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The Empirical Analysis on Prices of the Malaysian Crude Palm oil Futures Market

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Abstract

Futures markets play an important role in the price discovery and forward pricing of agricultural commodities. The analysis of this study has mainly focused on the empirical test of the effect of production, stock and export variables on the prices of the Malaysian Crude Palm oil futures market. For the empirical work, correlation analysis, multiple regression and recent econometric analysis were conducted to determine the price relationships of the Malaysian Crude Palm oil futures markets with the production, stock and export variables. Order of integration for all the variables was checked using Augmented Dickey-Fuller and Phillips-Perron tests of unit root. The Johansen approach was used to test cointegration in multivariate system that involved long run and short run estimations. The Vector Error Correction Model was used to test for causal relationships. The empirical evidence obtained from the study shows there exist a significant long run and short run relationships between the cash and future prices of the Malaysian Crude Palm oil futures market with the production, stock and export variables. The results of the causality test also shows that there is a strong relationship between the Malaysian Crude Palm oil futures market with the production, stock and export variables This mean that any information flow regarding the price movement of the Malaysian Crude Palm oil futures market will affect the production, stock and export variables and vice-versa.

Key Words: *Oil, Future Markets, Correlation, and Empirical Evidence.*

Introduction

Palm oil is currently the second most important vegetable oil in the world oils and facts market, accounting for 14.35% of world production of seventeen major oils and facts, ranking only behind soyabean oil, which contributed 20.23% of world output. In terms of world exports of oils and facts, palm oil is currently leading with a market share of 32% while soyabean oil has a share of 16.2%. Palm oil and palm kernel oil have become the production growth leaders in the oils and facts complex since the early seventies (Mielke, 1991).
Although palm oil has been dominating the world export market, palm oil futures are not as active as the Chicago Board of Trade (CBOT) soyabean oil futures where volume is about 23 times the production of soyabean oil in the United States of America. The volume of crude palm oil (CPO) futures on Malaysian Derivatives Exchange (MDEX) market is slightly more than the production of the Malaysia palm oil.

As the price of a palm oil is dependent on its consumption and the level of the stock, it is important to analyze these two variables simultaneously. The world stock/usage of palm oil usually higher than that of Malaysia, not only because of the large stocks in transshipment centers such as Singapore and Rotterdam, but also because some consuming countries prefer to keep relatively large stocks (Mielke, 1991). It has become a common practice among major industrialized countries to use buffer stocks to stabilize the prices of agricultural commodities in the world market [Sarasorro (1988)], including palm oil.
Studies in agricultural economics have shown that the fluctuation of commodities prices is significant and persistent (Wilkinson (1976), Brandt (1985)). According to Mad Nasir and Fatimah (1992), two of the salient features of agricultural commodities are the volatility and variability in prices.

As far as volatility and variability of prices are concerned, the impact is more remarkable in the vegetable oils and fats market, notably palm oil, which is the most widely consumed edible oil in the world. If producers are in fact using futures prices as expected output prices when allocating resources, an assessment of the quality of the prices is important. Thus studies on the efficiency of futures markets have important implications on the issue of whether economics resources are being optimally allocated in the agricultural sector.

It is particularly important to assess the Malaysian Derivatives Exchange (MDEX) market since it is the only futures market for palm oil and producers and other market intermediaries use it as a price indicator. The existence of pricing efficiency in the markets will assume that futures prices move in lines with cash prices in the long-term and that they do not deviate from cash prices for long periods of time.

The major objective of this studies is to examine empirically the price relationships and the direction of information flow between the Malaysian crude palm oil futures market and the production, stock, export variables.

Review of Related Literature

Initial empirical research on the theory of efficient markets was concerned with testing the randomness of futures price series. This followed from Working (1958) who emphasized in his Theory of Anticipatory Prices that prices are formed through human decision-making based on available information about supply and demand and past conditions on the market. The continuous flow of the many different kinds of information into the market caused frequent changers, which might be random. Price fluctuations were, therefore, implied to be due to expert appraisal of changing economics information and thus price quotations in a futures market exhibited a random walk.

There has been substantial empirical work, which has investigated the efficiency issue by testing the random walk model. Some of this work rejected the random walk hypothesis, for example, Stevenson and Bear (1970), Cargill and Rausser (1975), and Barnhart (1984); other studies accepted the hypothesis, for example, Larson (1960). Kamara (1982) noted that most of these studies found some evidence of serial correlation in futures prices in the short-run, but the evidence is not strong, and the result depend heavily on the technique as well as the sample period of the studies.

Another definition is that the efficiency of a market refers to the performance of its functions in facilitating transactions and improving on the terms of transactions (Burns, 1983). According to this definition, the efficiency of a market can be related to three aspects: transaction costs, liquidity and pricing efficiency. Pricing efficiency reflects the degree to which an asset's price reflects to demand and supply conditions in a market. Pricing efficiency is defined to include two elements: the degree to which an asset's price is determined by competitive prices and the speed with which an asset's price reflects changes in information.

According to Hawawini (1993), there are two kinds of efficiency: informational efficiency and operational efficiency. Informational efficiency refers to the performance of a market as an information processor and a price setter whereas operational efficiency refers to the performance of a market as an exchange system. If the market is informationally efficient, then it means that the market is able to process information and the securities prices in that market reflect all that is known about the firms. A market can be operationally efficient in the sense that it offers an inexpensive and reliable trading mechanism. It can be stated that the informational and operational efficiency is related; poor operational efficiency may delay the adjustment of prices to new information and prevent them from reaching their equilibrium value. As a consequence, in an efficient market, securities will be traded at price, which is close to their true value, and investors will be unable systematically to earn above normal profits.

Mad Nasir, Zainalabidin and Fatimah (1989) compared the forecasting performance of crude palm oil (CPO) futures on the KLCE to forecast generated from several other models, i.e., moving average, exponential smoothing, Box-Jenkins and econometric models. They concluded that the futures market does not show any significant inefficiency. Using the RMSE, RMPE and U-statistic to compare the performance of the various models, they found that the futures market fared fairly well in comparison with other models.

Only the Box-Jenkins model outperformed the futures market, but the main weakness of this method was its inability to provide an economic explanation for its forecasts.

While the semi-strong approach provided a performance norm with which to compare futures prices, finding a model that generates more accurate forecasts than the futures price may not be sufficient to establish market inefficiency. As argued by Rausser and Carter (1983), it is important to consider the effects of risk and information costs on market information. The risk-adjusted profits from using any particular model should be compared to the cost of its construction and application. Even if a particular model has a lower MSE than the futures market and there is a zero information cost, market Inefficiency is not established unless an agent can earn abnormal profits.

As cited by Liew and Brooks (1995) that Kok and Goh's (1994) study the random walk hypothesis in the Kuala Lumpur crude palm oil futures market, their results fail to find strong evidence against the random walk hypothesis.Mohammad Haji Alias and Jamal Othman (1997) used bivariate cointegration technique to determine the long-run relationship of palm oil price and the soybean oil price. Using quarterly data from 1980 through 1995 and Dickey-Fuller and augmented Dickey-Fuller to test for stationarity. The results showed that the time series on palm oil and soybean oil prices are cointegrated and each time series is non-stationary.

A.D Owen et al (1997) examine five major international traded oils: coconut, palm, palm kernel, soybean and sunflower to investigate the price interrelationships in the vegetable and tropical oils market whether they are cointegrated or not. Using monthly data from 1971 through 1993, a vector autoregressive approach to test for cointegration and augmented Dickey-Fuller and Phillips-Perron to test for unit root. The results showed that the relationships were not found to be strong enough to label them as cointegrated series.

Mukesh Chaudhry and Rohan Christie-David (1998) investigates the long-run stochastic properties of informationally linked futures contracts in diverge groups such as soft commodities, grain and oil seeds, livestock, precious metals, energy, foreign currencies, and interest-rate instruments. Using the Phillips-Perron test for unit root and Johansen's test for cointegration to analyse the monthly data covers the period July 1986 through March 1995. The results showed that most futures in the sample exhibit the presence of non-stationarity. The test for cointegration within groups provides strong evidence for soft commodities, precious metals, energy, and short-term interest rates. Weaker evidence for grains and oil seeds and livestock while foreign currency and long-term interest rate futures show evidence of segmentation.

The Multivariate Cointegration Approach

The Johansen approach to testing for cointegration in multivariate system involves the following steps:

1. Testing the order of integration of all the variables that will enter the multivariate model by applying unit root test.
2. Choosing the suitable lag-length of each of the equations in VECM ($\Delta \mathbf{z}_{t-1}$) to ensure that the residuals are Gaussian (there is no problem of auto-correlation, non-normality, etc).
3. Testing for reduced rank in order to determine the number of cointegrating equations in the system.
4. Testing for weak exogeneity
5. Conduct test involving restrictions on α and β

There are several unit root tests available in the literature to determine the order of integration of the individual series. However, the most widely used methods are Augmented Dickey Fuller test (ADF) which was proposed by Said and Dickey (1984) and Phillips and Perron test (PP) by Phillips and Perron (1988). In this study both the ADF and the PP are utilised in the analysis since Schwert (1987) has noted that the ADF statistics may reject the null hypothesis of unit root too often in the presence of the first order moving average process. However, recently Campbell and Perron (1991) have also shown that the ADF class of statistics has better small-sample properties.

Once we determine the order of integration of each series, the next step is to test for cointegration relationships among the series.The Johansen-Juselius is based on maximum-likelihood estimation is designed to test a number of linearly independent cointegrating vectors existing among the variables. The model also utilises the likelihood ratio test statistic that has an exact limiting distribution, which can be used to estimate cointegration relationships among a group of two or more variables. Besides it can estimate a number of linearly independent vectors, Perman (1991) pointed out that the advantage of Johansen-Juselius approach over E-G approach is that the procedure allows testing for linear restriction on the cointegrating parameters. The test statistic in the Johansen and Juselius also can be compared to known critical values.

The likelihood-ratio test of the null hypothesis is obtained by the trace test defined as;

$$\text{Trace Tests} = -T\sum_{i=r+1}^{p}\ln(1-Q_i^2) \qquad (1)$$

where T is the number of time period available in the data. The null hypothesis for trace test is that whether there are r or less cointegrating vector. The null of r = 0 is test against the general hypothesis of r ≤ 1, …, r ≤ p. Equivalently we can also use the maximal eigenvalue test. The test is that there are r-cointegrating vectors in a set of p variables against r+1. In other words, the null of r = 0 is test against the specific hypothesis of r = 1, …, r = p. It is defined as;

$$\text{Maximal Eigenvalue Tests} = -T\ln(1-Q_{r+1}^2) \qquad (2)$$

The test statistics of the trace and maximum eigenvalues may be compared with the critical values provided by Osterwald-Lenum (1992).

Attaining the long run estimates of the cointegration relationships is only half of the whole process of cointegration in multivariate systems. Estimating the short run model of spot prices and the futures price of Malaysian crude palm oils is another important part of the analysis in order to capture the short run adjustment behaviour of economic variables, which is quite relevant to policy implications. The number of cointegrating vectors, which is revealed from the results of Johansen's tests, will determine the approach of estimating the short run model of spot prices and the futures price of Malaysian crude palm oil futures market. When there is only one cointegrating vector, the short run dynamics of spot prices and the futures price of Malaysian crude palm oils functions can be estimated using the (single equation) general to specific procedure. The technique departs from the general autoregressive distributed lag representation with error correction term(s) or EC obtained from the relevant estimated cointegrating vector(s):

$$A(L)\Delta SPT_t = \alpha_0 + B(L)\Delta LPROD_t + C(L)\Delta LSTOCK_t + D(L)\Delta LEXPORT_t + \alpha_1 EC_{t-1}$$

where SPT_t is spot price while *A(L) ... D(L)* are lag polynomials. The equation can be estimated using ordinary least square (OLS) if all of the independent variables are weakly exogenous, however, when one or some of the independent variables are not weakly exogenous, the function needs to be estimated using Instrumental Variables (IV) technique.

Data Used in the Study.

The data in this study consist of the Malaysian crude palm oil, the two variables required are the spot price (SPT) and futures price. The futures price are the futures contract at one month FPM1),two months (FPM2) and three months (FPM3) before maturity. Each futures contract will mature at the 15th of each month and if 15th is a non-market day, the preceding business day is selected. There is only one contract for each month and thus for every month, only one futures contract will mature.

Futures price are collected from MDEX for contracts maturing at each month from Jan 1992 to Dec. 2007, providing a total of 192 observations. Consecutively, the cash (spot) prices totalling 156 observations, with one cash price corresponding to one futures price, are gathered from the same period from MPOB Update

Report. The fundamental factors i.e; the closing stock (STOCK), production (PROD) and export (EXPORT), are gathered from the same period from MPOB Update Report.

Empirical Results

Results of unit root test in level are presented in Table 2. The computed values of statistics in both time periods are all insignificant at the five percent significance level for both ADF and PP tests. The results fail to reject the null hypothesis of unit roots in their level form in the autoregressive representation of the price series, that is, they are all not I(0). Thus, implying that there is no possibility of the series to be stationary around a constant mean or around deterministic linear trend.

Unit root tests on the first difference on all series were also conducted. Table 2 shows the values of statistics for both sub-periods are significant at the one percent level. Indicating the rejection of null hypothesis of the existence of a unit root for each of the price series in their first difference. Thus all the prices series needed to be differenced once in order to achieve stationarity and they are confirmed to be integrated of order one. The standard cointegration model requires that all variables included in the regression must be of the same order of integration.

Table 2 Results of Phillips-Perron and (Augmented) Dickey Fuller Unit Root Tests for Spot and Future Prices of Malaysian Crude Palm Oil Futures Market, Production, Stock, Export

	Phillips-Perron		Aug. Dickey –Fuller	
	Levels	1st diff	Levels	1st. diff
LSPT	- 1.5408	- 10.0254**	- 1.5980	- 5.1102**
LFPM1	- 1.4107	- 9.2629**	- 1.4630	- 4.9597**
LFPM2	-1.3012	-9.1861**	-1.2993	-5.0009**
LFPM3	- 1.2075	- 9.2330**	- 1.1630	-7.5692**
LEXPORT	- 3.3239	- 23.5092**	- 2.4859	- 7.5692**
LPROD	-2.7922	-9.3309**	-2.8498	-8.1670**
LSTOCK	-3.0888	- 9.1018**	- 3.3082	- 6.7378**

Note:
** denotes significant at 1 % level
* indicates significant at 5 % level
[1] Significant at 10 % level

The above Phillips-Perron and Aug. Dickey-Fuller test statistics are compared to the MacKinnon (1991) critical values for rejection of hypothesis of a unit root. Unlike the ADF test, there are no truncation lagged difference terms. Instead of specifying the number of lagged difference terms, the truncation lag for the Newey-West correction is specified, that is, the number of periods of serial correlation to be included. The equation is estimated using ordinary least squares (with the optional inclusion of constant and time trend) and then the t-statistic of the coefficient is corrected for serial correlation in t.

The results of the application of the Johansen technique to the identification of long run relationships between the Spot and Future prices of the Malaysian crude palm oil futures market with the fundamental factors can be seen in Table 3 We assume that there is no deterministic trend in data, no intercept or trend in the cointegrating equation. Result of Johansen's test suggests that one cointegrating vector exists based upon the λ_{max} test at 1 % level (Panel I). The trace statistic suggests rejection of one cointegration vector at 1 % level. The cointegrating vector was estimated with a provision for 10 lags and we found no serious serial correlation and no normality problem with the inclusion of this number of lags (Panel V).

The estimated cointegrating vector has theoretically plausible coefficients (Panel II). The results of tests for weak exogeneity are consistent with the information on the values of alpha (α) or speed of adjustment's coefficients and their respective standard errors in Panel III[1]. The test of weak exogeneity reveals that production appears to be weakly exogeneous at a marginal level of significant at 78.71% (Panel VI). Imposing restrictions on the independent variables do not seem to be valid. Thus our restricted cointegrating equation remains similar to the unrestricted one. The following is the estimated long run Spot and Future prices of the Malaysian crude palm oil futures market function;

Table 3 *Results of Johansen Procedure for Cash and Future Prices of Malaysian crude palm oil future prices, Export,Production and Stock,VAR with 10 lags. Sample period: 1992 – 2007 (192 observations)*

I. Eigenvalues: 0.400 0.204 0.157 0.108 0.061 0.018 0.0004

Test statistics for the number of co-integrating vectors:

	λmax			**Trace**		
Ho:rank= r	T	T-nk	95%	T	T-nk	95%
r = 0	74.63**	38.85	45.3	162**	84.33	124.2
r ≤ 1	33.48	17.43	39.4	87.37	45.48	94.2
r ≤ 2	25.10	13.07	33.5	53.89	28.05	68.5
r ≤ 3	16.82	8.76	27.1	28.78	14.98	47.2
r ≤ 4	9.18	4.78	21.0	11.96	6.23	29.7
r ≤ 5	2.73	1.42	14.1	2.78	1.45	15.4
r ≤ 6	0.06	0.03	3.8	0.06	0.03	3.8

II. ESTIMATED CO-INTEGRATING VECTOR

LSPT	LFPM1	LFPM2	LFPM3	LEXPORT	LPROD	LSTOCK
1.0000	3.9524	-7.6125	2.9680	-6.7545	5.1514	0.6152

III ESTIMATED ADJUSTMENT MATRIX

LSPT	LFPM1	LFPM2	LFPM3	LEXPORT	LPROD	LSTOCK
-0.1200	-0.1249	-0.1133	-0.0937	0.1904	0.0176	0.2122
{0.0681}	{0.0695}	{0.0669}	{0.0658}	{0.0873}	{0.0926}	{0.1053}

IV. RESTRICTED CO-INTEGRATING VECTOR

LSPT	LFPM1	LFPM2	LFPM3	LEXPORT	LPROD	LSTOCK
1.0000	3.5376	-6.7158	2.4699	-6.5352	4.9864	0.5999

V. TEST FOR APPROPRIATE LAG LENGTH (10)

Serial CORRELATION:	LSPT	LFPM1	LFPM2	LFPM3	LEXPORT	LPROD	LSTOCK
$\chi^2(7)$	10.77[0.14]	5.70[0.57]	7.58[0.37]	10.16[0.18]	11.00[0.13]	34.79[0.00]	14.50[0.04]
F(7,98)	0.77[0.61]	0.39[0.90]	0.53[0.81]	0.73[0.65]	0.79[0.59]	3.04[0.00]	1.07[0.39]
Normality:							
$\chi^2(2)$	0.73[0.69]	0.53[0.77]	0.95[0.62]	1.31[0.52]	1.56[0.45]	2.83[0.24]	5.63[0.06]

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[1] The t-value of the alpha (speed of adjustment) coefficient calculated as a ratio of the coefficient over the standard error can be used as an initial indicator whether an independent variable is weakly exogenous or not. Lower t-value is normally associated with the independent variable being weakly exogenous and vice-versa.

ARCH $\chi^2(7)$
2.53[0.92] 1.52[0.98] 1.18[0.99] 2.78[0.90] 3.42[0.84] 8.73[0.27] 8.26[0.31]
ARCH (7,61)
0.16[0.99] 0.09[0.99] 0.08[0.99] 0.17[0.98] 0.21[0.97] 0.58[0.76] 0.55[0.79]

1. EXOGENEITY TESTS (Lprod WEAKLY EXOGENOUS)

Ho: $\alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 0$	$\chi^2_{0.05}$ with 5 d.f. = 48.856 [0.0000]**
Ho: $\alpha_2 = 0$	$\chi^2_{0.05}$ with 1 d.f. = 5.419 [0.0019]**
Ho: $\alpha_3 = 0$	$\chi^2_{0.05}$ with 1 d.f. = 4.896 [0.0269]*
Ho: $\alpha_4 = 0$	$\chi^2_{0.05}$ with 1 d.f. = 9.55 [0.0020]*
Ho: $\alpha_5 = 0$	$\chi^2_{0.05}$ with 1 d.f. = 0.072[0.7871]
Ho: $\alpha_6 = 0$	$\chi^2_{0.05}$ with 1 d.f. = 6.902[0.0080]**
Note:	

** denotes significant at 1 % level.
*indicates significant at 5 % level.
Figures in square parentheses [ ] refer to marginal significance level.
Figures in { } refer to standard errors of alpha's (speed of adjustment) coefficients.

$LSPT_t$ = -3.9524$LFPM1_t$ + 7.6125$LFPM2_t$ - 2.9680$LFPM3_t$ + 6.7545$LEXPORT_t$ - 5.1514$LPROD_t$ - 0.6152$LSTOCK_t$

The above equation indicates that future prices of one and three months are negatively impact with estimated elasticities of -3.9524and –2.9680 respectively. It is also shown that in the long run is negatively influenced the production and stock estimated elasticities of –5.1514 and –0.6152 respectively. On the other hand, two-month future price and export shows a positive impact with estimated elasticities of 7.6125 and 6.7545 respectively.

Since the outcome of Johansen's test shows that there is only one cointegrating vector, we estimate the short run model using the single equation generalized unrestricted model (GUM) applying the instrumental variable (IV) technique. The short run parsimonious Spot and Future prices of the Malaysian crude palm oil futures with the fundamental factors function can be seen in Table 4. Based upon the estimated model, future price two-month yields negative impact with an estimated elasticity of –3.045 while future price one-month and production yields positive impact with an estimated elasticities of 3.889 and 0.073 respectively.

Estimate of attached error correction term indicates that the speed of adjustment to long run changes are moderate (-0.385) is significant at 1 % level. Despite the significant reduction in the parameters (from 79 to 31 variables) our final specifications still maintain superiority over the initial largely parameterized model in terms of standard error of regression and explanatory power. Generally, the estimated coefficients are significant and the estimated equations could pass the battery of diagnostic tests for normality of residuals, tests for functional form misspecifications and joint significance of all the explanatory variables except for autocorrelation, autoregressive conditional heteroscedasticity (ARCH test).

This implies that there is a strong long-run relationship between the spot and the futures prices of the Malaysian crude palm oil futures market and the production, stock and export variables for the period under investigation. In other words, the price series are cointegrated. These implies that the Malaysian crude palm futures market are inefficient in relation to the production, stock and export variables.

The results also support the earlier findings of Mielke (1991) and Mad.Nasir and Fatimah (1992) that there are relationship between prices of palm oil with the level of stock, production and export.

Table 4. Results of Short Run Reduced Form GUM -TSLS for Cash and Future Price of Malaysian Crude Palm Oil Future Prices, Export, Production and Stock .

D(LSPT) = -0.385ECM(-1)+ 3.889 D(LFPM 1) - 3.045 D(LFPM 2) + 0.073 D(LPROD) – 0.211D(LSPT(-1)) - 0.207 D(LSPT(-6)) + 1.900 D(LFPM 1(-1)) + 0.879 D(LFPM 1(-2)) + 1.877D(LFPM 1(-4)) + 2.619D(LFPM 1(-5)) + 1.126D(LFPM 1(-6)) – 3.533D(LFPM 2(-1)) - 0.879D(LFPM 2(-2)) - 0.107D(LFPM 2(-3)) – 3.273D(LFPM 2(-4)) – 5.629D(LFPM 2(-5)) – 2.665D(LFPM 2(-6)) + 1.910D(LFPM 3(-1)) + 1.357 D(LFPM 3(-4)) + 2.872 D(LFPM 3(-5)) + 1.813 D(LFPM 3(-6)) + 0.113 D(LEXPORT(-1)) + 0.104 D(LEXPORT(-2)) - 0.039 D(LEXPORT(-4)) – 0.099 D(LPROD(-1)) – 0.095 D(LPROD(-2)) + 0.049 D(LPROD(-8)) – 0.126 D(LSTOCK(-2)) – 0.113 D(LSTOCK(-3)) – 0.098 D(LSTOCK(-6)) – 0.048 D(LSTOCK(-7))

II.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECM(-1)	-0.385808	0.095003	-4.061005**	0.0001
D(LFPM1)	3.889347	1.336427	2.910258**	0.0044
D(LFPM2)	-3.045290	1.354677	-2.247983*	0.0265
D(LPROD)	0.073060	0.031598	2.312165*	0.0226
D(LSPT(-1))	-0.211242	0.108996	-1.938068	0.0551
D(LSPT(-6))	-0.207845	0.090280	-2.302241*	0.0232
D(LFPM1(-1))	1.900033	0.532258	3.569760**	0.0005
D(LFPM1(-2))	0.879126	0.352552	2.493608*	0.0141
D(LFPM1(-4))	1.877658	0.673048	2.789784**	0.0062
D(LFPM1(-5))	2.619017	0.843943	3.103309**	0.0024
D(LFPM1(-6))	1.126127	0.522586	2.154913*	0.0333
D(LFPM2(-1))	-3.533672	1.283539	-2.753070**	0.0069
D(LFPM2(-2))	-0.879546	0.369848	-2.378130*	0.0191
D(LFPM2(-3))	-0.107432	0.043166	-2.488803*	0.0143
D(LFPM2(-4))	-3.273343	1.231964	-2.657011**	0.0090
D(LFPM2(-5))	-5.629932	1.697987	-3.315652**	0.0012
D(LFPM2(-6))	-2.665181	1.033558	-2.578647*	0.0112
D(LFPM3(-1))	1.910345	0.797028	2.396834*	0.0182
D(LFPM3(-4))	1.357421	0.617627	2.197802*	0.0300
D(LFPM3(-5))	2.872779	0.865118	3.320678**	0.0012
D(LFPM3(-6))	1.813121	0.604783	2.997969**	0.0033
D(LEXPORT(-1))	0.113656	0.033574	3.385262**	0.0010
D(LEXPORT(-2))	0.104164	0.030809	3.380960**	0.0010
D(LEXPORT(-4))	-0.039015	0.021017	-1.856377	0.0660
D(LPROD(-1)	-0.099369	0.033381	-2.976758**	0.0036
D(LPROD(-2))	-0.095183	0.033569	-2.835492**	0.0054
D(LPROD(-8))	0.049981	0.024673	2.025726*	0.0451
D(LSTOCK(-2))	-0.126665	0.032681	-3.875773**	0.0002
D(LSTOCK(-3))	-0.113050	0.031306	-3.611110**	0.0005
D(LSTOCK(-6))	-0.098851	0.037032	-2.669328**	0.0087
D(LSTOCK(-7))	-0.048660	0.027826	-1.748735	0.0831

Adjusted R-squared	**0.8907**	**S.E. of regression**	**0.0254**
F-statistic	**38.5728****	**Prob(F-statistic)**	**0.0000**

III. Autocorr (Breusch-Godfrey Serial Correlation LM Test):

χ^2 (1) = 143.29 [0.000]** χ^2 (2) = 143.33 [0.000]**
χ^2 (3) = 143.29 [0.000]** χ^2 (4) = 143.30 [0.000]**
F(1) = 8.8415 [0.003]** F(2) = 5.1113 [0.007]**
F(3) = 3.3398 [0.021]* F(4) = 2.7797 [0.030]*

Normality: χ^2 (2) = 1.173 [0.5562]

ARCH: χ^2 (1) = 9.4761 [0.002]** χ^2 (2) = 11.0252 [0.004]**
χ^2 (3) = 11.0587 [0.011]* χ^2 (4) = 10.9390 [0.027]*
F(1) = 10.0076 [0.001]** F(2) = 5.8504 [0.003]**
F(3) = 3.8865 [0.010]* F(4) = 2.8608 [0.0258]*

Functional Form: Number of fitted terms = 1: F-statistics 1.6494 [0.2016]

IV Instruments: C ECM(-1) D(LFPM1(-11)) D(LFPM2(-11)) D(LFPM3) D(LEXPORT(-11)) D(LPROD) D(LSTOCK(-11)) D(LSPT(-1)) D(LSPT(-6)) D(LFPM1(-1)) D(LFPM1(-2)) D(LFPM1(-4)) D(LFPM1(-5)) D(LFPM1(-6)) D(LFPM2(-1)) D(LFPM2(-2)) D(LFPM2(-3)) D(LFPM2(-4)) D(LFPM2(-5))D(LFPM2(-6)) D(LFPM3(-1)) D(LFPM3(-4)) D(LFPM3(-5)) D(LFPM3(-6)) D(LEXPORT(-1)) D(LEXPORT(-2)) D(LEXPORT(-4)) D(LPROD(-1)) D(LPROD(-2)) D(LPROD(-8)) D(LSTOCK(-2)) D(LSTOCK(-3)) D(LSTOCK(-5)) D(LSTOCK(-6)) D(LSTOCK(-7)) D(LSTOCK(-8))

V. INFORMATION ON THE FULL UNREDUCED MODEL: (79 parameters)

Adjusted R-squared	0.8340	S.E. of regression	0.0313
F-statistic	11.5810**	Prob(F-statistic)	0.0000

Note:
** denotes significant at 1 % level.
* denotes significant at 5 % level.
Figures in square parentheses [ ] refer to marginal significance level.

To examine the nature of the direction of information flow and the lead-lag relationship between spot and future prices of the Malaysian crude palm oil futures market with the production, stock and export variables, the Granger causality and vector error correction model (VECM), are used.

NOTE: All variables are in first differences (denoted by Δ). VECM was estimated including an optimally determined criteria [Akaike's FPE]. **, and * indicates significance at the 1percent and 5 percent level.

The VECM results in Table 4, shows that, there is evidence of one cointegrating vectors that signal one ECTs embedded in the system. Secondly, short-run channels of Granger-causality is statistically significant at 5 percent in the price series.

These suggest, there is a causal relationship from the spot and future prices with the fundamental factors. Thirdly, we find that there is a bidirectional flow of information from spot to future prices (one-month, two-months and three-months) and also a unidirectional flow of information from spot price to export variables. Meanwhile, we can see that there is a bidirectional flow of information from one-month and two-month future prices with the production variables and a unidirectional flow of information from production to spot prices. On the other hand, we can see that there is a unidirectional flow of information from production to stock variables and export to production variables.

Table 4. Causality Results Based on Vector Error-Correction Model (VECM) on Cash and Future Prices of Malaysian Crude Palm Oil Future Prices, Production, Export and Stock. 1992-2007

Dep. Variable	LSPT	LFPM1	LFPM2	LFPM3	LPROD	LEXPORT	LSTOCK	$ECT[_{e1,t-1}]$	A- R^2	SE
	t-statistics									
LSPT	-	-2.4324*	-2.0685*	2.5162*	-2.1729*	0.3698	1.0319	-3.4664**	0.3006	0.068
LFPM1	-2.5041*	-	-1.5985	2.2227*	-2.3756*	0.7688	0.7819	-2.4598*	0.1698	0.073
LFPM2	-2.4326*	1.6092	-	2.5439*	-2.1002*	0.9073	0.6382	-1.8952	0.1582	0.072
LFPM3	-2.2072*	1.8129	-2.1081*	-	-1.5726	0.6784	0.7523	-1.6638	0.1204	0.071
LPROD	-0.6363	2.1123*	-2.9653**	-3.8691**	-	-3.8691**	0.7676	-3.6544**	0.2003	0.117
LEXPORT	2.2248*	-0.6576	-0.1757	0.1082	0.5088	-	-0.2367	3.3440**	0.3259	0.103
lSTOCK	-1.3137	-1.7125	2.4896*	0.9457	3.5318**	0.9457	-	2.8513**	0.1990	0.108

It is conclude from the evidence that the cash and future prices of the Malaysian crude palm oil futures market has a causal relationship with the export, production and stock level variables.

Concluding Remarks

The study also proved that the spot prices of the Malaysian crude palm oil market has a stable long-run and short-run relationships with the production, stock and export from the results of Johansen's cointegration and vector error-correction model. This indicates that the production, stock level and export variables plays an important role in influencing the prices of the crude palm oil. These results uphold the previous studies that production; stock level and export variables do influence the prices of the Malaysian crude palm oil futures market and this indicates the existence of inefficient. The study of market efficiency of agricultural futures market has important implications for commodities exchange, policy makers, traders and producers. The most important implication is that a good price transmission system is essential to ensure that future prices do not diverge from fundamentals.

The futures market has to be closely related to actual demand and supply conditions in order for futures prices to be good indicators for the cash market. Therefore the government should take great care on the policy of replanting of palm oil trees, so that the production of crude palm oil can be enhance to reflect the price of the crude palm oil. Stock level of palm oil should be maintained in order the supply of palm oil to the market are at a consistent to the needs of the market so that it can be justified to the demand in order to maintained the price of crude palm oils.

Being the main producers of the crude palm oils, export of the goods should be monitors so that the stability of the prices can achieved through quotas and negotiations among producing counties like Indonesia, South African countries etc. The commodities exchange should be aware the signals from the production output, stock level and export numbers which can cause an effect on the spot prices of the crude palm oils. Any fluctuations on these variables, thus has to be monitor in order to maintain the market efficiency of the commodities.

The potential uses of these findings are numerous. Hedgers may benefit from this information when deciding upon the appropriate futures contract to be used. They should be aware that any information about the supply conditions of the crude palm oils will have an effect on spot prices, which make it more concern in identifying the appropriate tools to analyse it. The cointegration results imply that it may be possible to hedge whether in the long term or short term in the Malaysian crude palm oil futures market in order to reduce their risks. Investors also have to realise that by hedging in the futures market can benefit them not only reduce losses but can diversify the risk to it. On the other hand, the causal relationships discovered in the studies may be useful to both traders and speculators in using their arbitrage opportunities between the cash (spot) and futures contracts.

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