Asian Academy of Management Journal, Vol. 20, No. 2, 147–161, 2015

ANALYSING THE PRICE DISCOVERY FUNCTION OF CRUDE PALM OIL FUTURES (FCPO) BEFORE AND AFTER SHARI'AH-COMPLIANCE

Noryati Ahmad

Arshad Ayub Graduate Business School,
Universiti Teknologi MARA, Shah Alam, 40450 Selangor, Malaysia

E-mail: noryatia@salam.uitm.edu.my

ABSTRACT

This paper examines the price discovery function of Malaysian crude palm oil futures (FCPO) before and after Shari'ah-compliance. The sample used in the study is composed of crude palm oil futures (FCPO) and crude palm oil (CPO) prices for the January 2007 until December 2011 period. The period is divided into two sub-periods: Period I (January 2007–July 2009) before Shari'ah-compliance and Period II (August 2009–December 2011) after Shari'ah-compliance. The results of the Augmented Dickey Fuller (ADF) and Philips Perrons (PP) unit root tests suggest that the CPO and FCPO series are integrated at first difference. Johansen's co-integration test indicates that FCPO and its underlying spot market (crude palm oil) for both periods are co-integrated, implying that there is a causal relation between the two markets. In period I, the estimated results of Vector Error Correction model (VECM) indicate a one-way causality direction from the CPO market to the FCPO market in the long run. This can be interpreted as a price discovery process that occurs from its underlying spot market to the FCPO market. Furthermore, the study observes that the price discovery function of the crude palm oil futures market is increasingly more prominent after the Shari'ah Advisory Board (SAC) classified the product as Shari'ah-compliant (Period II).

Keywords: Price discovery, crude palm oil futures, Shari'ah-compliant, Vector Error Correction model, Granger causality

INTRODUCTION

The palm oil industry forms the economic backbone of Malaysia and continues to encounter new challenges with globalisation and a series of financial crises. Currently, palm oil utilises the largest acreage of farmed land in both Malaysia and Indonesia, having overtaken rubber and coconuts, respectively. Malaysia is one of the largest producers and exporters of palm oil in the world; it manufactures 39% of the world's palm oil and exports approximately 44% of oils and fats. However, the prices of crude palm oil (CPO) have always been very volatile because of fundamental factors influencing the demand and supply of the commodity product. In lieu of this volatility, palm oil traders and manufacturers are seeking alternatives that could enable them to manage price risk. Consequently, the first world crude palm oil futures (FCPO) were launched in October 1980 and have become the most successful and active commodity futures contract in Malaysia. Since its establishment, the derivative market has undergone a series of structural changes. Initially, FCPO was traded on the Kuala Lumpur Commodity Exchange (KLCE); however, in November 1998, the exchange merged with the Malaysian Monetary Exchange and was renamed the Commodity and Monetary Market Exchange (COMMEX). The trading in futures contracts was, at that time, via the open outcry system. However, the 1997 financial crisis catapulted the Malaysian capital market into a major restructuring, and several derivative markets were forced to merge into one derivative market known as Bursa Derivative Malaysia Berhad (BDMB). In December 2001, FCPO futures migrated to an automated trading system. A US denominated palm oil futures (FUPO) contract was introduced in September 2008 to complement the existing FCPO contracts. Nevertheless, these newly introduced futures contracts have not been performing as well as the FCPO futures contracts. Since 2000, there has been rapid growth and development in Malaysia's Islamic capital market, and the market has been running parallel with the conventional capital market. As documented by the Islamic Financial Services Industry (IFSI) Stability Report 2014, from 2000 to 2010, the size of the Islamic capital market grew at the rate of 13.6% per annum and achieved RM1.42 trillion in December 2012. The growth in the Islamic capital market also triggered strong demand among Islamic countries for not only Shari'ah-compliant financial products but also for Shari'ah-compliant derivatives for managing the price risk of Islamic financial products. In contrast to conventional capital markets, financial products transacted in the Islamic capital market should not be involved in activities that are against the religion of Islam; therefore, the transactions must not have the elements of *riba* (usury), *maisir* (gambling) and *gharar* (ambiguity).

On 17 August 2009, Bursa Malaysia Berhad collaborated with Bank Negara Malaysia (BNM), the Securities Commission Malaysia (SC) and other industry players to establish Bursa Suq Al-Sila (BSAS), formerly known as Commodity Murabahah House. BSAS facilitates trading of Shari'ah-compliant commodities under *murabahah, tawarruq* and *musasuwamah* concepts. The trading platform is under Bursa Malaysia Islamic Services Sendirian Berhad (BMIS) and is wholly owned by Bursa Malaysia. Crude palm oil is the first commodity chosen as its underlying Shari'ah-compliant asset. The idea of BSAS is that the CPO producer sells directly to the identified Islamic Bank X through a broker. BSAS plays the role of ensuring that the delivery of the CPO and the trade are confirmed. The identified Islamic Bank X settles the payment through BSAS and then sells CPO to its clients or another Islamic bank Y on a *Murabahah* basis. The bank notifies BSAS of the transaction for the change of ownership. The new owner (client or

Islamic Bank Y) then sells CPO to BSAS via a broker, and BSAS makes the payment to Islamic bank Y via Islamic bank X. BSAS takes ownership of the CPO and sells them to the CPO buyers. In short, the electronic-based BSAS provides an avenue for commodity market participants to invest, finance and manage their liquidity.

In essence, the design of the derivatives markets (whether Shari'ah- or non-Shari'ah- compliant) is to serve as an efficient price discovery mechanism and to manage financial assets price variations (Garbade & Silber, 1983). The price discovery role exists when a particular market reflects new information quickly. Empirical evidence has supported the notion that the price discovery process starts from the futures markets because of lower transactions costs and the ability to engage in short-selling. Because the requirement of the FCPO futures trading processes is to be Shari'ah-compliant, the CPO seller is required to possess the commodity and therefore eliminate excessive speculating activities. Speculating activity has been one crucial issue that has raised doubts regarding crude palm oil futures contracts being considered Shari'ah-compliant. The Shari'ah advisory council (SAC) has refuted that the *'iwadh* does not occur in crude palm oil futures transactions. *'Iwadh* refers to the buying and selling transaction that does not actually occur and, therefore, has no added economic value. Conversely, SAC consensually agreed that crude palm oil futures (FCPO) do enhance the value of market participants. For instance, when manufacturers of crude palm oil manage their price risk using FCPO contracts, they are able to increase firm profits and remain competitive. Hence, this microstructure change of the FCPO market and its underlying spot market generates an interesting setting to analyse whether the price discovery function between the two markets differs before and after it is Shari'ah-compliant.

REVIEW OF PREVIOUS LITERATURE

The spot and futures price relation can be best explained through the cost and carry model. Cost-of-carry is the costs involved with holding the physical commodity before being delivered on a specific date. These costs include the storage of and insurance for the commodity. The futures market can effectively conduct its price discovery function when the market efficiently consumes and reflects all available information and provides an unbiased estimate of the future spot price at all times (Viljoen, 2004). Schroeder and Goodwin (1991), Yang, Bessler and Leatham (2001) and Brooks, Rew and Ritson (2001) are also of the opinion that the causal relation between spot and futures prices is useful to the analysis of the price discovery role of the spot and futures markets, which is defined as the lead-lag relation and the information flows between the spot and futures markets. Chan (1992) interpreted the price discovery role as having a

Granger causality relation, that is, a lead-lag relation existed between the futures price and the spot price.

Many researchers have been attracted to examining the price discovery function of futures in relation to various markets including financial futures markets. Theoretically, because of low transaction costs and few restrictions on short selling (Sendhil, Kar, Mathur, & Jha, 2013), the price discovery role is usually inherent in the financial futures markets. However, empirical evidence has been mixed on the price discovery function of commodity futures. In their studies, Garbade and Silber (1983), Hernandez and Torero (2010) and Naziman, Nawi and Naziman (2012) documented that the price discovery function emanated from the futures markets to the spot markets. For example, Henandez and Torero (2010) discovered that, in most cases studied, the futures prices of wheat, corn and soybeans Granger-caused their respective underlying spot prices. Moreover, the researchers concluded that these unidirectional causality relations are stronger after the trading system has been automated.

Alternatively, the empirical results of Quan (1992), Kuiper, Pennings and Meulenberg (2002) and Mohan and Love (2004) confirm that spot prices rather than futures prices play a key role in the price discovery process. In contrast, a study by Sehgal, Rajput and Desiting (2013) confirms that Chana, Guarseed and Soybean futures markets led their underlying spot markets. The researchers used cointegration and Vector error correction techniques to examine this relation. Fabio and Philip (2004) concluded that the price discovery relation between the Brazilian agricultural spot markets and futures markets are mixed. For the coffee markets, the futures prices lead the spot market, whereas the corn, cotton and soybeans markets show no price discovery process between the futures and spot markets. In contrast, the sugar market's spot prices appear to play the dominant role in the price information transmission. The researchers rationalise the findings because of the limited trading volume of the markets investigated. Salvadi and Ramsundaram (2008) examine the price discovery function of the agriculture commodities futures markets in India. Their study revealed that both the futures and spot markets are not integrated, and the futures markets do not play the price discovery role. The authors justify their findings as resulting from the thin trading and the low market depth of the futures markets as well as the undeveloped underlying spot markets.

Substantial empirical research has also been performed on the price discovery relation between Malaysian FCPO and CPO markets, and the results are indecisive. Tazli (2001) found the futures prices of crude palm oil and rubber lead the respective underlying spot prices. Naziman et al. (2012) investigated the market efficiency of the Malaysian crude palm oil price, covering the period from January 1998 to December 2012. Using Johansen co-integration and VECM methods, the researchers concluded that the CPO futures price serves the price discovery role, and there is a long-term relation between the two markets. However, in their study, the authors did not consider the structural breaks that occur throughout the period studied. In contrast, Ahmad (2005) discovered a bidirectional relation between the FCPO and CPO markets both at first and second moments during the January 1990 to December 2003 period. Nonetheless, the magnitude of coefficient for FCPO is greater than the coefficient for CPO. This implied that the impact of FCPO prices is stronger on the CPO market. Although this research also examines the price discovery function of the Malaysian FCPO and CPO, it differs from the previous studies because the study attempts to investigate whether the price discovery role of FCPO and its underlying spot market differ before and after treatment as Shari'ah-compliant. The rapid growth and development of the Islamic capital market has provided Shari'ah-compliant investors with several investment opportunities. In addition to this development, there is also a rising demand for Shari'ah-compliant derivative products that are solely meant for managing price risk and for hedging purposes of these Islamic financial products. With the proclamation of FCPO as Shari'ah-compliant, CPO sellers and buyers particularly from the Islamic countries can use the crude palm oil futures market as a risk management tool.

DATA AND METHODOLOGY

The data for the study are composed of daily FCPO settlement prices and daily closing CPO prices. The three months nearby futures contract is used because it is the most active and liquid trading month. The period of analysis is from January 2007 to December 2011. The prices are in natural logarithm form to minimise the problem of heteroscedasticity in the data. The source of price information is from the Malaysian Palm Oil Board and the Bursa Malaysia Derivatives Berhad website. The data are further sub-divided into period I (January 2007–July 2009) and period II (August 2009–December 2011). Period I is the period before FCPO is Shari'ah-compliant, and period II is after FCPO is Shari'ah-compliant.

Both the Augmented Dicker Fuller (ADF) test and the Philips-Perron (PP) test are applied to determine the integration of individual series and the presence of unit roots. The ADF test incorporates additional lagged difference terms to ensure that the error term is white noise. In addition, the PP test is used to confirm the results obtained from the ADF test because the ADF test is known to have limited power in regards to finite samples.

Previous studies utilised the Johansen co-integration technique to investigate the price discovery relation between the futures prices and its underlying spot prices

(Yang & Leatham, 1999). The cost-of-carry model noted that the logarithms of FCPO and CPO prices are co-integrated with a common stochastic trend. This technique is employed because it shows the extent to which the two markets moved together towards long run equilibrium and it permits the divergence of two respective markets from long-run equilibrium in the short run. The procedure uses the Trace test and the Maximum Eigen Value test to determine whether the two markets are co-integrated. Both tests are specified in the following Equations (1) and (2), respectively.

$$j_{trace} = -\mathrm{T}\sum_{i=rt1}^{n} In\left(1-\lambda_i\right) \tag{1}$$

$$j_{max} = -\mathrm{T1n}(1-\lambda_{r+1}) \tag{2}$$

where T is the sample size and λ_i is the largest canonical correlation. The trace test tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of n co-integrating vectors. The maximum Eigen value test, in contrast, tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of $r + 1$ co-integrating vectors. If the two prices are found to be co-integrated, the relation between the two markets are not only short-term but also long-term in nature. Hence, there is a basis to use the bivariate vector error correction model (VECM) to investigate the long-term relation between spot and futures prices. The model includes the error correction term (ECT) to detect the speed of the adjustment made by either or both markets if disequilibrium exists. The VECM model initiated by Johansen (1988) and Johansen and Juselius (1990) is specified as follows:

$$\mathit{\Delta} CPO_i = \alpha_0 + \delta_{cpo}\, ECT_{t-1} + \sum_{j=1}^{p} \alpha_{cpo,j} \Delta CPO_{t-j} + \sum_{j=1}^{p} \alpha_{fcpo,j} \Delta FCPO_{t-j} + \varepsilon_{cpo,j} \tag{3}$$

$$\mathit{\Delta} FCPO_i = \beta_0 + \delta_{cpo}\, ECT_{t-1} + \sum_{j=1}^{p} \beta_{fcpo,j} \Delta FCPO_{t-j} + \sum_{j=1}^{p} \beta_{fcpo,j} \Delta FCPO_{t-j} + \varepsilon_{fcpo,t} \tag{4}$$

In Equations (3) and (4), ECT is the error correction terms that capture the dynamic relation between the two markets when disequilibrium exists, whereas ΔCPO_t and $\Delta FCPO_t$ are the return series of CPO and FCPO, respectively. Regarding Equation (3), the coefficients of ΔCPO_{t-j} and $\mathit{\Delta} FCPO_{t-j}$ measure the impact of their lagged returns and lagged FCPO returns on CPO returns. For Equation (4), the coefficients $\beta_{cpo,\, j}$ and $\beta_{fcpo,\, j}$ estimate the impact of their lagged returns and lagged CPO returns on FCPO returns.

The choice of lag lengths for previous changes of FCPO and CPO prices for both periods are determined based on Schwarz's Bayesian Information Criterion (SIC). ε_t represents the residual term for Equations (3) and (4), respectively.

To determine the interaction in CPO and FCPO returns, the causality tests are run via the long-term relation (ECT_{t-1}) or through the short-term relation ($\alpha_{fcpo,j}\Delta CPO_i$; $\alpha_{cpo,j}\Delta FCPO_i$). For example, if FCPO returns Granger-cause CPO returns, previous FCPO returns must be significant for predicting CPO returns. Specifically the following null hypotheses are tested in the CPO equation:

$$H_0 : \alpha_{fcpo,1} = \alpha_{fcpo,2} = ... = \alpha_{fcpo,p} = 0 \; and \; H_0 : \delta_{cpo} = 0.$$

A rejection of at least one of the null hypotheses is evidence of Granger causality running from FCPO to CPO returns (Bohl, Salm, & Schuppli, 2011). Similarly, we detect a causality relation from CPO to FCPO returns, then one of the following null hypotheses is rejected, that is, in the FCPO equation:

$$H_0 : \beta_{fcpo,1} = \beta_{fcpo,2} = ... = \beta_{fcpo,p} = \Delta CPO_{t-j} = 0 \; and \; H_0 : \delta_{fcpo} = 0.$$

Price discovery occurs from FCPO (CPO) to CPO (FCPO) if FCPO (CPO) Granger-causes CPO (FCPO). Alternatively, if there is a bidirectional Granger causality relation between the two markets, both markets play the price discovery role.

RESULTS

Table 1 reports the descriptive data series for crude palm oil (CPO) and crude palm oil futures (FCPO) prices before and after Shari'ah-compliance. On average, the prices of the CPO and the FCPO after Shari'ah-compliance are higher than before Shari'ah-compliance. The standard deviation after being treated as an Islamic derivative appears to be lower compared to before being Shari'ah-compliant. This implies that CPO and FCPO prices are less volatile after they are Shari'ah-compliant. The CPO and FCPO series for both periods are positively skewed, and the kurtosis values are less than three.

A logarithmic transformation is carried on both CPO prices and FCPO prices to mitigate the heteroscedasticity issue. Both the ADF and the PP tests are conducted to determine if both data price series have a unit root at a level. Table 2 reveals that the data series are stationary at the first order level, and suggest that they are integrated at the first order I(1).

Table 1
Descriptive statistics of crude palm oil and crude palm oil futures price series

	Period I: Before Shari'ah-compliant		Period II: After Shari'ah-compliant	
	CPO	FCPO	CPO	FCPO
Mean	2563.254	2560.789	2884.830	2898.470
Median	2530.500	2535.000	2785.000	2812.000
Maximum	4195.000	4298.000	3926.000	3982.000
Minimum	1400.000	1418.000	2091.500	2069.000
Std. Dev.	626.6276	615.6722	467.0433	473.2738
Skewness	0.2722	0.2893	0.3219	0.3435
Kurtosis	2.2339	2.263473	2.065071	2.104018
Jarque-Bera	23.5987	23.43234	30.0715	29.7442
Probability	0.0000	0.000008	0.000000	0.000000
Observations	641	641	560	560

Table 2
Results of ADF Test and PP Test for Unit Root

Period		Variables	Augmented Dickey-Fuller		Phillips Perron		Order of Integration
			Levels	First Diff.	Levels	First Diff.	
Period I (Before Shari'ah-compliant)	Intercept	LCPO	–1.4832 (0.5417)	–4.0267 (0.0014)***	–1.3993 (0.5836)	–21.7036 (0.0000) ***	I(1)
	Intercept	LFCPO	–2.0910 (0.2485)	–5.7512 (0.0000) ***	–1.8687 (0.3474)	–34.9745 (0.0000) ***	I(1)
	Intercept & Trend	LCPO	–1.6100 (0.7883)	–4.0520 (0.0077)***	–1.5106 (0.8253)	–21.6940 (0.0000) ***	I(1)
	Intercept & Trend	LFCPO	–2.0510 (0.5721)	–5.7603 (0.0000) ***	–1.8331 (0.6881)	–34.9670 (0.0000) ***	I(1)
Period II (After Shari'ah-compliant)	Intercept	LCPO	–1.3374 (0.6135)	–4.4966 (0.0002)***	–1.1655 (0.6907)	–22.2149 (0.0000) ***	I(1)
	Intercept	LFCPO	–1.6766 (0.4428)	–4.4761 (0.0002) ***	–2.3320 (0.1622)	–27.3875 (0.0000) ***	I(1)
	Intercept &Trend	LCPO	–1.2822 (0.8910)	–4.6140 (0.0011)***	–1.2123 (0.9063)	–22.1936 (0.0000) ***	I(1)
	Intercept & Trend	LFCPO	–1.8425 (0.6829)	–4.5530 (0.0013) ***	–2.2095 (0.4830)	–27.4141 (0.0000) ***	I(1)

( ) denotes *p*-value, *** significant at 1% level; Diff = difference

Johansen's co-integration test is used to examine whether the variables are co-integrated. Table 3 displays the results from both the Trace and the Max-Eigen tests, which show one co-integrating equation at the 5% level of significance for both periods. This implies that there is a long-term relation between the CPO and FCPO prices.

Table 3
Results of trace and max-eigen statistics tests

	Hypothesised number of co-integrating equations	Eigen value	Trace statistics	Critical value at 5%	Max-eigen statistics	Critical value at 5%
Period I	None	0.1278	87.3838	20.2618 (0.0000)***	87.0912	15.8921 (0.0000)***
	At most 1	0.0036	2.2926	9.1645 (0.7190)	2.2926	9.1645 (0.7190)
Period II	None	0.1345	82.7252	20.2618 (0.0000)***	80.4546	15.8921 (0.0000)***
	At most 1	0.0041	2.2706	9.1645 (0.7235)	2.2706	9.1645 (0.7235)

( ) denotes *p*-values;*** significant at the 1% level

Results of VECM model

Table 4 presents the bivariate VECM results from Equations (3) and (4) for both periods. The price discovery processes appear to differ between the two periods. During period I, the error correction term coefficient (δ_{cpo}) in Equation (3) for CPO is negative and statistically significant at the 1% level. This result means that, when both markets are in disequilibrium, the CPO prices will adjust to reinstate the equilibrium condition. None of the lagged changes in CPO prices and FCPO prices is significant for the CPO equation. As in the FCPO equation, the three-period lagged changes in FCPO prices are statistically significant, and the error term is positive but statistically insignificant.

For period II, the coefficients of the error-terms for both the CPO equation and the FCPO equation are statistically significant at the 1% and 5% levels, respectively. However, the ECT coefficient (δ_{cpo}) in the CPO equation is negative, whereas that in the FCPO equation (δ_{fcpo}) is positive. The magnitude of the CPO's error correction term is also greater than the FCPO's error correction term. This implies that, if the relation between the two markets is perturbed, CPO prices will adjust downward; however, FCPO prices will adjust upward to achieve the equilibrium position in the next period. The results also reveal that, in the CPO equation, the one-period lagged changes in CPO prices as well as one-period lagged changes in the FCPO prices are significant, which is an indication of information flows from both the spot and futures market to the spot market.

Table 4
Estimated results of the bivariate Vector Error Correction Model (VECM) for Period I and II

$$\varDelta CPO_t = \alpha_0 + \delta_{cpo}\, ECT_{t-1} + \sum\nolimits_{j=1}^{p} \alpha_{cpo,j} \Delta CPO_{t-j} + \sum\nolimits_{j=1}^{p} \alpha_{fcpo,j} \Delta FCPO_{t-j} + \varepsilon_{cpo,j} \quad (3)$$

$$\varDelta CPO_t = \alpha_0 + \delta_{cpo}\, ECT_{t-1} + \sum\nolimits_{j=1}^{p} \alpha_{cpo,j} \Delta CPO_{t-j} + \sum\nolimits_{j=1}^{p} \alpha_{fcpo,j} \Delta FCPO_{t-j} + \varepsilon_{cpo,j} \quad (4)$$

	Period I		Period II	
	ΔCPO_t	$\Delta FCPO_t$	ΔCPO_t	$\Delta FCPO_t$
ECT_{t-1}	–0.4439 (–4.2977)***	0.2154 (1.6567)	–0.2610 (–4.5035)***	0.1571 (2.0230)**
$\alpha_0(\beta_0)$	0.0001 (0.4301)	0.0001 (0.2960)	0.0001 (0.7903)	0.0001 (0.6818)
ΔCPO_{t-1}	–0.0589 (–0.6001)	0.1375 (0.5882)	–0.2205 (–3.3498)***	0.0501 (0.5680)
ΔCPO_{t-2}	–0.0908 (–1.01945)	0.0659 (0.5882)	–0.0008 (–0.0153)	–0.0153 (0.9575)
ΔCPO_{t-3}	0.0197 (0.2619)	0.1340 (1.4105)	–	–
ΔCPO_{t-4}	–0.0658 (–1.20535)	–0.0683 (–0.9937)	–	–
$\Delta FCPO_{t-1}$	0.1974 (1.9831)	0.0043 (0.0347)	0.3112 (5.1823)***	0.0233 (0.2897)
$\varDelta FCPO_{t-2}$	0.1330 (1.4986)	0.0316 (0.2835)	0.0775 (1.4821)	–0.0007 (–0.0101)
$\varDelta FCPO_{t-3}$	–0.0753 (–0.9676)	–0.1965 (–2.0058)***	–	–
$\varDelta FCPO_{t-4}$	0.04902 (0.8282)	0.0055 (0.0739)	–	–

( ) denotes *t*-statistics, ***, ** and * represents the level of significance at 1%, 5% and 10%, respectively

As noted in the earlier section, to confirm whether there are long-term and short-term interactions between the two markets, the joint hypotheses on the returns interaction coefficients are estimated. Table 5 displays the results. In period I (Panel A), both null hypotheses on the long-term dependencies and the short-term dependencies for the CPO equation are statistically significant at 1% level. This shows that past lagged FCPO returns Granger-cause CPO returns. In the FCPO equation, the null hypothesis of the cross-effect for short-term dependencies is statistically insignificant, whereas the null hypothesis that the coefficient of ECT term (δ_{fcpo}) is statistically significant but only at 10% level. Since our acceptance level is at 5%; therefore it is concluded that there is undirectional Granger causality from spot return to future return.

Regarding period II (Panel B), based on the results of the joint hypotheses test, the study fails to accept both null hypotheses at the 1% level of significance in the CPO equation. This shows that FCPO returns Granger-cause CPO returns. However, the null hypotheses for cross-effect interaction in the FCPO equation are not statistically significant at 5% level. Bohl et al. (2011) stated that a rejection of at least one of the hypotheses tested is indicative of Granger causality relationship emerging from FCPO to CPO returns. Accordingly, it is concluded there is bidirectional Granger causality between the two markets. In this period, the results imply that the price discovery function of FCPO has gradually become visible.

Table 5
Results of joint null hypotheses on short-term and long-term interactions

Panel A: Period I		Conclusion
ΔCPO_t	$H_0: \alpha_{fcpo,1} = \alpha_{fcpo,2} = ... = \alpha_{fcpo,p} = 0$	Unidirectional
	Chi - square(χ^2): 17.9483(0.0013) ***	
	$H_0: \delta_{cpo} = 0$	CPO ⟷ FCPO
	Chi - square(χ^2): 18.4707(0.0000) ***	
$\Delta FCPO_t$	$H_0: \beta_{fcpo,1} = \beta_{fcpo,2} = ... = \beta_{cpo,p}\ \Delta CPO_{t-j} = 0$	
	Chi - square(χ^2): 5.9945(0.1996) ***	
	$H_0: \delta_{fcpo} = 0$	
	Chi - square(χ^2): 2.7448(0.0076) ***	
Panel B: Period II		Conclusion
ΔCPO_t	$H_0: \alpha_{fcpo,1} = \alpha_{fcpo,2} = ... = \alpha_{fcpo,p} = 0$	Bidirectional
	Chi - square(χ^2): 29.5345(0.0000) ***	
	$H_0: \delta_{cpo} = 0$	FCPO ⟷ CPO

(continue on next page)

Table 5 (*continued*)

Panel B: Period I		Conclusion
$\Delta FCPO_t$	$H_0 = \beta_{cpo,1} = \beta_{cpo,2} = ... = \beta_{cpo,p}\ \Delta CPO_{t-j} = 0$	
	Chi-square (χ^2): 0.9654 (0.6171)	
	$H_0 : \delta_{fcpo} = 0$	
	Chi-square (χ^2): 4.0928 (0.0431)**	

( ) denotes *t*-statistics, ***, ** and * represents the level of significance at 1%, 5% and 10%, respectively.

CONCLUSIONS

Although previous studies have analysed the price discovery processes between the FCPO and its spot market, relatively few studies have sought to investigate the price discovery contributions between the two markets before and after being Shari'ah-compliant. Hence, this study attempts to fill this gap. Empirical results found that, prior to being considered as Shari'ah-compliant, both markets played the price discovery function. Because the estimated ECT coefficient is solely significant for the CPO equation, this suggests the role of the spot market to make necessary adjustments when these two markets deviate. The results of the short-term interaction tests imply a bidirectional Granger causality relation between the two markets.

After being declared Shari'ah-compliant (Period II), the price discovery role of the FCPO futures market appears to be increasingly important. The error correction terms in both markets are significant, implying that the FCPO also plays a part in ensuring that long-term equilibrium is preserved if disequilibrium occurs. Interactions tests also reveal that FCPO Granger causes the CPO market. Combined, the estimated results in Period II suggest that the price discovery contribution of the crude palm oil futures market has become more prominent after being classified as Shari'ah-compliant.

A plausible reason for the increasing price discovery processes of the FCPO futures market in period II could be linked to the change in the demography of market participants. Since its inception, the derivative market is primarily dominated by local and domestic retail investors. Possibly, when the FCPO contracts became Shari'ah-compliant, the market gradually began to attract new foreign institutional investors; particularly those who seek Shari'ah-compliant derivatives to manage their risk. The involvement of foreign institutional trading could increase the informational contribution of the FCPO market. Table 6 displays the trading demography of FCPO contracts, in which the percentage of foreign institutional traders has increased from 19% in 2009 to 30% in 2012. Bohl, Salm and Schuppli (2011) observed similar findings when they attempted to relate the price discovery of the Polish WIG20 index futures markets to the changing investor structure.

Table 6
Trading demography of FCPO contract

	2008	2009	2010	2011	2012
Local	27%	37%	34%	34%	37%
Domestic Retail	38%	27%	26%	13%	20%
Domestic Institution	15%	17%	15%	14%	12%
Foreign Institution	20%	19%	25%	28%	30%
Foreign Retail	–	–	–	1%	1%
Total	100%	100%	100%	100%	100%

Source. Bursa Malaysia (2012)

The price discovery function of the futures market is affected when the market is inefficient because of excessive speculation and a poor regulatory framework (Salvadi & Ramasundaram, 2008), which could cause a moral hazard. If the futures market is efficient, prices from the FCPO market cannot provide information regarding the anticipated underlying spot market demand that is useful for production decisions; in addition, the prices are unable to influence CPO prices. Being a Shari'ah compliant product, the SAC has eliminated the issues of speculation, *gharar, maysir, bay' ma'dum* and *'iwadah* from FCPO trading. In addition, the FCPO market is now more regulated and is being closely monitored by not only the Securities Commission but also the Shari'ah Advisory Council (SAC) to ensure that futures trading is within the Shari'ah tenets. The need for the FCPO product to fulfil the Shari'ah requirements as well as monitoring could curtail the excessive speculation that is associated with the futures market and minimise the moral hazard. Ultimately, this product will boost the confidence of market participants to trade in the FCPO market, which could increase information flows from FCPO to CPO and hence intensify the price discovery role of the FCPO market as revealed in the results of this study.

This study contributes to the existing literature on the price discovery role between the FCPO and CPO markets. In addition, the increasing price discovery role of the FCPO would enable traders to use futures prices as a price reference in making appropriate hedging decisions (Sehgal et al., 2013). Avenues for future study can be extended to investigate whether the investor structure affects the price discovery function of the FCPO market and thus could support this study's findings.

REFERENCES

Ahmad, N. (2005). *Volatility behavior patterns and information transmission mechanism: Evidence from Malaysian futures markets*. Unpublished doctoral dissertation, Universiti Sains Malaysia, Pulau Pinang, Malaysia.

Bohl, M. T., Salm, C. A., & Schuppli, M. (2011). Price discovery and investor structure in stock index futures. *Journal of Futures Markets*, *31*, 282–306.

Brooks, C., Rew, A. G., & Ritson, S. (2001). A trading strategy based on the lead-lag relationship between the spot index and futures contract for the FTSE 100. *International Journal of Forecasting*, *17*, 31–44.

Bursa Malaysia. (2012). *2012 annual report.* Retrieved from http://bursa.listedcompany.com/misc/ar2012/html/index.php?page=Independent%20Auditors%20Report

Chan, K. (1992). A further analysis of the lead-lag relationship between the cash markets and the index futures market. *Review of Financial Studies, 5,* 123–152.

Eswaran, S. R. & Ramasundaram, P. (2008). Whether the commodity futures in agriculture are efficient in price discovery? An econometric analysis. *Agricultural Economics Research Review*, *21*, 337–344.

Fabio, M., & Philip, G. (2004). *Price discovery in thinly traded markets: Cash and futures relationships in Brazilian agricultural futures markets.* Paper presented at the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, St. Louis, Missouri, 19–20 April.

Garbade, K. D., & Silber, W. L. (1983). Dominant satellite relationship between live cattle cash and futures markets. *Journal of Futures Markets*, *10*(2), 123–136.

Hernandez, M., & Torero, M. (2010). *Examining the dynamic relationship between spot and future prices of agricultural commodities*, Discussion Paper No. 00988, International Food Policy Research Institute.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, 12,* 107–112.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration – with application to the demand of money. *Oxford Bulletin of Economics and Statistics*, *52*(2), 169–210.

Kuiper W. E., Pennnings, J. M. E., & Meulenberg, M. T. G. (2002). Identification by full adjustment: Evidence from the relationship between futures and spots prices. *European Review of Agricultural Economics*, *29*, 67–84.

Mohan S., & Love J. (2004). Coffee futures: Role in reducing coffee producers' price risk. *Journal of International Development, 16*, 983–1002.

Naziman, A. R., Nawi, A. S., & Naziman, Y. H. (2012). The price discovery of the Malaysian crude palm oil futures markets. *Journal of Applied Finance and Banking*, *2*, 25–47.

Quan J. (1992). Two-step testing procedure for price-discovery role of futures prices. *Journal of Futures Markets*, *12*, 139–149.

Salvadi, E. R., & Ramsundaram, P. (2008). Whether commodity futures market in agriculture is efficient in price discovery? An econometric analysis. *Agricultural Economics Research Review*, *21*, 337–344.

Schroeder, T. C., & Goodwin, B. K. (1991). Price discovery and cointegration for live hogs. *Journal of Futures Markets*, *11*, 685–696.

Sehgal, S., Rajput, N., & Desiting, F. (2013). Price discovery and volatility spillover: evidence from indian commodity markets. *International Journal of Business and Finance Research*, *7*(3), 57–75.

Sendhil, R., Kar, A., Mathur, V. C., & Jha, G. K. (2013). Price discovery, transmission and volatility: Evidence from agricultural commodity futures. *Agricultural Economic Research Review*, *26*(1), 41–45.

Tazli, N. (2001). *Empirical test on mispricing and market efficiency in the commodity futures markets*. Unpublished Master Thesis, Universiti Sains Malaysia, Pulau Pinang, Malaysia.

Viljoen, C. (2004). *Price discovery, price behaviour, and efficiency of selected grain commodities traded on the agricultural products division of the JSE securities exchange.* Unpublished doctoral dissertation, Rhodes University, South Africa.

Yang, J., Bessler, D. A., & Leatham, D. J. (2001). Asset storability and price discovery in commodity futures markets: A new look, *Journal of Futures Markets, 21*, 279–300.

Yang, J., & Leatham, D. J. (1999). Price discovery in wheat futures markets. *Journal of Agricultural and Applied Economics*, *31*, 359–370.