Chapter 1
Introduction

1.1 Statement and the Signification of the Problem

The increase in the price of oil has caused many countries to consider using alternative renewable energy from the agricultural sector, particularly energy crops such as soybean, rapeseed, sugarcane, corn, and palm oil. This increase in production reflects the rising global demand for energy crops, and palm oil production is the dominant one compared with other energy crops (Carter et al., 2007).

However, there are regional distinctions in the choice of energy crops for conversion to biodiesel output. For example, in Europe, the primary production of biodiesel is based on the use of rapeseed oil; in Brazil and the USA, the base is soybean oil, and in Malaysia, palm oil is the main source for biodiesel production (Yu et al., 2006). Nowadays, palm oil has more importance in the world because it contributes to a cheap and efficient biofuel. This advantage gives palm oil more potential as an agricultural product than other energy crops, as shown in Table 1.1

Palm oil is a type of fatty energy crop derived from the fruit of the palm tree. It is used for both food and non-food consumption. Palm oil is a highly efficient and high yielding source of food and fuel. Approximately 80% of the palm oil is used for food, such as cooking oils, margarines, noodles, baked goods, etc. (World Growth, 2011). In addition, palm oil is used as an ingredient in non-edible products such as biofuel, soaps, detergents, and pharmaceuticals. With such a high range of versatile use, the global demand for palm oil is expected to grow further in the future (USDA, 2011).

Table 1.1 World Productions of Major energy crops (Million Metric Tons)

Crop	Production Year					May
	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Coconut	3.22	3.53	3.53	3.62	3.68	3.68
Cottonseed	5.13	5.21	4.78	4.64	4.98	5.27
Olive	2.83	2.78	2.78	3.05	3.01	3.02
Palm	37.33	41.08	43.99	45.86	47.26	50.26
Palm Kernel	4.44	4.88	5.17	5.50	5.65	5.66
Peanut	4.49	4.86	5.02	4.68	5.03	5.06
Rapeseed	17.13	18.42	20.47	22.31	22.97	23.14
Soybean	36.53	37.83	35.89	38.89	41.84	43.27
Sunflower seed	10.70	10.03	12.00	11.66	11.38	12.18
total	121.78	128.61	133.64	140.20	145.80	151.53

Source: USDA, FAS

Many countries plant oil palms to produce oil to provide for local consumption. World trade in palm oil has increased significantly due to the enlargement in global demand. Over the past 30 years, there has been a gradual increase in the world production of palm oil due to the outcome of a rapid expansion of oil palm plantations which are located in Southeast Asian countries (Basiron, 2005). This energy crop was produced at the rate of 13.01 million tons in 1992 and then increased to 50.26 million tons by May, 2011: this is a figure of 286% increase in 19 years (USDA, 2011). Moreover, the world palm oil production is expected to increase by 32% to almost 60 million tons by 2020 (FAPRI, 2010).

The major world producers and exporters of palm oil are Malaysia and Indonesia. For these countries that are considered as the champions of producing and exporting palm oil, their endowed natural resource are deemed to be highly practicable and the most cherished cash crop that replaces other traditional crops such as rubber. However, in order for these countries to maintain a high yielding level of palm oil production throughout the period, it is quite essential that they ensure the means that paves the way for achieving viability towards the export market (MPOB, 2010). Indonesia is the largest exporter of palm oil in the world, it exports around 19.55 million tons a year between 2008-2011 (USDA, 2011). Malaysia is the second largest exporter. In the past until 2007, Malaysia was the largest exporter of palm oil in the world, producing about 15 million tons of palm oil a year. Malaysia has been playing an important role to accomplish the needs and to stay competitive in the world's oils and fats market (World Growth, 2011), as shown in Table 1.2.

Table 1.2 The Exporter of Palm Oil (Thousand Metric Tons)

Country	Year					May
	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Indonesia	11,419	13,969	15,964	16,573	17,850	19,550
Malaysia	12,900	14,644	15,485	15,530	15,100	15,900
Papua New Guinea	383	451	496	490	496	525
Benin	273	358	348	450	485	500
United Arab Emirates	334	336	232	344	430	465
Other	2,293	2,549	2,270	2,245	2,341	2,380
Total	27,602	32,307	34,795	35,632	36,702	39,320

Source: USDA, FAS

The main consumer and business market for the palm oil commodity is the food industry. The major importers of palm oil are India, China, and the European Union. India is the largest and leading consumer of palm oil worldwide, importing about 7.8 million tons in 2011. China is the second largest importer of palm oil, importing about 6.65 million tons in 2011 (USDA, 2011). See Table 1.3.

Table 1.3 The Importer of Palm Oil (Thousand Metric Tons)

Country	Year					May
	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
India	3,650	5,013	6,867	6,603	7,000	7,600
China	5,139	5,223	6,118	5,760	5,950	6,650
EU-27	4,332	4,960	5,504	5,422	5,100	5,500
Pakistan	1,619	1,958	1,957	2,041	2,100	2,200
Malaysia	403	669	1,047	1,283	1,350	1,400
Egypt	768	553	1,024	1,174	1,125	1,250
Bangladesh	898	724	700	951	1,050	1,120
U.S.A	702	952	1,036	994	907	998
Iran	419	610	504	548	570	650
Singapore	220	287	328	352	475	600
Other	8,282	9,335	8,579	9,623	10,229	10,423
Total	26,432	30,284	33,664	34,751	35,856	38,391

Source: USDA, FAS

Palm oil prices can be significantly affected in many ways, for example fluctuation in nature, the expanding trade, and world demand (OECD, 2008). Since nature is unpredictable, the main source of world palm oil price fluctuation is mainly changing from its demand. However, the world demand for palm oil depends on food demand, as well as the demand for biofuel in the industrial sector. Additionally, other relevant factors such as rising crude oil and soybean oil prices, and the recession of the world economy have made the prices of palm oil to fluctuate. Therefore, the price of palm oil remains uncertain in the future.

Figure 1.1 presents the fluctuation in Malaysia palm oil futures price over the past 25 years (1986 – 2011). The price was $182.00 per metric ton in July 1986 which has increased to $1,033.57 per metric ton in July 2011, an increase of 468%.

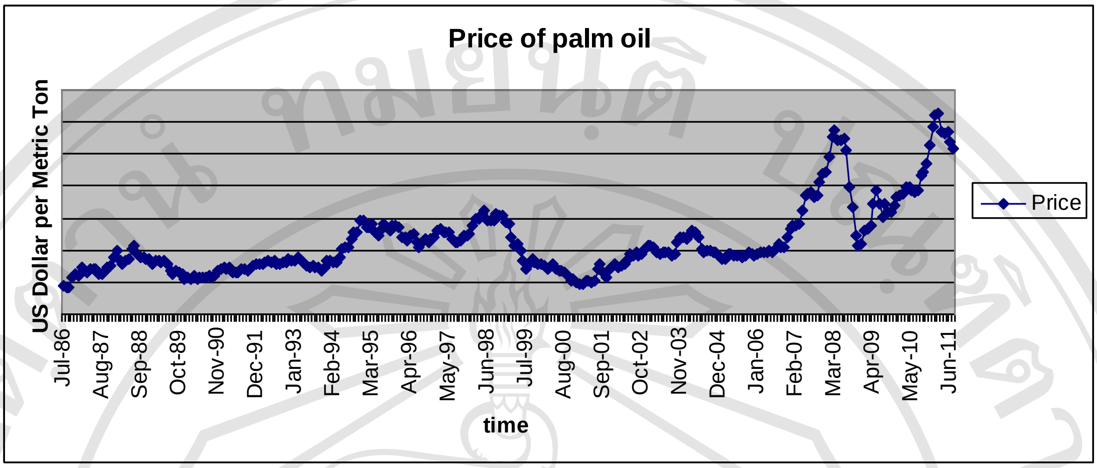

Figure 1.1 Palm oil monthly prices, Jul 1986 - Jul 2011

Source: www.indexmundi.com

Note: The Palm oil price of this paper is Malaysia Palm Oil Futures (first contract forward) 4-5 percent FFA, US Dollars per Metric Ton.

The uncertainty of palm oil prices provides many advantages to various nations, not only countries like Malaysia, but also other developing countries which are heavily involved in oil palm plantation. Such a high price of palm oil automatically triggers an influence for firms or commercial operators to make more capital investment and procure recruitment of labor for the purpose of creating an increase in the production of palm oil. However, instability of palm oil prices can create significant risks to producers, suppliers, consumers, and other stakeholders. In risky conditions and price instability, an accuracy of palm oil price analysis is very important in supporting policymakers to make informed decisions and development for their own countries.

An analysis has been traditionally implemented with an econometric model on the prices of palm oil. The models applied were the Autoregressive Integrated Moving Average (ARIMA), Autoregressive Conditional Heteroscedastic (ARCH), and Generalized Autoregressive Conditional Heteroscedastic (GARCH) (Assis et al., 2010). These methods were gathered from a historical data. The general linear regression analysis used in the aforementioned models assumes normality of the distribution, and, therefore, analysis of prices using such an approach ignores the possibility of extreme events. As the palm oil price analysis determines the probability of extreme events, this thesis will be based on the Extreme Value Theory (EVT). The EVT can describe both the behavior of random variables at extremely high or low levels. The theory enables to describe the performance of the heavy-tail properties of the high frequency time series data. Thus, this thesis applies the extreme value econometric to analyze the palm oil price.

1.2 Overview

The oil palm tree was originally from West Africa in the 20th century. It is also called *Elaeis guineensis* (Basiron, 2005). According to Karia and Bujang (2011), this plant had a rapid expansion in world production because palm oil was found to be a cheap and efficient source of bio-fuel. The world production of palm oil has increased rapidly during the last 30 years because of the extension in oil palm plantations in Southeast Asian countries, including Malaysia and Indonesia (Basiron, 2002). As a result, Malaysia and Indonesia are the major net exporters of palm oil, thus the applications of palm oil market were studied in these countries.

Accordingly, many palm oil producing countries have confirmed involvement with organizations and research institutes that generate data and information to add to the knowledge on oil palm cultivation, palm oil processing, and related applications. Previous works on palm oil industry were conducted by Talib & Darawi (2002) and Basiron & Simeh (2005). From Talib & Darawi (2002) it was discovered that the importance of factors affecting palm oil production were palm oil stock level, price of palm oil, the exchange rate, world population, and the price of soybean oil. Moreover, Basiron and Simeh (2005) found that palm oil has been the driving force of the world oils and fats economy. In the future, the production and consumption of palm oil are expected to become the number one edible oil of the entire world.

Wahid et al., (2007) investigated development in the world palm oil prices. This research considered the impact of the trends on world palm oil price assessed with the consumption, trade, price competitiveness, investment in oil palm/palm oil, and the use of palm oil producing biodiesel. The high rise in the trend of the oil palm price had a great implication for the agricultural and industrial sector in producing countries (Pleanjai et al., 2007). The price of oil palm surges over time due to the uncertain price of oil palm. There are risks and unreliability for tree-crop farmers, shareholder, traders, and producers. To decrease the risk and uncertainties, there should be effective risk management strategies (Karia and Bujang, 2011).

Previous works on forecasting palm oil prices and other agricultural prices were conducted by Arshad and Ghaffar (1986), Nochai (2006), Liew et al., (2007) and Karia and Bujang (2011) employing a range of forecasting techniques to predict palm oil prices. Arshad and Ghaffar (1986) used a univariate ARIMA model developed by Box-Jenkins to forecast the short-run monthly price of crude palm oil. They found that the Box-Jenkins model is limited to short-term predictions. Nochai (2006) identified an appropriate set of ARIMA models for forecasting Thailand palm oil price, based on minimum Mean Absolute Percentage Error (MAPE) at three levels. For farm level price, ARIMA (2,1,0) was seen to most suitable, ARIMA (1,0,1) or ARMA(1,1) is suitable for wholesale price and ARIMA (3,0,0) or AR(3) is suitable for pure oil price. A further study on forecasting other agricultural prices using methods from the ARMA family was reported by Liew et al., (2007) which used the ARMA model to forecast Sarawak black pepper prices. This found that the ARMA model fits the price and correctly predicts the future trend of the price series within the sample period of study. Assis et al., (2010) compared four methods – exponential smoothing, ARIMA, GARCH and mixed ARIMA/GARCH models – to forecast cocoa bean prices. They concluded that the mixed ARIMA/GARCH model outperformed the other three models within the sample period of study.

Others studied factors that affect palm oil price. Those factors include the magnitude of demand, especially from India and China (USDA, 2011). Other factors are the recession of the world economy, the variation of weather conditions that impact the increasing of crude oil, and soybean oil prices. Moreover, there are some studies that reveal the relationship between soybean oil and palm oil prices for example Arhsad and his colleagues used the ‘two stage least squares method’ to estimate soybean and palm oil prices. With regards to the application employed, their work found that soybean prices would have a positive relationship with world palm oil price. Based on the analysis of relationship with Abdullah, Abas, & Ayatollah (2007), his group reveals that soybean oil and palm oils are two good examples of agricultural commodities that have similar characteristics. They are also substitutable in many applications, and have prices of soybean and palm oil that are highly correlated.

In terms of the relationship between crude oil and palm oil prices, there have been many previous studies done by Hameed & Arshad (2009), they studied the relationship between the prices of crude oil and selected vegetable oils using the Granger causality test. According to this study, the results show that in the long-run there was a one direction relationship between crude oil price and the prices of each of four vegetable oils, i.e., palm, rapeseed, soybean, and sunflower oils, but the reverse was not true. Moreover, our work points to Hadi, Yahya, Shaari, & Huridi (2011) studying the effect of changes in crude palm oil prices on the price of crude oil. Upon applying the Engle-Granger Cointegration test and Error Correction Model to find a significant long-term result, their work found that the prices of crude palm oil and crude oil are also positively correlated.

All of the above studies have assumed that the data were normally distributed. However, the palm oil price analyses involve determining the probability of extreme events. According to a study done by Manfred and Evis, (2003) the authors proclaimed that "*EVT provides a strong theoretical basis with which this thesis can construct statistical models that are capable of describing extreme events*". Extreme value methods have been used in environmental science, hydrology, insurance, and finance. EVT became a popular method to forecast extreme financial risks. For example, Silva and Mendes (2003), as well as Bekiros and Georgoutsos (2004), used EVT to forecast Value at Risk (VaR) of stock and found that EVT provided accurate forecasts to be made of extreme losses with very high confidence levels. Moreover, Peng et al., (2006) have compared EVT and GARCH models to predict VaR, thus concluding that EVT method is superior to GARCH models in estimating and predicting VaR. In disaster studies, there have been many previous works done, such as the ones conducted by Lai and Wu (2007), Lei and Qiao (2010) and Lei et al., (2011). They have used EVT to evaluate and analyse the distribution of agricultural output loss and VaR is used to assess agricultural catastrophic risk. Brodin & Rootzen (2009) who have used univariate and bivariate extreme value methods for predicting extreme wind storm losses. Based on their study, they believed that the bivariate model provided the most realistic picture of the real uncertainties.

In general, the work mentioned above used the EVT to analyze and evaluate extreme risks in the finance and disasters sector, but does have not applied it to analyze energy-crop extreme prices. Therefore, this thesis examines the applications of extreme value econometrics to palm oil price analysis. The extreme value of univariate and bivariate will be used in the data analysis, as well as an adaptation of Block Maxima (BM) and Peak Over Threshold (POT) in estimation.

1.3 Objectives of the study

The objectives of this dissertation are as followed:

1.3.1 To apply univariarate BM and POT methods for extreme events prediction of palm oil prices in the future.

1.3.2 To use bivariate BM and POT approaches for the relationship analysis between soybean oil and palm oil price, crude oil and palm oil price.

1.3.3 To focus on the dependence structure between the return on palm oil price in various futures markets using the Extreme Value Copulas and study the tail behavior of palm oil futures prices by using the EVT.

1.4 Policy relevance

This research will provide the appropriate methodology to predict palm oil prices and price movement, the relationship among palm oil price, soybean price, and crude oil price. Additionally, it will study the dependence structure between the return on palm oil future price in various markets using the Extreme Value Copulas approach.

The stakeholders who are both located in Thailand and overseas, for example buyers, sellers, producers, and consumers, could utilize the results from this study as the determining factor for their future planning.

The policymakers might adopt the results from this research as a major policy in order to issue the efficiency policy to maximize the benefits for related palm oil agents.

1.5 Structure of the Dissertation

This research uses both univariate and bivariate extreme value, as each type of estimation adopts BM and POT. Finally, the third objective of this paper employs the extreme value copulas model.

Chapter 2 will deal with the explanation of the methodology of the dissertation.

Chapter 3 provides the information to the first objective which is about the application of both univariate BM and POT to predict extreme events of palm oil prices in the future.

Chapter 4 identifies the second objective which uses the bivariate BM and POT to analyze the relationship between soybean oil and palm oil prices, crude oil and palm oil prices.

Chapter 5 assesses the third objective which adopts the extreme value copula to find the dependence structure between the return on palm oil price in the future markets.

Chapter 6 provides the conclusion from the three studies. Suggestions are also made for future research.