UNIVERSITI PUTRA MALAYSIA

MARKET, VALUE CHAIN AND PRICE TRANSMISSION ANALYSES OF THE THAI PALM OIL INDUSTRY

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Drastic movement of global prices for crude oil and palm oil has become a major concern in several countries due to its impact on domestic prices .One of the major concerns is the impact on the price of Thai agricultural products, especially palm oil, because it is the main crop in Thai economic development .Although the country is not a net importer, global price changes of the commodity can transmit to domestic markets for palm oil products. This study aims to examine the structure and marketing system of the palm oil industry in Thailand, also investigates the value chain of the industry as well as analyses price transmission and volatility spillover effect on Thai prices. The study used both primary and secondary data for analyses. For primary data, a survey was conducted in Krabi, a province located in Southern Thailand. For secondary data, this study used prices data for the period of January 1996 to September 2015. Outcomes from the survey were analysed using descriptive and value chain analyses. While the secondary data was analysed using Threshold Cointegration to estimate asymmetric price transmission and Dynamic Conditional Correlation Generalised Autoregressive Conditional Heteroscedasticity (DCC-GARCH) to estimate price volatility effect. In total, the results show that the main players in the Thai palm oil value chain consists of oil palm growers, collection ramps and palm oil mills. The most used trade channel at the farm level is found to be through the ramps, while the direct contact between the growers and millers is minimal. The chain is more likely to be a buyer-driven chain. Trading in the upstream level is based on relational and market coordination, midstream is market coordination, and downstream is industrial coordination. Furthermore, Malaysia crude palm oil and world crude oil prices are found to affect the Thai price. Both positive and negative price shocks bring significant effect to the Thai palm oil price and the price responds faster to the negative shock. Also, high returns in the Thai crude palm oil indicate a positive impact of its uncertainty. Therefore, in order to enhance the Thai palm oil industry and increase global competitiveness, improvements in the relational and market coordination through the grading and harvesting activities at the farm level are needed to ensure higher profit margins for the growers. Besides, the efforts to strengthen the knowledge management aspect on oil palm cultivation and provide financial support may help the growers to improve production and their position in the value chain. Moreover, the government should have effective strategies such as fruits quality control, setting daily

price changes ceiling, maintaining a balance domestic stock, and providing the information regarding alternative buyers in the case of excess crude palm oil stock. These strategies will help to improve the capability and efficiency in the production system, thus reducing the risk and fluctuation in Thai palm oil market.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PASARAN, RANTAIAN NILAI DAN ALIRAN HARGA ANALISIS-ANALISIS INDUSTRI MINYAK SAWIT THAI

Oleh

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Mei 2018

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Pergerakan drastik dalam harga minyak mentah dan minyak sawit global telah menjadi kebimbangan di beberapa negara disebabkan kesannya ke atas tingkat harga tempatan. Salah satu kebimbangan adalah kesannya ke atas harga produk pertanian terutamanya kelapa sawit disebabkan ia merupakan tanaman utama yang membantu meransang pertumbuhan ekonomi di Thailand. Walaupun Thailand bukanlah pengimport bersih minyak sawit, perubahan harga komoditi ini di peringkat global masih memberikan kesan kepada produk minyak sawit di pasaran tempatan. Oleh itu, kajian ini dijalankan dengan tujuan untuk meneliti struktur dan sistem pemasaran industri minyak sawit di Thailand, memahami rantaian nilai industri dan juga untuk menganalisis aliran harga dan kesan lonjakan atau penurunan harga ke atas harga di Thailand. Kajian ini menggunakan sumber data primer dan sekunder. Untuk data primer, satu survei telah dijalankan di Krabi, sebuah wilayah yang terletak di selatan Thailand. Manakala untuk data sekunder pula, kajian ini menggunakan data harga bagi tempoh Januari 1996 sehingga September 2015. Dapatan daripada survei dianalisis menggunakan analisis deskriptif dan rantaian nilai. Data sekunder pula dianalisis menggunakan *Threshold Cointegration* untuk menganggarkan pengaliran harga tidak simetri dan *Dynamic Conditional Correlation Generalised Autoregressive Conditional Heteroscedasticity* (DCC-GARCH) untuk menganggarkan kesan lonjakan dan penurunan harga. Secara keseluruhannya, dapatan kajian menunjukkan bahawa pemain utama dalam rantaian nilai minyak sawit Thai di peringkat ladang terdiri daripada penanam kelapa sawit, pusat pengumpulan hasil dan kilang pemprosesan. Saluran penjualan yang paling banyak digunakan pada peringkat ladang adalah melalui pusat pengumpulan, manakala hubungan terus antara penanam dan pengilang adalah minima. Rantaian yang wujud pula adalah berteraskan rantaian yang didorong oleh pembeli. Penjualan pada peringkat huluan secara asasnya berdasarkan perhubungan dan koordinasi pasaran, peringkat pertengahan berdasarkan koordinasi pasaran dan peringkat hiliran menggunakan koordinasi industri. Selain itu, harga minyak sawit mentah Malaysia dan minyak mentah dunia didapati mempengaruhi harga di Thailand. Kejutan harga yang positif dan negatif membawa kesan yang ketara kepada harga minyak sawit Thai dan tindak balas terhadap kejutan harga yang negatif adalah lebih pantas. Pulangan yang tinggi terhadap minyak sawit mentah Thai menunjukkan wujud kesan positif daripada ketidaktentuan harga yang berlaku. Oleh itu, untuk meningkatkan industri minyak

sawit Thai dan meningkatkan daya saing global, penambahbaikan melalui aktiviti penggredan dan penuaian di peringkat ladang diperlukan untuk memastikan margin keuntungan yang lebih tinggi untuk penanam. Di samping itu, usaha untuk mengukuhkan aspek pengurusan pengetahuan mengenai penanaman kelapa sawit dan memberi sokongan kewangan dapat membantu penanam untuk meningkatkan pengeluaran dan kedudukan mereka dalam rantaian nilai. Tambahan lagi, kerajaan juga perlu mempunyai strategi yang berkesan seperti kawalan kualiti terhadap hasil tuaian, penetapan siling perubahan harga harian, mengekalkan keseimbangan stok tempatan, dan memberikan maklumat pembeli alternatif sekiranya terdapat lebihan stok minyak sawit mentah. Strategi ini akan membantu untuk meningkatkan keupayaan dan kecekapan dalam sistem pengeluaran, sekaligus mengurangkan risiko dan turun naik dalam pasaran minyak sawit Thai.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion
CCC	Constant Conditional Correlation
CPO	Crude Palm Oil
CSFs	Critical Success Factors
DCC	Dynamic Conditional Correlation
DCC-GARCH	Dynamic Conditional Correlation General Auto-Regressive Conditional Heteroskedasticity
DCC-MGARCH	Dynamic Conditional Correlation Multivariate General Auto-Regressive Conditional Heteroskedasticity
ECM	Error Correction Model
EGARCH	Exponential General Auto-Regressive Conditional Heteroskedasticity
FELDA	Federal Land Development Authority
FFA	Free Fatty Acid
FFB	Fresh Fruit Bunches
GARCH	General Auto-Regressive Conditional Heteroskedasticity
MGARCH	Multivariate General Auto-Regressive Conditional Heteroskedasticity
MTAR	Momentum Threshold Auto-Regressive
MYCPO	Malaysian Crude Palm Oil Price
OLS	Ordinary Least Square
PP	Phillips-Perron
RBD	Refined, Bleached and Deodorized
SBC	Schwarz-Bayes Criterion
SPO	Special Palm Oil
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TAR	Threshold Auto-Regressive
TGARCH	Threshold General Auto-Regressive Conditional Heteroskedasticity
THCPO	Thai Crude Palm Oil Price
THFFB	Thai Fresh Fruit Bunches Price
TPO	Technical Palm Oil
TSLS	Two-Stage Least Squares
VAR	Vector Auto-Regressive
VECM	Vector Error Correction Model
WCO	World Crude Oil Price

CHAPTER 1

INTRODUCTION

1.1 Overview

The agricultural sector plays a significant role in economic development in numerous countries. In fact, it is one of the leading economic sectors in many countries' gross domestic product and helps the country to be self-sufficient regarding providing food to its population and creating jobs.

In Thailand, agriculture has played an important role in the nation' s economy since The First National Economic and Social Development Plan (1961-1966). Thailand was a popular provider of goods with various products taking the lead in production in the world. The major agricultural products are rice, maize, cassava, soybean, sugarcane, oil palm, rubber, coffee, pineapple, longan, durian, mangosteen, potatoes, and orchids (Office of Agricultural Economics Research, 2015). These products create tremendous value for the country in terms of both domestic consumption and export revenue.

Oil palm is one of the major crops that Thailand has promoted for commercial purpose since 1968 (Eksomtramage, 2011). Its production was encouraged by the government to smallholders, especially in Southern of Thailand where the areas are suitable for oil palm cultivation (Office of Agricultural Economics: OAE, 2016a). In 1968, the oil palm was cultivated on only 950 hectares (Food and Agriculture Organisation of the United Nations: FAOSTAT, 2015), but it expanded rapidly and become a key crop in the country. Between 1978 and 1988, the average growth rate of oil palm cultivation was up to 33.39 percent/year with an average yield of 10.18 tons/hectare (FAOSTAT, 2015). In 2013, Thailand had 0.6 million hectares of oil palm plantations with an average yield of 20.60 tons/hectare; its production was about 12 million tons with a value of 44,020 million THB to the oil palm growers (OAE, 2016a). In the same year, it generated 17,646 million THB for the country (OAE, 2016b).

Palm oil not only plays an important role in the economic development of Thailand, it plays a significant role in the global food industry. It is a vegetable oil that is regularly consumed in households and is a source of various nutrients. It is used as a raw material in industrial production for numerous products, such as margarine, chocolate, biscuits, snacks, shampoo, soap and cosmetics among others.

The leader-producing countries of palm oil are Indonesia and Malaysia. In crop year 2014/15, the world produced 61.63 million tons of crude palm oil, which is an increased from 59.27 million tons in 2013/14 or about 3.98 percent from the earlier year (United States Department of Agriculture: USDA, 2016). In at that time, Indonesia produced 33.00 million tons and Malaysia produced 19.88 million tons, with the total production

from these two major countries accounted for 85.80 percent of global palm oil production. Thailand is ranked third and produced at 2.07 million tons of palm oil in crop year 2014/15, accounting for 3.36 percent of the global palm oil output.

Although the production volumes of Thailand may be small compared with the leading countries, it can sufficiently produce and supply palm oil for the domestic market and export the surplus to its neighbouring countries like Malaysia, Myanmar, Cambodia, China, Laos and India (OAE, 2017a) (Table 1.1). The production of palm oil in Thailand is currently mainly for domestic utilisation. About 90 percent of Thai palm oil production is domestically consumed and is widely used in a variety of products and industries, such as cooking oil, consumer goods, industrial lubricants and biodiesel production (Figure 1.1).

Table 1.1: Export Quantities and Value of Palm Oil by Country

Country	2014		2015		2016	
	Quantity (tons)	Value (1,000 THB)	Quantity (tons)	Value (1,000 THB)	Quantity (tons)	Value (1,000 THB)
Malaysia	92,253	3,265,918	57,668	1,558,075	73,489	2,999,875
Myanmar	41,490	1,518,228	35,262	1,084,732	27,992	1,009,239
Cambodia	26,774	1,071,285	14,309	499,607	5,999	239,374
China	14,757	536,871	11,332	375,516	4,336	163,092
Laos	7,359	252,288	5,173	159,033	4,004	123,990
India	91,204	2,461,978	5,036	145,822	-	-
Others	81,494	2,193,417	2,409	81,111	1,718	75,661
Total	**355,331**	**11,299,985**	**131,189**	**3,903,896**	**117,538**	**4,611,231**

Source: OAE (2017a)

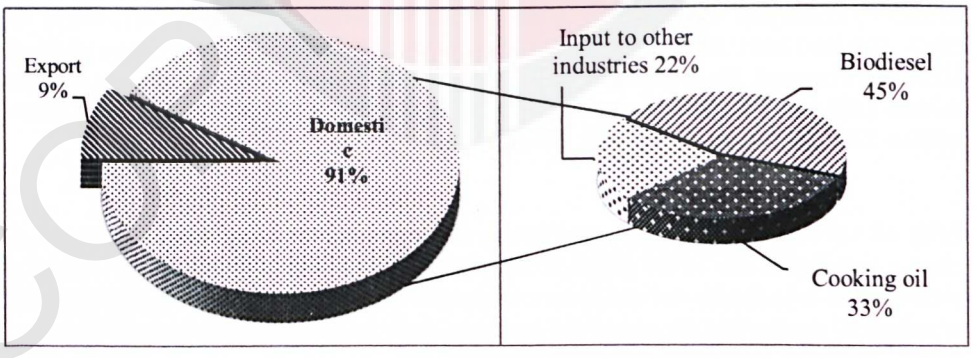

Figure 1.1: Domestic Consumption and Usage of Thai Palm Oil
Source: Petchseechoung (2016)

The trend of palm oil supply and demand in Thailand is continuously increasing. Several projects were supported by the government to expand oil palm cultivation areas (Office of Agricultural Economics Research, 2004). Also, its demand increased because the

palm oil price is affordable compared to other edible oils and is used as a raw material for both food and non-food products. Moreover, the Thai government has a strategic plan to enlarge oil palm plantation areas up to 1.6 million hectares by the year of 2029. The vision of this strategy is to help Thailand to become one of the leaders in production and export of palm oil, as well as fostering its use as a source of sustainable energy to the nation (Office of Agricultural Economics Research, 2004). High demand for palm oil and greater yield at a lower cost in the production of oil palm makes palm oil industry worthy of attention. Therefore, the development of the palm oil industry in Thailand should be seriously considered by scholars and applied scientists, among others.

1.2 Backgroud of the Study

This section presents a description of the palm oil market at the global level as well as the palm oil industry in Thailand, which includes the background, crises and fluctuation of Thai palm oil prices.

1.2.1 Global Vegetable Oils and Animal Fats Market

1.2.1.1 Vegetable Oils vs. Animal Fats

In the past, the oils and fats manufacturing sector used to be led by animal fats, which produced approximately 10.48 million tons (about 36 percent of the world's oils and fats production) in 1961. Whereas vegetable oils like soybean oil, sunflower oil, palm oil and rapeseed oil, were minor with just 3.04, 1.95, 1.25 and 1.14 million tons produced accounting for only 25 percent of global oil and fat production (FAOSTAT, 2018) (Figure 1.2).

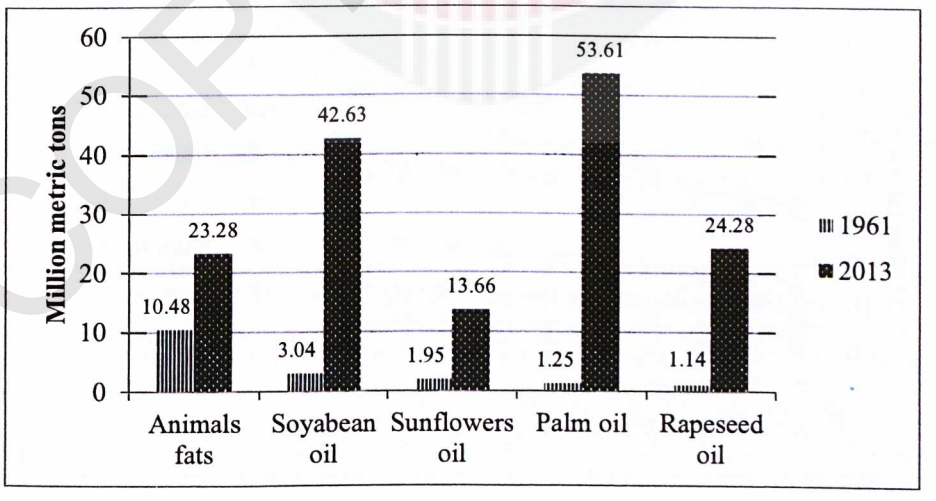

Figure 1.2: World Oils and Fats Production
Source: FAOSTAT, 2018

Over the last decade, vegetable oils surged to become the major edible oils come replacing animal fats due to the high expansion of planting areas, increased productivity and greater health benefit over animal fats. Evidence shows that vegetable oils have higher growth rate than animal fats, but varied considerably between 2001-2013; palm oil expanded over 100 percent, rapeseed oil expanded by 93 percent, sunflower oil by 66 percent, and soybean oil by 54 percent. Whereas the production of animal fats has a lower growth rate of only 16 percent within the same period.

1.2.1.2 Global Oils and Fats Production

The main production of oils and fats in the world market are palm, soybean, animal fats, rapeseed, and sunflower seed. They hold around 84 percent of global oils and fats production shares (Basiron, 2007; R.E.A. Holdings plc, 2014). In 2013, aggregations of production oils and fats were 187 million tons; palm oil and soybean oil were at the forefront with 59 and 44 million tons, respectively. Thus, they account more than 50 percent of the world oils and fats production (USDA, 2015).

Looking at the vegetable oils industry data, it is clearly an essential sector of the global economy. Palm oil is the leader in this field, followed by soybean oil, rapeseed oil and sunflower oil. These vegetable oils account for about 85 percent of the world vegetable oils production, of which around 60 percent are palm oil and soybean oil. During the 2013/14 production year, palm oil increased 59.60 million metric tons, an increase from the previous year of 6.49 percent, whereas soybean oil increased 44.57 million metric tons, which is a growth of 3.92 percent. Rapeseed oil and sunflower oil increased 26.05 and 15.59 million metric tons, respectively (Figure 1.3). In the same year, the world consumed 56.97 million metric tons of palm oil and 44.96 million metric tons of soybean oil, or 34.44 and 27.18 percent of vegetable oils consumption, respectively. These facts show that palm oil is the current leader in edible oils for human consumption.

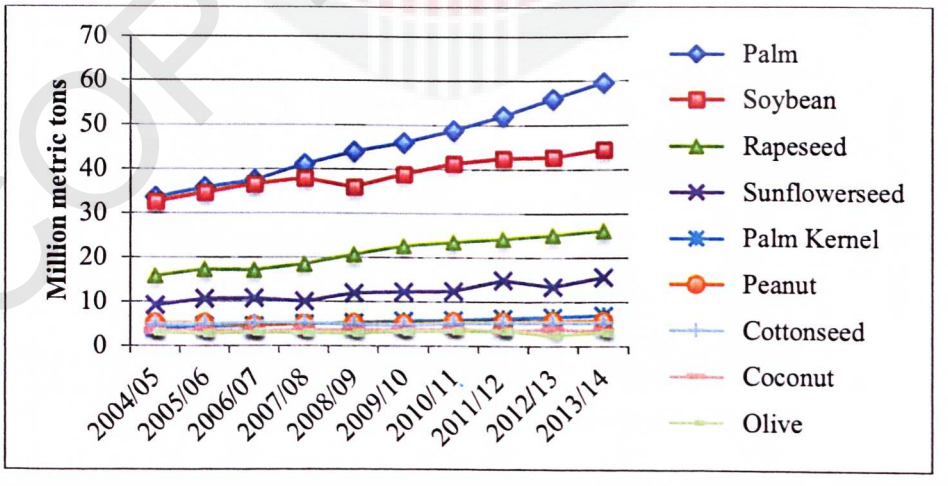

Figure 1.3: World Vegetable Oils Production, 2004/05-2013/14
Source: USDA, 2015

1.2.1.3 Global Palm Oil Production

Palm oil has recently become one of the major edible oils. It is widely popular and holds the most market shares among vegetable oils because of its higher yield and lower cost in planting (Dallinger, 2011). The output of oil palm per hectare is 5-10 times greater than the other vegetable oils (WWF et al., 2012). Furthermore, oil palm is very easy to maintain due to being susceptible to fewer pests and having longer lives (trees with more than 25 years life expectancy) (Department of Agriculture Mindanao Regions, 2014). It can also be used as a substitute for many other oils. Thus, it serves as a long-term staple of the global diet.

Oil palm normally is planted in 43 countries[1], which are in the tropical areas of Asia, Africa and South America (FAOSTAT, 2018). In Southeast Asia, it has become a major agriculture commodity and significantly contributes benefits to the countries' economy, particularly in the rural areas (Rofiq, 2013). In 1961, world oil palm production was only 13 million tons in 35 countries, but then it increased intensely to 300 million tons in 43 countries in 2016 (FAOSTAT, 2018). The region that expanded oil palm plantation the most is Southeast Asia. Within this region the countries of Indonesia, Malaysia, Thailand and Philippines are producing palm fruits for nearly 90 percent of world production.

The countries leading production of oil palm are Indonesia and Malaysia. Indonesia has 9.33 million hectares of oil palm harvesting areas, under cultivation and Malaysia has 5.00 million hectares. These produced 160 and 86 million tons of fresh oil palm bunches in 2016. Thailand, as the third leader of oil palm producer-countries, has oil palm harvested areas of 0.65 million hectares produced 12.08 million tons fresh palm fruit bunches in the same year (Table 1.2).

Oil palm plantations in these countries increased rapidly in the last decade. Indonesia has a growth rate of 181 percent, whereas Malaysia and Thailand have a growth rate of 47 and 110 percent, respectively. The production growth rate of oil palm fruit during 2004-2016 skyrocketed with Indonesia having the highest growth rate at 165 percent, followed by Thailand and Malaysia at 133 and 24 percent, respectively. The average annual growth rate of palm fresh fruit bunches production of these countries in the last ten years is at 8.62, 8.69 and 1.99, respectively (Table 1.2).

Indonesia and Malaysia produce and supply about 87 percent of the world palm oil production, or around 25 percent of the world vegetable oil production. Palm oil production from these countries increased in Indonesia from 0.43 million tons in 1975 to 31.00 million tons in 2013. Malaysia increased from 1.39 million tons to 20.20 million

[1] List of the 43 countries that plant oil palm are Angola, Benin, Brazil, Burundi, Cambodia, Cameroon, Central Africa Republic, China, Colombia, Congo, Costa Rica, CÃ´te d'Ivoire, Dominican Republic, Ecuador, Equatorial Guinea, Gabon, Gambia, Ghana, Guatemala, Guinea, Guinea-Bissau, Honduras, Indonesia, Liberia, Madagascar, Malaysia, Mexico, Nicaragua, Nigeria, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Suriname, Thailand, Togo, United Republic of Tanzania, and Venezuela.

tons at the same periods with an average per annum growth rate of 11.94 and 7.57 percent, respectively (Table 1.3). Expanding plantations in Indonesia are the main reasons that raised palm oil production increased rapidly and overtook Malaysia in 2005 as the world's largest contributor of palm oil (Figure 1.4).

Table 1.2: Area Harvested and Production of Oil Palm (Million)

Year	**Harvested area** (Hectares)			**Production** (Tons)		
	Indonesia	Malaysia	Thailand	Indonesia	Malaysia	Thailand
2004	3.32	3.40	0.31	60.43	69.88	5.18
2005	3.69	3.55	0.32	74.00	74.80	5.00
2006	4.11	3.68	0.38	80.25	79.40	6.72
2007	4.56	3.74	0.43	78.00	79.10	6.39
2008	4.98	3.90	0.46	85.00	88.67	9.27
2009	5.37	4.01	0.51	90.00	87.83	8.16
2010	5.78	4.13	0.54	97.80	84.97	8.23
2011	6.17	4.33	0.57	105.00	94.56	10.76
2012	6.65	4.44	0.59	113.00	97.70	11.35
2013	7.08	4.55	0.63	120.00	100.00	12.81
2014	8.15	4.69	0.64	139.95	95.38	12.47
2015	8.63	4.86	0.65	149.07	98.34	11.06
2016	9.33	5.00	0.65	160.14	86.33	12.08
Average growth rate	**9.02**	**3.27**	**6.49**	**8.62**	**1.99**	**8.69**

Source: FAOSTAT (2018)

Table 1.3: World Palm Oil Production (1,000 Tons)

Country	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Indonesia	28,500	31,000	33,000	32,000	36,000	38,500
Malaysia	19,321	20,200	19,879	17,700	18,858	20,500
Thailand	2,135	2,150	2,068	1,804	2,500	2,700
Colombia	974	1,042	1,110	1,275	1,147	1,250
Nigeria	910	930	910	970	970	970
Other	4,129	4,276	4,783	5,141	5,780	5,801
Total	**55,969**	**59,598**	**61,750**	**58,890**	**65,255**	**69,721**

Source: USDA (2018)

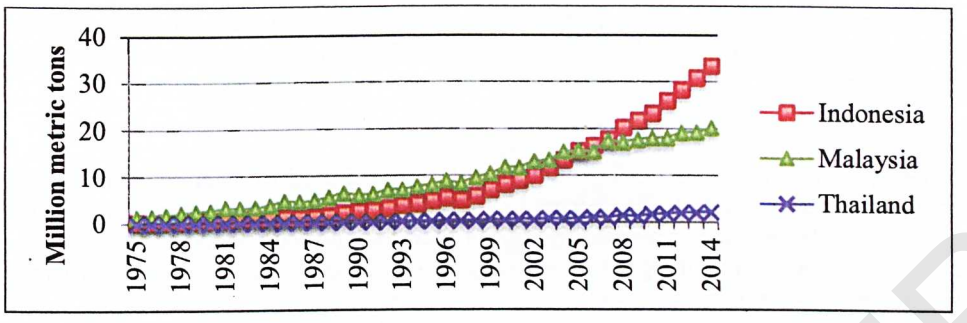

Figure 1.4: Top Palm Oil Production, 1975-2014
Source: FAOSTAT (2015)

1.2.2 Thai Palm Oil Market

This section explains the background of palm oil industry in Thailand as well as the crises and fluctuations in Thai palm oil prices.

1.2.2.1 Background of the Thai Palm Oil Industry

Oil palm was first introduced to Thailand in 1942. It was first planted in Songklar and Chantaburi provinces as ornamental plants. It later became a commercial product and was first started in Songklar province with 160 hectares of plantations. It was then expanded to Satun and Krabi province with 3,200 hectares each put under cultivation. Both projects succeeded and expanded rapidly to numerous provinces in the southern part of Thailand (Prukampi, 2005).

Tenera used to be the palm species typically planted in Southern Thailand. It is a hybrid species created by crossing Dura and Pisifera (DxP), which were imported from Malaysia. Later in 1972, Thailand established its first palm oil mill through the Thai Oil Palm Industry and Estate Co., Ltd. (now changed its name to Univanich Palm Oil Public Company Limited). Construction was completed and production started in late 1974. Oil palm grew dramatically and was added to the Sixth National Economic and Social Development Plan (1987-1991) for the first time. During that period, there were approximately 59,981 hectares of harvested areas; with an average yield of 11.56 tons per hectare.

Unfortunately, in 1987, Malaysia created a law to ban the export of palm oil seeds to Thailand. Thus, inferior and fake species from seeds flooded the market and led to many oil palm disease outbreaks between 1987 and 1996. Eventually, the Thai Agriculture Department began a breeding program by purchasing germplasm from the Agriculture Service and Development (ASD) company from Costa Rica for studying its own species of oil palm seeds. The project was successful and Thailand started to produce hybrid seeds domestically in 1997. These were called Surat Thani 1 (number 38). However,

some importing of seeds for the planting still occurred because the production of Surat Thani 1 seeds was not enough to satisfy domestic demand given the rate of expanding cultivation.

In 1999, for the first time Thailand began exporting palm oil to other countries and is now an exporter instead of an importer. In 2004, the Thai government created a plan for oil palm plantations to encompass 1.6 million hectares within the scope period of 2004-2029. At the same time, the government began a continuously funded subsidy program for growers (Eksomtramage, 2005).

In 2014, Thailand had 739,400 hectares of oil palm plantations and 643,811 hectares of harvested area. It produced 12.47 million tons palm fruit bunches or the equal of 19.38 tons per hectare (Table 1.4-1.5). Approximately 85 percent of the total planting areas are in the South of Thailand, which produced about 91 percent of the nation' s oil palm production (Figure 1.5). Surat Thani is the leading province followed by Krabi and Chumphon. The plantation areas of these provinces are 169.82, 157.55 and 134.99 thousand hectares, respectively. The areas harvested are 157.19, 152.07 and 121.95, respectively. Output was around 72 percent of domestic oil palm production. Krabi is the province that has the highest yield per hectare (21.83 tons), followed by Surat Thani (20.88 tons), and Chumphon (19.13 tons) (Table 1.6).

Table 1.4: Planted and Harvested Areas of Oil Palm in Thailand

Region	Area planted (1,000 Hectares)				Area harvested (1,000 Hectares)			
	2011	**2012**	**2013**	**2014**	**2011**	**2012**	**2013**	**2014**
North	3.66	7.09	8.74	10.87	0.97	1.40	2.01	4.75
Northeast	12.41	16.33	19.23	22.07	4.00	5.95	7.27	10.34
Central	61.67	67.65	70.93	74.96	47.88	51.45	53.62	60.99
South	578.02	610.66	619.36	631.49	517.52	533.28	540.80	567.73
Total	**655.75**	**701.73**	**718.26**	**739.40**	**570.36**	**592.08**	**603.70**	**643.81**

Source: OAE (2014; 2015; 2016a; 2017b)

Table 1.5: Oil Palm Production in Thailand

Region	Yield (1,000 Tons)				Average Yield (Tons/Hectare)			
	2011	**2012**	**2013**	**2014**	**2011**	**2012**	**2013**	**2014**
North	6.24	9.04	13.94	31.41	6.43	6.46	6.94	6.61
Northeast	36.01	60.79	66.77	90.21	9.00	10.22	9.18	8.73
Central	889.14	809.60	914.71	1,004.40	18.57	15.74	17.06	16.47
South	9,828.67	10,432.87	11,439.10	11,346.49	18.99	19.56	21.15	19.99
Total	**10,760.06**	**11,312.30**	**12,434.52**	**12,472.51**	**18.86**	**19.11**	**20.60**	**19.38**

Source: OAE (2014; 2015; 2016a; 2017b)

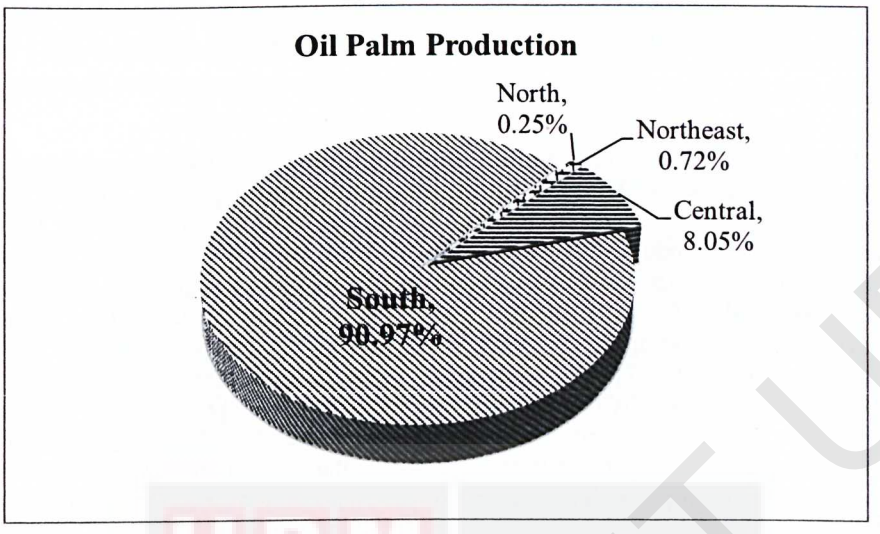

Figure 1.5: Oil Palm Production in Thailand, 2014
Source: OAE (2017b)

Table 1.6: Area and Yield of Oil Palm by Top Provinces in Thailand, 2014

Province	(Unit: Thousand)			Yield (Tons/Ha)
	Area planted (Ha)	**Area harvested** (Ha)	**Yield** (Tons)	
Surat Thani	169.82	157.19	3,282.17	20.88
Krabi	157.55	152.07	3,320.12	21.83
Chumphon	134.99	121.95	2,332.40	19.13
Nakhon Si Thammarat	55.57	44.57	808.68	18.14
Phangnga	28.60	25.66	502.27	19.57
Trang	26.93	23.90	461.51	19.31
Prachuap Khiri Khan	19.10	17.44	299.32	17.16
Satun	17.00	15.83	220.23	13.91
Chonburi	16.33	15.03	279.16	18.57
Ranong	14.50	10.94	214.89	19.64

Source: OAE (2017b)

The production of oil palm in Thailand in the last ten years has been increasing at approximately 11 percent per year, except in 2008 and 2011 which had a growth rate of 45.08 and 30.78 percent, respectively. One reason for the boost in oil palm in Thailand is the government's strategies that promote farmers to expand oil palm plantations and thereby increase yields and productivity. The other strategy is an alternative energy development plan for 15 years (2008-2022) using palm oil as a raw material for renewable energy, namely biodiesel, to reduce energy imported from abroad and to promote the use of biodiesel B3, B5 and further develop B10. These strategies are used to motivate farmers to increase oil palm plantations in all regions. Furthermore, the price of oil palm fresh fruit bunches in the last few years has also increased. These then induced farmers to expand planting areas, and whenever palm fresh fruit bunches price

increases or decreases, it also affects the price of crude palm oil and bottled palm cooking oil in the same direction, these indicate the linkages among palm product prices (Table 1.7).

The Thai government has plans and is expanding oil palm's cultivation and increasing its production. The use of biodiesel for increasing the value of palm oil and decreasing the number of importing crude oil makes the commodity further valuable. The Thai oil palm and palm oil's Industry Development Plan (2014-2021) is dedicated to promoting oil palm and is committed to increasing oil palm plantings. The target is 80,000 hectares for each year, and the total increase over 5 years will be 400,000 hectares, these increases are targeted for supporting the renewable energy strategy and to reduce the risk of food insecurity in the country. The plan contains five strategic development areas that consist of (i) improving productivity and value of palm fruit and products (ii) marketing optimisation (iii) the use of renewable energy (iv) research and development (v) the administration and management (Office of Agricultural Economics Research, 2004). This plan is set to comply with the Alternative Energy Development Plan: AEDP (2012-2021).

Table 1.7: Palm Fresh Fruit Bunches Price and Palm Oil Wholesale Price in Bangkok, 2000-2013

Year	Palm Fresh Fruit Bunches price[1] (THB/Kg)	Palm oil wholesale price in Bangkok[2]	
		Crude palm oil (THB/Kg)	Palm oil (THB/Liter)
2000	1.66	12.91	23.32
2001	1.19	10.80	20.23
2002	2.30	17.20	25.98
2003	2.34	18.28	28.59
2004	3.11	20.33	30.42
2005	2.76	16.89	27.52
2006	2.39	15.80	25.74
2007	4.07	24.45	33.87
2008	4.23	28.96	41.96
2009	3.64	24.32	34.73
2010	4.26	29.10	34.92
2011	5.34	33.63	39.52
2012	4.91	30.86	39.37
2013	3.54	25.24	31.67

Source: [1]OAE (2014); [2]Department of Internal Trade (2014)

Additionally, the Thai government set a goal to increase productivity in order to create a high-value processing industry for adding value to palm oil, increasing competitiveness and creating revenue. Thailand expects to expand oil palm plantations by 1.6 million

hectares to produce 25 million tons of palm fruit or 4.50 million tons of crude palm oil, each hectare averaging a yield of 17.50 tons, and including the establishment of an integrated oil palm industry to achieve the full privatisation.

Thailand's interest in using palm oil as a sustainable energy resource is supported by the research of Basiron (2008) and Hadi et al. (2011) who revealed that there is a significant relationship between crude oil and crude palm oil prices. The work of Applanaidu et al. (2009) showed that the prices of biofuel feedstock, such as palm, soybean, rapeseed oil and maize are now inevitably following crude oil prices, and have a strong positive relationship between them, particularly from 2005 to 2009. This parallel pricing is because when the crude oil price increases, it will certainly increase demand for biofuel as an alternative energy. Thus, the demand for palm oil will always expand and play a significant role in the Thai domestic economy.

1.2.2.2 Palm Oil Crises and Fluctuation of Domestic Palm Oil Prices in Thailand

Thailand faced strong palm oil crises twice: from 2010 to 2011 and during the beginning period of 2012. In fact, Thailand set strict restrictions to protect both domestic producers and consumers, but during those crises, the domestic policies could not prevent nor protect the changes in domestic palm oil prices. Despite government policies, changes in pricing strongly affected all stakeholders throughout the value chain. Since 1982, the Ministry of Commerce enacted measures to control the import of palm oil in order to protect the viability of oil palm growers and palm oil producers in the country (Thai Feed Mill Association, 2011). Import control measures were set to protect Thai palm oil prices because the palm oil price from Indonesia and Malaysia are much lower than the Thai price due to abundance and economy of scale. The Thai government allows the import of crude palm oil only through Public Warehouse Organisation: PWO, Ministry of Commerce Thailand, when there is an insufficiency for domestic consumptions (Sriwirote, 2011). For domestic consumers, the government authority set the controlling price at 42 THB for bottled palm cooking oil, which is a staple in household consumption.

1. *Palm Oil Crises in Thailand*

The palm oil crises that happened in Thailand were caused by different determinants. The first palm oil crisis was due to domestic determinants that pertain to the natural disaster that occurred in the main areas of oil palm plantations and the increasing demand for biodiesel fuel. The second crisis occurred due to international determinants, which pertain to the impact of changes in world crude oil and world crude palm oil prices. The details are described as follows:

1.1 First Palm Oil Crisis in Thailand

From 2010 to 2011, there was a serious crisis in the Thai palm oil industry, which started from the rising price of palm oil fresh fruit bunches on the market. The price of Thai palm oil fresh fruit bunches (FFB) unexpectedly increased dramatically for the first time in the history of raw palm products (Department of Internal Trade, 2013). Due to a period of drought, the products of oil palm trees were scarce, making the raw materials insufficient for internal usage and domestic consumption. At the same time, there was a higher demand for the products to produce biodiesel. The average price for palm fresh fruit bunches formerly was just 4.83 THB/kilogram (153.79 USD/ton) in 2010, but then it doubled to 9.27 THB/kilogram (303.14 USD/ton) in January 2011. The increasing price pushed produced an increase in the Thai crude palm oil price (wholesale price in Bangkok) from 29.10 THB/kilogram (924.67 USD/ton) up to 58.20 THB/kilogram (1,903.19 USD/ton) (Figure 1.6).

The effects of sharp price increases from both palm fresh fruit bunches price and crude palm oil price were transmitted to the price of bottled palm cooking oil. The price of bottled palm cooking oil was increased abruptly from 38 THB to 47 THB, exceeding the controlling price of 42 THB/bottle. As a result, the production of bottled palm cooking oil rapidly declined in the market and suddenly disappeared. There was no single bottled palm cooking oil on groceries shelves and supermarkets. It became the first serious crisis in the domestic supply of palm oil in Thailand. The shock from the fresh fruit bunches market affected the crude palm oil market and finally affected the production of final consumer bottled palm cooking oil. This relationship shows clearly the cointegration of raw supply and produced commodity pricing discussed previously.

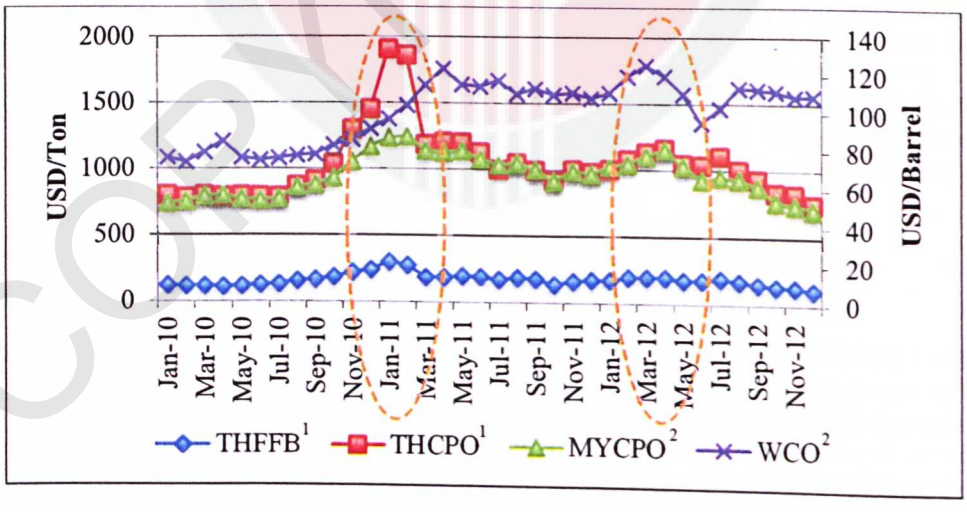

Figure 1.6: Fresh Fruit Bunches, Crude Palm Oil and World Crude Oil Prices
Source: [1] Department of Internal Trade, Thailand (2015), [2] World Bank (2015)

To make the business lucrative and more profitable at that time, the producers of bottled palm cooking oil changed the process of containing the product from bottles to plastic bags and cans, which were not in the lists of the controlling price standard by Thai government. This was a clever form of avoiding the established rule. The bottled palm cooking oil then inevitably disappeared from the shelves and markets in March 2011. These high prices brought about considerable consumers welfare loss, financial stress and inaccessibility in consumption by the poor. The situation led many economists to question the efficiency of Thai palm oil markets and the effects of policy measures as well as the extent to which industry concentration, consolidation and vertical integration may be related to the events of the palm oil price crisis. Therefore, to relieve the tension of that crisis, the Thai government decided to import crude palm oil from Malaysia.

1.2 Second Palm Oil Crisis in Thailand

Another strong palm oil crisis in Thailand happened from the impact of global market prices on Thai domestic prices. The crisis started during the beginning period of March 2012 where the world crude palm oil's price, which was led by Malaysia, was high due to intervening factors in the world soybean oil market and world petroleum oil market. The world price of soybean oil was affected due to a long drought in South America. The whole process of soybean oil production was affected and increased prices (Sriwirote, 2012).

Furthermore, the tight, tense relationship between Iran and America was apparent and getting worse; the petroleum market price seemed to be high and reached 125.45 USD/barrel in March 2012, which was the highest price of crude oil in 4 years after the oil price crisis in 2008 (World Bank, 2013). First the pricing of soybean affected the price of crude palm oil in the Malaysian market, increasing it to 1,105.74 USD/ton, or around 5.54 percent more from the previous month. At the same time, the crude palm oil price in Thailand increased as well from 1,075.49 to 1,130.98 USD/ton or around 5.16 percent more from the previous month (Figure 1.6). This evidence shows the impact of world crude oil price affecting crude palm oil prices as well as demonstrating the co-movement of the prices between world crude oil and crude palm oil in various level markets, which induced transmission to one another.

These rises in global prices not only affected the crude palm oil price but also enabled domestic producers to increase their export volumes and raise their products' prices. The export volume of palm oil was increased several times from 1,918 tons in February 2011 (when the first crisis of palm oil happened) up to 70,115 tons in the same period a year later (OAE, 2013). As a result, producers turned to focus on producing for export rather than producing for inner or domestic consumption. Thus, the amount of palm oil production used to meet domestic demand declined, and the domestic price increased.

Moreover, because the Thai government first declared using more of biodiesel on 21 October 2011, the price of palm fresh fruit bunches, which is the main ingredient in producing biodiesel, began to creep higher. The average price rose from 4.05

THB/kilogram (129.66 USD/ton) in October 2011 to 5.71 THB/kilogram (187.65 USD/ton) in March 2012 (OAE, 2013). It increased more than 40 percent from the time the Thai government promoted biodiesel to the country. Thus, the producers of Thai palm oil pleaded with the government to expand the controlling price of bottled palm cooking oil from 42 THB to 50 THB for sale by claiming that they could not bear the cost of the raw material prices. Instead, the government banned the claims referring that the supply was still in abundance and the stock was also high.

These palm oil crises are key pieces of evidence presenting the links and the effect of variation in global prices on domestic palm oil prices as well as demonstrating the variation in product prices domestically. Therefore, to keep the market proper and efficient, knowing the links in the palm oil value chain and mechanism of price transmission and price volatility is needed in order to deal with the fluctuation of prices in the palm oil market that will probably occur in the future.

2. Fluctuation in Thai Domestic Palm Oil Prices

The fluctuation in Thai domestic palm oil prices is affected by many factors. These factors can be the rising in world crude oil price, the changing in world crude palm oil price and domestic palm oil prices, the variation in weather, domestic policy, imperfect market information, growth in population and income, etc. Figure 1.7 demonstrates the fluctuation of palm fresh fruit bunches and crude palm oil prices in Thailand over time.

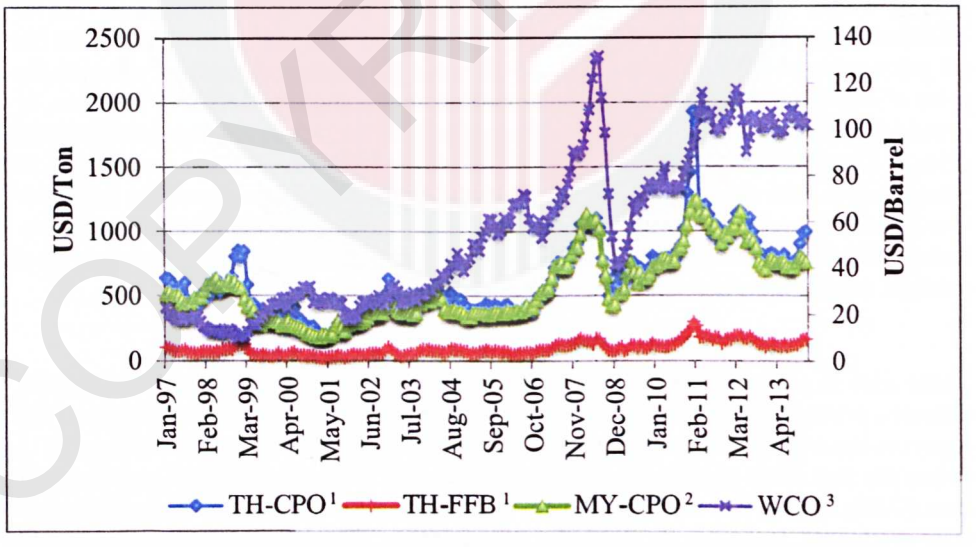

Figure 1.7: Palm Products Prices and World Crude Oil Price
Source: [1]Department of Internal Trade (2015), Thailand, [2]World Bank (2015), [3]International Financial Statistics (IMF) (2015)

From the figure above, prices of fresh fruit bunches and crude palm oil in Thailand are varied and likely changes in parallel during the same time period. Furthermore, the prices of crude palm oil both in Thailand and Malaysia moved more or less in tandem over time. Both started to vary in the same direction, following world crude oil since 2007. Consequently, any shocks in the world petroleum market will transmit to international and domestic crude palm oil markets. Likewise, any shocks in the Thai domestic fresh fruit bunches market will transmit to Thai crude palm oil market, and in the other way around. The high volatility in these prices makes crude palm oil and fresh fruit bunches prices in Thailand very sensitive to any small shocks and forecasts or events made in the news. Therefore, to adjust production and processing procedures in the palm oil market in an appropriate way, clear market signals become very important. If the market signals are blurred by overreactions and high volatilities in global market prices, it is difficult to adjust proper production. Thus, stakeholders in the industry will be faced with increased price risk and inefficiency in production.

To summarise, oil palm is becoming an extremely key crop in the development of the Thai economy, both in the short and long period. Consequently, there is an opportunity for Thailand to improve its production because oil palm is intended to become a primary economic crop in Thailand. The government is paying close attention to its production and has a strategic plan to step up its global leadership in producing palm oil, standing shoulder to shoulder with neighboring countries like Malaysia. Besides, to enhance palm oil industry in Thailand, it is very important to examine the structure and marketing system of the current palm oil industry. Results from gaining greater understanding could help the authorities and stakeholders in the value chain making data-driven decisions and plans for developing the palm oil industry, including helping to create a stable and sustainable industry for the long term.

1.3 Problem Statement

Oil palm is a cash crop that plays an important role in vegetable oil, downstream industries and biodiesel production. Currently, the Ministry of Agriculture and Cooperatives collaborates with provinces, who are major sources of palm oil in Thailand, to determine the strategic plan to encourage farmers to expand oil palm cultivation areas. The strategic target is to increase palm oil yield in response to its current growth in demand and projected growth in the future. The Thai government supports oil palm cultivation by promoting the replacement of old and less productive rubber and oil palm trees good and high-yielding oil palm varieties. Also, the government is promoting the use of technology in the production and harvesting to enhance palm oil production quantity and quality.

However, though palm oil production in Thailand is increasing dramatically, productivity remains relatively low, and the quality of raw material is less than it could be (Eksomtramage, 2005; Roumpunpong, 2007; Choengthong et al., 2008; Thongrak et al., 2011). There is a need to analyse the structure of the Thai palm oil industry and the current problems that the industry faces. The operations and functions of each stakeholder along the value chain also need examination, especially in the upstream level

where the key players of the industry operate, because it can help to improve competitiveness and promote the development of the industry (Jongrungrote, 2007). Moreover, considering the importance of palm oil usage globally, many countries are concerned about the price of palm oil used for industrial and commercial purposes. Because the global prices of food and commodities are now widely believed to be co-integrated (Nazlioglu and Soytas, 2012; Bin et al., 2014), if the price of palm oil rapidly increases, an inevitable price increase in food products and household goods will occur and may strain the capacity of some social economic groups to get by (Larson, 1996; Rifin, 2009; Harjanti, 2012). The linkage between standard of living in food and commodity prices occurs because there is a pass-through; at least partly, between the global prices and final consumer prices. When there is a rise in global prices, it eventually affects domestic product prices in one-way or another (Selliah et al., 2015). Even though there are domestic policies to protect domestic prices, in the long-run they cannot prevent the co-variations of domestic prices with the global prices (Mundlak and Larson, 1992). Consequently, the marketing system and price transmission of the palm oil industry in Thailand is essential to study because a great marketing system will encourage and support efficient and strong revenue-generating production and insulate against adverse impacts on standards of living (Choengthong et al., 2008; Chuangchid et al., 2012; Kaewchuey, 2007; Roumpunpong, 2007).

Given the issues described above, therefore, the current study attempts to uncover the roles, linkages and marketing system of the stakeholders along the palm oil value chain as well as the price transmission and volatility between Thai palm oil prices and global prices. Better understanding the value chain can help stakeholders and authorities to understand dynamic and existing problems in the market and to make effective plans and resolutions to enhance the industry. The result will be greater revenue for the nation and a higher standard of living for the people.

1.4 Research Questions

The main question of this study is to examine what and how Thailand can organize and manage the effects that transmit to Thai palm oil market when there are changes in global prices. Three research questions have been formulated:

1. What is the structure and marketing system of the Thai palm oil industry?
2. What are the key drivers in Thai palm oil value chain? How is the value chain of the Thai palm oil industry organized?
3. How does the change and volatility of global prices affect the Thai palm oil price?

1.5 Objectives of the Study

This research strives to provide ways to enhance the Thai palm oil industry and enable it to become more globally competitive. The general objective of this study is to analyse the structure and marketing system of the palm oil industry in Thailand as well as related price transmission and volatility mechanisms. The specific objectives of this study are:

1. To examine the structure and marketing system of the palm oil industry in Thailand
2. To analyse the value chain of the Thai palm oil industry.
3. To analyse price transmission and volatility spillover effects on Thai palm oil price.

1.6 Justification of the Study

To increase productivity in the Thai palm oil industry, the activities alongside the value chain, the governance of the industry as well as the factors affecting the industry need to be revealed. Results from this inquiry can be used to analyse the opportunities and constraints to promoting growth and may help Thailand to improve production capacity and reduce production costs that impact food security and the domestic economy.

An efficient marketing system is a requirement for agricultural products in order to achieve a better price and increase negotiation among the producers. Basically, the marketing system can be enhanced by emphasising the improvement of how fresh fruits our marketed (Tracey-White, 2015). Likewise, it is necessary to investigate the marketing channels, linkages, and functions of the fruits market in order to make effective inventions for the marketing system (Abbot et al., 1986; Tracey-White, 2015). Similarly, the marketing system would make clear the characteristics of the stakeholders inside the value chain with the roles and activities of each player made explicit, which will help people involved better understand how the market is organised so that they may make effective plans.

Value chain analysis is another analytical tool for economic growth and stability. It shows information of the commodity in its sector, reveals the activities alongside the chain, presents how governance in the industry operates and shows the intervention policies that affect the industry. The proper management of activities alongside the chain is very important for improving productivity and predicting prospects for future exports that can elevate the economic status of the country (Thomas et al., 2011).

Price transmission and volatility spillover analysis[2] are other tools that were used to investigate the relations in the value chain when it comes to studying marketing procedures, policy objectives, and academic circles (Serra and Goodwin, 2003; Arshad and Hameed, 2014). Price transmission analysis shows the relationships of markets that are integrated vertically and horizontally, and it provides important insights on how changes in one market affect another market (Meyer and Cramon-Taubadel, 2004). The

[2] The analysis of price transmission and volatility spillover looks similar in the context of the study, but actually, they have different foci. Volatility spillover analysis focuses on the unknown factors that affect the variation of global prices, which are transmitted or spillover to domestic prices, whereas price transmission analysis focuses on the changes in the global prices itself that are transmitted to domestic prices. The economists mostly prefer to use both analyses to investigate the impact of changes in global prices on domestic prices.

extent and speed of adjustment are significant factors for presenting the activities of participants at diverse market levels as well as providing some implications on market integration (Arshad and Hameed, 2014). In contrast, if the considered markets are not integrated, it may result in vague price information. This could lead to misleading decisions in the production cycle and promote inefficiency in the markets. Symptoms of these effects include low production, loss in welfare, and a slowdown in growth, especially in the developing countries.

When markets are linked, it is reasonable to assume volatility spillover among the markets (Haigh and Bryant, 2001). Volatility spillover analysis shows the impact of factors that affect variables being considered. Past experiences show that market price volatility has important consequences for the consumer's and producer's welfares, especially the unforeseen price variations in agricultural commodities, occur in response to spontaneous exogenous or endogenous shocks. From the consumer's volatility spillover creates large price fluctuations that affect the purchasing power and the access to consumption. On the other hand, it creates uncertainty and volatility in profit margins that affect risk and confidence in the investment of the producers (Gardner and Gardner, 1977; Uchezuba, 2010). Therefore, accurate modelling of price volatility spillover is required as a tool for investment, pricing and risk management.

A good understanding of the marketing system, value chain, and price fluctuations suggests authorities and policymakers should establish appropriate policies in order to empower the Thai palm oil industry and enhance competitiveness in the global market. The result can benefit not only the policymakers but also the users of palm oil, such as farmers, processors, traders and consumers. Oil palm farmers and intermediate users of palm oil can use this knowledge for managing and planning their production as well as maximising their profit and reducing their risk. Finally, consumers would eventually get the benefits from the resulting fair prices.

In conclusion, this study of the Thai palm oil industry emphasizes understanding the industry's marketing, value chain, and price fluctuations. First of all, the palm oil industry currently plays a significant role in the country's economy, demand is continuously rising, and the Thai government is paying more attention to sustainable palm oil and promotes the production of this industry. Second of all, the Thai palm oil industry underwent two important crises that were caused by the fluctuation of domestic and global prices, resulting in higher levels of concentration, especially in the fresh fruit market and crude palm oil market. It increased social and political concern about market efficiency and how to manage the market when a shock occurs. Lastly, analysis of value chain and prices in the palm oil market provides an understanding of activities alongside the chain. Analysis also delivers understanding of the behaviour and interaction of each player in the industry, as well as the impact of changes in global prices on domestic prices over time.

1.7 Organisation of the Study

This study consists of seven chapters, including the introduction. Chapter 2 reviews the theoretical frameworks of the value chain, price transmission and volatility, and illustrates previous empirical studies on palm oil and agricultural products. Chapter 3 describes the conceptual and analytical framework of the study as well as the research methodology, sample and sampling, data collection, and the research model used in this study. Chapter 4 provides the results and findings of marketing system of the palm oil industry in Thailand. Chapter 5 presents the analysis of palm oil value chain, opportunities and constraints on developing the Thai palm oil industry. Chapter 6 is the analysis and discussion of price transmission and volatility spillover on domestic palm oil price in Thailand. Lastly, Chapter 7 concludes the findings of this study and policy recommendations.

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