UNIVERSITI PUTRA MALAYSIA

A SYSTEM DYNAMICS ANALYSIS OF MALAYSIAN PALM OIL PRICE DETERMINANTS

SAHRA MOHAMMADI

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By

SAHRA MOHAMMADI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Master of Science

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Chairman: Prof., Datin Paduka, Fatimah Mohamed Arshad, PhD
Faculty: Economics and Management

The palm oil industry has made a significant contribution to the Malaysian agricultural sector and has become an important driver in Malaysian economy. In 2011, palm oil accounted for 6% of the GDP and 61.8% of the export value in Malaysia. The industry provides employment to approximately 2.2 mn people, which is the largest in the country. Moreover, oil palm cultivation has become an effective means to address rural poverty.

Nevertheless, the palm oil price demonstrates volatile behavior and appears with significant fluctuations over time. Price volatility poses risks in the market and affects both producers and consumers. It also hampers economic growth and reduces the stability of returns to firms and investments plus all other parties involved in the palm oil supply chain. It causes direct economic losses, impacts trade competitiveness which diverts trade and investment activities. Thus, understanding the price behavior is vital for the stakeholders of industry. This study, aims to investigate major determinants of Malaysian palm oil price.

Based on the relevant literature, this study hypothesizes that the major determinants of palm oil price behavior are the level of production, demand for palm oil, world palm oil price, substitute price such as soybean oil, biodiesel production, and delay in decision making. Understanding the price behavior helps decision makers to become more aware of the possible future trends and turns and enables them to take measures such as inventory and fund management and to reduce the impact of possible shocks into the system.

This study employs system dynamics approach to examine the Malaysian palm oil market by using secondary data between 1982 until 2012 reported by government agencies such as Malaysian Palm Oil Board (MPOB) and Ministry of Plantation Industries and Commodities (MPIC). The system dynamics methodology is very relevant for examining the feedback relationships between variables, non-linearity, and delay that exist in a system including the palm oil market. System dynamics simulation helps understand the impact of the market structure, and hence, the behavior of palm oil price both in the short run and long run. A short-run perspective gives opportunities to the industry players to make short term decisions such as taking position in the futures market (hedging) and fund management. In addition, a long-run perspective allows time

for them to make long-term decisions such as investment on land capital as well as inventory management.

The study found that the palm oil price behavior has been affected by its supply and demand, the world CPO price, and the world soybean oil price. The simulation results indicate that palm oil price will increase by approximately 36.0 percent over the next fifteen years, from RM 2,764/mt in 2012 to RM 4,335/mt in 2030. The price increase attributed to changes in the world palm oil price and an increase in the demand for palm oil products.

The study concludes that it is vital for the palm oil industry to monitor the price movement and to keep track closely the changes in the fundamentals particularly CPO production as well as the world CPO and soybean oil prices. Moreover, the Malaysian palm oil industry must develop further value-added products in order to internalize the price changes and to make palm oil ventures economically viable regardless of price changes. To cushion the impact of significant price variability, it is believed that the production and export of biodiesel product can be a major thrust for the palm oil industry in Malaysia.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia Sebagai memenuhi keperluan untuk ijazah Master Sains

ANALISIS SISTEM DINAMIK TERHADAP PENENTU HARGA MINYAK SAWIT MALAYSIA

Oleh

SAHRA MOHAMMADI

April 2015

Pengerusi: Prof., Datin Paduka, Fatimah Mohamed Arshad, PhD
Fakulti: Fakulti Ekonomi dan Pengurusan

Industri minyak kelapa sawit memberi sumbangan yang signifikan kepada sektor pertanian di Malaysia dan menjadi salah satu pemacu utama dalam ekonomi Malaysia. Pada tahun 2011, minyak kelapa sawit merupakan 6% daripada Keluaran Kasar Dalam Negara (KDNK) dan 61.8% daripada nilai eksport di Malaysia. Industri ini juga menyediakan pekerjaan kepada kira-kira 2.2 juta orang Malaysia yang merupakan terbesar di negara ini. Tambahan pula, penanaman kelapa sawit telah menjadi suatu cara yang berkesan bagi menyelesaikan isu kemiskinan luar bandar.

Walau bagaimanapun, harga minyak sawit memaparkan tingkah laku yang sentiasa berubah-ubah dan muncul dengan turun naik yang signifikan sepanjang masa. Harga yang berubah-ubah menyebabkan risiko kepada pasaran dan menjejaskan kedua-dua pengeluar serta pengguna. Ia juga memperlahankan pertumbuhan ekonomi dan mengurangkan kestabilan pulangan kepada firma dan pelaburan serta pihak-pihak lain yang terlibat dalam rantaian bekalan minyak sawit. Ia menyebabkan kerugian ekonomi secara langsung, memberik impak terhadap daya saing dagangan yang mengubah haluan aktiviti dagangan dan pelaburan. Sesungguhnya, memahami tingkah laku harga adalah penting bagi pihak berkepentingan dalam industri tersebut. Kajian ini bertujuan untuk menyiasat faktor-faktor utama yang mempengaruhi tingkah laku harga sawit di Malaysia.

Berdasarkan karya yang relevant, kajian ini membuat hipotesis bahawa faktor-faktor utama yang mempengaruhi tingkah laku harga minyak sawit ialah tingkat pengeluaran, permintaan terhadap minyak sawit, harga minyak sawit dunia, harga barangan gantian seperti minyak kacang soya, pengeluaran biodiesel, dan kelewatan dalam membuat keputusan. Memahami tingkah laku harga ini membantu pembuat keputusan untuk lebih sedar akan arah aliran dan pusingan masa depan serta membolehkan mereka mengambil langkah-langkah seperti pengurusan inventori serta dana dan mengurangkan impak terhadap kemungkinan kejutan di dalam sistem tersebut.

Kajian ini menggunakan pendekatan sistem dinamik bagi memeriksa pasaran minyak sawit Malaysia dengan menggunakan data sekunder daripada tahun 1982 hingga 2012 yang dilaporkan oleh agensi kerajaan seperti Lembaga Minyak Sawit Malaysia (MPOB) dan Kementerian Industri Perladangan dan Komoditi (MPIC). Metod sistem dinamik ini adalah sangat relevan bagi mengkaji hubungan maklum balas antara pembolehubah-pembolehubah, ketaklinearan, dan kelewatan yang wujud dalam sesebuah sistem

termasuklah pasaran minyak sawit. Simulasi sistem dinamik membantu untuk memahami impak struktur pasaran, dan tingkah laku harga minyak sawit dalam jangka pendek dan jangka panjang. Perspektif jangka pendek memberi peluang kepada pemain industri untuk membuat keputusan jangka pendek seperti mengambil tempat di dalam pasaran ke hadapan (perlindungan nilai) dan pengurusan dana. Selain daripada itu, perspektif jangka panjang memberi masa kepada mereka untuk membuat keputusan jangka panjang seperti pelaburan dalam modal tanah dan pengurusan inventori.

Kajian mendapati tingkah laku harga minyak sawit telah dipengaruhi oleh pengeluaran dan permintaan, harga minyak sawit mentah dunia, dan harga minyak kacang soya dunia. Keputusan simulasi menunjukkan harga minyak sawit akan meningkat lebih kurang 36.0 peratus selepas 15 tahun, daripada RM 2,764 per tan metrik pada tahun 2012 kepada RM 4,335 per tan metrik pada tahun 2030. Peningkatan harga tersebut disebabkan oleh perubahan dalam harga minyak sawit dunia dan peningkatan dalam permintaan terhadap produk minyak sawit.

Sebagai rumusan, ia amatlah penting untuk peserta industri bagi memantau perubahan harga minyak sawit secara lebih dekat serta beberapa perubahan fundamental teutamanya pengeluaran CPO, harga dunia bagi minyak CPO dan kacang soya. Selain itu, industri minyak sawit di Malaysia juga disaran untuk membangunkan lebih banyak produk nilai tambah bagi memasukkan perubahan harga sekaligus menjadikan perusahaan minyak sawit lebih menguntungkan dan kurang terjejas oleh perubahan harga. Pengeluaran biodiesel dan eksport produk biodiesel juga dipercayai mempunyai potensi besar untuk menjadi tujah utama dalam industri minyak sawit selain daripada mengurangkan impak perubahan harga yang sangat ketara mampu.

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Last but not least, my deepest gratitude goes to my beloved family for their endless love and support. I owe more than thanks to my mother, Fatemeh Poursafdari, who always showed interest in my work, and has constantly encouraged me in pursuing my studies.

I certify that a Thesis Examination Committee has met on 22 April 2015 to conduct the final examination of Sahra Mohammadi on her thesis entitled "A System Dynamics Analysis of The Determinants of The Malaysian Palm Oil Price" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

Members of the Thesis Examination Committee were as follows:

Ahmad Shuib, PhD
Professor
Faculty of Economics and Management
Universiti Putra Malaysia
(Chairman)

Mohd Khairol Anuar bin Mohd Ariffin, PhD
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Internal Examiner)

Muhammad Tasrif, PhD
Associate Professor
School of Architecture
Bandung Institute of Technology
Indonesia
(External Examiner)

Nor Aini Ab. Shukor, PhD
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia
Date:

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Fatimah Mohamed Arshad, PhD
Professor
Faculty of Economics and Management
Universiti Putra Malaysia
(Chairman)

Kusairi Mohd Noh
Associate Professor
Institution of Agricultural and Food Policy Studies
Universiti Putra Malaysia
(Member)

Bilash Kanti Bala, PhD
Professor
Institution of Agricultural and Food Policy Studies
Universiti Putra Malaysia
(Member)

_____
BUJANG KIM HUAT, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by Graduate Student

I hereby confirm that:

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This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature: _____
Fatimah Mohamed Arshad, PhD
Professor
(Chairman)

Signature: _____
Kusairi Mohd Noh
Associate Professor
(Member)

Signature: _____
Bilash Kanti Bala, PhD
Professor
(Member)

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BD	Biodiesel
BOD	Biodiesel Oxygen Demand
CLD	Causal Loop Diagram
CPO	Crude Palm Oil
FAO	Food and Agriculture Organization
FELCRA	Federal Land Consolidation and Rehabilitation Authority
FELDA	Federal Land Development Authority
FFB	Fresh Fruit Brunch
FOB	Free on Board
KLCE	Kuala Lumpur Commodity Exchange
KLOFFE	Kuala Lumpur Options and Financial Futures Exchange
MDEX	Malaysia Derivatives Exchange
MPOB	Malaysian Palm Oil Board
MPIC	Ministry of Plantation Industries and Commodities
MPOPC	Malaysian Palm Oil Promotion Council
MSE	Mean Square Error
OER	Oil Extraction Rate
PK	Palm Kernel
PKO	Palm Kernel Oil
PKO	Palm Kernel Oil
PO	Palm Oil
PORLA	Palm Oil Registration and Licensing Authority
PPO	Processed Palm Oil
RBD	Refined Bleached Deodorized
RISDA	Rubber Industry Smallholder Development Authority
RM	Malaysian Ringgit
RMSPE	Root Mean Square Percent Error
SD	System Dynamics
WMOPA	West Malaysian Palm Oil Producers Association

CHAPTER 1

INTRODUCTION

1.1 Overview of the Palm Oil Industry

Oil palm plantation in Malaysia started in1917 but the actual development of palm oil industry began in 1960s, in accordance with government policy of agricultural diversity. The new policy aimed to reduce national dependency on rubber and tin. During the same period, land settlement schemes for oil palm cultivation were introduced in order to eradicate poverty in rural area. Since then, the palm oil industry has become an important component to the Malaysia's economy. Currently, Malaysia is the second larger producer and exporter of palm oil products in the world (MPOB, 2012).

Table 1.1 shows the oil palm planted area and production of CPO in Sabah, Sarawak, and Peninsular Malaysia. As shown, planted area and CPO production in Sabah has increased by 93.4% and 97% from 93,967 ha and 156,471 mt in 1980 to 1.4 mn ha and 5.5 mn mt in 2012, respectively[1]. Similarly, plantation and production in Sarawak show significant increase of 97% and 99%, respectively, during the same period. In Peninsular Malaysia, planted area and CPO production has increased from 906,590 ha and 2.4 mn mt in 1980 to 2.5 mn ha and 10.3 mn mt in 2012, suggesting an increase of 64% and 76% respectively.

Table 1.1. The Palm Planted Area ('000 ha) and Production of CPO ('000 mt) in Sabah, Sarawak, and Peninsular Malaysia, 1980-2012

Year	Sabah		Sarawak		Peninsular Malaysia	
	Planted Area	CPO Production	Planted Area	CPO Production	Planted Area	CPO Production
1980	94	156	23	22	907	2,394
1981	101	158	24	21	983	2,643
1982	111	221	24	35	1,048	3,255
1983	128	202	25	33	1,100	2,782
1984	161	266	26	42	1,144	3,407
1985	162	285	29	49	1,292	3,801
1986	163	368	26	57	1,411	4,118
1987	183	396	30	57	1,461	4,079
1988	213	434	36	82	1,557	4,511
1989	253	540	49	94	1,644	5,422
1990	276	679	55	108	1,698	5,308
1991	289	811	60	117	1,745	5,214

[1] ha stands for hectares, mt stands for metric tonne, and mn stands for million.

Year	Sabah		Sarawak		Peninsular Malaysia	
	Planted Area	CPO Production	Planted Area	CPO Production	Planted Area	CPO Production
1992	345	887	77	137	1,776	5,349
1993	387	1,049	87	164	1,832	6,190
1994	452	1,105	102	196	1,858	5,920
1995	518	1,494	119	222	1,903	6,095
1996	626	1,703	140	275	1,926	6,407
1997	759	2,124	175	332	1,959	6,612
1998	842	2,016	248	310	1,987	5,994
1999	941	2,665	320	462	2,052	7,428
2000	1,001	3,110	330	520	2,046	7,212
2001	1,027	3,716	375	610	2,097	7,477
2002	1,069	4,152	414	738	2,187	7,019
2003	1,135	4,523	465	886	2,202	7,945
2004	1,165	4,766	508	1,117	2,202	8,094
2005	1,209	5,334	543	1,337	2,299	8,291
2006	1,239	5,406	591	1,503	2,334	8,972
2007	1,278	5,561	665	1,635	2,362	8,627
2008	1,334	5,740	744	1,864	2,410	10,130
2009	1,362	5,450	840	1,995	2,490	10,120
2010	1,410	5,316	919	2,180	2,525	9,498
2011	1,432	5,843	1,022	2,696	2,547	10,373
2012	1,443	5,543	1,076	2,923	2,558	10,320

(Source: MPIC, 1990 & 2005; MPOB, 2012)

Figure 1.1 shows the total production and annual growth rates of CPO in Malaysia for the period of 1980 and 2012. As shown, the total production of CPO has increased by 86% from 2.5 mn mt in 1980 to about 18.8 mn mt in 2012. The annual growth of CPO production has changed over the last three decades indicating an average growth of 7.7% in 1980s, 5.2% in 1990s, and 4.2% in 2000s. The CPO production growth rate reached its peak in 1998 with an increase of 21% and then continued to increase at a decreasing rate over the following decade.

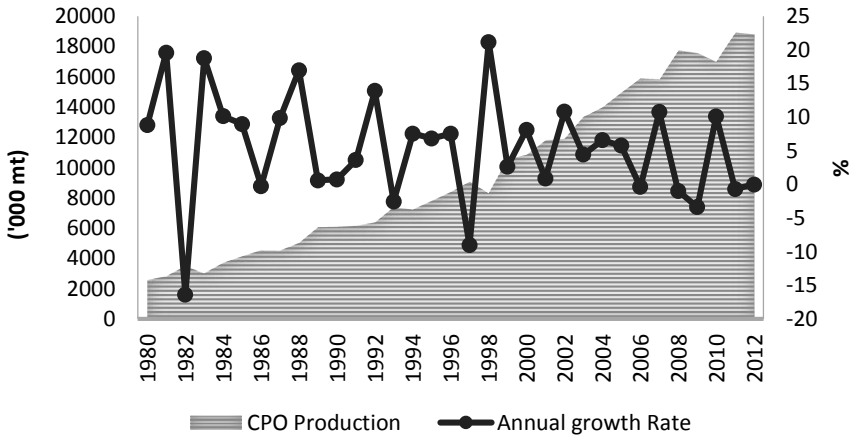

Figure 1.1. Total production ('000 mt) and Annual Growth Rate (%) in Malaysia, 1980-2012
(Source: MPIC, 1990 & 2005; MPOB, 2012)

Figure 1.2 shows the palm oil price and export amount in Malaysia over the last three decades. There is a strong relationship between palm oil price and its export (Mad Nasir Shamsudin et al., 1994; Basri Abdul Talib and Zaimah Darawi, 2002; Fatimah Mohamed Arshad et al., 2012). The price of Malaysian palm oil and its export are highly correlated with a high correlation of 0.81. In 2007, the export amount of palm oil decreased by 10% as a result of 22% increase in palm oil price from RM 2,414/mt to RM 3,109/mt in Malaysia.

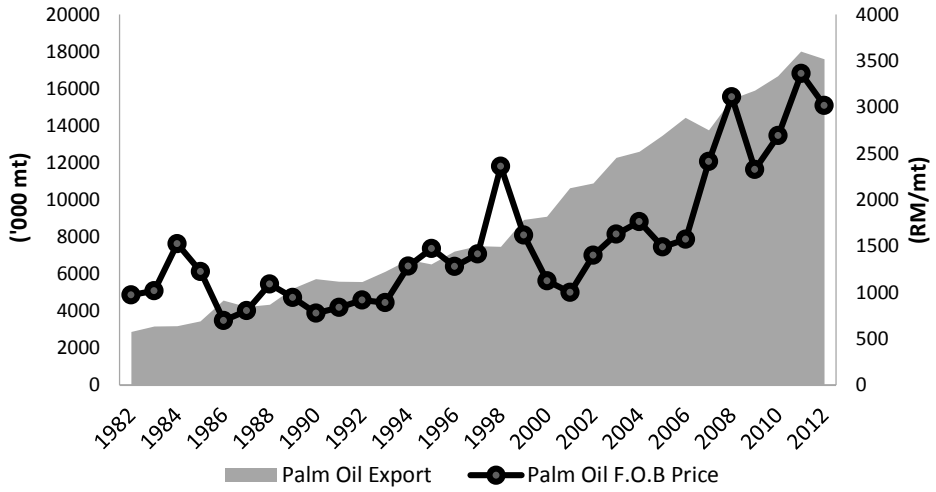

Figure 1.2. Palm Oil F.O.B Price (RM/mt) and Export ('000 mt) in Malaysia, 1982-2012
(Source: MPIC, 1990 & 2005; MPOB, 2012)

1.2 Problem Articulation

Malaysia is the second biggest producer and exporter of palm oil products, accounting for 35.5% and 43% of world production and export in 2012, respectively. It plays significant role in fulfilling global need for vegetable oil and fats. The palm oil industry also plays crucial role in Malaysia's economy. The industry brings opportunities for employment and poverty eradication. It contributed 6% of Malaysian GDP and 61.8% of Malaysia's export value in 2011.

Nevertheless, the price of Malaysian palm oil demonstrates significant variation from time to time, and it is known to be volatile (Anordin et al., 2007; Ramli Abdullah et al., 2007; Ayat K Ab Rahman et al., 2007; Mohd Basri Wahid et al., 2010). Price volatility hampers economic growth and it poses risk and uncertainty in returns and investments. As indicated in Figure 1.3, the price of Malaysian palm oil has been fluctuating through the reviewed period. Even though Malaysia is a powerful force in the global oil and fats economy, price volatility of palm oil produces uncertainty to the industry players.

Like other agricultural commodities, variation in palm oil price increases due to three important market fundamentals. First, agricultural output varies from period to period because of natural shocks such as weather. Second, supply and demand elasticity are relatively small with respect to price, especially in the short run. Third, there is a high delay in supply of agricultural commodities as their production take considerable time, and supply cannot respond to price changes in short term (FAO et al., 2011).

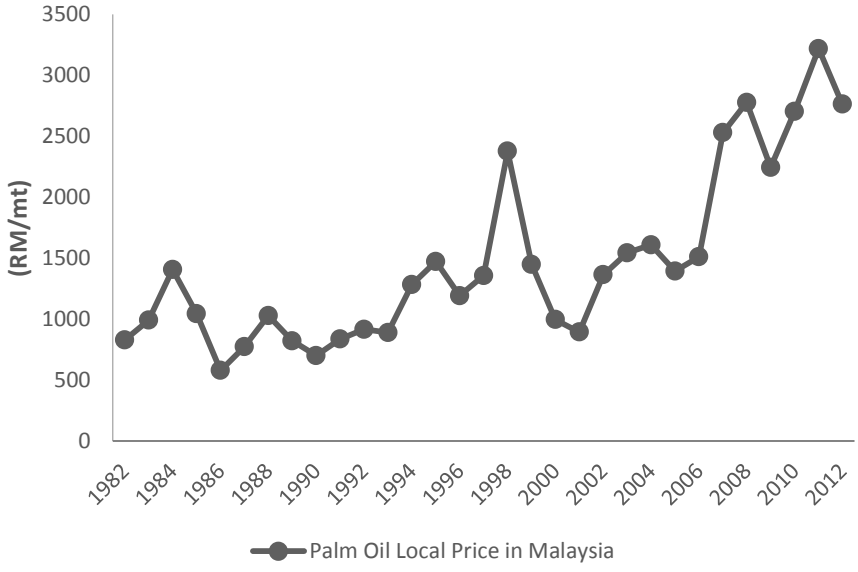

Figure 1.3. Local Price of Malaysian Palm Oil, 1982-2012
(Source: MPOB, 2012)

Understanding the dynamic relationship between the important aspects of the commodity system may provide clues as to possible strategies to address price fluctuations. Although it is unrealistic to influence the magnitude of exogenous disturbance, we can reduce their impact by understanding the commodity system (Meadows, 1979). The palm oil industry has significant economic advantages and it requires a careful understanding of the market structure as well as price behavior. Identifying factors contributing to the behavior of palm oil price in Malaysia will help the decision makers to be aware of the possible future trends and turns of this variable. With this knowledge, they may be able to take necessary measures and reduce the impact of possible shocks into the system.

This study adopts system dynamics methodology to study Malaysian palm oil price. This methodology is very relevant for examining the feedback relationships between variables, non-linearity, and delay that exist in the palm oil market. As mentioned, one of the fundamental causes of price variation is the delay exist in the palm oil market. Hence this study adapts system dynamics as it allows us to captures the delays in the system and their influences on the price behavior.

Moreover, the most fundamental cause of failure to address price variation is our inability to comprehend the dynamic relationship exist in the market. It is important to determine how structure affects the price behavior of palm oil, and to study the market determinants of the price. Identifying factors contributing to the behavior of palm oil price in Malaysia will help decision makers to be aware of the possible future trends and turns. System dynamics helps to understand the impact of the market structure and the resultant behavior on palm oil price. The study aims to answer the following question:

i. What are the likely impact of changes in the local CPO production, world CPO price, world soybean oil price, and biodiesel production on the Malaysian CPO price?

1.3 Research Objectives

The main objective of this study is to identify the major determinants of the Malaysian palm oil price. More specifically, this study attempts:

i. To examine the oil palm market structure and the resultant behavior and performance particularly on CPO price;
ii. To simulate the impact changes in local CPO production, the world CPO and soybean oil prices, and biodiesel production on the Malaysian CPO price.

1.4 Dynamic Hypothesizes

i. Increase in CPO production leads to reduction in CPO price;
ii. The world CPO price leads local CPO price;
iii. An increase in world soybean oil price causes an increase in CPO price;
iv. The introduction of blend 10 in biodiesel production leads to an increase in CPO price.

1.5 Scope of the Study

The scope of this study confines to understanding the determinants of Malaysian palm oil price. To understand the market structure and its resultant behavior, the author looks into relevant sector including local CPO production, inventory, demand, export, the world's CPO price, and biodiesel production. The attempt is to examine how key variables interact with one another and how the interrelationships among the key variables contribute to the price behavior. This study adapts system dynamics methodology. System dynamics is a relevant methodology to study the causal and feedback structure, non-linearity as well as delays in Malaysian palm oil market. System dynamics emphasizes on feedback relationships or loops that generate system behaviors arising from an internal structure.

Moreover, system dynamics models are developed not only based on information from quantitative data or statistical correlations among variables observed in historical data, but they also incorporate qualitative data that exert great influence on decision rules and system behaviors. This study relies on secondary annual data collected from published reports of main institutions including Malaysian Palm Oil Board (MPOB) and Ministry of Plantation Industries and Commodities (MPIC). Given the data availability, the model structure in this study was built on the basis of 30 years from 1982 to 2012. The author runs simulations up to 2030 for a long term analysis of palm oil price behavior.

1.6 Justification of the Study

This study aims to provide a systematic view of the problem of price variation in palm oil market in Malaysia. The attempt is to study the market structure of Malaysian palm oil by picturing different aspects of the market i.e. production, supply and demand, as well as export. The price volatility has put Malaysian palm oil market on an economic risk which is threatening the country's position as the world's largest palm oil trader and producer. Hence, it is vital to identify the factors causing variations in the price of palm oil for which the system dynamics methodology can be used. System dynamics enables policy makers to make strategic decisions and policy recommendations, as it provides a better picture of the market by taking into account the main components affecting the behavior of palm oil price.

Unlike econometric and other methodologies, system dynamics does not provide point to point prediction. It focuses on the elements that create the palm oil system. System dynamics simulation helps to understand the impact of the market structure and hence the behavior of palm oil price both in the short-run and long-run. A short-run perspective gives opportunities to the industry players to make short term decisions such as taking position in the futures market (hedging) and fund management. A long-run perspective allows time for participants to make long term decisions such as investment in land capital as well as inventory management.

Moreover, system dynamics model captures the key structural relationships that define a system. It captures the causal and feedback relationship as well as the non-linearity exist in palm oil market. System dynamics can be used for policy design and evaluation. It allows policy makers to test the consequences of alternative scenarios to avoid ineffective actions. It allows to test virtual systems and to quantify the cost and

performance tradeoffs of alternative decision choices. In addition, simulation models will save time, save money, reduce risk, and improve performance

Furthermore, the significance of the study is to provide efficient and effective information to the Malaysian government as well as the industry players. The study enables the respective organizations and institutions to develop strategic policies that bring countless economic values to the nation. And lastly, this study provides insights to the research community as, currently, there is no evidence showing that system dynamics was used to study the price behavior of palm oil. In conclusion, this study aims to propose policies to address price inefficiency in palm oil industry. It is believed that the result of the study can initiate further improvement to the Malaysian palm oil industry which is beneficial to the industry in terms of growth and competitiveness.

1.7 Summary

This chapter provided a precise discussion on the problem that this study aims to address, that is, the price variation of Malaysian palm oil. Moreover, the research objectives and dynamic hypothesizes were defined. The general objective of this study is to identify the major determinants of the Malaysian palm oil price. Next, the scope and justification of the study were explained. The following section provides the organization of the study.

1.8 Organization of the Study

This study comprises six chapters. Chapter one began with an overview of the palm oil industry, and it continued with the problem statement and research objectives. Chapter two provides an in-depth discussion on the importance of palm oil industry in the world and in Malaysia. Chapter three reviews previous works related to this study. Chapter four explains the system dynamics methodology that is adopted in this study. Chapter five presents the results and validation of the palm oil model. And the final chapter presents the conclusion and the policy implications.

REFERENCE

Amna Awad Abdel Hameed, & Fatimah Mohamed Arshad (2010). *Inroads of Palm Oil into the Middle East and North Africa Region*. Selongor Malaysia: University Putra Malaysia Press.

Andrea M. B. *A Review of Methodologies and Models to Support Green Economy Policy*. Paper presented at the workshop on Modeling an Inclusive Economy, Bergen Norway. May 2013.

Anordin Ahmad Borhan, Mohd Noor Mamat, Mohd Arif Simeh, and Norhanani Mohd Baharin. (2007). A Study on the Relationship between the Futures and Physical Prices of Palm Oil. *Oil Palm Industry Economic Journal*, 7(1): 18-23.

Applanaidu, S. D., Fatimah Mohamed Arshad, Mad Nasir Shamsudin, & Yusop Z. (2010). *The Impact of Biodiesel Demand on the Malaysian Palm Oil Market: A Combination of Econometric and System Dynamics Approach*. Paper presented at the International Conference on Business and Economic Research (ICBER), Sarawak. March 2010.

Ayat K Ab Rahman, Faizah Mohd Shariff, Ramli Abdullah, & Nurul Hufaidah Sharif. (2007). Price Volatility Spill Over in the Malaysian Palm Oil Industry. *Oil Palm Industry Economic Journal*, 7 (1): 24-32.

Basri Abdul Talib and Zaimah Darawi. (2002). An Economic Analysis of the Malaysian Palm Oil Market. *Oil Palm Industry Economic Journal*, 2(1): 19-27.

Basri Abdul Talib, Mohd Fauzi Mohd Jani, Mohd Noor Mamat, & Rosli Zakaria. (2007). Impact Assessment of Liberalizing Trade on Malaysian Crude Palm Oil. *Oil Palm Industry Economic Journal*, 7(1): 9-17.

Basiron, Y. & Simeh, M.A. (2005). Vision 2020- The Palm Oil Phenomenon. *Palm Oil Industry Economic Journal*. 5(2): 1-10.

Basiron, Y. (2008). Palm Oil Production through Sustainable Plantations. *European Journal of Lipid Science and Technology*. 109: 289-295.

Bergman, L., & Henrekson, M. (2003). *CGE Modeling of Environmental Policy and Resource Management*. Working paper, Department of Economics. University of Stockholm, Stockholm.

Bockermann, A., Meyer, B., Omann, I., Joachim, H., & Spangenberg. (2005). Modeling Sustainability Comparing an Econometric (PANTA RHEI) and a Systems Dynamics Model (SuE). *Journal of Policy Modeling*, 27: 189-210.

Business Times. (2011). Rising costs worry oil palm planters. The New Straits Times Press (Malaysia) Berhad, Kuala Lumpur, Malaysia.

Carri, C. B. (2008). CGE Approaches to Policy Analysis in Development Countries: Issues and Perspectives. Working paper, No. 2/2008. Study Centre for Rural and Environmental Economic Policies (SPERA). University of Verona, Verona.

Economic Planning Units. (2012).

Fatimah Mohamed Arshad, Mad Nasir Shamsudin, Kusairi Mohd Noh, Khalid Abdul Rahim, Zainal Abidin Mohamed ... Abdul Rahim Abdul Samad. (2012). MAgPa; Volume 1: Commodity Market Models. Institute of Agricultural and Food Policy Studies. UPM Press. Malaysia.

Fatimah Mohamed Arshad, Kusairi Mohd Noh, Normaz Wana Ismail, Tai Shzee Yew, Amna Awad Abdel Hameed, Ahmad Hanis Izani Abdul Hadi, Ng Xin Khai, Mohd Khairul Rafiz Ramli, Ng Keng Yap, & Sahra Mohammadi. (2013). *Enhancing Supply Chain Connectivity and Competitiveness of Malaysian Agriculture Products: Identifying Chokepoints and Opportunities for*

Improvement. Report submitted the Economic Research Institute for ASEAN and East Asia (ERIA), Jakarta.

Fold, N. (2000). Oiling the Palms: Restructuring of Settlement Schemes in Malaysia and the New International Trade Regulations. *World Development*, 28(3): 473-486.

Forrester, J. (1994). *Industrial Dynamics*. The MIT Press, England.

Franco, C. J., Ochoa, M. C., Florez, A. M. (2009). System Dynamics Approach to Biofuels in Colombia. The Twenty Seventh International Conference of the System Dynamics Society. Albuquerque, New Mexico, USA.

Fuchs, H. U. (2006). System Dynamics Modeling in Science and Engineering. *System Dynamics Conference.* University of Puerto Rico. Puerto Rico.

Giraldo, D., Arango, S., Betancur, M. (2008). Model on Food Security in Development Countries: a Systemic Perspective. *Proceedings of the 2008 International Conference of the System Dynamics Society*, Athens, Greece.

Henriksson, J. (2012). The Malaysian Palm Oil Sector- Overview. Trade and Economic Section, European Union.

Hidayatno, A., Sutrisno, A., Zagloel, Y. M., Purwanto, W. W. (2011). System Dynamics Sustainability Model of Palm-Oil Based Biodiesel Production Chain in Indonesia. *International Journal of Engineering & Technology LJET-LJENS*, 11(3): 1-6.

Ibragimov, A., Arshad F. M., Bala, B. K., Tasrif, M. (2014). Impact of Crude Palm Oil Export Duties on Malaysian Palm Oil Industry. *American Journal of Applied Science*, 11(8): 1301-1309.

Johnston, D., Soderquist, C., & Meadows, D. H. (2000). The global shrimp market. M. Ruth and J. Lindholm (Ed.). *Dynamic Modeling for Marine Conservation*. Springer: New York.

Jones, A., Seville, D., & Meadows, D. H. (2002). Resource Sustainability in Commodity Systems: The Sawmill Industry in the Northern Forest. *System Dynamics Review*, 18(2): 171-204.

Kajisa, K., Maredia, M. & Boughton, D. (1997). Transformation versus Stagnation in the Oil Palm Industry: A Comparison between Nigeria and Malaysia. Working paper 97/05, Department of Agricultural Economics, Michigan State University, Michigan.

Khera, H. S. (1976). *The Oil Palm Industry of Malaysia: an Economic Study*. Working paper, University Malaya, Kuala Lumpur.

Kumar, S., Nigmatullin, A. (2012). A System Dynamics Analysis of Food Supply Chains – Case Study with Non-Perishable Products. *Simulation Modelling Practice and Theory*, 19: 2151–2168.

Landel, R. D. (1971). Commodity Market Dynamics a System Analysis of Fundamental Relationships. *Proceedings of the 5th conference on Winter Simulation*, New York.

Mahlia, T. M. I., Abdulmuin, M. Z., (2001). An Alternative Energy Source from Palm Wastes Industry for Malaysia and Indonesia. *Energy Conversion and Management*, 42(18): 2109-2118.

Mad Nasir Shamsudin, Fatimah Mohamed Arshad, Zainal Abidin Mohamed, Abdul rahman lubis. (1994). A Market Model for Malaysian Palm Oil Industry. *The Malaysian Journal of Agriculture Economics*, 11: 81-101.

Martinez-Moyano. I. J., Richardson, G. P. (2013). Best practices in system dynamics modelling. *System Dynamics Review*, 29(2): 102-123.

Meadows, D. L. (1970). *Dynamics of Commodity Production Cycles*. Cambridge MA. Wright-Allen Press. Cambridge, Massachusetts.

Meadows, D. H. (1979). The Unavoidable A Priori. J. Randers (Ed.), *Elements of the System Dynamics Method* (Page 161-240). The MIT Press, Cambridge MA.
MEIH (Malaysia Energy Information Hub). (2013). Statistics. Retrieved from http://meih.st.gov.my/statistics;jsessionid=E31B71E3B285F9A0826AAD17089F931A
Mehta, A., Chavas, J. P. (2008). Responding to the Coffee Crisis. What can we learn from price dynamics? *Journal of development economics*, 85(1): pp 282-311.
Meyers, R. A. (2011). Complex Systems in Finance and Economics. New York, Springer.
Mohammad Jaafar, A. (1994). The Malaysian Palm Oil a Dynamic Industry. In Technical Committee of 1994 Palm Oil Familiarization Programme, Selected Readings on Palm Oil and its Uses, Palm Oil Research Institute, Malaysia.
Mohd Basri Wahid, Ramli Abdullah Abdullah, & Faizah Mohd Shariff. (2010). Lessons Learned from Sustaining Remunerative Palm Oil Prices: The Malaysian Experience. *Oil Palm Industry Economic Journal*, 10(1): 1-13.
Mohd Nasir Amiruddin. (2003). Palm Oil Products Exports, Prices and Export Duties: Malaysia and Indonesia Compared. *Oil Palm Industry Economic Journal*, 3(2): 21-31.
Moll, H. A. J. (1987). The Economies of Oil Palm. Wageningen, the Netherlands: Pudoc Wageningen.
MPIC (Ministry of Plantation Industries and Commodities). (1990). *Statistics on Commodities 1990*, 2nd Edition.
MPIC (Ministry of Plantation Industries and Commodities). (2005). *Statistics on Commodities 2005*, 19th edition.
MPIC (Ministry of Plantation Industries and Commodities). (2012). *Statistics on Commodities 2012*, 26th edition.
MPOB (Malaysian Palm Oil Board). (2012). *Malaysian Palm Oil Statistics*. 32th edition.
Nik Muhammad Naziman Ab Rahman, Abdol Samad Nawi, Yusrina Hayati Nik Muhd Naziman. (2012). The Price Discovery of the Malaysian Crude Palm Oil Futures Markets. *Journal of Applied Finance & Banking*, 2(4): 25-47.
Oil World. (2009). *Oil World Annual 2009*, Hamburg, Germany.
PORAM (Palm Oil Refiners Association of Malaysia). (2013). Number of Refineries Approved and Capacities. Retrieved from http://poram.org.my/wp-content/uploads/2013/12/Refineries-20131.pdf
Pruyt, E. (2013). *Small System Dynamics Models for Big Issues*. TU Delft Library, Delft, The Netherlands.
Ramli Abdullah, Roslan Abas, & Ayatollah, K. (2007). Impact of Palm Oil-based Biodiesel Demand on Palm Oil Price. *Oil Palm Industry Economic Journal*, 7(2): 19-27.
Richardson, G. P. Pugh, A. L. (1985). *Introduction to System Dynamics Modeling with Dynamo*. The MIT Press, England.
Rosalan, A. (1998). A Study on the Use of Crude Palm Oil Futures as an Effective Hedging Tool for the Malaysian Palm Oil Producers and Refiners. *AAM Journal*, 3(2).
Salmiah, A. (2000). *Non-food Uses of Palm Oil and Palm Kernel Oil.* MPOPC Palm Oil Information Series, Kuala Lumpur.
Sterman, J. D. (1984. Appropriate Summary Statistics for Evaluating the Historical Fit of System Dynamics Models. *Dynamica*, 10(2): 51-66.
Sterman, J. D. (2000). *Business dynamics: Systems Thinking and Modeling for a Complex World*. New York: McGraw-Hill.

Swaminathan, J. M. (1998). Modeling Supply Chain Dynamics: A Multiagent Approach. *Decision Sciences*, 29(3): 607-632.
Velasquez, J. F. P. (2010). A System Dynamics Study of Instability in the Colombian Coffee Market. (Unpublished doctoral dissertation). University of Bergen. Bergen.
Yahaya, J., Sabri Ahmad, Kennedy, S. W. (2006). Impact of Biodiesel Development on the Palm Oil Industry. *Malaysian Journal of Economic Studies*, 43(1): 113-140.

BIODATA OF STUDENT

Sahra Mohammadi was born in 1985, Mazandaran, the north of Iran. She studied Experimental Science during high school, but shifted to Fine Art and eventually completed the Associate of Arts Degree in photography from Islamic Azad University of Tehran in 2007. She moved to Malaysia to pursue her studies in 2009. She attended UCSI University from 2010 to 2013, and graduated with First Class Honours in Business Administration. While studying at UCSI, Sahra received the Dean's List- Certificate of Academic Excellence- for three consecutive years. In 2013, she entered the Master's Program at Universiti Putra Malaysia (UPM) in the field of Business Economics, and achieved a CGPA 3.91/4.