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Hedging Effectiveness of Crude Palm Oil Futures Market in Malaysia

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Abstract: This paper investigated the hedging effectiveness of crude palm oil futures market in Malaysia from January 2009 to June 2011 which traded under Bursa Malaysia Derivatives Berhad. Ordinary Least Squared (OLS) method was used to compute Minimum-Variance hedging ratio (MVHR), R-squared and hedging effectiveness by using daily data from settlement price of crude palm oil futures contracts and spot price of crude palm oil. The empirical results indicate that the highest hedging ratio has been observed in the February 2009 FCPO contract, 66.7660%. Meanwhile, the lowest hedging ratio occurs in June 2010 contract which is 35.7131%. In overall, Malaysia FCPO market only provides a low level of hedging effectiveness (19% - 53%) due to less volatility of CPO spot price. As a conclusion, hedging effectiveness of crude palm oil futures market in Malaysia shows a low level of hedging effectiveness. This result indicates that the spot price of crude palm oil in Malaysia is relatively stable and consistent over the period of 2009 to 2011. The outcome of this research intends to provide hedging information of the Malaysia FCPO futures market in order to cover risk exposure by holding FCPO in BMD.

Key words: Hedging effectiveness · Ordinary Least Squared · Minimum-Variance Hedging Ratio · R-squared

INTRODUCTION

Futures market has been used by arbitrageurs, speculators, producers and policymakers for risk reduction purpose by predicting the spot prices in the future. A stress test of any futures market is its ability to generate prices that are efficient especially during extremely volatile economic uncertainty periods [1]. Economic agents are exposed to high risks associated with movements in commodities cash prices during the trading of physical commodities. Therefore, the interest and main objective of the development in commodity futures markets is due to the demand for hedging facilities [2]. It is important to understand the role of commodity futures market for risk management purpose. People commonly know that the prices are fluctuating over time for shares, commodities and currency. So, there is possibility of adverse price changes in future creates risk arising from unforeseen price changes. A derivative is a financial contract whose price depends on, or is derived from, the price of another asset [3]. There are two types of commodity derivatives which is futures contracts and options contracts. However, this study will only focus on commodity futures contracts.

Bursa Malaysia's Crude Palm Oil Futures contract (FCPO) first established in the Kuala Lumpur Commodity Exchange (KLCE) in 1980. Asian financial crisis in July 1997 has caused the restructuring of Malaysia derivative market which undergo series of regulatory framework. In November 1998, FCPO were traded in Commodity and Monetary Exchange (COMMEX).In 2003, Bursa Malaysia Derivatives Berhad (BMD) has been established and used in trading derivative market in Malaysia. Meanwhile, FCPO is also traded under BMD. In the year end of 2009, there is a highlight for Malaysia futures market where there is an establishment of strategic alliance partnership between BMD and Chicago Mercantile Exchange (CME) Group. FCPO is a very standardized contract which is set and managed under BMD. A FCPO contract consists of 25 metric tonnes of palm oil. Each FCPO contract is quoted in Ringgit Malaysia (RM) per metric tonne. The tick price is RM1.00 per metric tonne. The physical

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settlement of contracts is realized upon the maturity date where the actual physical commodity is sent to the contract buyer at the port specified by the seller [4].

Background and Purpose of Study: In futures markets, the hedging effectiveness (HE) measure has been used to examine the usefulness of direct hedges. The HE measure indicates the proportion of the unhedged return variance that can be purged through hedging when only price variability is considered. [5]. The accuracy of hedging effectiveness measurement is relatively important in efficient decision making [6]. The objective of hedging ratio is aimed to minimize the risk by holding futures contract and spot market at the same time. Hedge ratio provides actual ratio information in terms of the number of units that should be held in one asset in order to offset the risk of holding/shorting one. The complexity in measuring hedge ratios may vary from simple native approaches to more complicated regression methods [7]. Overall the best or optimal hedging approach will be a function of the hedging ratio in formulating the hedge. Ordinary Least Square (OLS) regression has been commonly recognized and suggested by researchers in determine the optimal hedge ratio in order to measure the difference between the cash prices and the futures prices. [8]. One of the most popular portfolio hedging theories has been recommended by Ederington [9]. Figlewski [10] has studied the hedging performance based on relationship of the different sources of basis risk. The finding has indicated that hedging performance is affected by hedging duration and time to expiration.

This study explores the hedging effectiveness of the Malaysia FCPO market. In a move to provide greater visibility and accessibility to international traders, BMD migrate its products onto the CME Globex electronic trading platform on 20 September 2010 following BMD collaboration with the CME Group in 2009 in which the operator of the world's largest derivatives exchange. According to media release by Bursa Malaysia dated 13 September 2011, the BMD crude palm oil futures contract set a new record as of the close of mid-day trading on 13 September 2011, with a total of 4,072,384 contracts traded so far for 2011, surpassing the previous record of 4,064,361 contracts traded for the whole of 2010. This is the highest ever number of contracts traded annually since FCPO contracts started trading in 1980. Therefore, this market is important to analyse because it is interesting to investigate whether Malaysian commodity futures can be as effectively used in hedging risk as open interest for FCPO contracts on BMD has risen steadily on the back of an even mix of players in the futures market.

Besides that, the sluggish economic growth during the 2008 US credit crisis and recently Europe debt crisis had sparked concerns which would negatively influence Malaysia's crude palm oil (CPO) export. A hold back over the global economic growth would inevitably impact emerging economic. Malaysian FCPO price has dropped 44.43% in 2008 which is the biggest yearly decline ever due to global financial crisis. However, the total FCPO contract traded has been increased dramatically from 3,003,549 contracts in 2008 to 4,008,882 contracts in 2009. Therefore, it is important to investigate the level of hedging effectiveness after 2008 financial crisis.

The outcome of this research intends to provide hedging information of the Malaysia FCPO futures market in order to cover risk exposure by holding FCPO in BMD. The derivatives can complete the market, improve efficiency, transfer risk and discover prices. Market participants can use FCPO to manage price risk, speculate and gain immediate exposure into the commodity market.

Literature Review: The main purpose and function of hedging is that the impact of downside price movements can be reduced on the value of the investment. In theory and in the absence of natural hedges, hedging is essential as a one of the valuable activity for investors to participate in. Brailsford, Corrigan, & Heaney [6] have identified that hedging activity involve costs. Apart from the direct costs associated with the hedging instrument, there are related indirect costs: (i) the risks of imperfect hedges through sub-optimal hedge ratios, (ii) the specification risk and basis risk and (iii) the costs of management and monitoring of the hedge position. Hence, the costs and benefits of a hedge must be weighted before engaging into a hedging strategy.

Three hedging theories have been distinguished by Pennings and Meulenberg [11]. An opposite but equivalent position in the futures market must be taken to hedge cash positions. Second theory proposes that hedgers should act as speculators and need to be principally interested in absolute prices instead of relative prices. Nowadays, the portfolio approach of hedging strategy has been utilized through a variance reduction function of the hedging model when there is a risk of price changes occurs. Furthermore, there is a direct relationship between expected returns and variance measured from the empirical results of previous studies.

The studies on measurement of return optimization of a portfolio have become a major concern due to the condition that whether the variance in returns can be reduced or optimal balance is establish between risk and return. The assumption has been made based on the perfect futures contract that incurs no risks [12]. However, the risks still exist with futures contract and it could even affect investors on the variance of returns. Therefore, a huge interest has been drawn to the management of futures exchange in order to study the impact of risks toward futures contract.

In evaluating the hedging performance of a futures contract, the following three main issues are relevant and important to take into consideration:

Optimum Hedge Ratio: Figlewski [10] has caused an enormous discussion in the literature for the best method to determine optimal hedge ratio due to the varying conclusion made in his research. Holmes [13] using UK stock indices concluded that the OLS estimated MVHR has delivered the highest hedging effectiveness compared to GARCH model, error correction (EC) methods and Beta hedging estimation. Later, Butterworth and Holmes [14] have found that regression thinning by cut off the outliers has caused minor impact on the hedging effectiveness for the investment companies. Koutmos [15] has examined the hedging of treasury bills and discovered that pure GARCH and OLS estimations are less effective than EGARCH of the hedge ratio. Besides, Lien [16] has reported that OLS-MVHR estimation delivered the worst results for hedging periods of more than 4 days as compared with Fractionally Integrated EC, VAR and EC models. However, Myers [17] has examined the hedge of commodity hedging and found that GARCH methods are just slightly better compared to OLS methods. Finally Brooks [18] examined the performance comparison for a few hedging models including utilization of the implied volatility from options contracts to find out the optimal hedge through the daily observations for foreign exchange.

Degree of Risk Reduction: The second issue is about the level of risk minimization obtained from the optimum hedge. The degree of risk minimization differs broadly and three aspects are related to it. The first concern is to determine whether there is a cross or a direct or indirect hedge. The second concern is about the hedging on types of asset portfolio, which may be commodities or non-commodities. The third concern is the risk minimization which depends on the measurement of within or post-sample. For instant, Holmes [13] has reported risk reduction of about 80% in direct hedges whereas Butterworth and Holmes [14] concluded that indirect hedges produce risk reductions ranging between 4% and 22% for weekly in sample hedges. Brooks and Chong reported out of sample risk reduction varying between 8% and 15% for the currencies using the exponential moving average model. Castelino [19] estimated in-sample risk reduction of 22% and 31% for T Bills and Eurodollars respectively but only 3% for corn and wheat. Figlewski [10] suggested hedging can achieve risk reduction of the order of about 20–30% of the unhedged portfolio's standard deviation.

Stationary or Time-Varying Hedge Ratio: The third issue is to determine a stationary or time-varying of an optimal hedge ratio. This concern is essential due to the characteristic and behaviour of time-varying hedge ratios which involve frequent updating of the hedge ratio. There are mix results have been observed. Holmes [13] reported that the optimum hedge ratio is stationary but is vary over time. Later, Ferguson [20] reported that if optimum hedge ratios are stationary, the hedge ratio update would not enhance the hedging performance. However, Koutmos [15] has discovered that dynamic hedging will lead to better hedge results. Myers [17], who has examined the time varying hedges for wheat has found that time varying hedging will just delivered minor benefits over the constant optimum hedge ratios assumption.

OLS Minimum Variance Hedging Model: Ederington [9] uses simple linear regression in the construction of relationship between the cash and futures market prices which named as OLS hedge ratio. The positive result has been obtained by deriving the hedge ratio from the model to determine hedging effectiveness. Furthermore, the hedging effectiveness is presented by regression which is the R^2 statistic. The better hedging effectiveness is represented by the higher R^2. The OLS model is relatively simple due to the only consideration for the ability of risk minimization of the hedging strategy which has excluded the existence of expected return. Besides, some previous studies also revealed that hedged portfolio return is not normally distributed.

The attention of financial econometricians has been attracted by the determination of optimal hedge strategy. Ederington [9] has proposed an ordinary lease-squares

regression-based method based on static hedge ratio which also known as the minimum variance hedge ratio. Later, Figlewski [10] has investigated the effects of basis risk on hedging performance based on vary sources. He has found that the hedging performance is affected by the hedging period and time maturity. The study also concludes that the overreaction of futures price to changes in the spot index will be weakened if futures market has been developed.

Floros and Vougas [21] have investigated the hedging effectiveness in Greek stock index futures market. They has examined hedge ratios by using OLS, ECM, VECM and BGARCH (1,1) methods to determine which hedge ratios provides better results of hedging effectiveness. The result from OLS has reported that the R-squared value of FTSE/ASE-20 is much higher than that of FTSE/ASE Mid 40. In line with that, Lien and Yang [22] has analysed the shanghai Futures Exchange. They compare the strategy of the na¿ve hedge strategy, OLS hedge strategy and BFIGARCH model. They find that OLS strategy has outperformed other models for the certain sub-period of aluminium.

Furthermore, Kavussanos and Visvikis [23] have examined the hedging effectiveness of the Greece futures markets. The conventional (OLS) model produces the highest variance minimization for daily data of in-sample hedge ratios. The VECM model has outperformed others constant hedge ratio models (na¿ve and OLS) for the FTSE/ATHEX-20 market, whereas for the OLS model has performed the best in FTSE/ATHEX Mid-40 market. The largest variance reduction has been achieved by the OLS model followed at lower values by the VECM, the na¿ve model and the VECM-GARCH.

However, Zanotti, Gabbi and Geranio [24] has analysed hedging policies implemented by using various hedge ratios approach in the case of electricity market. They have found that only time varying GARCH models delivered a noteworthy and consistent variance reduction. The higher volatility of market movement will cause the improvement in performance of dynamic hedging model in comparison to traditional hedging models when there is relatively high correlation of the standard deviation.

The OLS minimum-variance hedging strategy will be proposed and applied in this research due to the simplicity of OLS model and assume that the behaviour of hedge ratio is stationary.Kavussanos and Visvikis [23] have proven that OLS minimum-variance hedge model able to give highest hedging effectiveness for the stationary hedge. This result is consistent with previous study by Ederington [9].

Methodology

Data Collection: Data are gathered from daily data on settlement price for crude palm oil futures traded on the Bursa Malaysia Derivative Berhad (BMD) and daily data of crude palm oil spot price from Malaysian Palm Oil Board (MPOB). The time period covered is from 15 August 2008 to 15 June 2011. FCPO contract will be expired on the 15th day of the delivery month at noon. If the 15th is a non-market day, the maturity day will be the preceding business day. Meanwhile, the crude palm oil spot price is based on daily closing price that provided by MPOB in Malaysian Ringgit per metric tonnes.

Ordinary Least Squares (OLS) Method

Minimum-Variance Hedging Ratio: In order to identify the existence of fluctuation in CPO spot market and FCPO futures market, the optimal futures position can be measured by minimizing the variance of the spot-future portfolio. Let the actual return represented by r_{st} on a CPO spot position for the duration of time $t - 1$ to time t. Furthermore, let r_{ft} represent the actual return on a CPO futures position. Therefore, $E(r_{pt})$ which is expected return of a portfolio comprising one unit of the CPO spot position and β unit of the CPO futures contract may be written as

$$E(r_{pt}) = E(r_{st}) - \beta_{t-1} E(r_{ft}) \quad (1)$$

where β is the hedging ratio that has been identified at time $r - 1$ for employment in time t.
The variance of the portfolio is written as

$$\sigma_{pt}^2 = \sigma_{st}^2 + \beta_{t-1}^2\sigma_{ft}^2 - 2\beta_{t-1}cov(r_{st},rft) \quad (2)$$

where σ_{pt}^2, σ_{st}^2 and σ_{ft}^2 represent the conditional variances of the portfolio, of the spot and of the futures positions and $cov(r_{sp}, r_{ft})$ is the conditional covariance between the spot and the futures position. Hence, the optimum quantity of futures contract in the hedger portfolio is equivalent to.

$$\beta_{t-1}^* = -\frac{\text{cov}(r_{st}, r_{ft})}{\sigma_{ft}^2} \quad (3)$$

Optimal hedging ratio can be obtained from the fraction of the covariance between spot and futures returns and the variance of futures returns. The constant optimal hedging ratio can be measured as the estimated slope coefficient in the OLS regression if the conditional

variance-covariance matrix is time invariant, where dependent variable is spot returns and the independent variable is futures returns:

$$r_{st} = a + \beta r_{ft} + \varepsilon_t \quad (4)$$

where r_{st} is the spot return and r_{ft} is the futures returns for period t. The OLS estimator of β has represented the minimum-variance hedging ratio. Since it is a static hedge then the hedging ratio is assessed once and can be used to the all hedging period [24].

As the hedge ratio has determined, a hedged position is constructed to produce the rate of return, R_H, which is given by

$$R_H = \Delta s_t - h\Delta F_t \quad (5)$$

where ΔS_t and ΔF_t represent spot and futures price changes [25].

Hedging Effectiveness: Following Ederington [9], the hedging effectiveness is represented by R-squared of the OLS regression:

$$\Delta s_t = c + b\Delta F_t + u_t \quad (6)$$

where S_t is logged spot price and F_t represents futures prices at time period t and u_t is the error term from OLS estimation. The R-squared of the regression line is equivalent to the effectiveness of hedge. The larger the R-squared presents the better of minimum-variance hedging effectiveness.

However, the degree of hedging effectiveness can be defined as the ratio of the variance of the unhedged position minus the variance of the hedged position, over the variance of the unhedged position:

$$E = \frac{Var(\mu) - Var(h)}{Var(u)} \quad (7)$$

where

$$\begin{aligned} Var(u) &= \sigma_S^2 \\ Var(h) &= \sigma_S^2 + h^2\sigma_F^2 - 2h\sigma_{S.F} \\ R_u &= S_{t+1} - S_t \\ R_h &= (S_{t+1} - S_t) - h(F_{t+1} - F_t) \end{aligned} \quad (8)$$

$Var(u)$ and $Var(h)$ represent variance of unhedged and hedged positions, while σ_S, σ_F are standard deviations of the spot and futures prices. The value of h and $\sigma_{S.F}$ represents the covariability of the spot and futures price can be defined as hedging ratio. The measure of the variance of the hedged returns to the portfolios can be done by evaluating $Var(\Delta S_t - h\Delta F)$, where h, $_t$is the computed hedge ratio [21].

DISCUSSION

Hedge Ratio: The determination of hedge ratio for each FCPO contract is important to determine a hedging position. The essential procedure is to simultaneously hold an offsetting position in futures while taking a spot position. Therefore, the fluctuation effect of price movement in the cash market can be minimized by the action in the futures market. The computed hedging ratio in this study is static without time varying concern. The expected return of a portfolio consist of return from single unit of CPO cash position and return from β unit of the CPO futures contract, where β is the hedge ratio as mentioned in equation (1) in methodology.

Table 1 reports the hedging ratio in percentage for the FCPO contracts from January 2009 to June 2011.

Table 1: Hedging Ratio, Hedging Effectiveness and R-Squared of 2009, 2010 and 2011 FCPO Monthly Contract

Year	FCPO Contract (Month)	Hedging Ratio (%)	Hedging Effectiveness (%)	R-Squared (%)
2009	Jan	60.0015	49.5443	48.0265
	Feb	66.7660	51.3682	50.5241
	Mar	66.2330	53.2205	53.5925
	Apr	50.9702	40.4114	40.9876
	May	49.3384	43.7036	44.9282
	Jun	52.9394	43.9838	49.1939
	Jul	44.1596	35.7131	37.7922
	Aug	53.7785	46.7351	48.8670
	Sep	58.3004	48.7126	50.1116
	Oct	55.8629	47.4889	48.5459
	Nov	50.8890	44.0181	44.7373
	Dec	52.9182	43.9480	45.2255
2010	Jan	57.8226	50.6512	51.9884
	Feb	50.2582	43.3951	44.6737
	Mar	51.7256	42.7432	43.7226
	Apr	51.3142	45.9789	45.0801
	May	46.1285	43.1084	42.6556
	Jun	31.5812	24.4370	24.1676
	Jul	34.2125	27.3671	27.2090
	Aug	42.6506	34.5246	35.5211
	Sep	35.3947	26.8372	26.4765
	Oct	49.8921	47.7832	49.1031
	Nov	52.1344	34.3005	31.8223
	Dec	38.2562	23.1872	19.5458
2011	Jan	39.0884	24.4189	23.4366
	Feb	43.0155	25.4884	25.9434
	Mar	46.6576	28.9169	31.9500
	Apr	45.4644	35.1118	37.7439
	May	51.4702	49.0771	50.7455
	Jun	50.7789	42.5520	44.5084

In 2009, the highest hedging ratio is recorded as 66.7660% in February contract, whereas, the lowest hedging ratio occurs in July contract which is 35.7131%. The uptrend of hedging ratio is spotted twice in 2009. First uptrend period is from January to March (first quarter), which the uptrend hedging ratio is 60.0015%, 66.7660% and 66.2330%, respectively. Second uptrend period is from July to September (third quarter), which is 44.1596%, 53.7785% and 58.3004%, respectively.

In year 2010, the highest hedging ratio is observed from January contract which is 57.8226%. In contrast, the lowest hedging ratio is June contract, 31.5812%. Hedge ratios downtrend has been observed from January contract until June contract. However, the uptrend has been observed in the second half of 2009, the ratio increased from 34.2125% in July contract to 52.1344% in November contract. There are two dips observed in September and December contracts, where the hedging ratio is 35.3947% and 38.2562%, respectively.

For the first six-month in 2011, the highest and the lowest hedging ratios have been observed in May contract and January contract, which amounted to 51.4702% and 39.0884%, respectively. The uptrend of hedging ratio is also observed during the period of January to May. Further, there is a small dip in Jun contract, which is 50.7789%.

In general, the observed hedging ratios for the sample period range from 31.5812% to 66.7660%.

Hedging Effectiveness: The hedging effectiveness and R-squared computed from Model (1) and Model (2) are compared to show the difference between these two models. These values are showed in Table 4.1. The results indicate that hedging effectiveness calculated from these two models is actually similar for each monthly FCPO contract. Meanwhile, these two models have given mixed results in obtaining best hedging effectiveness. It is concluded that none of the model will outperform the other in calculating hedging effectiveness of FCPO contracts.

The hedging effectiveness for Model (1) and Model (2) within period of January 2009 and May 2010 is considered to provide average performance in hedging effectiveness. Most of the hedging effectiveness has fluctuated within the range of 40% to 50%. In this period, the highest hedging effectiveness for both models have been observed from March 2009 FCPO contract, which is 53.2205% for Model (1) and 53.5925% for Model (2). Meanwhile, these two models also show that the lowest hedging effectiveness occurred in July 2009 FCPO contract, which is 35.7131% and 37.7922%, respectively. However, the hedging effectiveness that observed within the period of June 2010 and April 2011 are considered as low level of hedging effectiveness. Most of the hedging effectiveness are spotted within the range of 20% to 40%. The highest hedging effectiveness has been observed in October 2010 contract at 47.7832% for Model (1) and 49.1031% for Model (2). This October 2010 contract is the only one contract that exceeded 40% of hedging effectiveness within the period. Besides, the lowest hedging effectiveness based on Model (1) and (2) is recorded in December 2010 contract at 23.1872% and 19.5458%.

The largest difference of hedging effectiveness between Models (1) and (2) is observed in June contract of 2009, where the difference is 5.2101%. However, the smallest difference occurs on July contract of 2010, which is only 0.1580%. In overall, the average difference of hedging effectiveness between Model (1) and Model (2) is just 0.67%. As the difference between these two models is too small, it can be considered that these two models are actually providing the similar results in calculating hedging effectiveness.

The R-squared of the OLS regression as proposed in Model (2) is equivalent to hedging effectiveness as proven by Ederington [9]. High degree of R-squared (80% to 99%) of the OLS regression is considered as effective hedge and this has been proven by Floros and Vougas [21]. However, Zanotti, Gabbi and Geranio [24] have found that maximum hedging effectiveness is observed when spot price is highly volatile. Therefore, there is a direct relationship between hedging effectiveness and pricing volatility. Referring to the hedging effectiveness based on Model (1) and (2) for FCPO in this study, it indicates that FCPO contracts in Malaysia are only providing average level of hedging effectiveness (19%-53%).

Year to Year Comparison from 2009 to 2011: Annually average of hedging ratio, hedging effectiveness and R-squared have been computed for monthly FCPO contracts and the results are reported in Table 2. All the results show a downward trend from 2009 to first half of 2010. The highest average hedge ratio is observed in 2009 (55.1798%), but it is dropped to 45.1142% in 2010. However, the average hedging ratio for the first six-month in 2011 remains consistent at 46.0792%.

Table 2: Annually Average of Hedging Ratio, Hedging Effectiveness and R-Squared for 2009, 2010 and 2011

Year	Average Hedging Ratio (%)	Average Hedging Effectiveness (%)	Average R-Squared (%)
2009	55.1798	45.7373	46.8777
2010	45.1142	37.0261	36.8305
2011 (First 6 months)	46.0792	34.2608	35.7213

Table 3: Quarterly Average of Hedging Ratio, Hedging Effectiveness and R-Squared for 2009, 2010 and 2011

Year	Quarter	Average Hedging Ratio (%)	Average Hedging Effectiveness (%)	Average R-Squared (%)
2009	1st quarter	64.3335	51.3776	50.7144
	2nd quarter	51.0827	42.6996	45.0365
	3rd quarter	52.0795	43.7202	45.5903
	4th quarter	53.2234	45.1517	46.1696
2010	1st quarter	53.2688	45.5965	46.7949
	2nd quarter	43.0079	37.8414	37.3011
	3rd quarter	37.4192	29.5763	29.7355
	4th quarter	46.7609	35.0903	33.4904
2011	1st quarter	42.9205	26.2747	27.1100
	2nd quarter	49.2378	42.2470	44.3326

Both the average hedging effectiveness and average R-squared have shown similar results over the sample period. The average hedging effectiveness has decreased from 45.7373% in 2009 to 37.0261% in 2010. The value declines further to only 34.2608% in the first six-month of 2011. The similar downtrend of average hedging effectiveness also observed in average R-squared. The average R-squared peaked in 2009 as 46.8777%, it is later decreased to 36.8305% in 2010 and slightly reduced to 35.7213% in first-half of 2011.

The highest average hedging effectiveness has been observed in 2009 in comparison with 2010 and 2011. This result shows the effects of credit crisis that crunched in the US financial market and further affected the global market that caused the sluggish CPO demand worldwide. As a result, the palm oil exports have slightly increased by 0.45 million tonnes and registered the total of 15.87 million tonnes in 2009. In contrast, the total production of 2009 CPO has been dropped to 17,564,937 tonnes which is 0.96% less than previous year. This is due to lower output of fresh fruit bunches which caused by weather condition such as heavy rainfall and biological stress on the trees. All this factors has mainly affected CPO pricing movement and caused higher pricing volatility in 2009 compared to 2010 and 2011.

The CPO price rose steadily with the rising of petroleum crude oil prices as a result of recovery on global economic conditions in 2010. However, the tsunami and earthquake in Japan and financial turbulence from the debt crisis in Europe has worried the markets globally in 2011 again. Anyway, the effect of the events is not obvious during the sample period. In overall, the hedging effectiveness level has been considered as low and consistent throughout the year 2010 and 2011.

Comparison of Quarterly Average within Specific Year: The quarterly average of hedging ratio, hedging effectiveness and R-squared has been computed and reported as in Table 4.3. In this section, the comparison will be made according to quarterly performance of a year.

Comparison of Quarterly Average in 2009: The quarterly average of hedging ratio, hedging effectiveness and R-squared in 2009 has been shown in Table 3. The highest average hedging ratio is observed in the first quarter of 2009 at the level of 64.3335%. However, the value has dropped dramatically to the lowest point (51.0827%) in the second quarter. After that, the average hedging ratio has remained consistent over the following quarters. The value is recorded as 52.0795% and 53.2234%, respectively.

On the other hand, the average hedging effectiveness has decreased from the peak position (51.3776%) in first quarter to the trough position of 42.6996% in second quarter. However, the average hedging ratio has slightly increased to 43.7202% in third quarter and 45.1517% in fourth quarter. Meanwhile, the average R-squared is also showing a similar trend where the highest average R-squared is observed in first quarter, which is 50.7144%. But, the average R-squared later dipped to the lowest level, 45.0365% in second quarter and remained relatively consistent in third and fourth quarter, which is 45.5903% and 46.1696%, respectively.

The highest hedging effectiveness level has been shown in first quarter. This mainly caused by the US financial market credit crisis and affected the global market's CPO demand. The weakening dollar from the bailout of banking and related insurance business has partially led to increasing dollar-based commodity prices. The market uncertainty has caused the heavy fluctuation in CPO prices in the beginning of the year. However, the CPO prices recovered with petroleum crude oil and other edible oil commodities in the third and fourth quarter. Meanwhile, the dramatically growth in Indonesia palm oil production has caused high stock levels and the gross supply growth may has threaten prices. In overall, speculative activity continues to influence the recovery of commodity prices, with petroleum still playing the

biggest role as driving force that caused the average hedging effectiveness consistent at average level throughout the year.

Comparison of Quarterly Average in 2010: The movement of quarterly average of hedging ratio, hedging effectiveness and R-squared in 2010 has shown a 'V'-shape trend. The average hedging ratio is having a downturn movement for the first three quarters, where it has dropped from the highest point (53.2688%) in the first quarter to the lowest point (37.4192%) in the third quarter. In the fourth quarter of 2010, the average hedging ratio has bounced back to 46.7609%.

Similar trends have been observed for both average hedging effectiveness and average R-squared. The trends are showed in Figure 4.6. The average hedging effectiveness peaks at 45.5965% in first quarter. However, it has decreased to 37.8414% in the second quarter and further dropped to 29.5763%, the lowest point in the third quarter. The average hedging effectiveness manages to recover in the fourth quarter to 35.0903%. Similarly, the average R-squared has dropped from the peak position (46.7949%) in the first quarter to the lowest point (29.4904%) in the third quarter. However, the value has bounced back to 33.4904% in the fourth quarter.

The downward trend of hedging effectiveness level from first quarter to third quarter is mainly attributed by the high stability and consistency of world prospects that considered as post-US credit crisis period. The CPO price rose steadily with the rising of petroleum crude oil prices. The increasing popularity of renewable energy where CPO used to create biofuel in Europe in Europe has boosted the growth in palm oil industry. However, La Nina phenomenon was a strong event at the end of the 2010 which caused bad weathers and disrupted the harvesting of palm oil in Malaysia and Indonesia and threatened soy planting in South America. This event has caused the oil palm fruits shortage and higher CPO pricing volatility. Thus, these events have directly caused the uptrend of average hedging effectiveness level for the last quarter of 2010.

Comparison of Quarterly Average in 2011: The uptrend movements of quarterly average of hedging ratio, hedging effectiveness and R-squared for the first and second quarter of 2011 are plotted in Table 4.3. The hedging ratio has moved up from 42.9205% in the first quarter to 49.2378% in the second quarter. Meanwhile, average hedging effectiveness and average R-squared also show the same uptrend pattern as average hedging ratio. The average hedging effectiveness has increased from 26.2747% in first quarter to 42.2470% in second quarter. Average R-squared has also increased from 27.1100% in the first quarter to 44.3326% in the second quarter of 2011.

The uptrend of hedging effectiveness level in the first two quarters has been affected by the La Nina Phenomenon 2010/11 that causing the bad weathers. Due to the La Nina phenomenon, the world production of total vegetable oils had been decreased. The Malaysia palm oil production has been decreased by 17.6% in the first quarter compared to last quarter of 2010. The weak growth in some of the major market, tsunami and earthquake in Japan and financial turbulence from the debt crisis in Europe has worried the markets globally and caused the slow CPO demands over the first-half of 2011.

CONCLUSION

In the financial market, commodity hedging is when a producer or manufacturer decides to offset or eliminate risks due to the fluctuations in the raw material prices. A hedge is effective if price movement of the hedged item and the hedging derivative roughly offset each other. The higher volatility of the price movement, the higher of hedging effectiveness will be observed. In this study, the hedging effectiveness of crude palm oil futures market in Malaysia will be studied by using OLS Minimum-Variance hedge ratio models.

The empirical results indicate that the highest hedging ratio has been observed in the February 2009 FCPO contract, 66.7660%. Meanwhile, the lowest hedging ratio occurs in June 2010 contract which is 35.7131%. In the comparison of annually average of hedging effectiveness and R-squared for 2009, 2010 and 2011, all the results show a downward trend from 2009 to first-half of 2010. The average hedging effectiveness has decreased from 45.7373% in 2009 to 37.0261% in 2010. The value declines further to only 34.2608% in the first six-month of 2011. The average R-squared peaked in 2009 as 46.8777%, it is later decreased to 36.8305% in 2010 and slightly reduced to 35.7213% in first-half of 2011. In the comparison of quarterly average of hedging effectiveness and R-Squared in 2009, the average hedging effectiveness has decreased from the peak position (51.3776%) in first quarter to the trough position of 42.6996% in second quarter. The average R-squared is also showing a similar trend where the highest average R-squared is observed in first quarter, which is 50.7144%. In 2010, the average hedging effectiveness peaks at 45.5965% in first quarter. Similarly, the average R-squared has dropped from the

peak position (46.7949%) in the first quarter to the lowest point (29.4904%) in the third quarter. Furthermore, in 2011, the average hedging effectiveness has increased from 26.2747% in first quarter to 42.2470% in second quarter. Average R-squared has also increased from 27.1100% in the first quarter to 44.3326% in the second quarter of 2011.

The hedging effectiveness and R-squared that computed by using OLS Minimum-Variance hedging ratio models have shown similar hedging effectiveness level for the same FCPO contract. This result is in-line with previous study by Floros and Vougas [21] who have observed the behaviour of R-squared and hedging effectiveness in the study of Greek stock index futures market. In overall, Malaysia FCPO market only provides a low level of hedging effectiveness (19% - 53%) due to less volatility of CPO spot price. This result is also consistent with previous study by Zanotti, Gabbi and Geranio [24] in the study of European electricity futures markets.

As a conclusion, hedging effectiveness of crude palm oil futures market in Malaysia shows a low level of hedging effectiveness. This result indicates that the spot price of crude palm oil in Malaysia is relatively stable and consistent over the period of 2009 to 2011.

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