



Malaysian Crude Palm Oil Market Volatility: A GARCH Approach

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ABSTRACT

This study aims to examine the volatility of Malaysian Crude Palm Oil (CPO) markets for it has important implication to both business communities and policy makers. This study adopted the GARCH (1,1) model and the result of the finding exhibited persistent volatility as well as volatility clustering in Malaysian CPO market. The persistent volatility implies that the percentage of market volatility is closer to unity. This reflects the frequency of occurrence of the CPO markets volatility while volatility clustering provides useful information on the broadness of the shock. Adequate understanding on the degree of volatility of the market can instigate informed decision by policy makers which may mitigate persistent uncertainty of returns. Business communities will consistently be alert on market volatility and ready to make sound decision on any events of the market. This study enhances the understanding on commodity market volatility by quantifying the half-life of decay of the shock in the market and contributes to the literature by providing in sight information on the volatility of the market.

Keywords: CPO, volatility, GARCH (1, 1)

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Any remaining errors or omissions rest solely with the author(s) of this paper.

INTRODUCTION

Malaysian crude palm oil (CPO) has been a major export commodity and contributing significantly to the Malaysian economic development. CPO is an agricultural commodity traded in a standardized exchange – Bursa Malaysia Derivatives Berhad (BMDB). Malaysian CPO futures market has also shown significant changes in their trading volume and open interest over the years. However, commodity market is perceived to be volatile thus risk hedging is very much anticipated (Kumar *et al.*, 2014; Ahuja, 2006). In addition, trading volume and open interest signify how active the trading of futures market is. Trading volume refers to the trading volume for a particular contract in a day while open interest is the total number of outstanding long or short contracts for a given contract month. Outstanding contracts are contracts that awaiting offset. It was documented that BMDB recorded an average of 120,000 contracts monthly and 88,000 open interests as at the end of April 2006. Both volumes of contracts and open interests increased to 400,000 and 90,000 respectively as at December 2010 (Source: Bursa Malaysia Derivatives Berhad). Trading volume of CPO futures contracts continued to increase rapidly to 9,596,896 and the open interest to 214,065 in 2012 (Source: Futures Industry Annual Volume Survey, 2013). Apparently, CPO futures contracts contribute the largest proportion of BMDB's revenue among other contracts available (Bacha, 2012).

Malaysia and Indonesia are jointly producing about 85 per cent of the world palm oil production. Despite being the major producers, the Ministry of Plantation Industries and Commodities (MPIC) of Malaysia acknowledged that both countries have been price taker for more than two decades, in which both countries are using global commodity pricing as benchmark (The Star Online, 2012). Being the largest production of palm oil to cater to the world demand should enable Malaysia and Indonesia to become the price maker rather than the price taker. Nonetheless, becoming a price taker indicates that their production magnitude do not empower them to dictate the price. Their inability to dictate the global CPO prices is a major disadvantage to these major world producers. The recent price war between the two major producers has even worsened the stability of crude palm oil price (The Star, 2014). The fluctuation in the CPO price which may be resulted from the inability to control the price and the recent reported price war between Malaysia and Indonesia leads to price uncertainty and volatility that may erode returns.

Realising the importance of CPO to the Malaysian economy has driven this study to examine the Malaysian CPO market volatility through the CPO price return by employing the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model. The objective of this study is to examine market volatility and the findings could provide adequate understanding of the degree of volatility.

This enhanced understanding can instigate informed decision by policy makers which may perhaps mitigate persistent of uncertainty. Business communities will consistently be alert on the market volatility hence be ready to make sound decision on any events of the market.

The rest of the study is organised as follows. Next is a review of past literature related to this study and followed by an outline of the methodology employed. Later is the results and discussion and the final section concludes the study.

REVIEW OF LITERATURE

Past studies investigated both financial and commodity markets on market volatility. Commodity markets are assumed to be volatile hence both producers and consumers undertake hedging strategy in the commodity market to avoid price volatility that may erode returns (Kumar *et al.*, 2014; Sehgal *et al.*, 2013). Past literature recorded price volatility not only increases production, search and opportunity cost but also accelerates risk and uncertainty thus contributing to slowdown in economic activities (Alom *et al.*, 2012). In view of this, studies such as Crain and Lee (1996); Morelli (2002); Meneu and Torro (2003); Pati and Rajib (2011); Patra and Mohapatra (2013); and Kumar *et al.* (2014) will be discussed further in this study.

Crain and Lee (1996) argued that commodity market is volatile based on their study on wheat spot and futures market using daily data. Ahuja (2006) and Kumar *et al.* (2014) also confirmed that commodity market is volatile and proposed proper risk management to mitigate the risk. Crain and Lee (1996) argument on market volatility having certain impact on the economic activity has motivated Morelli (2002) to examine market volatility and macroeconomic variables.

Morelli (2002) examined the relationship between UK stock market and macroeconomic volatility using monthly data from 1967 to 1995. The study found that macroeconomic variables were unable to explain stock market volatility. He explained further that the selected macroeconomic variables were exhibiting neither short-run nor long-run relationship with the UK stock market. This may be due to impacts of other variables but were not captured by the model. However, in general, it was concluded that macroeconomic variables affect economy at large.

Spanish market was also reported to be volatile when Meneu and Torro (2003) detected the existence of market volatility on spot–futures market in Spanish stock index for the trading period of 1994 to 2001. The study also reported that volatility is more pronounced in the spot market compared to the futures market. Spot market is confirmed to be the source of volatility and provides spillover effects to futures market. The result indicated that the volatility in the Spanish stock market during the study period is unidirectional.

Offering different market landscape, Kumar *et al.* (2014) examined pricing efficiency and volatility spillover of Indian commodity markets covering four commodities spot and futures indices such as aggregate commodity index (MCXCOMDEX), agriculture futures price index (MCXAGRI), energy futures price index (MCXENERGY) and metal futures price index (MCXMETAL). The study period ranged from June 2005 to December 2008 with 1,047 observations for MCXAGRI and 1,049 for the rest of the three commodities indices. The study adopted the GARCH family and the result also shared similar scenario with previous studies and confirmed a volatility spillover from futures to spot in three indices except in MCXAGRI which was reported otherwise.

On the other hand, Pati and Rajib (2011) investigated the volatility of NSE S&P CNX Nifty futures market using a 5-minutes Intraday return from 2007 to 2008 with the application of GARCH (1,1) model. The study found bi-directional volatility between the spot and futures market.

Meanwhile, Alom *et al.* (2012) studied the asymmetry and persistency of shocks in petroleum futures price volatility. They used a set of petroleum futures price returns such as crude oil, heating oil, gasoline, natural gas and propane with daily series over the duration of 1995 to 2010. The findings confirmed a diverse level of volatility persistency as well as asymmetric effect of shocks for all futures price returns. They proposed policy makers to adopt policy measures that can accommodate long lasting effects of the shock to the volatility.

The identification of volatility and its adverse effects on the CPO market has urged players in the market to mitigate the situation. Hedging has the capability to mitigate these volatility effects on commodity transaction to the business community. This scenario is later confirmed by Ranganathan and Ananthakumar (2014) when they found positive relationship between hedging and farmer's risk aversion. They found that farmers in India benefited from hedging in Indian futures market and enjoyed certainty equivalent income due to hedging activities. Jubinski and Lipton (2013), on the other hand, studied volatility in three commodities; gold, silver and oil using intraday S&P 500 Index returns from 1990 to 2010. They found that gold and silver futures returns appeared to be less volatile than oil.

Patra and Mohapatra (2013) investigated the volatility of Indian futures using daily closing data. The result revealed that volatility in Indian futures market was lower relative to the spot market. Ahuja (2006) concluded that derivatives were used to reduce or eliminate price risk arising from unforeseen price changes.

In general most of the studies discussed above confirm that both financial and commodities markets are volatile. There also exists volatility spillover between spot and futures market in some markets reflecting a mixed result on the volatility of different market environments which is consistent with Kumar *et al.* (2014).

Some studies do not specify the direction of volatility such as Crain and Lee (1996); some concluded that there is spillover volatility between spot and futures market such as Pati and Rajib (2011) and Kumar *et al.* (2014); Morelli (2002) concluded that macro-variables were unable to explain market volatility. Nevertheless, the introduction of the futures market reduces spot market volatility in India, like Patra and Mohapatra (2013).

RESEARCH METHODOLOGY

To explore the CPO futures market volatility, this study adopted Generalized Autoregressive Conditional Heteroskedasticity, GARCH (p,q) approach which generally expressed as:

$$Y_t = a + \beta' X_t + u_t \quad (1)$$

$$u_t | \Omega_t \sim \text{iid } N(0, h_t)$$

$$h_t = \gamma_0 + \sum_{i=1}^q \delta h_{t-i} + \sum_{j=1}^q \gamma_j u_{t-j}^2 \quad (2)$$

where, equation (1) is a mean equation and equation (2) is the variance equation for the spot and futures market parameters. Parameter h_t depends on past value of shocks and past values of itself. Past value of shocks are captured by lagged squared residual terms ($\gamma_j u_{t-j}^2$) and past values of itself, are captured by lagged h_t terms (δh_{t-i}). The first parameter “p” is refers to ARCH term, and “q” is GARCH term.

The GARCH model is mostly preferred to the ARCH due to the drawback in the ARCH specification. One of the ARCH criticisms was that the specification resembles moving average specification rather than autoregression hence, GARCH was developed as a modified version of ARCH by Bollerslev (1986). Bollerslev (1986) modified ARCH to GARCH by including the lagged conditional variance into the ARCH specification.

Despite there are different order of GARCH adopted in past studies, standard GARCH (GARCH (1,1)) is equivalent to higher order ARCH (Asteriou and Hall, 2011) and is assumed to be more parsimonious. This implies that measuring GARCH (1,1) is equivalent to the result of higher order of ARCH such as ARCH (6,6). At the same time, measuring higher order ARCH in most cases is not advisable as some of the coefficient of some orders may be negative which is not consistent with the theory. This study adopted GARCH (1, 1) which is expressed by Asteriou and Hall (2011) as:

$$h_t = \gamma_0 + \delta h_{t-1} + \gamma_1 u_{t-1}^2 \quad (3)$$

Then $\gamma_0 + \delta h_{t-2} + \gamma_1 u_{t-2}^2$ is substituted for the lag of h_t in the equation (3) and the equation can be written as:

$$= \gamma_0 + \delta(\gamma_0 + \delta h_{t-2} + \gamma_1 u_{t-2}^2) + \gamma_1 u_{t-1}^2 \quad (4)$$

$$\frac{\gamma_0}{1-\delta} + \gamma_1 \sum_{j=1}^{\infty} \delta_{j-1} u_{t-1}^2 \quad (5)$$

Finally, equation (5) shows that GARCH (1,1) model is equivalent to infinite order ARCH models (Asteriou and Hall, 2011) hence, estimating GARCH (1,1) is found to be an alternative to ARCH models and it requires fewer parameters while fewer loss in degree of freedom.

Before carrying out the main analysis of GARCH (1,1), two preliminary tests are performed which are the unit root test on return series and Autoregressive Conditional Heteroskedasticity (ARCH) effect test. Unit root test examines the stationarity of the series hence, the Augmented Dickey-Fuller (ADF) unit-root test was used in this study. Though the priori expectation for the unit root test is that return series need be stationary at level, this implies integration of order zero, $I(0)$. Examining the stationarity of the series provides detail information on the series that can assist in taking appropriate decision on the type of analysis to be carried out. Series of $I(0)$ can be the model for the Ordinary Least Square (OLS), otherwise other models that are capable of higher order integration should be adopted.

Upon confirming the stationarity of the returns, we tested for ARCH effect which is the second preliminary test before modelling for the market volatility. The result of ARCH effect test will determine whether there is a need to proceed to examining market volatility. In analysing the ARCH effect this study adopted Engle's ARCH test. Engle (1982) presented a new concept that enabled autocorrelation in variance of the error terms and developed an ARCH model to capture autocorrelation. The ARCH effect test is determined by comparing the Lagrange Multiplier (LM) statistics with chi-squared critical value. The decision of the ARCH effect test is, if $LM >$ chi-square critical value, the null hypothesis which states that there is no ARCH effect will be rejected. This indicates that the market is volatile; we can then proceed with examining the volatility of the market. But if $LM <$ chi-square critical value, this implies that there is no ARCH effect, that is, the market is stable and not volatile, thus no need for modelling volatility of the market. Upon confirming the need to model for market volatility, next is to determine the optimality of GARCH parameters, which is the values of p and q . This optimality of p and q in GARCH model is derived based on the specific to general approach. This is based on minimum value of information criteria, that

is, Schwarz information criterion (SC) and Akaike information criterion (AIC) suggestion. In case where there is a conflicting suggestion between SC and AIC, the optimum selection will then be selected on the model with the best diagnostic result (Asteriou and Hall, 2011).

Firstly, standard GARCH (1,1) was modelled and robustness of the model was checked by comparing the parameters coefficient with the priori expectation of using GARCH (1,1). The priori expectation of GARCH parameters are aggregation of coefficient of ARCH and GARCH that should be less than 1 ($\alpha_1 + \beta_1 < 1$); and constant term, individual coefficient of ARCH and GARCH, are not negative ($\alpha_0 \geq 0, \alpha_1 \geq 0, \beta_1 \geq 0$) (Jafari *et al.*, 2007; Asteriou and Hall, 2011). More so, robustness of the finding is confirmed further using the ARMA model. This is to avoid over-fitting of the model while taken the parsimony model. The model fitness is confirmed based on the diagnostic result.

After the volatility of the market is confirmed, half-life of decay of the shock in the market is measured. Half-life decay of the market volatility is calculated as:

$$\text{Half-life of Decay} = \frac{\log ((\alpha + \beta) / 2)}{\log (\alpha + \beta)} \quad (6)$$

where, $\log (\alpha + \beta)$ stands for logarithm value of coefficient of ARCH (α) and GARCH (β).

Half-life of decay quantifies the expected period for the shock in a market to persist before it decays to half of the original size. By applying the Half-life of decay approach the shock in the market can be quantified and market participants can decide on their market exposure accordingly. The result of the half-life of decay is interpreted in respect to the frequency of the series used. For example, if the series are monthly series then the series will be reported in the number of the months required for the shock in the market to be half decayed.

In calculating the half-life of decay, the natural logarithm of coefficient of ARCH (α) and GARCH (β) are used. Based on natural logarithm of aggregate $(\alpha + \beta) / 2$ divided by natural logarithm aggregation of $\alpha + \beta$, we can derive the duration needed for the shock to decay in the market. The closer $\alpha + \beta$ to unity the more persistent the volatility, this implies the longer it takes before the shock in the market to decay. The more $\alpha + \beta$ is away from the unity, the lower the volatility (lower the persistence), $\alpha + \beta = 1$ indicates permanency of the shock to volatility, whereas $\alpha + \beta > 1$ indicates the shock is explosive (Brooks *et al.*, 2005; Asteriou and Hall, 2011; McMillan and Thupayagale, 2011). In addition, GARCH coefficients are not only provide an insight on market volatility but also provide information

on the degree of the volatility in the market. More persistent volatility implies that the shock in the market is continuously experiencing volatility (Michelfelder and Pandya, 2005).

In addition, the coefficient of ARCH and GARCH provide information on volatility spillover. When the volatility is said to be spillover, it indicates a transmitting effect in the market that is, a shock in one market will be transmitted to the other market. This transmitting effect can either be unidirectional or bidirectional. High or low volatility has implication on investment. Therefore, if return series exhibited volatility clustering, investors would be interested to know the degree of price volatility as this could provide necessary information for their decision making.

This study used monthly returns of Malaysian CPO spot and futures market. The prices for Malaysian CPO and futures market were downloaded from Bloomberg for the period ranges from March, 1995 to March, 2014, resulted in 229 observations. The monthly Malaysian CPO spot and futures prices were converted to return hence, the process reduces the observations by one, 228 observations.

Moreover, the variables selected and the frequencies of data used were based on the previous empirical studies related to the commodity futures contracts pricing efficiency (Alom *et al.*, 2012). The more the frequency of the series the more reliable the result is, provided that the underline assumption is not overridden.

RESULTS AND DISCUSSION

Preliminary Results

As noted earlier, preliminary tests such as the unit-root test and ARCH effect test are common tests that need to be done before proceeding with the analysing of market volatility. Therefore, we first check the unit-root and then the ARCH effect of the returns. To recall, certain conditions that need to be met are: returns should be stationary at level indicating a constant mean and a constant variance; and there should be ARCH effect.

In examining the volatility of the local CPO futures market, the prices are transformed to returns. The stationarity of the returns series was confirmed at level using ADF unit root test (t-statistic = -13.4012 , $\rho = 0.0000$) and (t-statistic = -13.6446 , $\rho = 0.0000$) for CPO futures return and CPO spot return respectively. Therefore, null hypothesis of returns having unit-root is rejected. This implies that returns series are integrated of order zero, $I(0)$.

We then examined the descriptive statistics of returns series but at this point the returns series are transformed into percentage which corresponds with Alom *et al.* (2012) and Bouri and Yahchouchi (2014) approach. This approach enables us

to express the statistical nature of returns series in percentage for the descriptive statistical only. The percentage returns of CPO futures prices are computed using standard continuously computed logarithm techniques as follows:

$$RF_t = 100X \ln \left(\frac{R_t}{R_{t-1}} \right) \quad (7)$$

where; RF_t stands for per cent logarithm returns computation, R_t is monthly returns at current time t , and R_{t-1} is returns for the previous months. The returns series are used in modelling volatility of CPO commodity markets. The descriptive statistics and unit root test of the returns series are reported in Table 1.

Descriptive Statistics and Unit Root of Returns

Descriptive analysis of spot market is similar to the futures market, therefore only the statistic on the futures market is stated in this study to avoid near repetition while graphical representation of stationary of both series are provided.

This study found that CPO futures return recorded the highest volatility during the global financial crisis (2007-2008; Std. Dev. = 12.235), followed by the period of after Asian financial crisis and before global crisis (1999-2006; Std. Dev. = 9.8177). Generally, standard deviation in each group is larger than their corresponding means return. This indicates high volatility in the returns of CPO commodity market. With the exception of return series before Asian financial crisis (1995-1996) and during global financial crisis (2007-2008), all returns are positively skewed.

All periods exhibited positive kurtosis and excess kurtosis. The periods before Asian financial crisis (1995-1996), during Asian financial crisis (1997-1998) and during global financial crisis (2007-2008) recorded kurtosis of below 3 while other periods above 3. This indicates that the return series are not normally distributed ($\rho = 0.00$). Hence, there is evidence that samples approximately have financial properties such as volatility clustering, leptokurtosis and long tails. GARCH modelling is capable of accounting for leptokurtosis in the series (Brooks *et al.*, 2005).

Unit root test (Augmented Dickey-Fuller) indicated that returns are stationary at level $I \sim (0)$ ($\rho < 0.05$). The normality assumption is rejected based on the JB statistic only in total period of study (1995-2014) and after Asian financial crisis and before the global financial crisis (1999-2006), although conditional normality assumption does not make estimators invalid (West and Cho, 1995; Michelfelder and Pandya, 2005); financial time series of high frequency tends to “have fatter tails than normal distribution” (Brooks *et al.*, 2005). Stationarity of returns (spot

Table 1 Summary statistics of the futures returns (1995 – 2014)

Column	1	2	3	4	5	6
	1995 – 2014	1995 – 1996	1997 – 1998	1999 – 2006	2007 – 2008	2009 – 2014
Returns	Total period of study	Before Asian financial crisis in 1997	During Asian financial crisis	After Asian Financial Crisis and Before Global Crisis	During global financial crisis	After global crisis
Mean	0.2884	-0.5478	2.119	0.0247	-0.5267	0.6827
Median	-0.1037	1.0471	1.897	-0.8913	3.1548	0.2087
Max.	37.7056	14.1029	20.951	37.7058	21.2687	25.5895
Min.	-29.2021	-13.3320	-15.402	-29.202	-28.431	-18.7816
Std. Dev.	9.1667	7.1474	9.2881	9.8177	12.235	7.5243
Skewness	0.3205	-0.2091	0.4706	0.8311	-0.597	0.1534
Kurtosis	5.2006	2.4694	2.8934	6.302	2.7683	4.2345
J-B	49.9053	0.3993	0.8597	54.119	1.4193	4.1806
Prob.	0.0000	0.8190	0.6505	0.0000	0.4921	0.1236
Unit Root (ADF) of return series	0.0000	0.0005	0.0103	0.0002	0.0273	0.0000
Observations	228	21	23	95	23	62

Notes: Table 1 reports the characteristics of returns series based on the different periods of studies. Column 1 is the total years of study (1995-2014) while subsequent columns are grouped according to the different crisis periods. 1995-1996 represents CPO futures returns series before Asian crisis in 1997. 1997-1998 represents returns series during the Asian financial crisis in 1997. 1999-2006 represents CPO returns series after the Asian financial crisis and before the global financial crisis. 2007-2008 represents returns series during the global financial crisis, while 2009-2014 represents returns series after the global financial crisis. This is to provide clarity on market volatility during the different periods of the study. Unit Root (ADF) represents the stationarity of return series in which the return series has to be stationary. Unit Root test (ADF) is a preliminary test to be conducted.

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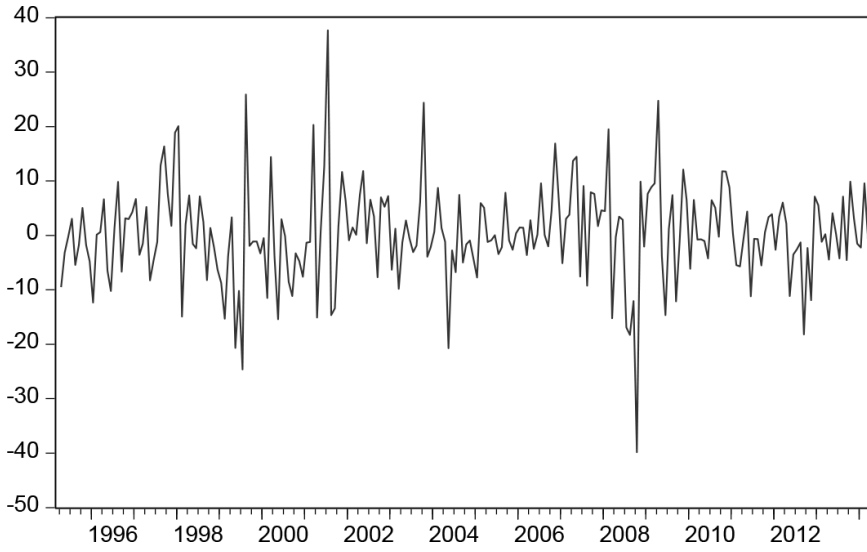


Figure 1 Spot returns integrated in order of 0, $S_t, I \sim (0)$

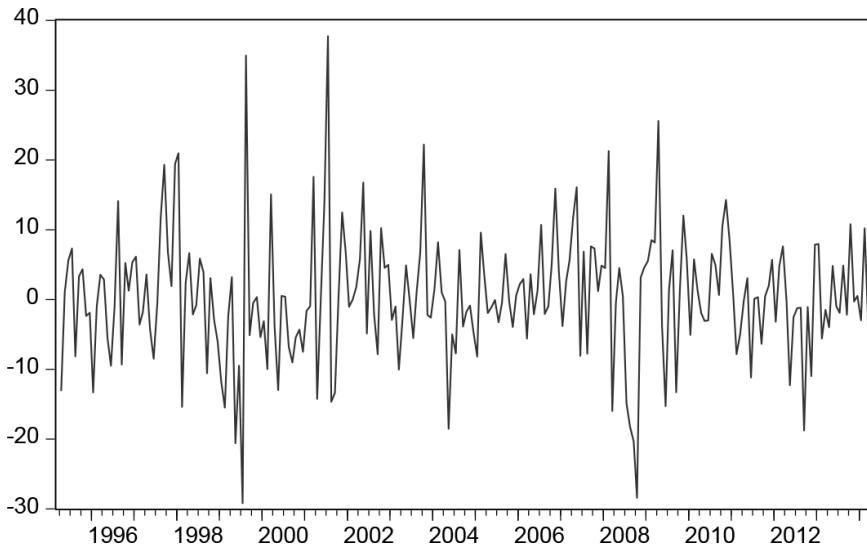


Figure 2 Futures returns integrated in order of 0, $S_t, I \sim (0)$

and futures) are graphically represented in Figure 1 and Figure 2. Furthermore, the graphical representation also indicates that the returns have a constant mean and a constant variance which satisfy some of the characteristics of stationary series (Asteriou and Hall, 2011). After performing the unit root test, we then proceeded with the ARCH effect test as the second preliminary test.

Estimation of ARCH Effect and GARCH Spot and Futures Returns

The analysis began with the estimation of ARCH effect of spot and futures returns. The futures-spot returns model was estimated using the OLS. Residual of each model was generated followed by square of residual. Square of residual was regressed on explanatory variable and χ^2 -statistic is estimated to be 3.8410. LM-statistic for each model was calculated and the decision on ARCH effect was then concluded. Table 2 presents the report of ARCH effect for each model and the null hypothesis of ‘no ARCH effect’ was rejected as LM statistics $> \chi^2$.

Table 2 ARCH effect of futures-spot model

	χ^2	LM = n*R ²	Decision
Futures return	3.8410	9.7420	There is ARCH effect
Spot return	3.8410	10.5930	There is ARCH effect

In examining the robustness of GARCH parameter estimation, we began with exploring autocorrelation function (ACF) and partial autocorrelation function (PACF) of return series. We found that both ACF and PACF exhibited slow exponential decay indicating that AR (1) and MA (1) model were identified (Brooks *et al.*, 2005). Moreover, the parameter for the GARCH was confirmed to be GARCH (1,1) which was consistent with the previous model – standard GARCH model. To avoid spurious analysis, a diagnostic test of the model was carried out and the result of the test was recorded in Table 3 and Table 4.

In addition, the estimated coefficients on the variance equation i.e. ARCH (1) - the lagged squared residual and GARCH (1) – lagged conditional variance terms are strongly statistically significant. This is to note that the aggregate of the estimated coefficient of the lagged squared residual and lagged conditional variance is close to unity (≈ 0.96) and (≈ 0.97) for futures and spot models. This implies that shock to the conditional variance is highly persistent. Since, the market is volatile; the half-life of decay of the shock is estimated to be 18.1 months for the shock

Table 3 GARCH estimates of CPO spot market

Dependent variable: r_s: Samples: 1995M03 – 2014M03	
Parameter	
Constant	1.7109 [0.1528]
r_s(-1)	0.1050 [1.4294]
Variance equation	
Constant	1364.8580 [2.3379]
ARCH(1)	0.1523 [2.8837]
GARCH(1)	0.8131 [14.9205]
R ²	0.0088
S.E of Reg.	177.3387
AIC	12.9824
SC	13.0579
J-B	37.5131 (0.0000)
ARCH-LM (1)	0.7060 (0.4008)
ARCH-LM (2)	2.0912 (0.3515)

Notes: Figures in parentheses [] are t-statistics and () are p-values at 5% significance level.

Table 4 GARCH estimates of CPO futures market

Dependent variable: r_f: Samples: 1995M03 – 2014M03	
Parameter	
Constant	6.6005 [0.5899]
r_f(-1)	0.0899 [1.2208]
Variance equation	
Constant	1482.4670 [2.2570]
ARCH(1)	0.1492 [2.7851]
GARCH(1)	0.8151 [15.1361]
R ²	0.0124
S.E of Reg.	179.5870
AIC	13.0506
SC	13.1260
J-B	44.0956 (0.0000)
ARCH-LM (1)	1.5045 (0.2200)
ARCH-LM (2)	3.2086 (0.2010)

Notes: Figures in parentheses [] are t-statistics and () are p-values at 5% significance level.

in CPO futures market and 20.7¹ months for the shock in spot market which is consistent with Meneu and Torro (2003). This indicates that it takes an average of 18.1 months for the shock in the futures market to decay to the half of the original size while it takes 20.7 months in the spot market. The results of volatility of the local CPO markets indicate that the speed of adjustment for each shock is very slow therefore it will take longer time for the market to adjust in case of any shocks taken place in the market.

The volatility clustering of the Malaysian CPO markets is graphically presented in Figure 3 and Figure 4. As shown by the graphs, the market was slightly volatile from early 1995 to late 1996 then the volatility reduced slightly. The first huge volatility in the CPO futures market was detected during the Asian crises in 1997. The market volatility was unable to normalize until January 2001 at which the volatility was similar to volatility of the market as in September 1996 CPO market volatility. The event sparked by the Asian financial crisis was not completely resolved when another shock hit the market in the middle of 2001 and the shock in the Malaysian CPO commodity market took another 8 months before another shock occurs. In April 2007, another noticeable shock occurred which was not fully resolved until October 2010.

As indicated in Figure 3 and Figure 4 local CPO commodity market was very volatile from late 2006 to late 2009 and was partly due to the global rally in commodity prices during the period as the event spilled over to local Malaysian commodity markets.

We finally checked the fitness of the model through correlogram of residual, the results indicated no autocorrelation (AC), no partial correlation (PAC), and Q-Statistic was statistically insignificant. ARCH-LM Test was statistically insignificant hence; null hypothesis of homoskedasticity of variance (equality of variance) is not rejected.

CONCLUSION

Malaysian CPO commodity markets show persistence in volatility with the most pronounced volatility during the Asian financial crisis (1997-1998) and global financial crisis (2007-2008). In contrast to the financial crisis, local CPO futures

¹ 20.7 months of half-life decay is derived by adding the coefficients of both ARCH(1) and GARCH(1) for each of the market and divide the summation by 2 then take the log of the value. Likewise, take the log of summation of coefficient of both ARCH (1) and GARCH(1). Finally, divide the latter log value by the first log value. The unit of measurement depends on the frequency of the data used. This study used monthly data; hence the unit for this study is on monthly basis.

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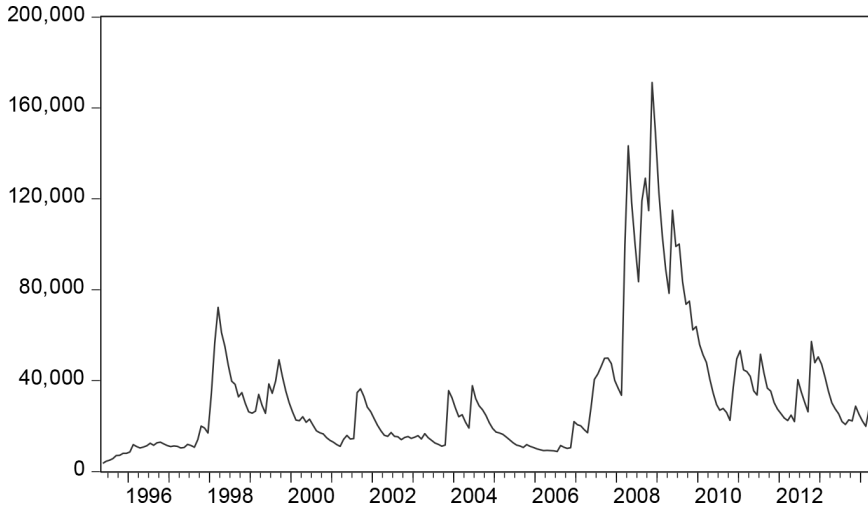


Figure 3 Spot returns volatility clustering

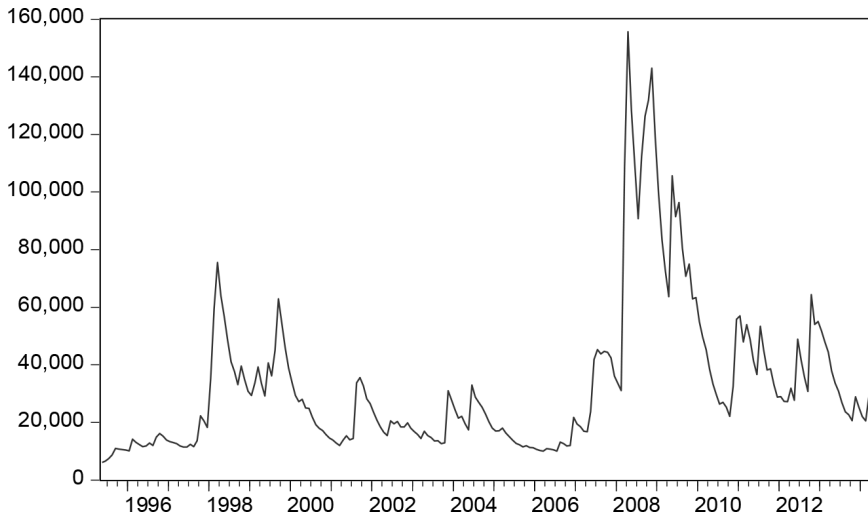


Figure 4 Futures returns volatility clustering

market is experiencing good performance rather than having adverse effect on the market (Futures Industry Annual Volume Survey, 2013).

The result of the study indicates that the Malaysian CPO commodity market is volatile. The market exhibited volatility clustering and the volatility persistent. Michelfelder and Pandya (2005) agree that stock return varies with time and shows volatility clustering. This can be inferred from the findings that shock in the Malaysian CPO market takes longer time to decay to the half of the original size. This indicates that the volatility of the local CPO markets is not only persistent but also clustered. Further inference in this study is, two most noticeable shocks (1997-1998 and 2007-2008) in the local CPO markets are traceable to financial crises but this does not mean that the market is not volatile on its own. Rather it implies that the volatility of the local CPO markets is aggravated further by the crisis.

This study provides evidence that the Malaysian CPO futures market needs some shock to show up its true nature on volatility. Volatility features is incumbent in the CPO market but with the shock from the global or connecting markets the volatility of the CPO market can be clearly recognized. Furthermore, any significant shock in the global market may adversely hit and transmitted into the local CPO markets.

Volatility can also be useful in comprehending market assimilation, co-movement and spillover effect. The existence of volatility spillover between the two CPO markets specifies that the volatility of returns in the market has an important effect on the volatility of returns of other market. This finding supports previous literature.

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