VOLATILITY, ASYMMETRIC RELATIONSHIP, AND HEDGING EFFECTIVENESS: A STUDY ON DERIVATIVE MARKETS IN MALAYSIA

BY

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ABSTRACT

Return volatility severely affects equity portfolio or increases the cost in agricultural commodity as the major input for production. This triggers the need to re-examine the long-run relationship between underlying and futures markets and also the effectiveness of the offsetting position in futures markets. With theoretical and empirical evidence, understanding the return volatility, the long-run relationship between underlying and futures prices and the hedging effectiveness are the three main objectives of this study. It is hoped that this study will assist policymakers on how to intervene in markets with the right policies. This is because interconnection between underlying and futures prices as well as hedging the underlying position in the futures market are empirically emphasized. Addressing volatility problems with the wrong policy may affect the economy negatively. Also, it has been documented that the futures market plays an important role in managing price risk exposure, thus determining the optimality of hedge ratio is crucial to avoid hedging errors that might result in over hedging or under hedging. For the purpose of this study, 16 hypotheses have been developed based on related literature. Also, the influence of structural break and the effects of the GST announcement are examined. The findings of this study are explained based on the Efficiency Market Hypothesis (EMH), Arbitrage Pricing Theory (APT) and Law of One Price (LOP). The period of study ranges from June 2009 to November 2016. This study uses daily closing prices of the Crude Palm Oil (CPO), Kuala Lumpur Composite Index (KLCI), CPO Futures (CPO-F), KLCI Futures (KLCI-F) and Basis. It has been documented in previous studies that basis is an important variable with predictive power to forecast changes in underlying prices and useful in improving hedging ratio. To achieve the three objectives, this study employs Generalized Autoregressive Conditional Heteroscedasticity (GARCH), Threshold Generalized Autoregressive Conditional Heteroscedasticity (TGARCH) and Multivariate-GARCH (M-GARCH), to specifically examine the return volatility of the Malaysian underlying markets (CPO and KLCI), the Johansen cointegration test and Vector Error Correction Model (VECM) for symmetric relationship, and the Threshold Autoregressive (TAR) together with the Momentum Threshold Autoregressive (M-TAR) for the asymmetric relationship between CPO and CPO-F, KLCI and KLCI-F, and CPO and KLCI. This study uses the M-GARCH model to quantify the optimal hedge ratio and hedging effectiveness. This study establishes that return volatility is persistent and clustered in the Malaysian derivatives market while asymmetric impact of shocks for TGARCH estimation is statistically insignificant. The M-GARCH model establishes that there exists a volatility spillover between CPO and KLCI market. This study also finds an asymmetric relationship between underlying and futures markets in the pre-GST announcement. The result of hedging effectiveness shows that hedging in the Malaysian derivatives market is effective, both in the CPO-F and KLCI-F, while the optimal hedge ratio of each market is significantly different. The optimal hedge ratio required from the Malaysian stock index is higher than the Malaysian commodity market. This study confirms that basis is an important variable for modelling return volatility, asymmetric relationship and quantifying hedging effectiveness. Proper monitoring and appropriate policy intervention will enhance contribution of Malaysian derivatives markets on economic performance by increasing global mobility of funds to the country. This study significantly contributes new knowledge to the literature especially in the field of derivatives studies.

الملخص

ويؤثّر تقلب العائد بشدة في سندات الأسهم أو يزيد من تكلفة السلع الزراعية باعتبارها المدخل الرئيس للإنتاج. ويؤدّي ذلك إلى الحاجة إلى إعادة النظر في العلاقة طويلة الأمد بين الأسواق الأساسية والأسواق الآجلة، وكذلك فعالية وضع المقاصّة في أسواق العقود الآجلة. اعتمادًا على الأدلة النظرية والتجريبية، تكمن أهداف هذه الدراسة في ثلاثة، هي فهم تقلب العائد، والعلاقة طويلة الأجل بين الأسعار الكامنة والأسعار المستقبلية وفعالية التحوط. والأمل أن هذه الدراسة ستساهم في مساعدة واضعي السياسات على كيفية التدخل في الأسواق بالسياسات الصحيحة؛ وذلك أنه يتِمّ التأكيد تجريبيّا على الربط بين الأسعار الأساسية والأسعار الآجلة مع التحوط من الموقف الأساس في سوق العقود الآجلة. إن اعتماد السياسة الخاطئة في معالجة مشاكل التقلب يؤثر تأثيرًا سلبيًّا في الاقتصاد. كما تم توثيق أن سوق العقود الآجلة يؤدي دورًا مهما في إدارة التعرض لمخاطر الأسعار؛ وبناءًا على ذلك فإن تحديد نسبة التحوط هو أمر حاسم لتجنب أخطاء التحوط التي قد يفضي إلى الإفراط أو التفريط في التحوط. ولأغراض هذه الدراسة، تم تطوير 16 فرضية استنادًا إلى الأدبيات ذات الصلة. أيضًا، تم فحص تأثير الانهيار الهيكلي وآثار إعلان ضريبة السلع والخدمات (GST). وقد تم شرح نتائج هذه الدراسة بناء على فرضية سوق الكفاءة (EMH) ونظرية تسعير التحكيم (أبت–APT) وقانون سعر واحد (لوب–LOP). وتراوحت فترة الدراسة بين حزيران / يونيو 2009م وتشرين الثاني / نوفمبر 2016م. واستخدمت هذه الدراسة أسعار الإغلاق اليومية لزيت النخيل الخام (CPO)، ومؤشر كوالالمبور المركب، و(CPO) الآجلة، و(CPO-F)، و(KLCI) الآجلة و(KLCI-F) والأساس. وقد تمَّ توثيقه في الدراسات السابقة أن الأساس هو متغيّر مهم مع القدرة التنبئية للتنبؤ بتغيرات الأسعار الأساسية ومفيدة في تحسين نسبة التحوط. ولتحقيق الأهداف الثلاثة، توظف هذه الدراسة متغاير الانحدار الذاتي المشروط العام (غارتش)، ومتغاير الانحدار الانحداري الخاضع للانحدار العام (تغارتش) والمتعدد المتغيرات–(غارتش–M) غارتش ، لدراسة تقلب العائد للأسواق الكامنة الماليزية (كبو و كلسي)، واختبار التكامل المشترك بين جوهانسن (Johansen) وأنموذج تصحيح الأخطاء المتصاعدة (فيسم) للعلاقة المتماثلة، والانحدار الذاتي للعتبة (تار)، جنبًا إلى جنب مع الانحدار الذاتي لعتبة الزخم–M) تار (للعلاقة غير المتماثلة بين كبو و كبو F–و كلسي و كلسيF– ، و كبو و كلسي. استخدمت هذه الدراسة أنموذج–M غارتش لتحديد نسبة التحوط المثلى وفعالية التحوط. وتؤكِّد هذه الدراسة أن تقلب العوائد مستمر ومستقر في سوق المشتقات الماليزية في حين أن التأثير غير المتماثل للصدمات لتقدير تغارتش غير ذي دلالة إحصائية. يثبت أنموذج–M غارتش أن هناك تباينًا في التقلبات بين سوق كبو و كلسي. كما وجدت هذه الدراسة علاقة غير متماثلة بين الأسواق الكامنة والأسواق الآجلة في إعلان ما قبل ضريبة السلع والخدمات (GST). وتظهر نتيجة فعالية التحوط أن التحوط في سوق المشتقات الماليزية فعال في كل من كبو F–و كلسيF–، في حين أن نسبة التحوط المثلِي لكل سوق تختلف اختلافاً كبيرًا. نسبة التحوط المثِلي المطلوبة من مؤشر الأسهم الماليزية أعلى من سوق السلع الماليزية. تؤكد هذه الدراسة أن الأساس هو متغير مهم لنمذجة تقلب العائد، والعلاقة غير المتماثلة، وقياس فعالية التحوط. ومن شأن الرصد السليم والتدخل المناسب في السياسات أن يعزز مساهمة أسواق المشتقات الماليزية في الأداء الاقتصادي عن طريق زيادة تنقل الأموال على الصعيد العالمي إلى البلد. وتساهم هذه الدراسة بشكل كبير في معرفة المعارف الجديدة وخاصة في مجال دراسات المشتقات.

APPROVAL PAGE

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DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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DEDICATION

This thesis is dedicated to my late parents for laying the foundation of what I turned out to be in life.

And also, to my husband (Dr. Buniyamin Adewale Bello) for his help on the achievement of the goal and children (Hashim, Ibrahim, Zulikha and Aisha) for their love and understanding.

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LIST OF ABBREVIATIONS

Abbreviation	Description
AEC	Asymmetric Error Correction
AGCC	Arabian Gulf Cooperation Council
AIC	Akaike Information Criterion
APT	Arbitrage Pricing Theory
ARCH	Autoregressive Conditional Heteroscedasticity
ARCH LM	ARCH-Lagrange Multiplier
ASI	Nigerian All Share Index
Basis	Underlying-futures Differential
BLUE	Best Linear Unbiased Estimator
BMDB	Bursa Malaysia Derivatives Berhard
BRICS	Brazil, Russia, India, China and South Africa
CAC 40	Cotation Assistée en Continu 40
CAPM	Capital Asset Pricing Model
CASE	Cairo and Alexandria Stock Exchange
CBOT	Chicago Board of Trade
CFTC	US Commodities and Futures Trading Commission'
CLRM	Classical Linear Regression Model
CMDF	Capital Market Development Fund
CME	Chicago Mercantile Exchange
CME Globex	Chicago Mercantile Exchange Globex
COMMEX	Commodity and Monetary Exchange of Malaysia
CPO	Crude Palm Oil
CPO-F	Crude Palm Oil Futures
CPO-O	Option on Crude Palm Oil Futures
CSI 300	China Stock Index 300
DAX 30	Deutscher Aktienindex (German stock index)
DCE	Dalian Commodity Exchange
DI	Domestic Institutions
DJ	DJIA
DR	Domestic Retail
D-W	Durbin-Watson Statistics
ECM	Error Correction Model
ECT	Error Correction Term
EMH	Efficient Market Hypothesis
EPP	Eight Point Project
ETD	Exchange Traded Derivatives
ETP	Economic Transformation Programme
EU	European Union
FELDA	Federal Land and Development Authority

FI	Foreign Institutions
FIA	Futures Industry Associations
FKB3	3-Month KL Interbank Offered Rate (KLIBOR) Futures
FMG3	3-Year Malaysian Government Securities Futures
FMG5	5-Year Malaysian Government Securities Futures
FR	Foreign Retail
FTSE 100	Financial Times and Stock Exchange 100 Index
GARCH	Generalized Autoregressive Conditional Heteroscedasticity
GasOil	Fossil Diesel
GDP	Gross Domestic Product
GED	General Error Distribution
GLD-F	Gold Futures
GNI	Gross National Income
GST	Goods and Service Tax
HE	Hedging Effectiveness
HIS	Hang Seng Index
HS	Hang Seng
ISE-30	Turkish Stock Index
JB	Jarque-Bera
JC	Jakarta Composite
JKSE	Jakarta Composite Index
K	Kurtosis
KLCE	Kuala Lumpur Commodity Exchange
KLCI	Kuala Lumpur Composite Index
KLCI-F	Kuala Lumpur Composite Index Futures
KLCI-O	Options on FTSE Bursa Malaysia KLCI Futures
KLIBOR	3-Month KL Interbank Offered Rate
KLOFFE	Kuala Lumpur Option and Financial Futures Exchange
KLSE	KLSE Composite
KOSDAQ	Korean Securities Dealers Automated Quotation
KOSPI	Korean Composite Stock Prices Index
KSE	Karachi Stock Exchange
KSP	Seoul Composite
L	Locals
LCPO	Logarithm of Crude Palm Oil
LCPO-F	Logarithm of Crude Palm Oil Futures
LKLCI	Logarithm of Kuala Lumpur Composite Index
LKLCI-F	Logarithm of Kuala Lumpur Composite Index Futures
LOP	Law of One Price
MAE	Mean Absolute Error
MCXAGRI	Multi Commodity Exchange (MCX) Agricultural
MCXCOMDEX	Maiden Composite Commodity Index
MCXENERGY	Multi Commodity Exchange (MCX) Energy Futures Index
MCXMETAL	Multi Commodity Exchange (MCX) Metal
M-GARCH	Multivariate GARCH

MME	Malaysian Monetary Exchange
M-TAR	Momentum-Threshold Autoregressive
NCDEX	National Commodity Exchange
NSE	Nifty 50
NYMEX	New York Mercantile Exchange
OHR	Optimal Hedge Ratio
OLS	Ordinary Least Squares
OTC	Over-the-counter
PKO-F	Crude Palm Kernel Oil Futures
POL-F	USD RBD Palm Olein Futures
Post-GST	After GST announcement
Pre-GST	Prior to GST announcement
PSE	Philippines Stock Exchange Composite Index
RapOil	Rapeseed Oil
RMSE	Root Mean Squared Error
S	Skewness
S&P 500	Standard and Poor 500
SC	Securities Commission
SC	Shanghai Composite
SET	Stock Exchange of Thailand Index
SHFE	Shanghai Futures Exchange
SIC	Schwarz Bayesian Criterion
SoyOil	Soybean Oil
SSE 50 Index	Shanghai Stock Exchange 50 index
SSEC	Shanghai Composite Index
SSFs	Single Stock Futures
ST	Straits Times
STI	Straits Times Index
SunOil	Sunflower Seed Oil
TA	TA 100
TAR	Threshold Autoregressive
TGARCH	Threshold Generalized Autoregressive Conditional Heteroscedasticity
The U. S.	The United States
The U.K.	The United Kingdom
TL/EUR	Turkish Lira-Euro
TL/USD	Turkish Lira-U.S. Dollar
TMINUS	Threshold Minimum (Negative Coefficient of TAR)
TOPIX	Tokyo Stock Exchange Price Index
TPLUS	Threshold Maximum (Positive Coefficient of TAR)
TVECM	Threshold VECM
TW	Taiwan Weighted
TWI	Taiwan Weighted Index
UAE	United Arab Emirates
UPO-F	USD Crude Palm Oil Futures

VAR	Vector Autoregressive
VECM	Vector Error Correction Model
ZMINUS	Minimum Momentum (Negative Momentum Coefficient)
ZPLUS	Maximum Momentum (Positive Momentum Coefficient)

CHAPTER ONE

INTRODUCTION

This chapter discusses the background of market volatility and hedging effectiveness, as well as the asymmetric relationship of the Malaysian derivatives markets, followed by problem statement, research objectives, research questions, significance of the study and organization of the study.

1.1 BACKGOUND OF THE STUDY

Market volatility is a measure of uncertainty in relation to business cycle which is linked with economic activity (Chauvet, Senyuz & Yoldas, 2015; Mele, 2007; Sharma, Narayan & Zheng, 2014; Trivedi & Birău, 2013). Market volatility has continued to recur since the Great Depression from 1929 to 1931. Volatility seems to be inevitable and unobservable. Since, market volatility recurs frequently, it can be inferred that there is no serious prior warning that alerts the market participants to volatility of the market other than the news in some situations. However, cointegration between the underlying and its futures prices, and effectiveness of hedging mechanism are also required. Adams and Gerner (2012) define cointegration as the speed at which adjustment of the short term deviation towards equilibrium is taken place as indicated by the error correction term. Also, Hedging is defined as a risk mitigation instrument to offset price risk exposure of taken position in the underlying market by using futures contracts (Zhou, 2016).

Heterogeneous behaviour of the market participants might hinder a clearer understanding of market pattern. Market participants are heterogeneous in terms of response to the news, level of awareness about market information, risk aversion and others. Reaction of the market participants to the news is also different; therefore, when the market seems to be calm, volatility may emerge suddenly, without prior warning. For example, in early 2016 the global stock market started going down, indicating poor performance. Commodity price increases were continuous to the extent that this became the central issue of world economy in September, 2009, at the Pittsburgh summit of the G20 (Creti, Joëts & Mignon, 2013; Business insider, Malaysia 2016). A recent study also established that underlying commodity volatility is becoming more pronounced (Han, Hu & Yang, 2016). This implies that volatility of the market should not be underestimated because it has the potential to increase inflation pressure, which may create a multiplier effect.

However, the impact of volatility may vary based on the time remaining to the expiration of derivative trading. Hence, holding a position in the futures market indicates that there is a limited time frame for such trading. Holding position in the futures market is known as hedging. In other word, offsetting the position held in the underlying market by trading in futures market simultaneously; is known as hedging the position. This is usually known as simultaneously a short position in one market and a long position in the other market. The short positon is to sell, while the long position is to buy. In this case uncertainty in the future becomes a big issue. Uncertainty about global business transactions affects markets such as stock and commodity markets and may influence return to investors (Karamah, Baharul-ulum, Ahmad & Salamudin, 2015).

Market volatility, pricing mechanism, and hedging are interrelated and require special attention, as documented in the finance literature. Logically, they are linked

and inferences may be made to arrive at better financial strategies. Previous studies also acknowledge that understanding market volatility is important (Ahmed & Valente, 2015; Choudhry, Papadimitriou & Shabi, 2016), and might provide adequate clue for making sound hedging decisions. Volatility is essential in making financial decisions such as pricing and hedging in derivatives markets (Ané & Ureche-Rangau, 2006). Volatility of the markets results in uncertainty of return due to frequent fluctuations in market return. Unstable return prompts the need for offsetting underlying market position in the futures market. This therefore, necessitates simultaneous trading in underlying and futures markets.

A futures price derives its value from the underlying price. With this, a strong relationship is expected between the two prices. However, a different trading period coupled with the information processing ability of each market might result in a symmetric or asymmetric relationship between underlying and futures price. A symmetric relationship shows that price adjustment towards long run equilibrium is continuous, while asymmetric relationship shows that price adjustment towards long run equilibrium is discrete. With asymmetric relationship, policy intervention is required only when the price exceeds the ceiling because of the cost for adjustment (Peri & Baldi, 2010; Subervie, 2011). However, a symmetric relationship indicates that neither the futures market nor the underlying price has permanent control of leading the price to equilibrium in the long run (Bumpass, Ginn & Tuttle, 2015). Recognising this, an understanding of the relationship between underlying and futures prices might provide hedgers with a better understanding of the markets they are trading in and of the need to offset the risk exposure of the underlying markets.

Furthermore, symmetric or asymmetric is not merely terminology but has different implications for return volatility, pricing mechanism and hedging

effectiveness. Symmetric return volatility indicates that impact of the shock in the market is the same, following the pricing mechanism that information at the market is instantaneously reflected in the price, and market participants are assumed to be homogeneous. Hedge ratio and hedging effectiveness may be accurately explained by the symmetric hedging model. On the other hand, asymmetric return volatility implies that the impact of bad and good shocks has different effects on the return volatility. It follows that the information processing of the market is different and therefore price does not instantaneously reflect all available information (Grasso & Manera, 2007). At the same time, market participants are heterogeneous and the risk aversion is different; therefore, hedge ratio and hedging effectiveness may be accurately explained by the asymmetric hedge model. Wen Cheong et al. (2007) argue that homogenous market participants are far from reality in the actual financial market.

Moreover, increasing uncertainty might divert hedgers' attention from unstable markets to relative stable markets in which to seek an effective futures market to hedge their underlying position. This shows a relatively stable market is needed to attract the attention of foreign hedgers. This means that market participants such as hedgers must strive to understand volatility of the underlying market. This enables hedgers to decide the proportion of their position in underlying market to be hedge in the futures market. For information that is not readily available in the market at which hedgers trade on, hedgers even proceed with cross-market information to make hedging decisions (Xue & Gençay, 2012). Likewise, Lim, Hooy, Chang and Brooks (2016) find that Malaysian foreign investors in the stock market are at an advantage in using local and global public information in making their investment decision. Consequently, the need for understanding market volatility is frequently emphasized in the finance literature.

In addition, mobilization of funds creates opportunities for the market that are capable of compensating for the level of risk or having an effective risk management instrument in-place. Global mobility of investment funds and activities is stressed in the study by Abdul Rahim, Ahmad and Ahmad (2009). A typical example is the record for substantial increases in global commodity trading over the years, for example, US$156 billion (in November 2008) to US$426 billon (in November, 2011) (Cochran, Mansur & Odusami, 2015). In this situation, hedgers have the chance to choose which market to trade in and need to note that such a huge investment move might enhance the economic well-being of that nation. Some emerging economic are vast-growing with investment opportunities that attract investors (Majid, Mydin, Omar & Aziz, 2009). Brooks, Prokopczuk and Wu (2013) link the rapid rise in commodity prices in the late 2000s reaching their peak in 2011 to economic booming of emerging markets. As market volatility and hedging effectiveness are pressing issues, international evidence of hedgers' concern about market volatility have been well documented. Sarno, Tsiakas and Ulloa (2016) find that a high degree of international capital mobility significantly affects domestic asset prices and adverse results in economic growth. Global capital flow increased from about 5 per cent (of global GDP) between 1980-1999 to nearly 20 per cent in 2007 (Li & Rajan, 2015; Sarno et al., 2016).

In the case of Malaysia, the crude palm oil futures (CPO-F) and Kuala Lumpur Composite Index Futures (KLCI-F) are the most active derivative instruments for the underlying CPO and KLCI respectively (Bacha, 2012). The performance of KLCI in the last decade is impressive and currently KLCI is internationally recognized as reference for Asia-Pacific equity market (Azevedo, Karim, Gregoriou & Rhodes, 2014). CPO is an agricultural commodity while KLCI is a stock index of the 30

largest stocks of market capitalization. The two derivatives instruments are traded in the Bursa Malaysia Derivatives Berhard (BMDB).

CPO-F and KLCI-F are introduced to hedge against price risk exposure. CPO-F is introduced to ease hedging against volatility in agricultural commodities (Hooi & Smyth, 2015). The hedgers in CPO-F markets, both industry and individuals, are users of CPO for their production; physical delivery of CPO is required. They are concerned about an increase in the price of CPO as this will increase the cost of their production. Therefore, they offset their position by trading in futures markets to lock in the price, which prevents CPO hedgers to be affected by upward movement in the price as shown in Figure 1.1.

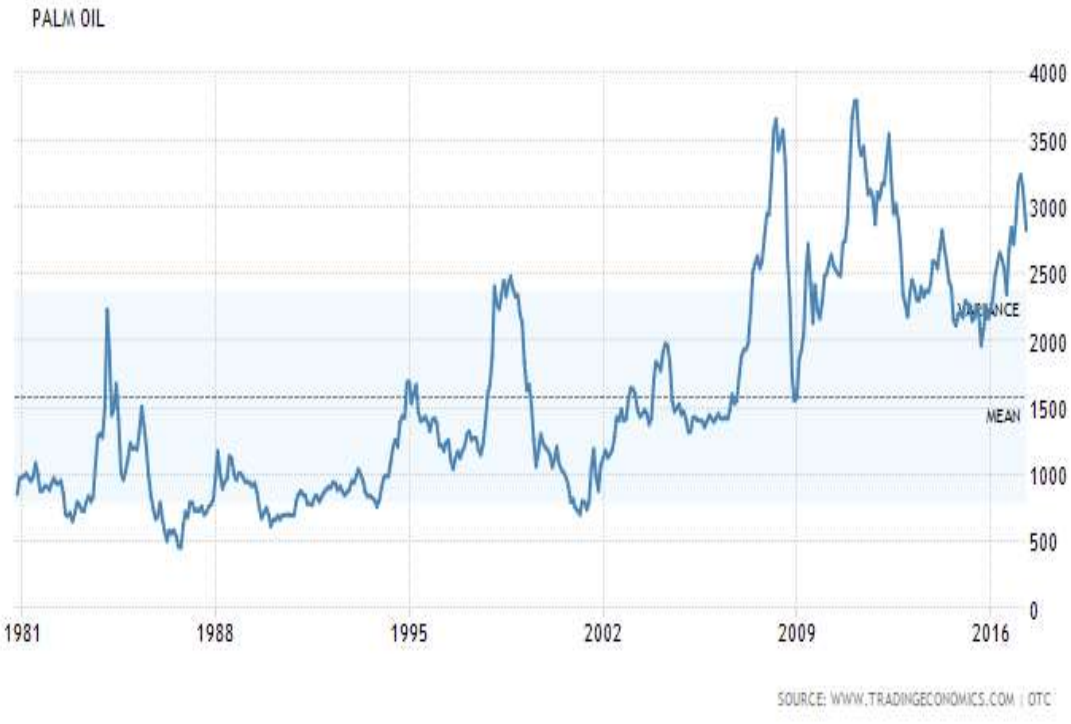

Figure 1. 1: Malaysian Palm Oil (CPO) Price Fluctuation from 1981 to 2016
Source: http://www.tradingeconomics.com/commodity/palm-oil