684.46	2750.97	2656.64
	Nov	2429.91	2684.94	2756.63	2653.84
	Dec	2430.06	2685.52	2764.18	2652.13
2024	Jan	2430.20	2686.17	2771.68	2648.50
	Feb	2430.30	2686.95	2772.36	2649.68
	Mar	2430.38	2687.71	2772.96	2650.93
	Apr	2430.43	2688.45	2773.49	2650.55
	May	2430.44	2689.21	2773.96	2650.43
	Jun	2430.42	2689.98	2774.40	2649.18
	Jul	2430.36	2690.82	2774.81	2648.44
	Aug	2430.28	2691.69	2775.18	2648.31
	Sep	2430.18	2692.59	2775.59	2647.51
	Oct	2430.07	2693.53	2776.01	2648.31
	Nov	2429.96	2694.47	2776.45	2648.82
	Dec	2429.85	2695.41	2776.90	2649.46

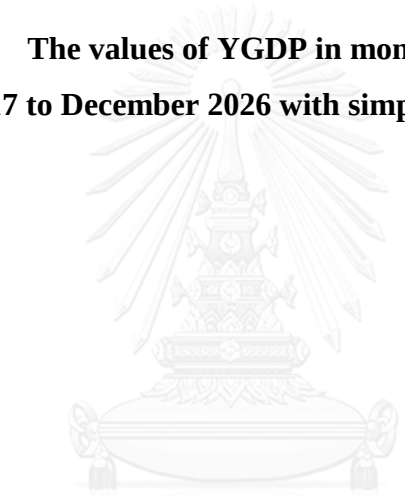
Appendix E. The value of SRPRICE in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		SRPRICE			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2025	Jan	2429.75	2696.34	2777.37	2650.43
	Feb	2429.65	2697.26	2777.83	2651.57
	Mar	2429.59	2698.16	2778.27	2653.78
	Apr	2429.55	2699.00	2778.65	2656.82
	May	2429.52	2699.76	2778.94	2661.65
	Jun	2429.51	2700.37	2779.11	2667.17
	Jul	2429.51	2700.80	2779.15	2672.34
	Aug	2429.53	2701.07	2779.07	2678.07
	Sep	2429.55	2701.15	2778.86	2682.58
	Oct	2429.57	2701.07	2778.54	2686.58
	Nov	2429.60	2700.86	2778.14	2690.57
	Dec	2429.63	2700.50	2777.65	2696.06
2026	Jan	2429.67	2699.94	2777.09	2701.49
	Feb	2429.70	2699.18	2776.45	2702.86
	Mar	2429.73	2698.46	2775.74	2704.18
	Apr	2429.76	2697.79	2774.96	2705.45
	May	2429.79	2697.16	2774.12	2706.67
	Jun	2429.82	2696.58	2773.24	2707.83
	Jul	2429.84	2696.05	2772.31	2708.94
	Aug	2429.86	2695.57	2771.33	2710.00
	Sep	2429.87	2695.13	2770.31	2711.00
	Oct	2429.88	2694.75	2769.26	2711.94
	Nov	2429.88	2694.40	2768.17	2712.84
	Dec	2429.88	2694.10	2767.04	2713.68

Appendix F

The values of YGDP in monthly data

from January 2017 to December 2026 with simple moving average technique



Appendix F. The value of YGDP in monthly data from January 2017 to December 2026 with simple moving average technique

		YGDP			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	Jan	1.77	1.45	0.91	1.06
	Feb	1.76	1.45	0.95	1.05
	Mar	1.76	1.45	1.00	1.04
	Apr	1.76	1.44	1.07	1.02
	May	1.76	1.44	1.13	1.01
	Jun	1.76	1.44	1.19	1.00
	Jul	1.76	1.44	1.25	0.99
	Aug	1.76	1.44	1.31	0.97
	Sep	1.76	1.45	1.37	0.96
	Oct	1.76	1.45	1.42	0.94
	Nov	1.76	1.46	1.46	0.93
	Dec	1.76	1.48	1.50	0.91
2018	Jan	1.77	1.49	1.52	0.90
	Feb	1.77	1.51	1.53	0.89
	Mar	1.76	1.53	1.54	0.88
	Apr	1.76	1.55	1.53	0.87
	May	1.75	1.57	1.52	0.87
	Jun	1.75	1.58	1.51	0.86
	Jul	1.74	1.60	1.49	0.86
	Aug	1.73	1.61	1.47	0.86
	Sep	1.73	1.62	1.45	0.87
	Oct	1.72	1.63	1.43	0.88
	Nov	1.72	1.63	1.41	0.89
	Dec	1.72	1.63	1.40	0.91

Appendix F. The value of YGDP in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		YGDP			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2019	Jan	1.73	1.62	1.38	0.94
	Feb	1.73	1.62	1.37	0.98
	Mar	1.74	1.61	1.36	1.02
	Apr	1.74	1.61	1.35	1.07
	May	1.75	1.61	1.34	1.12
	Jun	1.75	1.60	1.34	1.17
	Jul	1.75	1.60	1.33	1.22
	Aug	1.75	1.60	1.33	1.27
	Sep	1.75	1.60	1.33	1.31
	Oct	1.75	1.59	1.33	1.35
	Nov	1.75	1.59	1.33	1.39
	Dec	1.75	1.59	1.33	1.42
2020	Jan	1.75	1.59	1.33	1.43
	Feb	1.75	1.59	1.33	1.44
	Mar	1.75	1.58	1.33	1.45
	Apr	1.75	1.58	1.33	1.44
	May	1.75	1.57	1.32	1.43
	Jun	1.75	1.56	1.32	1.42
	Jul	1.75	1.56	1.32	1.41
	Aug	1.75	1.55	1.32	1.39
	Sep	1.75	1.54	1.32	1.37
	Oct	1.75	1.54	1.32	1.36
	Nov	1.75	1.53	1.33	1.34
	Dec	1.75	1.53	1.34	1.33

Appendix F. The value of YGDP in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		YGDP			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2021	Jan	1.75	1.53	1.35	1.31
	Feb	1.75	1.53	1.35	1.30
	Mar	1.74	1.53	1.36	1.29
	Apr	1.74	1.53	1.38	1.28
	May	1.74	1.53	1.38	1.28
	Jun	1.74	1.53	1.39	1.27
	Jul	1.74	1.54	1.40	1.27
	Aug	1.74	1.54	1.40	1.27
	Sep	1.74	1.54	1.41	1.27
	Oct	1.74	1.54	1.41	1.27
	Nov	1.74	1.54	1.41	1.27
	Dec	1.75	1.54	1.41	1.27
2022	Jan	1.75	1.55	1.40	1.27
	Feb	1.75	1.55	1.40	1.27
	Mar	1.75	1.55	1.39	1.27
	Apr	1.75	1.55	1.39	1.26
	May	1.75	1.55	1.38	1.26
	Jun	1.75	1.55	1.38	1.26
	Jul	1.75	1.56	1.37	1.25
	Aug	1.75	1.56	1.37	1.25
	Sep	1.75	1.56	1.37	1.26
	Oct	1.75	1.56	1.36	1.26
	Nov	1.75	1.56	1.36	1.26
	Dec	1.75	1.57	1.36	1.27

Appendix F. The value of YGDP in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		YGDP			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2023	Jan	1.75	1.57	1.35	1.27
	Feb	1.75	1.57	1.35	1.28
	Mar	1.75	1.57	1.34	1.29
	Apr	1.75	1.57	1.34	1.30
	May	1.75	1.57	1.33	1.30
	Jun	1.75	1.57	1.32	1.31
	Jul	1.75	1.57	1.32	1.31
	Aug	1.75	1.57	1.31	1.32
	Sep	1.75	1.57	1.30	1.32
	Oct	1.75	1.57	1.30	1.32
	Nov	1.75	1.57	1.29	1.32
	Dec	1.75	1.57	1.29	1.31
2024	Jan	1.75	1.56	1.28	1.31
	Feb	1.75	1.56	1.29	1.30
	Mar	1.75	1.56	1.29	1.30
	Apr	1.75	1.56	1.30	1.30
	May	1.75	1.56	1.30	1.29
	Jun	1.75	1.56	1.31	1.29
	Jul	1.75	1.56	1.31	1.28
	Aug	1.75	1.56	1.32	1.28
	Sep	1.75	1.56	1.32	1.28
	Oct	1.75	1.56	1.33	1.27
	Nov	1.75	1.56	1.34	1.27
	Dec	1.75	1.56	1.34	1.26

Appendix F. The value of YGDP in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		YGDP			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2025	Jan	1.75	1.56	1.35	1.26
	Feb	1.75	1.56	1.35	1.26
	Mar	1.75	1.55	1.35	1.25
	Apr	1.75	1.55	1.36	1.25
	May	1.75	1.55	1.36	1.24
	Jun	1.75	1.55	1.36	1.23
	Jul	1.75	1.55	1.36	1.23
	Aug	1.75	1.55	1.37	1.22
	Sep	1.75	1.55	1.37	1.22
	Oct	1.75	1.55	1.37	1.21
	Nov	1.75	1.55	1.37	1.21
	Dec	1.75	1.55	1.37	1.20
2026	Jan	1.75	1.55	1.36	1.20
	Feb	1.75	1.56	1.36	1.20
	Mar	1.75	1.56	1.36	1.20
	Apr	1.75	1.56	1.36	1.20
	May	1.75	1.56	1.36	1.20
	Jun	1.75	1.56	1.35	1.20
	Jul	1.75	1.56	1.35	1.20
	Aug	1.75	1.56	1.35	1.20
	Sep	1.75	1.56	1.35	1.20
	Oct	1.75	1.56	1.35	1.20
	Nov	1.75	1.56	1.35	1.20
	Dec	1.75	1.56	1.35	1.20

Appendix G

The values of CNY in monthly data

from January 2017 to December 2026 with simple moving average technique

Appendix G. The value of CNY in monthly data from January 2017 to December 2026 with simple moving average technique

		CNY			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	Jan	5.34	5.16	5.01	4.94
	Feb	5.34	5.16	5.01	4.94
	Mar	5.34	5.16	5.01	4.94
	Apr	5.34	5.17	5.01	4.95
	May	5.35	5.17	5.01	4.95
	Jun	5.35	5.18	5.01	4.95
	Jul	5.35	5.18	5.01	4.96
	Aug	5.36	5.18	5.01	4.96
	Sep	5.36	5.19	5.01	4.96
	Oct	5.37	5.19	5.01	4.97
	Nov	5.37	5.20	5.01	4.97
	Dec	5.37	5.20	5.01	4.97
2018	Jan	5.37	5.21	5.01	4.98
	Feb	5.37	5.21	5.01	4.98
	Mar	5.38	5.22	5.01	4.98
	Apr	5.38	5.23	5.02	4.99
	May	5.38	5.24	5.02	4.99
	Jun	5.38	5.24	5.02	5.00
	Jul	5.38	5.25	5.03	5.00
	Aug	5.38	5.25	5.03	5.00
	Sep	5.37	5.25	5.03	5.00
	Oct	5.36	5.25	5.04	5.00
	Nov	5.36	5.25	5.04	5.00
	Dec	5.35	5.25	5.05	5.00

Appendix G. The value of CNY in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		CNY			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2019	Jan	5.34	5.25	5.05	5.00
	Feb	5.35	5.25	5.06	5.00
	Mar	5.35	5.25	5.06	4.99
	Apr	5.35	5.25	5.07	4.99
	May	5.35	5.25	5.07	4.99
	Jun	5.35	5.25	5.08	4.99
	Jul	5.36	5.25	5.08	4.99
	Aug	5.36	5.25	5.08	4.99
	Sep	5.36	5.25	5.09	4.99
	Oct	5.36	5.25	5.09	4.99
	Nov	5.36	5.25	5.09	4.99
	Dec	5.36	5.25	5.10	4.99
2020	Jan	5.36	5.25	5.10	4.99
	Feb	5.36	5.25	5.10	5.00
	Mar	5.36	5.25	5.10	5.00
	Apr	5.36	5.25	5.10	5.00
	May	5.36	5.25	5.11	5.00
	Jun	5.36	5.24	5.11	5.00
	Jul	5.36	5.24	5.11	5.01
	Aug	5.36	5.24	5.11	5.01
	Sep	5.36	5.23	5.11	5.01
	Oct	5.36	5.22	5.11	5.01
	Nov	5.36	5.22	5.12	5.02
	Dec	5.36	5.21	5.12	5.02

Appendix G. The value of CNY in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		CNY			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2021	Jan	5.36	5.20	5.12	5.03
	Feb	5.36	5.21	5.12	5.03
	Mar	5.36	5.21	5.13	5.03
	Apr	5.36	5.21	5.13	5.04
	May	5.36	5.21	5.13	5.04
	Jun	5.36	5.21	5.14	5.04
	Jul	5.36	5.22	5.14	5.05
	Aug	5.36	5.22	5.14	5.05
	Sep	5.36	5.22	5.14	5.05
	Oct	5.36	5.22	5.14	5.05
	Nov	5.36	5.22	5.14	5.06
	Dec	5.36	5.22	5.14	5.06
2022	Jan	5.36	5.22	5.14	5.06
	Feb	5.36	5.22	5.13	5.06
	Mar	5.36	5.23	5.13	5.06
	Apr	5.36	5.23	5.13	5.06
	May	5.36	5.23	5.13	5.06
	Jun	5.36	5.23	5.13	5.06
	Jul	5.36	5.23	5.13	5.06
	Aug	5.36	5.23	5.13	5.07
	Sep	5.36	5.23	5.12	5.07
	Oct	5.36	5.23	5.12	5.07
	Nov	5.36	5.23	5.12	5.07
	Dec	5.36	5.23	5.12	5.07

Appendix G. The value of CNY in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		CNY			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2023	Jan	5.36	5.23	5.12	5.07
	Feb	5.36	5.23	5.12	5.07
	Mar	5.36	5.23	5.11	5.08
	Apr	5.36	5.23	5.11	5.08
	May	5.36	5.23	5.11	5.08
	Jun	5.36	5.23	5.11	5.08
	Jul	5.36	5.23	5.11	5.08
	Aug	5.36	5.23	5.10	5.08
	Sep	5.36	5.23	5.10	5.08
	Oct	5.36	5.23	5.09	5.08
	Nov	5.36	5.23	5.08	5.08
	Dec	5.36	5.23	5.08	5.08
2024	Jan	5.36	5.23	5.07	5.08
	Feb	5.36	5.23	5.07	5.08
	Mar	5.36	5.23	5.08	5.07
	Apr	5.36	5.23	5.08	5.07
	May	5.36	5.23	5.08	5.07
	Jun	5.36	5.23	5.08	5.07
	Jul	5.36	5.23	5.08	5.07
	Aug	5.36	5.23	5.08	5.07
	Sep	5.36	5.23	5.08	5.07
	Oct	5.36	5.23	5.08	5.06
	Nov	5.36	5.23	5.08	5.06
	Dec	5.36	5.23	5.08	5.06

Appendix G. The value of CNY in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		CNY			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2025	Jan	5.36	5.23	5.08	5.06
	Feb	5.36	5.23	5.08	5.06
	Mar	5.36	5.23	5.08	5.05
	Apr	5.36	5.23	5.09	5.05
	May	5.36	5.23	5.09	5.05
	Jun	5.36	5.23	5.09	5.05
	Jul	5.36	5.23	5.09	5.04
	Aug	5.36	5.23	5.09	5.04
	Sep	5.36	5.23	5.09	5.04
	Oct	5.36	5.23	5.09	5.03
	Nov	5.36	5.23	5.09	5.03
	Dec	5.36	5.23	5.09	5.02
2026	Jan	5.36	5.23	5.09	5.02
	Feb	5.36	5.23	5.09	5.02
	Mar	5.36	5.23	5.09	5.02
	Apr	5.36	5.23	5.10	5.02
	May	5.36	5.23	5.10	5.02
	Jun	5.36	5.23	5.10	5.02
	Jul	5.36	5.23	5.10	5.02
	Aug	5.36	5.23	5.10	5.02
	Sep	5.36	5.23	5.10	5.02
	Oct	5.36	5.23	5.10	5.02
	Nov	5.36	5.23	5.10	5.02
	Dec	5.36	5.23	5.10	5.03

Appendix H

The values of STOCK in monthly data from January 2017 to December 2026 with simple moving average technique

Appendix H. The value of STOCK in monthly data from January 2017 to December 2026 with simple moving average technique

		STOCK			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	Jan	2914.40	2481.88	2061.55	1979.10
	Feb	2904.07	2493.76	2065.16	1974.89
	Mar	2889.64	2505.93	2068.58	1970.11
	Apr	2880.32	2520.99	2074.79	1966.60
	May	2877.31	2537.64	2082.39	1964.77
	Jun	2877.95	2554.84	2090.22	1963.98
	Jul	2879.61	2570.68	2096.89	1963.53
	Aug	2880.61	2584.80	2103.12	1963.80
	Sep	2882.12	2597.07	2109.27	1963.37
	Oct	2883.51	2607.03	2115.19	1963.02
	Nov	2884.79	2615.69	2120.08	1962.52
	Dec	2882.24	2622.73	2124.01	1961.60
2018	Jan	2877.60	2629.77	2126.32	1959.81
	Feb	2863.42	2634.69	2127.70	1963.89
	Mar	2848.16	2640.14	2128.58	1968.38
	Apr	2840.02	2647.08	2132.58	1974.13
	May	2839.97	2656.53	2139.33	1981.54
	Jun	2844.19	2667.44	2147.36	1989.94
	Jul	2851.55	2678.14	2155.78	1998.81
	Aug	2859.57	2687.29	2164.42	2007.32
	Sep	2865.97	2694.25	2172.62	2015.52
	Oct	2870.09	2700.00	2180.29	2022.99
	Nov	2870.84	2703.70	2187.94	2030.02
	Dec	2866.83	2704.10	2195.44	2036.96

Appendix H. The value of STOCK in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		STOCK			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2019	Jan	2858.72	2700.60	2202.67	2043.03
	Feb	2861.94	2690.83	2209.57	2045.76
	Mar	2864.94	2678.62	2215.45	2048.33
	Apr	2867.68	2669.51	2223.85	2053.14
	May	2870.08	2664.19	2234.53	2059.04
	Jun	2872.00	2661.02	2246.33	2065.10
	Jul	2873.36	2658.40	2257.57	2070.23
	Aug	2874.14	2655.32	2268.17	2074.99
	Sep	2874.40	2652.47	2278.74	2079.68
	Oct	2874.19	2649.48	2289.25	2084.17
	Nov	2873.58	2646.34	2299.24	2087.82
	Dec	2872.62	2640.84	2309.30	2090.70
2020	Jan	2871.46	2634.03	2318.53	2092.27
	Feb	2870.26	2621.46	2324.26	2093.09
	Mar	2869.33	2608.27	2330.09	2093.51
	Apr	2868.76	2599.39	2337.68	2096.41
	May	2868.44	2595.35	2346.17	2101.51
	Jun	2868.19	2593.81	2354.93	2107.62
	Jul	2867.92	2594.05	2362.75	2114.02
	Aug	2867.60	2594.57	2369.40	2120.59
	Sep	2867.24	2594.00	2374.83	2126.79
	Oct	2866.82	2591.93	2378.74	2132.53
	Nov	2866.36	2587.74	2381.78	2138.26
	Dec	2865.85	2580.62	2383.74	2143.84

Appendix H. The value of STOCK in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		STOCK			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2021	Jan	2865.39	2570.98	2385.65	2149.20
	Feb	2865.05	2575.93	2386.18	2154.27
	Mar	2865.10	2580.75	2387.00	2158.52
	Apr	2865.57	2585.47	2388.70	2164.76
	May	2866.28	2590.03	2391.91	2172.81
	Jun	2867.01	2594.35	2395.98	2181.74
	Jul	2867.64	2598.40	2399.84	2190.19
	Aug	2868.09	2602.19	2402.66	2198.11
	Sep	2868.33	2605.73	2404.04	2205.99
	Oct	2868.39	2609.02	2404.61	2213.79
	Nov	2868.34	2612.04	2403.85	2221.15
	Dec	2868.28	2614.81	2400.98	2228.54
2022	Jan	2868.32	2617.31	2395.63	2235.26
	Feb	2868.58	2619.57	2386.35	2239.14
	Mar	2868.77	2621.67	2375.54	2243.11
	Apr	2868.87	2623.59	2366.69	2248.45
	May	2868.91	2625.30	2360.22	2254.50
	Jun	2868.87	2626.77	2355.07	2260.74
	Jul	2868.79	2627.96	2350.24	2266.21
	Aug	2868.66	2628.92	2345.11	2270.73
	Sep	2868.51	2629.65	2340.09	2274.25
	Oct	2868.34	2630.20	2334.97	2276.54
	Nov	2868.18	2630.58	2329.73	2278.12
	Dec	2868.03	2630.83	2322.99	2278.82

Appendix H. The value of STOCK in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		STOCK			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2023	Jan	2867.90	2630.97	2315.43	2279.48
	Feb	2867.80	2630.99	2304.26	2279.02
	Mar	2867.74	2630.93	2292.71	2278.78
	Apr	2867.69	2630.77	2283.87	2279.24
	May	2867.66	2630.50	2278.06	2280.90
	Jun	2867.64	2630.07	2273.79	2283.22
	Jul	2867.63	2629.44	2270.61	2285.37
	Aug	2867.62	2628.63	2267.56	2286.67
	Sep	2867.62	2627.65	2263.80	2286.82
	Oct	2867.63	2626.54	2259.07	2286.29
	Nov	2867.65	2625.32	2252.98	2284.69
	Dec	2867.69	2624.01	2245.05	2281.41
2024	Jan	2867.74	2622.68	2235.53	2276.13
	Feb	2867.80	2621.38	2238.43	2267.71
	Mar	2867.88	2620.22	2241.31	2258.08
	Apr	2867.96	2619.25	2244.16	2250.02
	May	2868.02	2618.41	2246.97	2243.86
	Jun	2868.07	2617.65	2249.71	2238.78
	Jul	2868.10	2616.93	2252.37	2233.95
	Aug	2868.11	2616.23	2254.94	2228.87
	Sep	2868.11	2615.58	2257.43	2223.89
	Oct	2868.11	2614.97	2259.83	2218.82
	Nov	2868.10	2614.39	2262.16	2213.66
	Dec	2868.09	2613.86	2264.43	2207.31

Appendix H. The value of STOCK in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		STOCK			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2025	Jan	2868.09	2613.41	2266.62	2200.29
	Feb	2868.08	2613.07	2268.76	2190.39
	Mar	2868.07	2612.93	2270.88	2180.21
	Apr	2868.05	2613.01	2272.99	2172.20
	May	2868.03	2613.23	2275.05	2166.62
	Jun	2868.00	2613.53	2277.06	2162.27
	Jul	2867.98	2613.86	2279.00	2158.80
	Aug	2867.95	2614.19	2280.90	2155.43
	Sep	2867.94	2614.52	2282.75	2151.49
	Oct	2867.92	2614.86	2284.56	2146.76
	Nov	2867.91	2615.24	2286.32	2140.96
	Dec	2867.90	2615.70	2288.06	2133.68
2026	Jan	2867.90	2616.28	2289.76	2125.13
	Feb	2867.90	2617.04	2291.47	2126.43
	Mar	2867.90	2617.72	2293.17	2127.73
	Apr	2867.90	2618.34	2294.89	2129.03
	May	2867.91	2618.89	2296.58	2130.33
	Jun	2867.92	2619.37	2298.22	2131.61
	Jul	2867.92	2619.79	2299.79	2132.88
	Aug	2867.93	2620.14	2301.29	2134.15
	Sep	2867.94	2620.44	2302.71	2135.43
	Oct	2867.95	2620.69	2304.07	2136.71
	Nov	2867.96	2620.88	2305.36	2138.00
	Dec	2867.97	2621.03	2306.58	2139.30

Appendix I

The values of MAREA_TH in monthly data
from January 2017 to December 2026 with simple moving average technique

Appendix I. The value of MAREA_TH in monthly data from January 2017 to December 2026 with simple moving average technique

		MAREA_TH			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	Jan	2554.94	2387.15	2198.09	2108.71
	Feb	2555.91	2390.12	2201.66	2111.56
	Mar	2556.91	2393.14	2205.26	2114.44
	Apr	2557.93	2396.20	2208.90	2117.33
	May	2558.99	2399.32	2212.57	2120.25
	Jun	2560.07	2402.49	2216.29	2123.20
	Jul	2561.18	2405.71	2220.04	2126.17
	Aug	2562.33	2408.99	2223.83	2129.16
	Sep	2563.50	2412.32	2227.66	2132.18
	Oct	2564.71	2415.71	2231.54	2135.22
	Nov	2565.95	2419.15	2235.45	2138.29
	Dec	2567.23	2422.65	2239.40	2141.39
2018	Jan	2568.54	2426.21	2243.39	2144.51
	Feb	2566.42	2429.83	2246.67	2147.22
	Mar	2564.23	2433.51	2249.97	2149.95
	Apr	2561.99	2437.25	2253.31	2152.70
	May	2559.68	2441.05	2256.69	2155.48
	Jun	2557.31	2444.92	2260.10	2158.28
	Jul	2554.88	2448.85	2263.54	2161.10
	Aug	2552.37	2452.85	2267.02	2163.95
	Sep	2549.80	2456.91	2270.54	2166.82
	Oct	2547.16	2461.04	2274.10	2169.71
	Nov	2544.44	2465.24	2277.69	2172.63
	Dec	2541.65	2469.51	2281.32	2175.57

Appendix I. The value of MAREA_TH in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		MAREA_TH			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2019	Jan	2538.78	2473.85	2284.98	2178.54
	Feb	2541.02	2473.08	2287.51	2181.23
	Mar	2543.13	2472.30	2290.06	2183.94
	Apr	2545.11	2471.50	2292.64	2186.67
	May	2546.93	2470.69	2295.24	2189.43
	Jun	2548.60	2469.87	2297.87	2192.20
	Jul	2550.10	2469.03	2300.53	2195.01
	Aug	2551.42	2468.19	2303.22	2197.83
	Sep	2552.55	2467.32	2305.94	2200.68
	Oct	2553.49	2466.44	2308.68	2203.55
	Nov	2554.20	2465.55	2311.45	2206.45
	Dec	2554.70	2464.64	2314.25	2209.37
2020	Jan	2554.95	2463.72	2317.08	2212.31
	Feb	2554.95	2460.70	2318.21	2214.67
	Mar	2554.92	2457.63	2319.34	2217.05
	Apr	2554.87	2454.51	2320.49	2219.45
	May	2554.78	2451.33	2321.65	2221.87
	Jun	2554.66	2448.10	2322.82	2224.30
	Jul	2554.51	2444.82	2324.01	2226.76
	Aug	2554.33	2441.48	2325.20	2229.24
	Sep	2554.11	2438.09	2326.41	2231.74
	Oct	2553.85	2434.64	2327.64	2234.26
	Nov	2553.54	2431.14	2328.87	2236.80
	Dec	2553.20	2427.57	2330.12	2239.37

Appendix I. The value of MAREA_TH in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		MAREA_TH			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2021	Jan	2552.81	2423.95	2331.38	2241.95
	Feb	2552.37	2425.60	2332.65	2243.61
	Mar	2551.98	2427.19	2333.94	2245.29
	Apr	2551.64	2428.73	2335.24	2246.97
	May	2551.36	2430.22	2336.55	2248.68
	Jun	2551.12	2431.65	2337.88	2250.39
	Jul	2550.95	2433.02	2339.22	2252.13
	Aug	2550.84	2434.33	2340.58	2253.87
	Sep	2550.80	2435.57	2341.95	2255.63
	Oct	2550.83	2436.74	2343.33	2257.41
	Nov	2550.93	2437.85	2344.73	2259.20
	Dec	2551.11	2438.88	2346.14	2261.00
2022	Jan	2551.37	2439.83	2347.57	2262.82
	Feb	2551.72	2440.71	2345.77	2263.27
	Mar	2552.02	2441.56	2343.96	2263.72
	Apr	2552.27	2442.36	2342.13	2264.18
	May	2552.47	2443.13	2340.27	2264.64
	Jun	2552.62	2443.86	2338.40	2265.10
	Jul	2552.73	2444.55	2336.51	2265.57
	Aug	2552.81	2445.20	2334.60	2266.04
	Sep	2552.84	2445.80	2332.67	2266.51
	Oct	2552.85	2446.36	2330.72	2266.99
	Nov	2552.83	2446.87	2328.74	2267.47
	Dec	2552.80	2447.33	2326.75	2267.96

Appendix I. The value of MAREA_TH in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		MAREA_TH			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2023	Jan	2552.74	2447.74	2324.74	2268.45
	Feb	2552.68	2448.10	2321.40	2268.94
	Mar	2552.62	2448.41	2318.03	2269.44
	Apr	2552.56	2448.66	2314.63	2269.95
	May	2552.49	2448.85	2311.18	2270.45
	Jun	2552.43	2448.98	2307.71	2270.96
	Jul	2552.37	2449.04	2304.19	2271.48
	Aug	2552.31	2449.05	2300.64	2272.00
	Sep	2552.25	2448.98	2297.06	2272.52
	Oct	2552.20	2448.85	2293.43	2273.05
	Nov	2552.15	2448.65	2289.77	2273.58
	Dec	2552.11	2448.37	2286.07	2274.12
2024	Jan	2552.08	2448.02	2282.33	2274.66
	Feb	2552.06	2447.59	2283.67	2272.62
	Mar	2552.05	2447.16	2284.99	2270.56
	Apr	2552.06	2446.75	2286.28	2268.48
	May	2552.07	2446.33	2287.55	2266.38
	Jun	2552.09	2445.93	2288.79	2264.27
	Jul	2552.11	2445.53	2290.01	2262.14
	Aug	2552.15	2445.14	2291.21	2259.99
	Sep	2552.18	2444.75	2292.38	2257.82
	Oct	2552.22	2444.38	2293.52	2255.64
	Nov	2552.26	2444.01	2294.64	2253.43
	Dec	2552.30	2443.65	2295.72	2251.21

Appendix I. The value of MAREA_TH in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		MAREA_TH			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2025	Jan	2552.33	2443.30	2296.78	2248.97
	Feb	2552.36	2442.96	2297.81	2245.67
	Mar	2552.37	2442.66	2298.81	2242.35
	Apr	2552.38	2442.41	2299.78	2238.99
	May	2552.39	2442.21	2300.73	2235.61
	Jun	2552.38	2442.06	2301.65	2232.20
	Jul	2552.38	2441.96	2302.54	2228.76
	Aug	2552.37	2441.91	2303.40	2225.29
	Sep	2552.36	2441.92	2304.23	2221.79
	Oct	2552.34	2441.98	2305.02	2218.26
	Nov	2552.33	2442.11	2305.79	2214.71
	Dec	2552.31	2442.29	2306.52	2211.12
2026	Jan	2552.30	2442.53	2307.22	2207.50
	Feb	2552.29	2442.84	2307.89	2208.62
	Mar	2552.28	2443.13	2308.52	2209.72
	Apr	2552.27	2443.40	2309.13	2210.80
	May	2552.26	2443.64	2309.72	2211.87
	Jun	2552.25	2443.86	2310.27	2212.93
	Jul	2552.25	2444.07	2310.79	2213.97
	Aug	2552.25	2444.25	2311.28	2214.99
	Sep	2552.24	2444.42	2311.74	2216.00
	Oct	2552.24	2444.56	2312.17	2216.99
	Nov	2552.25	2444.70	2312.57	2217.97
	Dec	2552.25	2444.81	2312.93	2218.93

Appendix J

The values of UPRICE in monthly data from January 2017 to December 2026 with simple moving average technique

Appendix J. The value of UPRICE in monthly data from January 2017 to December 2026 with simple moving average technique

		UPRICE			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	Jan	295.70	335.71	328.86	343.06
	Feb	294.12	335.16	329.55	343.67
	Mar	292.73	334.37	330.13	344.00
	Apr	292.09	333.10	330.81	344.21
	May	292.11	330.43	331.70	344.68
	Jun	291.92	327.66	332.65	345.08
	Jul	291.75	326.12	333.64	345.55
	Aug	291.48	325.14	334.58	346.20
	Sep	290.63	324.31	335.49	346.84
	Oct	289.66	323.31	336.55	347.11
	Nov	288.79	322.10	337.56	347.22
	Dec	288.16	321.23	338.53	346.98
2018	Jan	287.49	320.27	339.33	346.66
	Feb	286.61	319.05	340.00	346.46
	Mar	286.32	317.51	340.53	346.64
	Apr	286.75	316.39	341.18	346.38
	May	287.52	315.64	342.10	345.34
	Jun	288.48	315.16	343.27	342.99
	Jul	288.38	315.05	344.46	340.61
	Aug	288.80	314.95	345.44	337.12
	Sep	289.24	315.14	346.20	333.51
	Oct	290.08	315.43	346.52	330.40
	Nov	291.06	315.70	346.70	329.78
	Dec	292.00	315.75	346.50	330.48

Appendix J. The value of UPRICE in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		UPRICE			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2019	Jan	293.45	315.52	346.20	331.35
	Feb	293.02	314.90	345.91	331.92
	Mar	292.64	314.41	345.78	332.41
	Apr	292.33	314.39	345.97	332.97
	May	292.08	314.78	346.03	333.70
	Jun	291.86	315.04	345.49	334.47
	Jul	291.68	315.32	344.03	335.28
	Aug	291.50	315.55	342.67	336.05
	Sep	291.34	315.44	341.26	336.79
	Oct	291.18	315.27	339.57	337.64
	Nov	291.02	315.18	338.03	338.47
	Dec	290.85	315.24	336.65	339.25
2020	Jan	290.69	315.29	336.47	339.90
	Feb	290.55	315.22	336.14	340.43
	Mar	290.45	315.53	335.65	340.86
	Apr	290.39	316.27	334.87	341.38
	May	290.34	317.23	333.22	342.12
	Jun	290.29	318.30	331.52	343.06
	Jul	290.25	318.73	330.60	344.01
	Aug	290.20	319.50	330.03	344.79
	Sep	290.17	320.27	329.57	345.39
	Oct	290.16	321.29	328.99	345.65
	Nov	290.17	322.40	328.30	345.78
	Dec	290.21	323.49	327.82	345.61

Appendix J. The value of UPRICE in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		UPRICE			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2021	Jan	290.27	324.88	327.29	345.36
	Feb	290.34	324.45	326.60	345.12
	Mar	290.45	324.02	325.71	345.02
	Apr	290.56	323.59	325.10	345.16
	May	290.67	323.14	324.72	345.20
	Jun	290.75	322.68	324.51	344.76
	Jul	290.82	322.22	324.55	343.59
	Aug	290.89	321.80	324.58	342.50
	Sep	290.94	321.40	324.80	341.37
	Oct	290.99	321.04	325.08	340.02
	Nov	291.02	320.71	325.35	338.79
	Dec	291.02	320.42	325.48	337.69
2022	Jan	290.99	320.16	325.44	337.56
	Feb	290.92	319.90	325.15	337.30
	Mar	290.86	319.65	324.96	336.92
	Apr	290.81	319.40	325.05	336.30
	May	290.77	319.17	325.40	335.00
	Jun	290.73	318.98	325.68	333.65
	Jul	290.70	318.84	325.97	332.93
	Aug	290.67	318.72	326.22	332.50
	Sep	290.65	318.61	326.27	332.15
	Oct	290.63	318.52	326.27	331.71
	Nov	290.62	318.44	326.33	331.17
	Dec	290.61	318.38	326.48	330.82

Appendix J. The value of UPRICE in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		UPRICE			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2023	Jan	290.60	318.33	326.63	330.42
	Feb	290.60	318.30	326.71	329.89
	Mar	290.60	318.28	327.02	329.21
	Apr	290.60	318.30	327.60	328.75
	May	290.61	318.33	328.32	328.47
	Jun	290.61	318.37	329.10	328.34
	Jul	290.62	318.43	329.49	328.40
	Aug	290.63	318.48	330.08	328.46
	Sep	290.65	318.54	330.67	328.67
	Oct	290.66	318.60	331.42	328.92
	Nov	290.67	318.65	332.21	329.17
	Dec	290.69	318.70	333.00	329.31
2024	Jan	290.70	318.75	333.97	329.30
	Feb	290.71	318.80	333.82	329.11
	Mar	290.72	318.87	333.67	328.98
	Apr	290.73	318.94	333.52	329.09
	May	290.73	319.02	333.38	329.41
	Jun	290.74	319.09	333.24	329.66
	Jul	290.74	319.16	333.13	329.93
	Aug	290.73	319.22	333.06	330.16
	Sep	290.73	319.28	333.02	330.23
	Oct	290.72	319.35	333.04	330.27
	Nov	290.72	319.41	333.09	330.35
	Dec	290.71	319.48	333.16	330.51

Appendix J. The value of UPRICE in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		UPRICE			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2025	Jan	290.70	319.55	333.21	330.66
	Feb	290.69	319.63	333.26	330.75
	Mar	290.69	319.70	333.30	331.03
	Apr	290.68	319.77	333.33	331.53
	May	290.68	319.83	333.36	332.14
	Jun	290.67	319.87	333.37	332.80
	Jul	290.67	319.90	333.38	333.14
	Aug	290.67	319.92	333.38	333.64
	Sep	290.67	319.92	333.36	334.14
	Oct	290.67	319.92	333.34	334.77
	Nov	290.67	319.89	333.31	335.44
	Dec	290.67	319.85	333.27	336.09
2026	Jan	290.68	319.79	333.21	336.89
	Feb	290.68	319.71	333.15	336.93
	Mar	290.68	319.63	333.08	336.97
	Apr	290.68	319.56	333.00	337.00
	May	290.69	319.49	332.91	337.02
	Jun	290.69	319.43	332.82	337.03
	Jul	290.69	319.37	332.71	337.04
	Aug	290.69	319.33	332.59	337.04
	Sep	290.69	319.28	332.45	337.03
	Oct	290.69	319.25	332.31	337.01
	Nov	290.70	319.22	332.16	336.98
	Dec	290.70	319.19	332.01	336.94

Appendix K

The values of RAINFALL_TH in monthly data from January 2017 to December 2026 with simple moving average technique

Appendix K. The value of RAINFALL_TH in monthly data from January 2017 to December 2026 with simple moving average technique

		RAINFALL_TH			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	Jan	126.09	134.11	138.27	138.86
	Feb	129.36	134.91	139.50	139.83
	Mar	132.85	136.74	140.87	140.90
	Apr	135.86	138.05	141.40	141.74
	May	137.30	138.63	141.50	141.96
	Jun	137.40	137.09	140.60	140.81
	Jul	135.88	136.70	140.36	140.47
	Aug	133.30	135.52	139.45	139.98
	Sep	130.01	134.21	138.68	139.38
	Oct	127.25	131.42	137.39	138.36
	Nov	125.76	131.73	137.17	137.64
	Dec	126.25	131.96	137.72	138.24
2018	Jan	127.67	133.10	138.93	139.16
	Feb	130.56	134.67	139.91	140.10
	Mar	133.73	136.46	141.24	140.95
	Apr	136.34	138.25	142.42	141.72
	May	138.01	139.09	143.29	141.78
	Jun	138.93	138.93	143.54	141.16
	Jul	138.78	137.66	143.06	140.64
	Aug	136.71	135.22	142.32	140.11
	Sep	133.91	133.75	140.52	139.66
	Oct	130.35	130.76	139.71	138.36
	Nov	129.57	129.34	138.51	137.86
	Dec	130.47	129.30	138.79	137.81

Appendix K. The value of RAINFALL_TH in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		RAINFALL_TH			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2019	Jan	132.82	130.63	139.37	138.56
	Feb	132.88	132.67	140.45	139.55
	Mar	132.87	134.82	141.72	140.65
	Apr	132.78	136.66	141.20	141.07
	May	132.61	137.53	141.59	141.14
	Jun	132.38	137.60	140.92	140.42
	Jul	132.16	136.69	140.31	140.23
	Aug	131.99	135.15	139.07	139.50
	Sep	131.93	133.21	137.53	138.89
	Oct	131.94	131.61	135.63	137.85
	Nov	132.08	130.79	134.94	137.68
	Dec	132.30	131.17	135.64	138.12
2020	Jan	132.53	132.10	136.45	139.10
	Feb	132.71	133.91	136.98	139.88
	Mar	132.80	135.87	138.15	140.94
	Apr	132.80	137.47	138.98	141.88
	May	132.72	138.49	139.35	142.58
	Jun	132.59	139.05	138.39	142.78
	Jul	132.45	138.96	138.17	142.38
	Aug	132.36	137.72	137.44	141.79
	Sep	132.33	136.06	136.65	140.34
	Oct	132.40	133.96	134.92	139.69
	Nov	132.54	133.55	135.16	138.73
	Dec	132.73	134.16	135.34	138.96

Appendix K. The value of RAINFALL_TH in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		RAINFALL_TH			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2021	Jan	132.91	135.63	136.08	139.42
	Feb	133.05	135.58	137.09	140.29
	Mar	133.12	135.49	138.24	141.30
	Apr	133.11	135.37	139.37	140.88
	May	133.02	135.27	139.91	141.19
	Jun	132.88	135.15	139.82	140.65
	Jul	132.71	135.04	139.04	140.16
	Aug	132.54	134.95	137.53	139.17
	Sep	132.43	134.89	136.63	137.94
	Oct	132.39	134.87	134.80	136.42
	Nov	132.44	134.91	133.95	135.88
	Dec	132.52	134.96	133.97	136.44
2022	Jan	132.58	134.99	134.85	137.10
	Feb	132.57	135.01	136.17	137.52
	Mar	132.56	135.01	137.55	138.46
	Apr	132.55	134.98	138.73	139.13
	May	132.55	134.93	139.30	139.43
	Jun	132.55	134.87	139.36	138.66
	Jul	132.55	134.83	138.81	138.49
	Aug	132.56	134.80	137.87	137.91
	Sep	132.58	134.79	136.68	137.28
	Oct	132.60	134.80	135.72	135.90
	Nov	132.61	134.85	135.25	136.10
	Dec	132.63	134.91	135.53	136.25

Appendix K. The value of RAINFALL_TH in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		RAINFALL_TH			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2023	Jan	132.64	134.95	136.16	136.85
	Feb	132.64	134.99	137.33	137.67
	Mar	132.64	134.99	138.59	138.59
	Apr	132.63	134.97	139.62	139.50
	May	132.63	134.91	140.28	139.93
	Jun	132.63	134.84	140.65	139.86
	Jul	132.63	134.77	140.61	139.24
	Aug	132.63	134.73	139.85	138.03
	Sep	132.64	134.72	138.84	137.32
	Oct	132.65	134.73	137.55	135.85
	Nov	132.66	134.80	137.33	135.18
	Dec	132.66	134.89	137.75	135.21
2024	Jan	132.66	134.98	138.71	135.93
	Feb	132.65	135.06	138.71	136.99
	Mar	132.64	135.10	138.69	138.10
	Apr	132.63	135.10	138.67	139.05
	May	132.61	135.07	138.63	139.50
	Jun	132.60	135.03	138.59	139.56
	Jul	132.59	134.99	138.56	139.12
	Aug	132.59	134.96	138.54	138.37
	Sep	132.59	134.96	138.52	137.42
	Oct	132.60	134.99	138.51	136.66
	Nov	132.60	135.04	138.51	136.29
	Dec	132.61	135.12	138.52	136.52

Appendix K. The value of RAINFALL_TH in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		RAINFALL_TH			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2025	Jan	132.61	135.18	138.54	137.04
	Feb	132.61	135.23	138.54	137.98
	Mar	132.61	135.25	138.53	138.99
	Apr	132.61	135.24	138.50	139.82
	May	132.61	135.21	138.47	140.35
	Jun	132.62	135.15	138.44	140.65
	Jul	132.62	135.09	138.42	140.61
	Aug	132.62	135.02	138.40	140.01
	Sep	132.62	134.98	138.39	139.20
	Oct	132.62	134.96	138.39	138.17
	Nov	132.62	134.98	138.40	138.00
	Dec	132.62	135.00	138.41	138.34
2026	Jan	132.62	135.01	138.42	139.12
	Feb	132.62	135.00	138.41	139.12
	Mar	132.62	134.99	138.40	139.11
	Apr	132.62	134.99	138.37	139.10
	May	132.62	134.98	138.32	139.08
	Jun	132.62	134.97	138.27	139.05
	Jul	132.62	134.97	138.22	139.04
	Aug	132.62	134.97	138.17	139.03
	Sep	132.62	134.97	138.12	139.02
	Oct	132.62	134.97	138.10	139.02
	Nov	132.62	134.97	138.08	139.03
	Dec	132.62	134.98	138.08	139.05

Appendix L

The values of CPETRO in monthly data from January 2017 to December 2026 with simple moving average technique

Appendix L. The value of CPETRO in monthly data from January 2017 to December 2026 with simple moving average technique

		CPETRO			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2017	Jan	75.80	89.40	85.88	85.33
	Feb	75.07	89.11	86.32	85.60
	Mar	74.24	88.72	86.79	85.83
	Apr	73.41	88.23	87.20	86.04
	May	72.54	87.81	87.59	86.21
	Jun	71.61	87.54	87.89	86.39
	Jul	70.59	87.48	88.09	86.54
	Aug	69.63	87.33	88.33	86.65
	Sep	68.79	87.03	88.51	86.79
	Oct	68.03	86.71	88.72	86.87
	Nov	67.53	86.43	88.87	86.91
	Dec	67.27	86.18	88.99	86.87
2018	Jan	67.45	85.93	89.13	86.85
	Feb	68.01	85.62	89.26	86.82
	Mar	68.37	85.25	89.41	86.76
	Apr	68.80	84.96	89.51	86.64
	May	69.12	84.73	89.57	86.45
	Jun	69.30	84.48	89.72	86.15
	Jul	69.53	84.23	89.87	85.77
	Aug	69.95	83.88	90.03	85.38
	Sep	70.62	83.48	90.18	85.13
	Oct	71.30	83.05	90.33	85.02
	Nov	71.97	82.68	90.42	85.12
	Dec	72.77	82.35	90.48	85.38

Appendix L. The value of CPETRO in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		CPETRO			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2019	Jan	73.78	81.96	90.48	85.74
	Feb	73.50	81.63	90.46	86.09
	Mar	73.24	81.24	90.38	86.46
	Apr	72.98	80.86	90.19	86.79
	May	72.73	80.46	89.92	87.10
	Jun	72.49	80.04	89.73	87.34
	Jul	72.26	79.56	89.56	87.49
	Aug	72.03	79.14	89.37	87.68
	Sep	71.82	78.79	89.26	87.81
	Oct	71.63	78.50	89.14	87.97
	Nov	71.45	78.38	89.02	88.09
	Dec	71.28	78.40	88.85	88.18
2020	Jan	71.14	78.70	88.69	88.29
	Feb	71.01	79.22	88.50	88.38
	Mar	70.89	79.62	88.25	88.50
	Apr	70.80	80.07	87.94	88.57
	May	70.73	80.45	87.67	88.61
	Jun	70.68	80.75	87.50	88.72
	Jul	70.65	81.07	87.47	88.83
	Aug	70.65	81.51	87.37	88.95
	Sep	70.68	82.11	87.19	89.06
	Oct	70.73	82.71	86.99	89.17
	Nov	70.81	83.30	86.82	89.23
	Dec	70.90	83.97	86.67	89.27

Appendix L. The value of CPETRO in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		CPETRO			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2021	Jan	71.00	84.76	86.52	89.27
	Feb	71.10	84.64	86.32	89.24
	Mar	71.19	84.52	86.10	89.17
	Apr	71.26	84.40	85.93	89.00
	May	71.33	84.27	85.79	88.78
	Jun	71.39	84.16	85.65	88.61
	Jul	71.45	84.05	85.51	88.47
	Aug	71.51	83.93	85.30	88.31
	Sep	71.55	83.83	85.06	88.21
	Oct	71.58	83.72	84.82	88.10
	Nov	71.58	83.61	84.60	88.00
	Dec	71.57	83.51	84.41	87.86
2022	Jan	71.54	83.41	84.19	87.72
	Feb	71.48	83.31	84.01	87.56
	Mar	71.42	83.21	83.79	87.35
	Apr	71.37	83.12	83.58	87.10
	May	71.32	83.03	83.36	86.88
	Jun	71.29	82.95	83.12	86.73
	Jul	71.25	82.88	82.86	86.70
	Aug	71.22	82.80	82.63	86.62
	Sep	71.20	82.73	82.45	86.46
	Oct	71.18	82.65	82.31	86.30
	Nov	71.17	82.59	82.27	86.15
	Dec	71.16	82.52	82.32	86.03

Appendix L. The value of CPETRO in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		CPETRO			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2023	Jan	71.16	82.46	82.55	85.90
	Feb	71.16	82.40	82.91	85.74
	Mar	71.17	82.35	83.21	85.56
	Apr	71.17	82.30	83.52	85.42
	May	71.18	82.26	83.79	85.31
	Jun	71.20	82.22	84.02	85.19
	Jul	71.21	82.18	84.25	85.07
	Aug	71.23	82.14	84.56	84.90
	Sep	71.24	82.11	84.97	84.71
	Oct	71.26	82.09	85.37	84.51
	Nov	71.27	82.08	85.77	84.33
	Dec	71.29	82.07	86.21	84.18
2024	Jan	71.30	82.06	86.73	84.00
	Feb	71.30	82.06	86.73	83.85
	Mar	71.31	82.07	86.72	83.68
	Apr	71.31	82.08	86.72	83.51
	May	71.32	82.10	86.71	83.33
	Jun	71.31	82.13	86.71	83.14
	Jul	71.31	82.17	86.72	82.93
	Aug	71.31	82.21	86.73	82.74
	Sep	71.30	82.26	86.74	82.60
	Oct	71.30	82.32	86.76	82.49
	Nov	71.29	82.38	86.77	82.46
	Dec	71.28	82.45	86.79	82.51

Appendix L. The value of CPETRO in monthly data from January 2017 to December 2026 with simple moving average technique (cont.)

		CPETRO			
		2013-2015 (3 years)	2011-2015 (5 years)	2008-2015 (8 years)	2006-2015 (10 years)
2025	Jan	71.27	82.52	86.81	82.69
	Feb	71.27	82.58	86.82	82.98
	Mar	71.26	82.64	86.82	83.22
	Apr	71.25	82.69	86.82	83.47
	May	71.25	82.73	86.82	83.69
	Jun	71.25	82.77	86.81	83.86
	Jul	71.25	82.80	86.80	84.05
	Aug	71.25	82.83	86.78	84.30
	Sep	71.25	82.85	86.77	84.62
	Oct	71.25	82.87	86.75	84.94
	Nov	71.25	82.87	86.73	85.25
	Dec	71.25	82.86	86.71	85.61
2026	Jan	71.26	82.84	86.68	86.01
	Feb	71.26	82.81	86.66	86.04
	Mar	71.26	82.78	86.63	86.06
	Apr	71.26	82.75	86.60	86.08
	May	71.27	82.72	86.57	86.10
	Jun	71.27	82.70	86.54	86.11
	Jul	71.27	82.67	86.51	86.13
	Aug	71.27	82.65	86.47	86.14
	Sep	71.27	82.63	86.44	86.16
	Oct	71.28	82.61	86.40	86.17
	Nov	71.28	82.59	86.36	86.19
	Dec	71.28	82.57	86.31	86.20

Appendix M

The predicted data of equilibrium of quantity and price in world natural rubber from 2017 to 2026 with Box and Jenkins by using actual predicted explanatory variables between 2004 and 2015

Appendix M. The predicted data of equilibrium of quantity and price in world natural rubber from 2017 to 2026 with Box and Jenkins by using actual predicted explanatory variables between 2004 and 2015

		Equilibrium Qd (thousand tones)	Equilibrium NRPRICE (thousand yens)
2016	Jul	-	14.5929
	Aug	-	9.5523
	Sep	-	4.7333
	Oct	-	2.1745
	Nov	-	2.3310
	Dec	-	2.6955
2017	Jan	985.96	3.2249
	Feb	966.29	4.0534
	Mar	959.96	3.9455
	Apr	948.07	4.4591
	May	964.86	4.5347
	Jun	976.42	6.3013
	Jul	1005.01	5.4365
	Aug	1014.89	3.5899
	Sep	1014.68	1.8104
	Oct	1013.68	0.8528
	Nov	998.62	0.9290
	Dec	993.08	1.1187
2018	Jan	997.42	1.5258
	Feb	977.49	1.8943
	Mar	970.82	1.8295
	Apr	959.16	2.0604
	May	977.38	2.0833
	Jun	990.21	2.8611
	Jul	1004.82	2.4541
	Aug	1014.11	1.6144
	Sep	1013.50	0.8140
	Oct	1012.32	0.3816
	Nov	996.99	0.4123
	Dec	990.90	0.4935

Appendix M. The predicted data of equilibrium of quantity and price in world natural rubber from 2017 to 2026 with Box and Jenkins by using actual predicted explanatory variables between 2004 and 2015 (cont.)

		Equilibrium Qd (thousand tones)	Equilibrium NRPRICE (thousand yens)
2019	Jan	994.67	0.6726
	Feb	974.59	0.8340
	Mar	967.90	0.8000
	Apr	956.04	0.8930
	May	973.80	0.8982
	Jun	986.29	1.2313
	Jul	1000.77	1.0477
	Aug	1009.93	0.6825
	Sep	1008.98	0.3407
	Oct	1007.37	0.1589
	Nov	991.85	0.1710
	Dec	985.67	0.2032
2020	Jan	989.22	0.2742
	Feb	968.80	0.3376
	Mar	961.68	0.3230
	Apr	949.64	0.3596
	May	967.09	0.3592
	Jun	979.14	0.4886
	Jul	993.04	0.4148
	Aug	1001.78	0.2697
	Sep	1000.69	0.1341
	Oct	998.93	0.0621
	Nov	983.21	0.0663
	Dec	976.71	0.0785
2021	Jan	979.96	0.1055
	Feb	959.62	0.1291
	Mar	952.37	0.1224
	Apr	940.08	0.1352
	May	957.00	0.1345
	Jun	968.72	0.1821

Appendix M. The predicted data of equilibrium of quantity and price in world natural rubber from 2017 to 2026 with Box and Jenkins by using actual predicted explanatory variables between 2004 and 2015 (cont.)

		Equilibrium Qd (thousand tones)	Equilibrium NRPRICE (thousand yens)
2021	Jul	982.29	0.1532
	Aug	990.60	0.0988
	Sep	989.08	0.0489
	Oct	986.99	0.0225
	Nov	971.24	0.0240
	Dec	964.58	0.0282
2022	Jan	967.45	0.0376
	Feb	946.98	0.0458
	Mar	939.57	0.0433
	Apr	927.30	0.0476
	May	943.76	0.0470
	Jun	954.96	0.0632
	Jul	968.02	0.0530
	Aug	976.01	0.0340
	Sep	974.34	0.0167
	Oct	971.99	0.0076
	Nov	956.12	0.0081
	Dec	949.27	0.0095
2023	Jan	951.88	0.0126
	Feb	931.51	0.0152
	Mar	923.88	0.0143
	Apr	911.46	0.0156
	May	927.36	0.0153
	Jun	938.16	0.0205
	Jul	950.72	0.0171
	Aug	958.20	0.0109
	Sep	956.24	0.0053
	Oct	953.71	0.0024
	Nov	937.94	0.0025
	Dec	930.94	0.0030

Appendix M. The predicted data of equilibrium of quantity and price in world natural rubber from 2017 to 2026 with Box and Jenkins by using actual predicted explanatory variables between 2004 and 2015 (cont.)

		Equilibrium Qd (thousand tones)	Equilibrium NRPRICE (thousand yens)
2024	Jan	933.18	0.0039
	Feb	912.94	0.0047
	Mar	905.28	0.0044
	Apr	892.90	0.0048
	May	908.17	0.0047
	Jun	918.43	0.0062
	Jul	930.47	0.0051
	Aug	937.58	0.0033
	Sep	935.38	0.0016
	Oct	932.57	0.0007
	Nov	916.83	0.0007
	Dec	909.76	0.0009
2025	Jan	911.71	0.0011
	Feb	891.66	0.0014
	Mar	883.87	0.0013
	Apr	871.51	0.0014
	May	886.22	0.0013
	Jun	896.00	0.0018
	Jul	907.45	0.0014
	Aug	914.08	0.0009
	Sep	911.70	0.0004
	Oct	908.75	0.0002
	Nov	893.17	0.0002
	Dec	885.97	0.0002
2026	Jan	887.60	0.0003
	Feb	867.86	0.0004
	Mar	860.05	0.0003
	Apr	847.76	0.0004
	May	861.77	0.0004
	Jun	871.02	0.0005

Appendix M. The predicted data of equilibrium of quantity and price in world natural rubber from 2017 to 2026 with Box and Jenkins by using actual predicted explanatory variables between 2004 and 2015 (cont.)

		Equilibrium Qd (thousand tones)	Equilibrium NRPRICE (thousand yens)
2026	Jul	881.93	-
	Aug	888.13	-
	Sep	885.53	-
	Oct	882.37	-
	Nov	867.00	-
	Dec	859.81	-

Appendix N

The predicted data of equilibrium of quantity and price in world natural rubber from 2017 to 2026 with Box and Jenkins by using actual predicted explanatory variables between 2011 and 2015

Appendix N. The predicted data of equilibrium of quantity and price in world natural rubber from 2017 to 2026 with Box and Jenkins by using actual predicted explanatory variables between 2011 and 2015

		Equilibrium Qd (thousand tones)	Equilibrium NRPRICE (thousand yens)
2016	Jul	-	37.4325
	Aug	-	18.2798
	Sep	-	9.3543
	Oct	-	5.1763
	Nov	-	8.0057
	Dec	-	8.4933
2017	Jan	925.77	8.7492
	Feb	890.76	12.8073
	Mar	884.31	15.8366
	Apr	878.68	19.0963
	May	905.02	19.6003
	Jun	912.48	24.7957
	Jul	914.76	15.1011
	Aug	927.65	7.3064
	Sep	938.60	3.7202
	Oct	933.56	2.0469
	Nov	921.17	3.1555
	Dec	908.56	3.3265
2018	Jan	910.07	3.4041
	Feb	875.11	4.9528
	Mar	868.39	6.0882
	Apr	862.47	7.3079
	May	888.01	7.4540
	Jun	894.90	9.3889
	Jul	896.68	6.3233
	Aug	908.88	3.0415
	Sep	919.18	1.5380
	Oct	913.87	0.8415
	Nov	901.31	1.2903
	Dec	888.61	1.3525

Appendix N. The predicted data of equilibrium of quantity and price in world natural rubber from 2017 to 2026 with Box and Jenkins by using actual predicted explanatory variables between 2011 and 2015 (cont.)

		Equilibrium Qd (thousand tones)	Equilibrium NRPRICE (thousand yens)
2019	Jan	888.09	1.3761
	Feb	853.56	1.9895
	Mar	846.58	2.4320
	Apr	840.42	2.9006
	May	864.92	2.9421
	Jun	871.22	3.6846
	Jul	872.56	2.3152
	Aug	883.99	1.1071
	Sep	893.60	0.5565
	Oct	888.00	0.3027
	Nov	875.39	0.4614
	Dec	862.66	0.4810
2020	Jan	862.69	0.4865
	Feb	828.76	0.6995
	Mar	821.59	0.8501
	Apr	815.23	1.0080
	May	838.61	1.0163
	Jun	844.33	1.2655
	Jul	845.23	0.8216
	Aug	855.92	0.3906
	Sep	864.81	0.1952
	Oct	859.00	0.1056
	Nov	846.39	0.1600
	Dec	833.70	0.1658
2021	Jan	832.81	0.1667
	Feb	799.68	0.2384
	Mar	792.40	0.2880
	Apr	785.89	0.3396
	May	808.05	0.3404
	Jun	813.19	0.4214

Appendix N. The predicted data of equilibrium of quantity and price in world natural rubber from 2017 to 2026 with Box and Jenkins by using actual predicted explanatory variables between 2011 and 2015 (cont.)

		Equilibrium Qd (thousand tones)	Equilibrium NRPRICE (thousand yens)
2021	Jul	813.67	0.2658
	Aug	823.58	0.1256
	Sep	831.75	0.0624
	Oct	825.78	0.0336
	Nov	813.28	0.0506
	Dec	800.71	0.0521
2022	Jan	799.78	0.0521
	Feb	767.62	0.0740
	Mar	760.27	0.0890
	Apr	753.68	0.1043
	May	774.57	0.1039
	Jun	779.13	0.1279
	Jul	779.23	0.0813
	Aug	788.35	0.0382
	Sep	795.80	0.0189
	Oct	789.72	0.0101
	Nov	777.40	0.0151
	Dec	765.03	0.0155
2023	Jan	763.61	0.0154
	Feb	732.56	0.0218
	Mar	725.21	0.0260
	Apr	718.59	0.0303
	May	738.16	0.0300
	Jun	742.16	0.0367
	Jul	741.91	0.0230
	Aug	750.25	0.0108
	Sep	756.99	0.0053
	Oct	750.85	0.0028
	Nov	738.80	0.0042
	Dec	726.70	0.0043

Appendix N. The predicted data of equilibrium of quantity and price in world natural rubber from 2017 to 2026 with Box and Jenkins by using actual predicted explanatory variables between 2011 and 2015 (cont.)

		Equilibrium Qd (thousand tones)	Equilibrium NRPRICE (thousand yens)
2024	Jan	725.12	0.0042
	Feb	695.31	0.0059
	Mar	688.01	0.0070
	Apr	681.41	0.0081
	May	699.65	0.0080
	Jun	703.11	0.0098
	Jul	702.54	0.0061
	Aug	710.11	0.0028
	Sep	716.15	0.0014
	Oct	710.01	0.0007
	Nov	698.29	0.0011
	Dec	686.54	0.0011
2025	Jan	684.67	0.0011
	Feb	656.21	0.0015
	Mar	649.02	0.0018
	Apr	642.50	0.0020
	May	659.39	0.0020
	Jun	662.34	0.0024
	Jul	661.50	0.0015
	Aug	668.31	0.0007
	Sep	673.69	0.0003
	Oct	667.60	0.0002
	Nov	656.27	0.0003
	Dec	644.92	0.0003
2026	Jan	642.90	0.0003
	Feb	615.90	0.0004
	Mar	608.86	0.0004
	Apr	602.46	0.0005
	May	618.01	0.0005
	Jun	620.49	0.0006

Appendix N. The predicted data of equilibrium of quantity and price in world natural rubber from 2017 to 2026 with Box and Jenkins by using actual predicted explanatory variables between 2011 and 2015 (cont.)

		Equilibrium Qd (thousand tones)	Equilibrium NRPRICE (thousand yens)
2026	Jul	619.42	-
	Aug	625.50	-
	Sep	630.24	-
	Oct	624.25	-
	Nov	613.38	-
	Dec	602.49	-

Appendix O

The predicted data of quantity of world natural rubber consumption from January 2017 to December 2026 by using actual predicted data and percentage change in explanatory variables from simple moving average

Appendix O. The predicted data of quantity of world natural rubber consumption from January 2017 to December 2026 by using actual predicted data and percentage change in explanatory variables from simple moving average

		Actual Predicted Data		Percentage Change	
		Demand Model	Supply Model	Demand Model	Supply Model
2017	Jan	948.82	965.58	948.91	964.32
	Feb	948.52	966.30	948.79	965.65
	Mar	948.84	967.11	948.55	966.38
	Apr	949.08	967.81	948.87	967.18
	May	949.00	968.41	949.07	967.87
	Jun	948.50	968.79	948.95	968.44
	Jul	947.97	969.26	948.45	968.84
	Aug	947.58	969.65	947.93	969.30
	Sep	947.62	970.03	947.59	969.69
	Oct	947.48	970.30	947.60	970.05
	Nov	947.67	971.22	947.50	970.40
	Dec	947.99	972.21	947.70	971.32
2018	Jan	948.26	973.19	948.02	972.31
	Feb	948.29	974.18	948.26	973.29
	Mar	949.11	975.16	948.38	974.28
	Apr	949.66	976.18	949.17	975.26
	May	950.24	977.11	949.72	976.28
	Jun	950.34	977.84	950.25	977.18
	Jul	950.02	978.46	950.31	977.90
	Aug	949.78	978.94	950.00	978.50
	Sep	949.73	979.62	949.78	979.01
	Oct	949.52	980.06	949.71	979.66
	Nov	949.55	980.76	949.52	980.13
	Dec	949.45	981.72	949.54	980.86
2019	Jan	948.66	982.90	949.36	981.84
	Feb	948.44	983.00	948.64	982.91
	Mar	948.59	983.10	948.46	983.01
	Apr	948.93	983.09	948.62	983.10
	May	949.44	982.86	948.99	983.07
	Jun	949.45	982.49	949.44	982.82

Appendix O. The predicted data of quantity of world natural rubber consumption from January 2017 to December 2026 by using actual predicted data and percentage change in explanatory variables from simple moving average (cont.)

		Actual Predicted Data		Percentage Change	
		Demand Model	Supply Model	Demand Model	Supply Model
2019	Jul	949.33	981.98	949.44	982.44
	Aug	949.26	981.45	949.32	981.92
	Sep	949.11	980.89	949.25	981.40
	Oct	949.17	980.35	949.12	980.83
	Nov	949.03	979.95	949.16	980.31
	Dec	948.59	979.86	948.98	979.94
2020	Jan	948.46	980.04	948.58	979.88
	Feb	948.26	980.05	948.44	980.04
	Mar	948.87	980.04	948.33	980.05
	Apr	949.76	979.91	948.97	980.03
	May	951.04	979.53	949.90	979.87
	Jun	951.79	978.95	951.12	979.47
	Jul	952.32	978.25	951.84	978.88
	Aug	952.56	977.47	952.35	978.17
	Sep	952.27	976.68	952.53	977.39
	Oct	951.68	975.80	952.21	976.59
	Nov	951.10	975.13	951.61	975.73
	Dec	950.72	974.68	951.06	975.09
2021	Jan	950.51	974.52	950.70	974.66
	Feb	950.38	974.66	950.49	974.53
	Mar	950.25	974.79	950.37	974.68
	Apr	950.11	974.87	950.23	974.80
	May	949.98	974.94	950.10	974.88
	Jun	949.86	975.01	949.97	974.95
	Jul	949.76	975.03	949.85	975.01
	Aug	949.70	975.27	949.75	975.06
	Sep	949.65	975.51	949.69	975.30
	Oct	949.61	975.73	949.64	975.53
	Nov	949.59	975.96	949.61	975.76
	Dec	949.58	976.17	949.59	975.98

Appendix O. The predicted data of quantity of world natural rubber consumption from January 2017 to December 2026 by using actual predicted data and percentage change in explanatory variables from simple moving average (cont.)

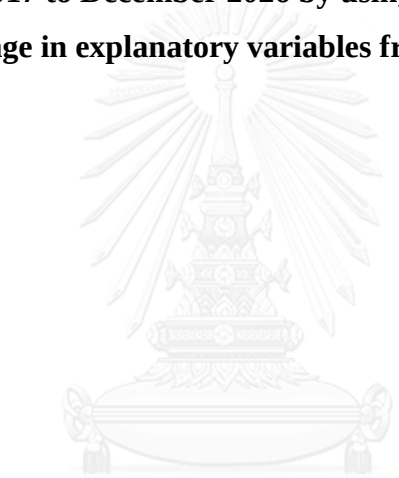
		Actual Predicted Data		Percentage Change	
		Demand Model	Supply Model	Demand Model	Supply Model
2022	Jan	949.58	976.37	949.58	976.20
	Feb	949.59	976.55	949.58	976.39
	Mar	949.60	976.72	949.59	976.57
	Apr	949.61	976.88	949.60	976.74
	May	949.61	977.03	949.61	976.90
	Jun	949.61	977.18	949.61	977.05
	Jul	949.63	977.32	949.61	977.19
	Aug	949.65	977.45	949.63	977.33
	Sep	949.68	977.58	949.65	977.46
	Oct	949.71	977.70	949.68	977.59
	Nov	949.75	977.83	949.71	977.72
	Dec	949.78	977.93	949.75	977.84
2023	Jan	949.80	978.03	949.78	977.94
	Feb	949.83	978.11	949.80	978.04
	Mar	949.85	978.17	949.83	978.12
	Apr	949.86	978.22	949.85	978.18
	May	949.86	978.26	949.86	978.23
	Jun	949.85	978.28	949.86	978.26
	Jul	949.84	978.28	949.85	978.28
	Aug	949.84	978.28	949.84	978.28
	Sep	949.84	978.27	949.84	978.28
	Oct	949.84	978.25	949.84	978.27
	Nov	949.84	978.22	949.84	978.24
	Dec	949.85	978.17	949.84	978.21
2024	Jan	949.85	978.11	949.85	978.17
	Feb	949.87	978.03	949.86	978.11
	Mar	949.90	977.95	949.88	978.03
	Apr	949.92	977.87	949.90	977.94
	May	949.93	977.78	949.92	977.86
	Jun	949.94	977.69	949.93	977.77

Appendix O. The predicted data of quantity of world natural rubber consumption from January 2017 to December 2026 by using actual predicted data and percentage change in explanatory variables from simple moving average (cont.)

		Actual Predicted Data		Percentage Change	
		Demand Model	Supply Model	Demand Model	Supply Model
2024	Jul	949.95	977.61	949.94	977.69
	Aug	949.96	977.54	949.95	977.61
	Sep	949.97	977.47	949.96	977.53
	Oct	949.98	977.42	949.97	977.47
	Nov	949.99	977.37	949.98	977.41
	Dec	950.01	977.32	949.99	977.36
2025	Jan	950.03	977.28	950.01	977.32
	Feb	950.05	977.23	950.03	977.27
	Mar	950.08	977.18	950.06	977.23
	Apr	950.10	977.13	950.08	977.18
	May	950.11	977.09	950.10	977.13
	Jun	950.09	977.05	950.10	977.08
	Jul	950.06	977.01	950.09	977.04
	Aug	950.02	976.99	950.06	977.01
	Sep	949.98	976.99	950.02	976.99
	Oct	949.94	976.99	949.98	976.99
	Nov	949.91	977.01	949.94	976.99
	Dec	949.89	977.04	949.91	977.01
2026	Jan	949.88	977.08	949.89	977.05
	Feb	949.87	977.12	949.88	977.09
	Mar	949.86	977.16	949.87	977.13
	Apr	949.85	977.20	949.86	977.17
	May	949.85	977.24	949.85	977.21
	Jun	949.84	977.28	949.85	977.25
	Jul	949.84	977.32	949.84	977.28
	Aug	949.84	977.36	949.84	977.32
	Sep	949.85	977.39	949.84	977.36
	Oct	949.85	977.42	949.85	977.39
	Nov	949.85	977.45	949.85	977.42
	Dec	949.86	977.47	949.85	977.45

Appendix P

The predicted data of world natural rubber price from January 2017 to December 2026 by using actual predicted data and percentage change in explanatory variables from simple moving average



Appendix P. The predicted data of world natural rubber price from January 2017 to December 2026 by using actual predicted data and percentage change in explanatory variables from simple moving average

		Actual Predicted Data		Percentage Change	
		Demand Model	Supply Model	Demand Model	Supply Model
2017	Jan	72.79	275.78	70.98	275.63
	Feb	63.10	283.97	59.47	278.75
	Mar	58.84	288.24	56.34	285.47
	Apr	59.09	284.84	59.27	287.06
	May	53.51	290.97	49.64	286.99
	Jun	50.82	290.64	48.49	290.85
	Jul	45.39	296.04	40.14	292.50
	Aug	42.23	298.58	38.43	296.89
	Sep	39.52	303.63	35.80	300.27
	Oct	37.06	307.96	33.31	305.06
	Nov	36.46	304.74	35.44	306.91
	Dec	36.41	300.38	36.32	303.31
2018	Jan	35.19	299.37	33.05	300.05
	Feb	32.91	300.30	28.70	299.68
	Mar	29.03	313.55	21.14	304.71
	Apr	28.88	310.97	28.49	312.73
	May	29.00	308.19	29.32	310.08
	Jun	28.28	306.73	26.50	307.72
	Jul	27.06	305.20	23.97	306.24
	Aug	25.76	305.78	22.24	305.39
	Sep	24.50	306.45	20.88	306.00
	Oct	24.42	302.32	24.18	305.10
	Nov	24.59	297.19	25.11	300.62
	Dec	24.20	291.94	23.00	295.42
2019	Jan	21.69	290.75	13.83	291.53
	Feb	20.46	295.03	16.01	292.22
	Mar	17.91	310.42	8.00	300.25
	Apr	18.95	306.88	23.72	309.28
	May	20.27	304.82	25.93	306.21
	Jun	20.65	305.70	22.12	305.11

Appendix P. The predicted data of world natural rubber price from January 2017 to December 2026 by using actual predicted data and percentage change in explanatory variables from simple moving average (cont.)

		Actual Predicted Data		Percentage Change	
		Demand Model	Supply Model	Demand Model	Supply Model
2019	Jul	20.41	309.93	19.51	307.08
	Aug	20.90	310.66	22.81	310.16
	Sep	21.34	311.35	22.97	310.88
	Oct	21.64	314.14	22.76	312.24
	Nov	22.15	313.28	23.99	313.87
	Dec	21.65	313.39	19.88	313.32
2020	Jan	21.09	314.17	19.08	313.64
	Feb	21.47	310.56	22.90	313.02
	Mar	19.56	326.01	12.56	315.53
	Apr	22.29	318.07	33.52	323.58
	May	25.64	313.75	37.33	316.71
	Jun	29.15	308.42	39.33	312.05
	Jul	33.24	302.13	43.17	306.38
	Aug	37.11	296.79	44.89	300.36
	Sep	39.85	292.17	44.49	295.23
	Oct	41.42	289.74	43.78	291.34
	Nov	41.66	289.42	42.01	289.63
	Dec	41.75	289.52	41.87	289.45
2021	Jan	40.77	291.57	39.41	290.23
	Feb	39.56	292.84	37.80	292.01
	Mar	38.43	294.10	36.70	293.27
	Apr	37.46	295.28	35.90	294.50
	May	36.51	296.62	34.92	295.73
	Jun	35.63	297.93	34.10	297.06
	Jul	34.83	299.47	33.39	298.44
	Aug	34.17	299.56	32.93	299.50
	Sep	33.55	299.66	32.36	299.60
	Oct	32.93	299.94	31.70	299.75
	Nov	32.35	300.25	31.18	300.05
	Dec	31.83	300.57	30.73	300.35

Appendix P. The predicted data of world natural rubber price from January 2017 to December 2026 by using actual predicted data and percentage change in explanatory variables from simple moving average (cont.)

		Actual Predicted Data		Percentage Change	
		Demand Model	Supply Model	Demand Model	Supply Model
2022	Jan	31.33	301.00	30.26	300.71
	Feb	30.88	301.44	29.90	301.15
	Mar	30.50	301.74	29.66	301.54
	Apr	30.16	301.97	29.38	301.82
	May	29.81	302.27	29.01	302.07
	Jun	29.52	302.47	28.82	302.33
	Jul	29.24	302.67	28.59	302.54
	Aug	29.02	302.79	28.49	302.71
	Sep	28.84	302.87	28.38	302.82
	Oct	28.68	302.86	28.29	302.87
	Nov	28.55	302.78	28.23	302.84
	Dec	28.43	302.76	28.13	302.78
2023	Jan	28.31	302.80	28.00	302.77
	Feb	28.20	302.87	27.93	302.83
	Mar	28.12	302.91	27.92	302.88
	Apr	28.10	302.74	28.05	302.86
	May	28.09	302.61	28.04	302.70
	Jun	28.07	302.52	28.02	302.58
	Jul	28.06	302.46	28.05	302.50
	Aug	28.08	302.41	28.12	302.44
	Sep	28.12	302.36	28.22	302.39
	Oct	28.18	302.29	28.34	302.33
	Nov	28.25	302.29	28.42	302.29
	Dec	28.31	302.37	28.48	302.31
2024	Jan	28.39	302.55	28.57	302.43
	Feb	28.51	302.75	28.83	302.62
	Mar	28.67	302.88	29.06	302.80
	Apr	28.89	302.76	29.45	302.84
	May	29.10	302.69	29.59	302.74
	Jun	29.27	302.66	29.69	302.68

Appendix P. The predicted data of world natural rubber price from January 2017 to December 2026 by using actual predicted data and percentage change in explanatory variables from simple moving average (cont.)

		Actual Predicted Data		Percentage Change	
		Demand Model	Supply Model	Demand Model	Supply Model
2024	Jul	29.44	302.61	29.85	302.64
	Aug	29.62	302.50	30.04	302.57
	Sep	29.79	302.37	30.19	302.45
	Oct	29.95	302.23	30.34	302.32
	Nov	30.11	302.04	30.49	302.16
	Dec	30.26	301.86	30.62	301.98
2025	Jan	30.43	301.68	30.82	301.80
	Feb	30.62	301.49	31.04	301.62
	Mar	30.79	301.34	31.20	301.44
	Apr	31.03	300.95	31.55	301.21
	May	31.20	300.68	31.58	300.86
	Jun	31.30	300.47	31.52	300.61
	Jul	31.33	300.34	31.41	300.42
	Aug	31.30	300.31	31.23	300.33
	Sep	31.21	300.37	31.02	300.33
	Oct	31.09	300.51	30.81	300.41
	Nov	30.94	300.69	30.61	300.57
	Dec	30.79	300.88	30.44	300.75
2026	Jan	30.63	301.07	30.28	300.94
	Feb	30.48	301.24	30.15	301.13
	Mar	30.35	301.38	30.05	301.28
	Apr	30.23	301.50	29.95	301.42
	May	30.12	301.61	29.87	301.54
	Jun	30.02	301.69	29.80	301.64
	Jul	29.94	301.76	29.74	301.72
	Aug	29.86	301.80	29.68	301.77
	Sep	29.79	301.83	29.64	301.81
	Oct	29.73	301.87	29.59	301.85
	Nov	29.68	301.90	29.56	301.88
	Dec	29.64	301.93	29.54	301.91

VITA

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