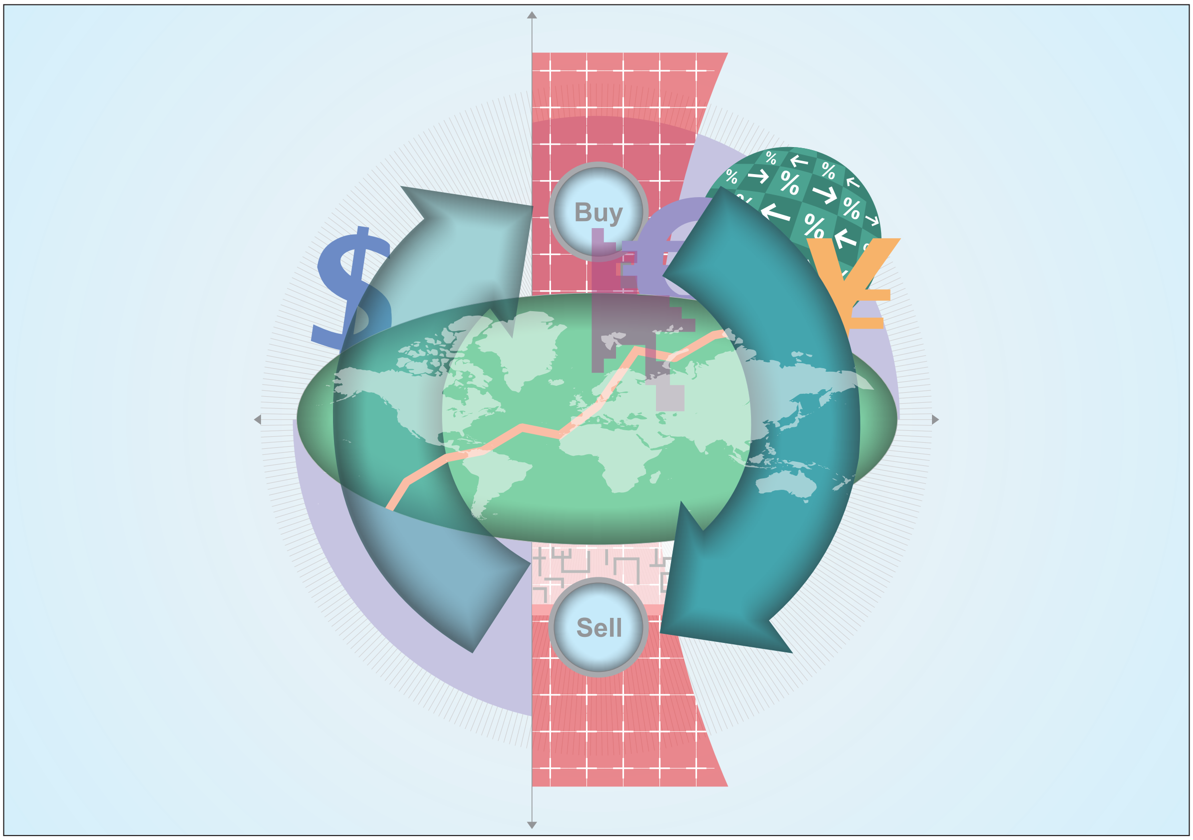


The International Journal of Applied Economics & Finance

ISSN 1991-0886

science alert

ANSInet
an open access publisher
http://ansinet.com

The International Journal of Applied Economics and Finance 7 (1): 23-36, 2013
ISSN 1991-0886 / DOI: 10.3923/ijaef.2013.23.36

Price Forecasting Methodology of the Malaysian Palm Oil Market

[1]Aye Aye Khin, [2]Zainalabidin Mohamed, [1]Chinnasamy Agamudai Nambhi Malarvizhi and [1]Seethaletchumy Thambiah

[1]Faculty of Management, Multimedia University, Persiaran Multimedia, 63100 Cyberjaya, Selangor, Malaysia

[2]Department of Agribusiness and Information Systems, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor DE, Malaysia

Corresponding Author: Aye Aye Khin, Faculty of Management, Multimedia University, Persiaran Multimedia, 63100, Cyberjaya, Selangor, Malaysia

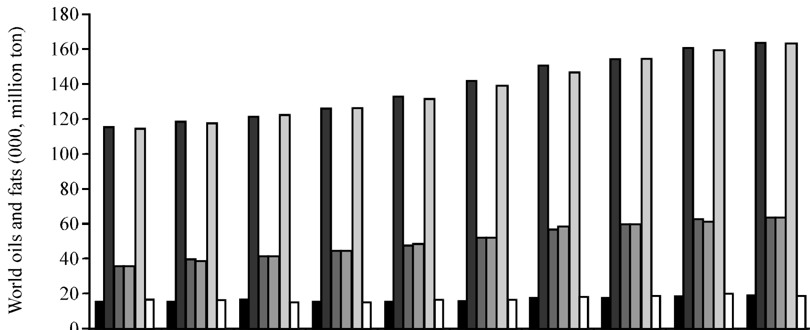
ABSTRACT

Malaysia is the second largest producer of palm oil in the world and the price of palm oil depends so much on the world oils and fat market. The study presents several numbers of econometric models that are being used to forecast a short term ex-ante spot palm oil price in future prices of the Malaysian palm oil market from July 2011 to December 2011. These models include Vector Error Correction Method (VECM) equation econometric model, Multivariate Autoregressive-Moving-Average (MARMA) model (composite model) and the univariate model of Autoregressive-Integrated Moving Average (ARIMA) (Box-Jenkins model). The objective is to determine the forecasting model in terms of the comparative forecasting models' accuracy of the monthly spot palm oil price. Monthly data of palm oil price from January 1980 to June 2011 were being used as an estimation periods to forecast palm oil spot price from July 2011 to December 2011. Comparative forecasting models accuracy between VECM equation econometric model, MARMA model and univariate model of ARIMA were made in terms of their estimation accuracy based on RMSE, MAE, RMPE and (U-Theil) criteria. The results revealed that MARMA model (composite model) is more accurate and efficient measured in terms of its statistical criteria than VECM equation econometric model and ARIMA model (Box-Jenkins model) in forecasting the spot palm oil price of the Malaysian palm oil market.

Key words: Ex-ante forecasts, VECM, MARMA, univariate model of ARIMA, spot palm oil price

INTRODUCTION

Palm oil plays a dominant role in the world vegetable oils export market (MPOC, 2011). Figure 1 shows the world oil and fats' opening stocks, production, imports, exports, disappearance and closing stocks. Similar pattern can also be seen for world palm oil production which has increased to 45.1 million ton in 2009-2010 as compared to 21.9 million ton in 2000-2001. This consequently increased the ranking of palm oil as number one world oils and fats production (MPOB, 2009-2011). The world palm oil consumption also has increased to 45.2 million ton in 2009-2010 as compared to 21.8 million ton in 2000-2001. Indonesia alone consumed 3.2 million ton of crude palm oil per year to carter the need of 242 million people in 2010 (Abdullah and Wahid, 2010).



	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010
Opening stocks	14,651	15,724	15,524	14,850	14,435	14,729	16,264	17,465	17,921	18,798
Production	114,75	117,62	120,72	125,62	132,39	141,06	150,02	154,11	160,01	163,94
Imports	35,682	38,193	40,605	44,027	46,855	51,018	56,505	58,248	61,512	62,989
Exports	35,934	38,029	40,624	44,282	47,372	51,165	57,535	58,294	60,814	63,090
Disappearance	113,43	117,99	121,37	125,78	131,58	139,38	147,79	153,61	159,83	163,88
Closing stock	15,724	15,524	14,850	14,435	14,729	16,264	17,465	17,921	18,798	18,750

Fig. 1: World balance of oils and fats from 2000-2001 to 2009-2010 (000 million ton) (Source: MPOB, 2009-2011)

Malaysia aims to boost palm oil industry's output to the gross domestic product (GDP) to RM 21.9 billion, with RM 69.3 billion in exports earnings during the 10th Malaysia Plan period (2011-2015). Thus making palm oil industry as a major contributor to the country's GDP. Its percentage contribution to GDP in 2010 was estimated to be 4.7%. The development of the Malaysian biofuel industry also boosted the importance of this commodity being an economically ideal feedstock for biodiesel production. Although, Malaysia exports her palm oil to more than 100 countries in the world, yet the bulk of these exports go to few selected markets. These markets are India, the European Union (EU), China P.R., Egypt and Pakistan, which together accounted for 65% of the country's palm oil exports in 2010. The shares of the major importers of palm oil from Malaysia are China, Pakistan, India, Egypt, Bangladesh, Turkey and Saudi Arabia. Several Latin-American and African countries are also buyers of Malaysian palm oil. Palm oil is mainly exported by Malaysia and Indonesia. Together Malaysia and Indonesia exported 16.6 milhon ton (43% of world's palm oil export of 38.8 million ton) and at 17.9 million ton (46%) in 2010, respectively. Meanwhile, palm oil consumption globally increased to 48.9 million ton (28.6% of world oil and fat market) and total global consumption of oils and fats at 171 million ton in 2010 (MPOB, 2009-2011). Although, the production of palm oil is showing an increasing trend, the pattern of price movements of crude palm oil price, palm kernel oil price and soyabean oil price had been fluctuating and showing similar pattern during the periods from 1975 to 2010 (Fig. 2).

Like any other agricultural commodities, palm oil is subjected to significant price fluctuations (Table 1). The determination of agricultural commodities prices are based on a complex interactions among multiple factors-including crude petroleum oil prices, exchange rates, time-lag, demand and supply situation and slowing growth in agricultural productivity as well as the government policies. The volatility of the Crude Palm Oil (CPO) price in term of long term trend in the past has created instability in the earnings for the country and the returns for the industry. Table 1 show the price instability indices (Ix) measure in percentage variation of the palm oil and other selected

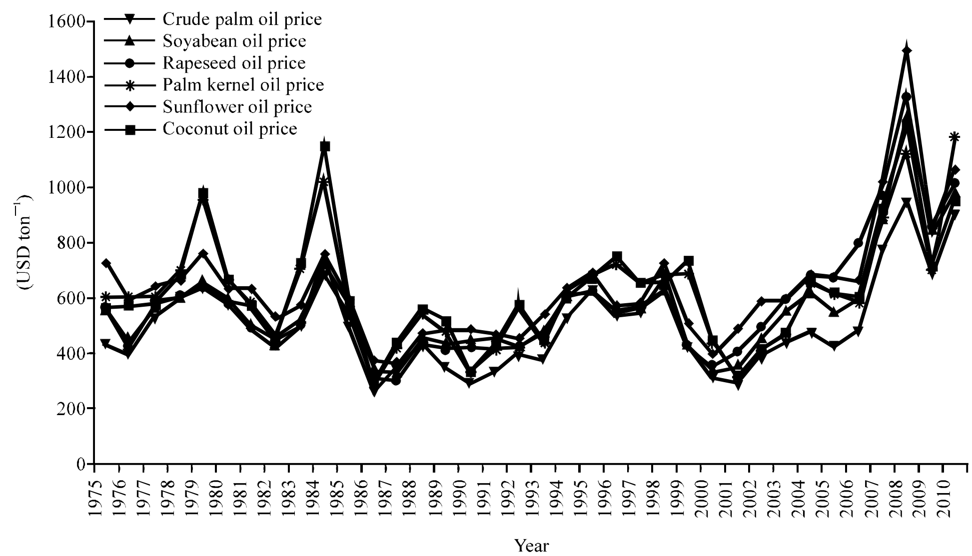


Fig. 2: Annual average prices of selected oils and fats from 1975 to 2010

Table 1: Price instability indices (Ix) variation of selected market commodities, 1970 to 2009

	(I_X) (% Variation)			
Commodities	1970-1979	1980-1989	1990-1999	2000-2009
Food	15.7	18.9	9.2	9.5
Rice	18.6	21.9	10.9	16.8
Vegetable oilseeds and oils	19.7	18.3	10.1	15.4
Sunflower oil	18.6	18.3	12.2	17.9
Groundnut oil	20.1	24.8	13.9	19.8
Coconut oil	28.6	29.5	15.3	20.2
Palm kernel oil		27.9	15.2	21.3
Palm oil	26.1	22.2	14.7	18.1
Agricultural raw materials	11.7	9.9	9.4	8.5
Rubber	21.8	16.9	26.6	17.4
Minerals, ores and metals	14.0	17.6	10.3	20.9
Crude petroleum oil	29.3	12.8	15.3	20.4

commodities prices in the world market. It reveals a much higher degree of market uncertainty in 1970-1979 compared to 1980-1989. In terms of price instability Index (I_x) examined, it had been much higher in 2000-2009 as compared with 1990-1999 for all commodities (MPOB, 2009-2011).

Similarly, the energy crisis, bad weather and international trade policy choices made by nations of the world also affected the prices of agricultural commodities. The Malaysian government is now refocusing the use of palm oil to the production of biodiesel to cater to the huge demand from European countries. It has encouraged the building of more biodiesel plants. This is due to the higher prices of fuel and increasing demand for alternative sources of energy in the Western world pushing the demand and crude palm oil prices even higher. The supply and demand situations as well as other price determining factors were usually considered in the process of setting the prices. Therefore, the increase and decrease of stock also led to decrease and increase of the prices, respectively. For example when the price of crude oil went and stayed up, it had a negative effect on the entire economy because crude oil was used in the production of virtually everything (Khin *et al.*, 2011a).

Similarly the exchange rates, especially the depreciation of the USD, had contributed to the upward pressure on world prices for most commodities traded in dollars. Depreciation (appreciation) of Malaysian Ringgit (RM) would be lower (increased) the USD value, thus enabling more demand for the commodity (Abdullah and Wahid, 2010). Studies have been conducted on forecasting accuracy of prices for commodity market and price instability. Harris and Leuthold (1985) for example described a comparison of forecasting accuracy of five alternative econometric models and univariate Box-Jenkins techniques for live cattle and live hog prices. The univariate Box-Jenkins model was showed that the lowest RMSE value of forecasting accuracy.

The objective of the study was to determine the comparative forecasting models' accuracy of the short-term ex-ante forecasts using Vector Error Correction Method (VECM) equation econometric model, multivariate autoregressive-moving-average (MARMA) model (composite model) and the univariate model of Autoregressive-Integrated Moving Average (ARIMA) (Box-Jenkins model) of palm oil price in Malaysia. Besides, the study is also to identify the important factors affecting the spot palm oil price in future prices of the Malaysian palm oil market.

MATERIALS AND METHODS

The study used monthly secondary data from January 1980 to June 2011 as estimation period and the ex-ante forecast value was estimated for the month of July to December 2011. The econometric model was estimated using (VECM) (Gilbert, 1986; Hendry and Ericsson, 2001) and co-integration method (Engle and Granger, 1991) for residual error correction. Comparative forecasting models accuracy between VECM equation, MARMA and univariate of ARIMA, were made in terms of their estimation accuracy based on Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Root Mean Percent Error (RMPE) and (U-Theil) criteria (Makridakis *et al.*, 1998). However, a number of studies have indicated that a combination of econometric and univariate approaches (ARIMA) into a composite model (MARMA) will give an accurate forecast (Bates and Granger, 1969; Labys, 1973; Brandt and Bessler, 1981; Blisard, 1985; Arshad and Zainalabidin, 1994; Box *et al.*, 1994; Makridakis *et al.*, 1998; Hossain *et al.*, 2006; Khin *et al.*, 2011b), this study will also include this model. Firstly, the study has formulated comprising of six behavioural equations of the short-term forecasting models of the Malaysian palm oil. The behavioural equations describe the supply (PRPO), Total Demand (TDPO), Export Demand (EDPO), Import Demand (IDPO), Domestic Demand (DDPO) and Spot Palm Oil Price (SPPO) and can be specifically described them in (Table 2). However, the spot palm oil price (SPPO) will be only carried out in detail the ex-ante forecast and based on data from period January 1980 - June 2011 for this study.

MODEL SPECIFICATION

Supply (PRPO): The Supply of Palm Oil (PRPO) as a function of related factors (in logs) is assumed to be determined by equation as follow:

$$PRPO_t = f\,(SPPO_{t-i}, PRPO_{t-i}, T, e_{ti}) \quad (1)$$

Table 2: Model specification of the short-term forecasting models of the Malaysian palm oil

Variables	Description
PRPO	Production of palm oil (supply) in thousand tons ('000 ton)
SPPO	Spot palm oil price using futures prices in Malaysia (USD/ton) deflated by the CPI
TDPO	Total consumption of palm oil (demand) in thousand tons ('000 ton)
PSBO	World soyabean oil price (USD/ton) deflated by the CPI
EDPO	Quantity of palm oil export demanded in thousand tons ('000 ton)
REER	Real effective exchange rate in foreign currency per USD (RM/USD)
WIPI	World industrial production index (2005100)
IDPO	Quantity of palm oil import demanded in thousand tous ('000 ton)
RGDP	Malaysian Real GDP per capita in RM/Population
DDPO	Quantity of palm oil domestic demanded in thousand tous ('000 ton)
IPI	Industrial production index (agricultural products in Malaysia) (2005100)
TDPO	Total cousumption of palm oil (total demand) in thousand tons ('000 ton)
STPO	Stock of palm oil in thousand tons ('000 ton)
COP	Crude petroleum oil price (USD/barrel)
T	Time trend, 1980 January to 2011 June monthly data
t and e_i	Time period and error terms, respectively

Total demand (TDPO): The total demand of palm oil (TDPO) as a function of the related factors (in logs) is assumed to be determined by equation as follow:

$$TDPO_t = f\,(SPPO_t, PSBO_t, TDPO_{t-i}, T, e_{ti}) \qquad (2)$$

Export demand (EDPO): The export demand of palm oil (EDPO) as a function of the related factors (in logs) is assumed to be determined by equation as follow:

$$EDPO_t = f\,(SPPO_t, PSBO_t, REER_t, WIPI_t, EDPO_{t-i}, T, e_{ti}) \qquad (3)$$

Import demand (IDPO): The import demand of palm oil (IDPO) as a function of the related factors (in logs) is assumed to be determined by equation as follow:

$$IDPO_t = f\,(SPPO_t, PSBO_t, REER_t, RGDP_t, IDPO_{t-i}, T, e_{ti}) \qquad (4)$$

Domestic demand (DDPO): The domestic demand of palm oil (DDPO) as a function of the related factors (in logs) is assumed to be determined by equation as follow:

$$DDPO_t = f\,(SPPO_t, PSBO_t, IPI_t, DDPO_{t-i}, T, e_{ti}) \qquad (5)$$

Spot palm oil price (SPPO): The spot palm oil price equation as a function of the related factors (in logs) is assumed to be determined by equation as follow:

$$SPPO_t = f(TDPO_t, STPO_t, COP_t, REER_t, PSBO_t, SPPO_{t-i}, T, e_{ti}) \qquad (6)$$

In Table 2, described the behavioural equations of the supply (PRPO), Total Demand (TDPO), Export Demand (EDPO), Import Demand (IDPO), Domestic Demand (DDPO) and Spot Palm Oil Price (SPPO).

Table 3: Unit-root tests for the monthly spot palm oil price (SPPO)

	Unit root test					
	Level		1st differ		Stationary	
Variables % critical value	ADF	P-P	ADF	P-P	Level	1st differ
SPPO (USD ton^{-1})	-1.85	-1.49	-8.82***	-12.37***		St
1			-3.45	-3.48		
5			-2.87	-2.89		
10			-2.57	-2.53		

**Statistically significant at the 0.05 level, ***Statistically significant at the 0.01 level, ADF = Augmented Dickey-Fuller test statistic, P-P = Phillips-perron test statistic

Model identification

Unit root test (data stationary test): A unit root test was conducted for all data to ensure stationarity of the data by using. Pindyck and Rubinfeld (1998), Ferris (1998) and Enders (2004) Augmented Dickey Fuller (ADF) and Phillips-Peron's tests (PP) (Table 3) shows the results of the unit root test, the Spot Palm Oil Price Variable (SPPO) at the level data (original data form) is not stationary for unit root and the price variable is significant stationary at the first difference form at the 0.01 level using Augmented Dickey Fuller (ADF) and Phillips-Peron's tests (PP) for unit root.

Model estimation

Vector error correction method (VECM): A Vector Error Correction Method (VECM model) is a restricted Vector Autoregression (VAR) designed for use with non-stationary series that are known to be cointegrated (Gilbert, 1986; Hendry and Ericsson, 2001) and is known as the error correction method (ECM model) since the deviation from long-term equilibrium is corrected gradually through a series of partial short-term adjustments (Engle and Granger, 1991). In this study, the VECM equation econometric model for spot palm oil price can be specified as follows:

$$\Delta SPPO_t = \alpha+\beta_1\ TDPO_{t-1}+\beta_2\ STPO_{t-1}+\beta_3\ COP_{t-1}+\beta_4 REER_{t-1}+\beta_5\ PSBO_{t-1}+\beta_6\ SPPO_{t-1}+\varepsilon_t \quad (7)$$

where, α_i is a vector of intercept terms, β_i is the coefficient matrices and ε_i is the disturbance terms. Therefore, the VECM model is included a vector of intercept terms (α_i) and the disturbance terms (ε_i). The ECM models however is without a vector of intercept terms (α_i) and the disturbance terms (ε_i). The coefficient α_i measures the speed of adjustment of the ith endogenous variable towards the equilibrium.

Again, the VECM equation econometric model results will be compared with MARMA model (composite model) and the univariate model of ARIMA in terms of the comparative forecasting accuracy for this study. The price forecasting models will be conducted the ex-ante forecast of the short-term monthly spot palm oil price (USD ton^{-1}) in the Malaysian palm oil market.

MARMA MODEL (COMPOSITE MODEL)

The multivariate autoregressive-moving-average (MARMA) model (Composite model) can be specified as follows:

$$SPPO_t = c_0+c_1\ TDPO_{t-1}+c_2\ STPO_{t-1}+c_3\ COP_{t-1}+c_4\ REER_{t-1}+c_5\ PSBO_{t-1}+\underbrace{AR(1)(\Phi_1)+MA(1)(\theta_1)}_{\varepsilon_t[\varphi^{-1}(B)\theta(B)\eta_t]} \quad (8)$$

where, η_t is a normally distributed error term which may have a different variance from residual error ε_t. The parameters c_0, c_1, c_2 and ..... of the structural regression equation and the parameters $\varphi_1,\ldots,\varphi_p$ and $\varepsilon_1,\ldots,\varepsilon_q$ of the time-series model ARIMA. Then:

- AR(1)(φ_1) = AR parameter of order 1 (The $\varphi_1 SPPO_{t-1}$ represented the fit to the series value $SPPO_t$)
- MA(1)(ε_1) = MA parameter of order 1 (The term $\varepsilon_1\ \varepsilon_{t-1}$ and ε_t represented the assumed random error in the data at period t-1 and period t)

Equation 8 is referred to as a transfer function model or, alternatively, a multivariate autoregressive-moving-average (MARMA) model (Composite model). This combined use of regression analysis with a time-series model of the error term is an approach to forecasting that in some cases can provide the best of both worlds.

ARIMA MODEL (BOX-JECKINS MODEL)

The autoregressive-integrated-moving average (ARIMA) model is discussed in detail by Hoff (1983), O'Donovan (1983) and Box *et al.* (1994). Briefly, this technique is an univariate approach, which is built on the premise that knowledge of past values of a time series is sufficient to make forecasts of the variable in question. The short-term spot palm oil price forecasting models based on the Box-Jeckins procedure, univariate time-series model of the autoregressive-integrated moving average ARIMA (p,d,q) can be specified with C = intercept terms and ε_t = the disturbance terms as follows:

$$SPPO_t = C+(\underbrace{\Phi_1\ SPPO_{t-1}+\ldots\ \Phi_p\ SPPO_{t-p}}_{(AR(1)(\Phi 1)})-(\underbrace{\theta_1\ \varepsilon_{t-1}+\ldots\ \theta_q\ \varepsilon_{t-q}}_{(MA(1)(\theta 1)})+\varepsilon_t \tag{9}$$

$SPPO_t$ is related to both past series values and past random errors and it was the stationary series. The ARIMA model of order ARIMA (1,1,1) was found to be the most appropriate model and generate the best forecast with minimum error. The numbers inside the parentheses of ARIMA (1,1,1) model of order (p,d,q) refer to the order of the autoregressive process, the degree of differencing required to induce stationary and the order of the moving average process, respectively. It meant that to find out what the autocorrelation and partial autocorrelation pattern was for the series the monthly prices of $SPPO_t$, we needed to determine the relationship between $SPPO_t$ and $SPPO_{t-1}$ for all t. Thus, $SPPO_t$ was autocorrelated for lag 1; i.e., the autocorrelation for lag 1 was nonzero. Otherwise, the autocorrelation for any lag greater than 1 was zero. The $\varphi_1 SPPO_{t-1}$ represented the fit to the series value $SPPO_t$ and φ_1 was also called an AR parameter of order 1. The term $\varepsilon_1\ \varepsilon_{t-1}$ and ε_t represented the assumed random error in the data at period t-1 and period t and ε_1 was also called a MA parameter of order 1.

The parameter diagnostics of MARMA model (composite model) and ARIMA model (Box-Jenkins model) showed that any given value in price of $SPPO_t$ was directly proportional to the previous value $SPPO_{t-1}$ plus some random error ε_t and ε_{t-1}. The residual diagnostics (White, 1980) showed that residuals were significance at the 0.01 level that the model has included the correct parameters. That was, what happens this period was only dependent on what happened last period, plus some current random error. The term ($-\varepsilon_1\ \varepsilon_{t-1}$) was the use of the minus sign in front of ε_1 was conventional only and had no other significance. The MARMA model (Composite model) and

ARIMA model (Box-Jenkins model) will also be developed to forecast short-term monthly spot palm oil prices in the Malaysian market. The spot palm oil price forecasting model will also be used to generate ex-ante forecasts for the period of July 2011 to December 2011 based on data from period January 1980 to June 2011.

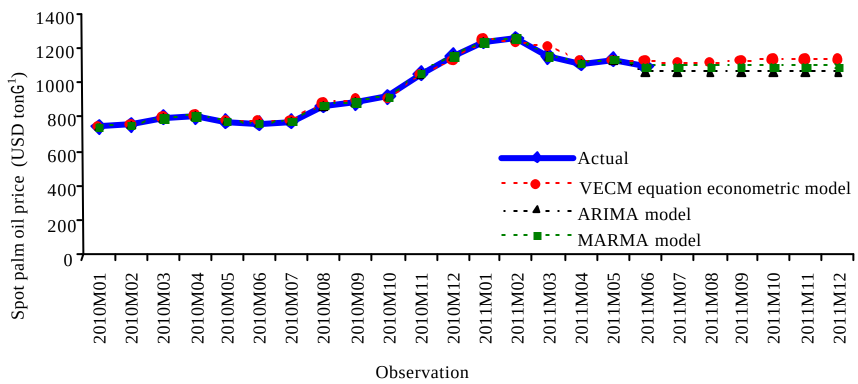
Model simulation: The comparison of the forecast accuracy of the selected spot palm oil price forecasting models of the single equation model, MARMA model (Composite model) and ARIMA model (Box-Jenkins model) evaluated and generated ex-ante forecasts for the period of July 2011 to December 2011 based on data from period January 1980 to June 2011. Firstly, the data from January 1980 to December 2009 were used for estimation purpose, with observations from January 2010 to June 2010 were simulated for ex-post forecast.. Similarly, the data were be simulated forward in time beyond the estimation period from January 1990 to June 2010 and reserved for ex-post forecast with observations from July 2010 to December 2010. The data were be subsequently employed for ex-post forecast from January 2011 to June 2011 and ex-ante forecasts for the period of July 2011 to December 2011.

Model evaluation: One way to test the accuracy of future forecast would be to use a subset of the known data to forecast the rest of the known data, enabling one to study the accuracy of the forecasts more directly. The forecast accuracy of the selected spot palm oil price forecasting models were evaluated based on ex-ante forecasts of short-term monthly spot palm oil price in the Malaysian market using data from January 1980 to June 2011. The forecasting ability was tested based on the Root Mean Squared Error (RMSE), the Mean Absolute Error (MAE), the Root Mean Percentage Error (RMPE) and Theil's Inequality Coefficients (U) criteria (Makridakis *et al*., 1998). Therefore, the price forecasting models with the smallest error (or with the maximum economic value) was judged to be the best model.

RESULTS AND DISCUSSION

Firstly, the Spot Palm Oil Price Variable (SPPO) is significant stationary at the first difference form at the 0.01 level using Augmented Dickey Fuller (ADF) and Philhps-Peron's tests (PP) for unit root in (Table 3). Based on the results of the short term ex-ante spot palm oil price forecasting models of the Malaysian palm oil market, MARMA model (composite model) is more accurate and efficient measured in terms of its statistical criteria than VECM equation econometric model and ARIMA model (Box-Jenkins model) compared with in terms of their estimation accuracy based on RMSE, MAE, RMPE and (U-Theil) criteria in Fig. 3. Accordingly, the results of the study will show in details below.

VECM equation econometric model of spot palm oil price: Equation 10 and 11 show that VECM equation econometric model and cointegration characteristics of the short-term monthly spot palm oil price. The explanatory variables which accounted for about only 24% of the variation of the monthly spot palm oil price model in the equation 10. From the Vector Error Correction Method (VECM) Eq. 10 of the Spot Palm Oil Price (SPPO) forecasting econometric model, estimations revealed that the explanatory variables, namely Stock of Palm Oil (STOP) and the Spot Palm Oil Price (SPPO) in previous period were the most important explanatory variables in the model with significance at 0.05 and 0.01 level, respectively. It meant that there was a significantly short-term



	VECM equation econometric model	ARIMA model	MARMA model
RMSE	0.623	0.309	0.239
MAE	0.711	0.213	0.173
RMPE	26.098	18.284	15.607
U-Theil	0.378	0.275	0.086

Fig. 3: Model evaluation of ex-ante forecast of monthly spot palm oil price SPPO (USD ton^{-1}) of VECM equation econometric model, MARMA model (composite model) and ARIMA model (Box-Jeckins model) from January 2010 to December 2011

relationship between the Spot Palm Oil Price (SPPO) and Stock of Palm Oil (STOP) and the Spot Palm Oil Price (SPPO) in previous period in the spot palm oil price forecasting econometric model:

$$\Delta SPPO_t = 0.976 -- 0.014\ TDPO_{t-1} -0.059\ STPO_{t-1}+0.564\ COP_{t-1} -0.048\ REER_{t-1}+0.023\ PSBO_{t-1}+0.383\ SPPO_{t-1}+1.828\ \varepsilon_t \quad (10)$$

t statistics = [-0.934] [-2.694] [1.044] [-1.742] [0.348] [5.576] [0.534]

R^2 = 0.238 Adjusted R^2 = 0.229 d = 1.731

Co-integration equation of spot palm oil price:

$$-0.013\ \Delta\ SPPO_t -0.066\ \Delta\ TDPO_t -0.017\ \Delta\ STPO_t+0.043\ \Delta\ COP_t -0.086\ \Delta\ REER_t+0.007\ \Delta\ PSBO_t = 0 \quad (11)$$

[-4.485] [-6.548] [-2.373] [+0.149] [-1.539] [+2.358]

In the cointegration Eq. 11 of Spot Palm Price (SPPO) forecasting econometric model, the Spot Palm Price (SPPO) is highly dependent on Total Consumption of Palm Oil (TDPO), Stock of Palm Oil (STOP) and Soyabean Oil Price (PSBO) with significance at 0.01 level and 0.05 level, respectively. Therefore, there was a statistically significant long-term relationship and cointegrated between the Spot Palm Oil Price (SPPO) and Total Consumption of Palm Oil (TDPO), Stock of Palm Oil (STOP) and Soyabean Oil Price (PSBO).

Khin *et al.* (2011a) estimated and analyzed the various natural rubber price forecasting models individually in terms of their comparative price forecasting accuracy and determined which between the models were more efficient. A comparison of forecasting abilities between short-term ex-post forecasts of VECM equation econometric model and cointegration characteristics, Multivariate Autoregressive Moving Average (MARMA) (Composite) model and Autoregressive Integrated Moving Average (ARIMA) model, of natural rubber SMR20 (Standard Malaysia Rubber of grade 20) prices in the world natural rubber market in terms of their estimation accuracy based on RMSE, MAE and (U-Theil) criteria. These statistics suggest that the MARMA model was more accurate and efficient measure in terms of its statistical criteria than the other models in predicting the price of SMR20 in the next 6 months.

Hadi *et al.* (2011) also examined the relationship between crude palm oil prices and the crude oil price by using cointegration approach. They found that there was a significant long-term relationship from the cointegration approach and short-term relationship from the Error Correction Method (ECM) support between the two variables. The two variables were also found to be positively correlated and same direction with 2 months lag in time dimension.

MARMA model (composite model): In the MARMA model price Eq. 12, the explanatory variables and AR and MA parameters also explains about 74% of the variation in the monthly spot palm oil price model. The term AR (1) (φ_1) ($\varphi_1 SPPO_{t-1}$) (φ_1 is an AR parameter of order 1) represents the fit to the series value $SPPO_t$ and the coefficient value is 0.453. The term MA (1) (ε_1) (ε_1 ε_{t-1}) (ε_1 is a MA parameter of order 1) and ε_{t-1} represents the assumed random error in the data at period t-1 and ε_t represented at period t and the coefficient value is 0.335 and 0.013. Besides, the spot palm oil price (SPPO) is positive and highly relationship between the crude oil price (COP):

$$SPPO_t = 0.007 -- 0.025\ TDPO_{t-1} -0.047\ STPO_{t-1}+0.012\ COP_{t-1} -0.241\ REER_{t-1}+0.042\ PSBO_{t-1}+0.453\ AR(1)\ (\varphi_1)+0.335\ MA(1)\ (\varepsilon_1\ \varepsilon_{t-1})+0.013\ \varepsilon_t \quad (12)$$

t statistics= [-2.821] [-3.185] [2.709] [-1.283] [11.872] [17.958] [13.773] [0.525]

R^2 = 0.738 Adjusted R^2 = 0.733 d = 1.801

The parameter diagnostics of MARMA model shows that any given value in price of $SPPO_t$ was directly proportional to the previous value $SPPO_{t-1}$ plus some random error ε_t and ε_{t-1} significant that the model have included the correct parameters. The residual diagnostics shows that residuals are significance at the 0.01 level that the model has included the correct parameters. Significantly, in the results of the spot palm oil price MARMA model (composite model), estimations revealed that the explanatory variables, namely, total consumption (TDPO), Stock of Palm Oil (STOP), Crude Petroleum Oil Price (COP) and soyabean oil price (PSBO), were the most important explanatory variables with statistically significance at the 0.01 level.

Shamsudin and Arshad (1998) provided some short term ex-ante forecasts of world crude palm oil prices. The forecasts were derived from the univariate autoregressive integrated moving average (ARIMA) model which integrated a multivariate autoregressive-moving average (MARMA) model (composite model) for the residuals into an econometric equation estimated beforehand. The results showed that the MARMA model produced a relatively more efficient forecast than the univariate and other econometric models. The forecast figures were discussed in relation to the current and expected fundamentals of the palm oil market.

ARIMA model (Box-jeckins model): In the ARIMA model of order (1,1,1) price Eq. 13, the explanatory variables and AR and MA parameters also explains about 56% of the variation in the monthly spot palm oil price model. The term AR (1) (φ_1) ($\varphi_1 SPPO_{t-1}$) (φ_1 is an AR parameter of order 1) represents the fit to the series value $SPPO_t$ and the coefficient value is 0.573. The term MA(1) (ε_1) (ε_1 ε_{t-1}) (ε_1 is a MA parameter of order 1) and ε_{t-1} represents the assumed random error in the data at period t-1 and ε_t represented at period t and the coefficient value is 0.425 and 0.016. The parameter diagnostics of ARIMA model (Box-Jenkins model) shows that any given value in price of $SPPO_t$ was directly proportional to the previous value $SPPO_{t-1}$ plus some random error ε_t and ε_{t-1} significant that the model have included the correct parameters. The residual diagnostics shows that residuals are significance at the 0.01 level that the model has included the correct parameters:

$$SPPO_t = 0.001+0.573\ AR(1)\ (\varphi_1)\ (\varphi_1 SPPO_{t-1})+0.425\ MA(1)\ (\varepsilon_1)\ (\varepsilon_1\ \varepsilon_{t-1})+0.016\ \varepsilon_t \quad (13)$$

t statistics= [18.948] [14.083] [0.047]

R^2 = 0.562 Adjusted R^2 = 0.559 d = 1.795

Hossain *et al*. (2006) developed and used ARIMA model of order (3,1,3)×(2,0,2) 12 was selected as the best model for both motor and mash prices and the model (3,1,2)×(3,0,2) 12 was selected as the best model for mung prices in Bangladesh for policy purposes as far as price forecasts of the commodities were concerned. He also generated forecasts, namely, historical, ex-post and ex-ante, using the familiar Box-Jenkins univariate time series models. The models on the basis of which these forecasts have been computed were selected by important information criteria such as Root Mean Squared Percent Errors (RMSPE), Mean Percent Forecast Errors (MPFE) and Theil's inequality coefficients (U). The smaller these values, the better are the forecasting performance of the model.

The results of the comparison of the forecast accuracy of the ex-ante forecast of monthly spot palm oil price (USD per ton) using VECM equation econometric model, MARMA model and ARIMA model are presented in Fig. 3. The forecasting power was compared based on the RMSE, MAE, RMPE and Theil's inequality coefficients (U) criteria. The values of the RMSE, MAE, RMPE and U of MARMA model were comparatively smaller than the values generated by VECM equation econometric model and ARIMA model. These statistics suggested that the forecasting performance of the MARMA model was more efficient than VECM equation econometric model and ARIMA model.

The generated price forecasts from January 2010 to December 2011 generated from single equation, MARMA and ARIMA models are presented in Fig. 3. The results of the ex-ante monthly spot palm oil price forecast (USD ton^{-1}) using MARMA model is predicted to decrease to around USD 1091 ton^{-1} in December 2011, a decrease of 5.1% from December 2010 at USD 1149 ton^{-1} and 11.5% from January 2011 at USD 1232 per ton, respectively. The price comparison

Fig. 4: Actual monthly spot palm oil price SPPO (Malaysian Ringgit RM ton^{-1}) from January 2011 to December 2011

of the finding of monthly spot palm oil price SPPO (USD per ton) and the actual monthly spot palm oil price SPPO (Malaysian Ringgit RM per ton) from January 2011 to December 2011 in Fig. 4 (MPOC, 2011).

CONCLUSION

Based on the results of the above analysis, MARMA's ex-ante forecasts were more efficient measured either in terms of its statistical criteria or even by visual proximity with the actual prices. If a forecast would be a high price, it may lead policy makers to alter their budgetary plans to invest for new decisions in the palm oil market. The result of the study indicates that spot palm oil ex-ante forecast price is predicted a decreasing trend and the spot palm oil price (SPPO) is highly relationship with total consumption of palm oil (total demand) (TDPO), stock of palm oil (STOP), crude petroleum oil price (COP) and soyabean oil price (PSBO) in the MARMA's ex-ante forecasting model.

Therefore, the increase and decrease of stock also lead to decrease and increase of palm oil prices, respectively. Otherwise, variations in a price series can arise from long term trends or short term fluctuations (instability) in the market variables or both together. Uncertainty in a market generally originates from short-term fluctuations rather than long term trends. These findings simply confirm our priori expectation, that is, since crude oil is one of the major raw materials for the production of palm oil and all the two prices-crude oil and palm oil prices are highly correlated and move in tandem with each other. Moreover, Malaysia's production in palm oil has also increased in volatility/instability. In the face of increasing cost of raw materials (palm oil) and crude oil prices, to remain competitive it is imperative that Malaysia continuously seeks methods that improve efficiency through productivity increase. This would mean more R and D and innovations.

Significantly, this conceptual economic framework was a good starting point for discussion and perceptive of short-term ex-ante forecast of spot palm oil price forecasting models developed, with the opportunity of using some of these factors later in the other study for forecasting of spot palm oil price. Forecasts using other alternative models such as simultaneous supply-demand and price model, long-term and medium-term model, not attempted for this study, could also be potentially beneficial for future work. Therefore, the study can be safely concluded that forecasts frequently are used as guides for public and private policy. Forecasts are also useful as guidelines for model building. Being such an important commodity to palm oil producing countries and world market, an accurate estimation methodology for palm oil price forecasting is vital to forecast together with supply, demand and price for decision-making process in economic planning, could be significantly beneficial for further study.

REFERENCES

Abdullah, R. and M.B. Wahid, 2010. World Palm Oil Supply, Demand, Price and Prospects: Focus on Malaysian and Indonesian Palm Oil Industry. Malaysian Palm Oil Board Press, Malaysia.

Arshad, F.A. and M. Zainalabidin, 1994. Price discovery through crude palm oil futures market: An economic evaluation. Proceedings of the 3rd Annual Congress on Capitalising the Potentials of Globalisation-Strategies and Dynamics of Business, (CPGSDB'94), IMDA, Malaysia, pp: 73-92.

Bates, J.M. and C.W. Granger, 1969. The combination of forecasting. Oper. Res. Quart., 20: 451-468.

Blisard, W.N., 1985. A comparison of alternative price forecasting models for slaughter hogs. Ph.D. Thesis, University of Tennessee, Knoxville, USA.

Box, G.E.P., G.M. Jenkins and G.C. Reinsel, 1994. Time Series Analysis: Forecasting and Control. 3rd Edn., Prentice Hall, New Jersey, ISBN-13: 978-0130607744, pp: 592.

Brandt, J.A. and D.A. Bessler, 1981. Composite forecasting: An application with U.S. hog prices. Am. J. Agric. Econ., 63: 135-140.

Enders, W., 2004. Applied Econometric Time Series. John Wiley and Sons, Hoboken.

Engle, R.F. and C.W.J. Granger, 1991. Long-Run Economic Relationships: Readings in Cointegration. Oxford University Press, New York.

Ferris, N.J., 1998. Agricultural Prices and Commodity Market Analysis. 1st Edn., McGraw Hill, Boston, Massachuset, pp: 142-145.

Gilbert, C.L., 1986. Professor Hendry's econometric methodology. Oxford Bull. Econ. Stat., 48: 283-307.

Hadi, A.R.A., M.H. Yahya, A.H. Shaari and M.H. Huridi, 2011. Investigating relationship between crude palm oil and crude oil prices-cointegration approach. Proceedings of the 2nd International Conference on Business and Economic Research, March 14-16, 2011, Langkawi Kedah, Malaysia, pp: 1554-1565.

Harris, K.S. and R.M. Leuthold, 1985. A comparison of alternative forecasting techniques for livestock prices: A case study. North Central J. Agric. Econ., 7: 40-50.

Hendry, F.D. and N.R. Ericsson, 2001. Understanding Economic Forecasts. MIT Press, Cambridge.

Hoff, J.C., 1983. A Practical Guide to Box-Jenkins Forecasting. Lifetime Learning Publications, Belmont, California.

Hossain, M.Z., Q.A. Samad and M.Z. Ali, 2006. ARIMA model and forecasting with three types of pulse prices in Bangladesh: A case study. Int. J. Soc. Econ., 33: 344-353.

Khin, A.A., E.C.F. Chong and Z.A. Mohamed, 2011a. Econometric Forecasting Models for Short Term Natural Rubber Prices. LAP Lambert Academic Publishing, Germany, ISBN-13: 9783846515464, Pages: 236.

Khin, A.A., M. Zainalabidin and S.M. Nasir, 2011b. Comparative forecasting models accuracy of short-term natural rubber prices. Trends Agric. Econ., 4: 1-17.

Labys, W.C., 1973. Dynamic Commodity Models: Specification, Estimation and Simulation. Lexington Books, New York, ISBN-13: 9780669818772, Pages: 351.

MPOB, 2009-2011. Quarterly reports on world oils and fats. Malaysian Palm Oil Board, Malaysia.

MPOC, 2011. Oil palm plantation and Malaysian palm oil industry. Malaysian Palm Oil Council, Malaysia.

Makridakis, S., S.C. Wheelwright and R.J. Hyndman, 1998. Forecasting Methods and Applications. 3rd Edn., John Wiley and Sons Inc., New York.

O'Donovan, T.M., 1983. Short Term Forecasting: An Introduction to the Box-Jenkins Approach. Wiley, New York, ISBN-13: 9780471900139, Pages: 282.

Pindyck, R.S. and D.L. Rubinfeld, 1998. Econometric Models and Economic Forecasts. 4th Edn., McGraw Hill, Boston, pp: 565.

Shamsudin, M.N. and F.M. Arshad, 1998. Short-term forecasting of Malaysian crude palm oil prices. http://www.econ.upm.edu.my/~fatimah/pipoc.html.

White, H., 1980. A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity. Econometrica, 48: 817-838.