Impact of Palm Oil Supply and Demand on Palm Oil Price Behaviour

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ABSTRACT

The article will highlight the impact of supply and demand and market sentiment factors on the Malaysian palm oil price behaviour, and will examine their impact in 2013. The price of crude palm oil (CPO) is dependent on many factors that vary from time to time, such as fundamental factors, i.e. both supply and demand factors in the world market and unpredictable market sentiments, e.g. extreme weather phenomenon, political crisis, new policies or regulations, and impact of natural disasters. The CPO price in 2012 is a good example where it was affected negatively by a combination of both supply and demand factors. From the supply perspective, the CPO stock build-up arising from high carry-over stocks at the beginning of the year and an increase in CPO production had contributed to its bearishness in 2012. From the demand side, it is a weaker export demand from major importing countries, like China, P R and Pakistan. The introduction of Malaysia's new CPO export tax structure effective 1 January 2013 is likely to result in an increase in palm oil exports and, thus, indirectly to a reduction in the high palm oil stock levels in the country. Moreover, the B5 programme which is to be expanded throughout Malaysia in 2013/2014 will also reduce the level of palm oil stock availability in the country. Besides that, the Malaysian palm oil supply growth in 2013 is expected to increase moderately due to the introduction of the oil palm replanting scheme with a government allocation of RM 100 million for this purpose. The scheme is expected to see the replanting of 100 000 ha of unproductive palms and palms over the age of 25 years. These scenarios will indeed be a positive indication of the firming up of CPO prices in the market place in 2013. The article will also incorporate the use of an econometric modeling method for an analysis of the factors affecting CPO price behaviour.

INTRODUCTION

Crude palm oil (CPO) price behaviour at this moment is very complex, thus creating high price volatility. This is because palm oil makes up the largest volume of vegetable oil traded in the world market, totalling 38.68 million tonnes in 2011, and estimated to rise to 43.50 million tonnes in 2012. CPO production in Indonesia and Malaysia amounted to 27.00 million tonnes and 18.79

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million tonnes, respectively, in 2012. Total palm oil export volume by these two countries in the same year amounted to 36.56 million tonnes, with Indonesia at 19.00 million tonnes and Malaysia at 17.56 million tonnes.

CPO price is dependent on a lot of factors that vary from time to time. Normally, its behaviour is determined by market forces, *i.e.* both supply and demand factors (Faizah *et al.*, 2006). A strong demand for oil palm products will lead to its increase in the market. However, if the palm oil supply growth is much faster than that of its demand, it will be affected in a negative manner. Prices of substitute products for palm oil, like soyabean and rapeseed oils, have also become a fundamental factor which can influence it in the world market. In addition, price of Brent crude oil has also played a significant role in terms of the impact of biodiesel, the use of which has been aggressively implemented in 2007 (Ramli *et al.*, 2007).

Thus, CPO price behaviour depends directly on four major fundamental factors. Firstly, palm oil supply, which comprises CPO production, palm oil stock and palm oil imports. Secondly, palm oil demand for export of oil palm products. Thirdly, the price of close substitute products, *e.g.* soyabean and rapeseed oils. As a result of the biodiesel factor, the price of Brent crude oil has become the fourth fundamental factor that is able to influence CPO price behaviour in the world market. Based on supply and demand factors, CPO price behaviour reflects equilibrium or volatility. *Figure 1* shows the monthly CPO price movement from 2008 to 2012. Each point of the CPO price shows price equilibrium as determined by supply and demand factors. Based on autoregression conditional heterocedasticity (ARCH) and generalised ARCH (GARCH), the volatility index is recorded at 0.8165, which indicates that high volatility exists in the CPO price.

CPO price is also dependent on market sentiments or the speculation factors that are very difficult to predict by economists. However, market sentiments can sometimes cause a higher impact on CPO price behaviour as compared to fundamental factors. Due to this, it is very difficult to forecast it. It is worth noting that market sentiments cannot be measured by time series data. For an econometrician, dummy variables will have to be used as their proxies to examine their impact on CPO price.

Extreme weather phenomena like *La Niña* and *El Niño* events occurring in countries where oil palm and other vegetable oils are produced will consequently cause supply disruptions and lead to an increase in prices. A political crisis in West Asia will contribute to an economic crisis, which will then put pressure on CPO prices to decline due to low palm oil demand. New policy introductions by importing countries that are unfavourable to palm oil will cause less demand for the oil and also lead to a decline in CPO prices. For example, China, P R strictly enforced her regulations for the import of vegetable oils with effect from 1 January 2013. If there is a problem to palm oil producers to fulfill the requirements, CPO prices will then be affected in a negative manner. This is because
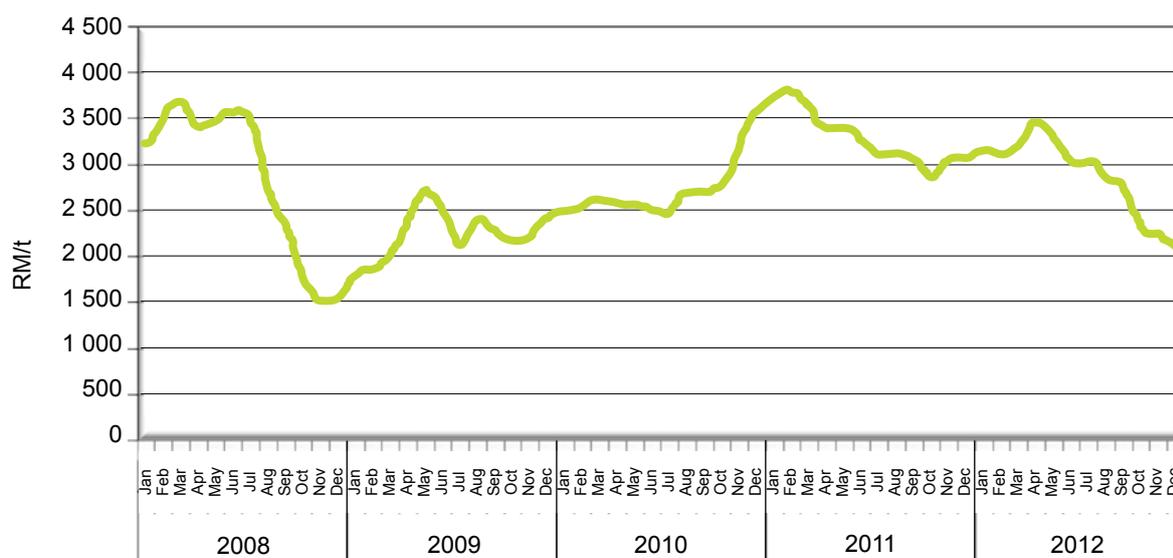
Source: MPOB (2012).

Figure 1. Monthly crude palm oil (CPO) prices from 2008 - 2012.

China, P R is one of the world's largest importers and consumers of vegetable oils.

OBJECTIVES

The objectives of this article, therefore, are to highlight the impact of Malaysian palm oil supply and demand on palm oil price behaviour and to examine fundamental and market sentiment factors on CPO price behaviour in 2013.

METHODOLOGY

The multiple regression technique has been used to examine the impact of palm oil supply and demand on CPO price behaviour. In order to identify significant factors affecting CPO production, the model was developed as follows:

$$PDO_t = a_1 + a_2MAT_{t-1} + a_3OER_t - a_4DUM_t + e_t$$

where:
PDO = CPO production (t).
MAT = oil palm mature areas (ha).
OER = oil extraction rate (%).
DUM = dummy weather for monsoon rains and *La Niña* (0 if there is no monsoon rain or *La Niña*, and 1 if there is monsoon rains or *La Niña*).
a = coefficient.
e = error term.

Meanwhile, the palm oil demand model was developed based on the need to identify significant factors influencing the export of oil palm products by Malaysia. The specific palm oil demand model can be stated as follows:

$$DD_t = c_1 - c_2CPO_t + c_3SBO_t + c_4PDO_t - c_5STO_t + c_6DD_{t-1} + e_t$$

where:
DD = total OP export products (t).
CPO = CPO price (RM/t).
SBO = soyabean oil price (USD/t).
PDO = CPO production (t).
STO = palm oil stock (t).
c = coefficient.
e = error term.

In order to identify significant factors influencing CPO price behaviour, its model was developed by incorporating all its significant factors. The specific CPO price model can be stated as follows:

$$CPO_t = c_1 - c_2PDO_t - c_3STO_t + c_4DD_t + c_5SBO_t + c_6BCO_t + c_7CPO_{t-1} + e_t$$

where:
CPO = CPO price (RM/t).
BCO = Brent crude oil price (USD/barrel).
c = coefficient.
e = error term.
Note: All time series data were in log form.

PALM OIL SUPPLY FACTORS

The supply of palm oil comprises CPO production, palm oil stock and palm oil imports. However, in Malaysia, CPO production and palm oil stock are the major components for palm oil supply. The influence of palm oil import, however, is not significant because its volume is small as compared to CPO production and palm oil closing stock. *Table 1* shows the total supply of palm oil in 2012, which amounted to 22.74 million tonnes.

Production of CPO is a palm oil supply component. Based on the monthly time series data, it was revealed that CPO production has a seasonal pattern every year. The low season for CPO production starts from November until February, the moderate season starts in March until August, while the peak season is either in September or October every year. The reason why CPO production starts to decline in November until February every year is due to the monsoon rains. Heavy rainfall during the monsoon season causes oil palm planted areas to be affected by floods, and this contributes to disruptions in the harvest and collection of fresh fruit bunch (FFB). *Figure 2* shows the seasonal trend in CPO production from 2009 to 2012. It is clear that CPO production starts to decline in November of each year and this will continue until February of the following year.

When harvest and collection activities are disrupted during monsoon season, FFB on the palms become overripe or become rotten, resulting in FFB losses. This scenario has led to the decline in CPO production during the monsoon season. A study revealed that during the monsoon season of 2010/2011, the total number of oil palm estates affected by floods was 402, covering an area of 428 912 ha (Ayat *et al.*, 2012). As a result of this phenomenon, Malaysian CPO production always declines from November until February of the next year.

Equation (1) shows the results of regression analysis on the CPO production model. The results indicate that CPO production is significantly dependent on oil palm mature areas (MAT), oil extraction rate (OER) and dummy weather (DUM). This analysis proves that monsoon rains and *La Niña* will cause a negative impact on CPO production. During monsoon rains or a *La Niña* event, CPO production is expected to decline by about 0.05% as compared with a situation

TABLE 1. TOTAL SUPPLY OF PALM OIL, 2012 (million tonnes)				
Month	Production of crude palm oil	Opening stock of palm oil	Import of palm oil	Palm oil supply
January	1.29	2.06	0.21	3.56
February	1.19	2.02	0.25	3.46
March	1.21	2.06	0.13	3.40
April	1.27	1.96	0.12	3.35
May	1.38	1.85	0.13	3.36
June	1.47	1.79	0.14	3.40
July	1.69	1.70	0.09	3.48
August	1.66	2.00	0.07	3.73
September	2.01	2.11	0.03	4.15
October	1.94	2.48	0.06	4.48
November	1.89	2.51	0.08	4.48
December	1.78	2.57	0.09	4.44
Total	18.78	2.57*	1.39	22.74

Note: *Equivalent to palm oil opening stock in December 2012.

Source: MPOB (2012).
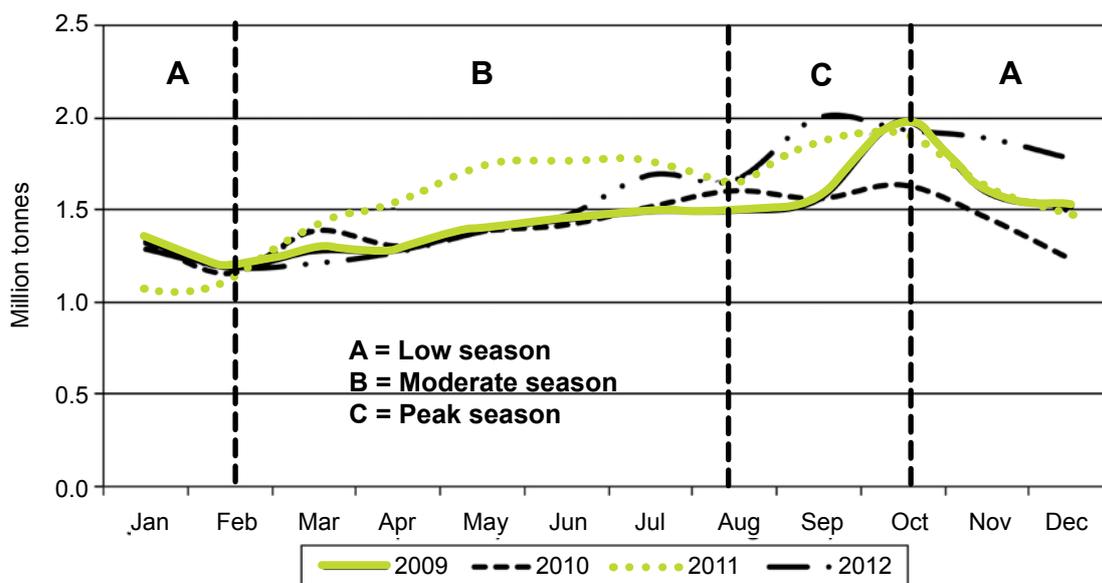
Source: MPOB (2012).

Figure 2. Seasonal trends in crude palm oil production.

without the monsoon rains or the *La Niña* event. Meanwhile, when mature areas or OER increased by 1%, CPO production is expected to increase by 1.1% and 1.2%, respectively.

Equation (1):

$$PDO_t = -3.9699 + 1.1181MAT_t + 1.2023OER_t - 0.0450DUM_t$$
$$\quad\; (-3.7679)^{**} \quad (51.917)^{**} \quad (2.9912)^{**} \quad (-2.0927)^{*}$$

Note: **, * Indicates *t*-statistics significance at 1% and 5%, respectively.
$R^2 = 0.9925$; *F*-stat = 1373 (significant at 1%); DW = 2.1298.

Table 2 shows the growth rates of CPO production and mature areas. Based on the time series data, there was a positive relationship between CPO production and oil palm mature areas which is in line with the results of the empirical analysis in Equation (1). CPO production and mature areas have recorded positive growth rates since 1980. However, the growth rates show a decreasing pattern over time, especially for oil palm mature areas.

Normally, CPO price is up-trending during the monsoon season. This is because the decline in CPO production leads to a decline in palm oil supply, thus resulting in a negative relationship between CPO price and palm oil supply (based on economic theory). However, this scenario is not always followed through. If the palm oil supply shows a declining pattern (supportive of CPO prices), but other factors are unsupportive of CPO prices (*e.g.* decreases in palm oil export and in soyabean oil prices), CPO prices can be on a declining trend.

Figure 3 shows the relationship between monthly CPO production and price. Based on this figure, it is clearly shown that from January to February 2011, November to December 2011, and January to February 2012, when CPO production was in the low season due to the monsoon rains, CPO price showed an increasing trend. The correlation index for both

TABLE 2. GROWTH RATES OF CRUDE PALM OIL (CPO) PRODUCTION AND MATURE AREAS				
	CPO production		Mature areas	
Year	t	Growth rate (%)	ha	Growth rate (%)
1975	1 257 573	-	641 791	-
1980	2 573 173	14.32	1 023 306	9.33
1985	4 134 463	9.48	1 482 399	7.41
1990	6 094 622	7.76	2 029 464	6.28
1995	7 810 546	4.96	2 540 087	4.49
2000	10 842 095	6.56	3 376 664	5.69
2005	14 961 654	6.44	4 051 374	3.64
2010	16 993 717	2.55	4 853 766	3.61
2012	18 785 139	5.01	5 037 959	0.74

Source: MPOB (2012).
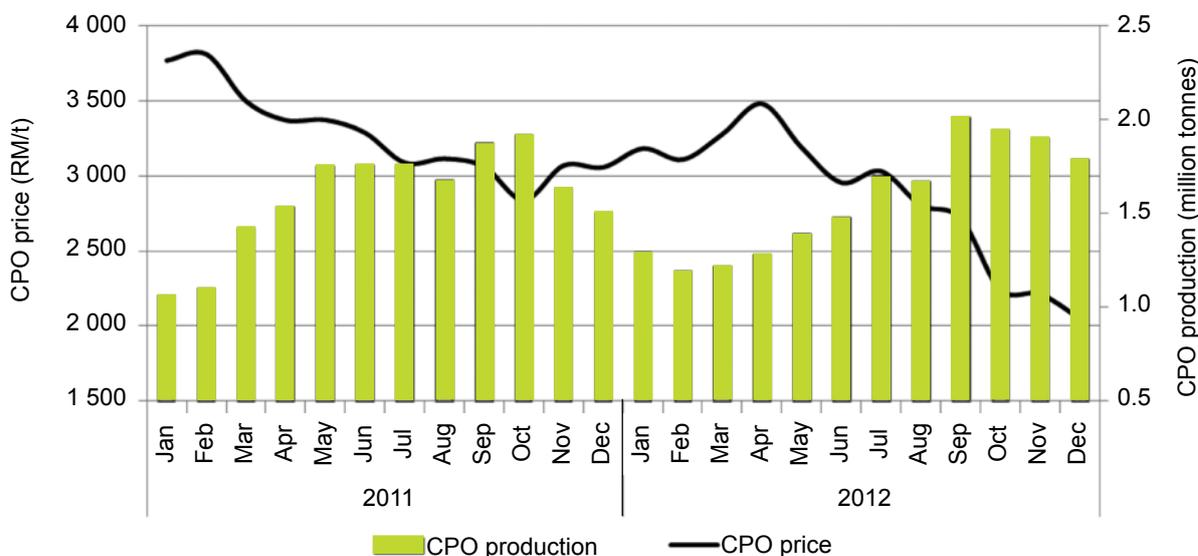
Source: MPOB (2012).

Figure 3. Relationship between production and crude palm oil (CPO) price.

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variables was recorded at -0.6683, which indicates a moderate negative relationship between the two variables.

Malaysian CPO production in 2013 is expected to increase moderately due to the increase in oil palm mature areas and the introduction of the oil palm replanting scheme with a government allocation of funds amounting to RM 100 million, which will reduce CPO production. The scheme is expected to see the replanting of 100 000 ha of unproductive palms and palms over the age of 25 years. Potential FFB loss is estimated at 1.0 million tonnes based on an average FFB yield of 10 t/ha/yr. Therefore, with the average OER at 20%, the estimated potential decline in CPO production is around 0.20 million tonnes.

Palm oil stock is also a component of palm oil supply and comprises both CPO and processed palm oil (PPO). The significant factors affecting palm oil stock levels are CPO production, palm oil imports and palm oil export performance. The relationship between palm oil stock and CPO price is negatively correlated, *i.e.* when palm oil stock increases, price will decline, and *vice versa. Figure 4* shows the monthly palm oil stock in 2012. The high palm oil stock during the first quarter of 2012 was due to high carry-over stocks from December 2011 (close to 2.0 million tonnes) and the slow palm oil export performance. During the second quarter of 2012, the decreasing stock trend was due to the strong palm oil export performance. Meanwhile, for the third and fourth quarters of 2012, the stock was at a high level due to the peak production season and slow export performance.

Figure 5 shows the relationship between palm oil stock and CPO production. This figure illustrates that when CPO production increases, the stock of palm oil also increases. For example, due to the increase in CPO production to 2.00 million tonnes in September 2012 from 1.66 million tonnes in August (or a 21% increase), the palm oil stock increased to 2.48 million tonnes from 2.11 million tonnes (or an 18% increase) over the same period. The correlation index is 0.7383, which indicates a high positive relationship between the two variables.
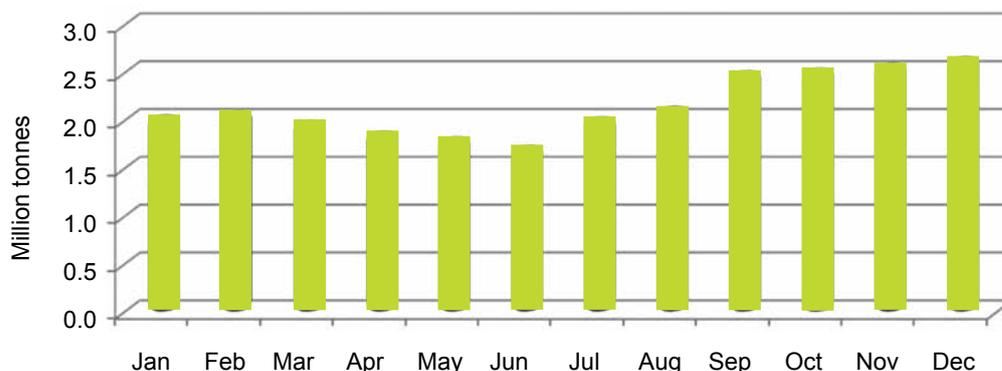
Figure 6 shows the relationship between palm oil stock and palm oil imports. Based on this figure, it was very difficult to prove that palm oil imports had a positive impact on the palm oil stock level. For example, from June until September 2012, while palm oil imports showed a downward trend, palm oil stock showed an upward trend.

Figure 7 shows the relationship between monthly palm oil stock and palm oil exports in 2012. This figure proves that palm oil stock has a negative relationship with palm oil export performance. For example, from June until September 2012, when palm oil export recorded a weak performance, palm oil stock showed an increasing trend.

Figure 8 shows the relationship between monthly palm oil stock and CPO price in 2012. It may be seen that monthly CPO price behaviour in 2012 was strongly influenced by palm oil stock levels. The CPO price bearishness during the fourth quarter of 2012 was clearly due to the high palm oil stock levels during this period. The correlation index is -0.8694, indicating a strong negative relationship between the variables.

High carry-over palm oil stock in December 2012 at 2.62 million tonnes contributed to the high palm oil stock level during the first quarter of 2013 (causing it to be above 2.0 million tonnes). The introduction of the oil palm replanting scheme is, however, expected to reduce CPO production by 200 000 t. Meanwhile, the B5 programme is to be expanded throughout Malaysia in 2013/2014, which will also reduce the level of palm oil stock availability in the country. However, the impact of the oil palm replanting scheme and the B5 programme on palm oil stock and CPO prices is expected to be evident only during the third and fourth quarters of 2013.
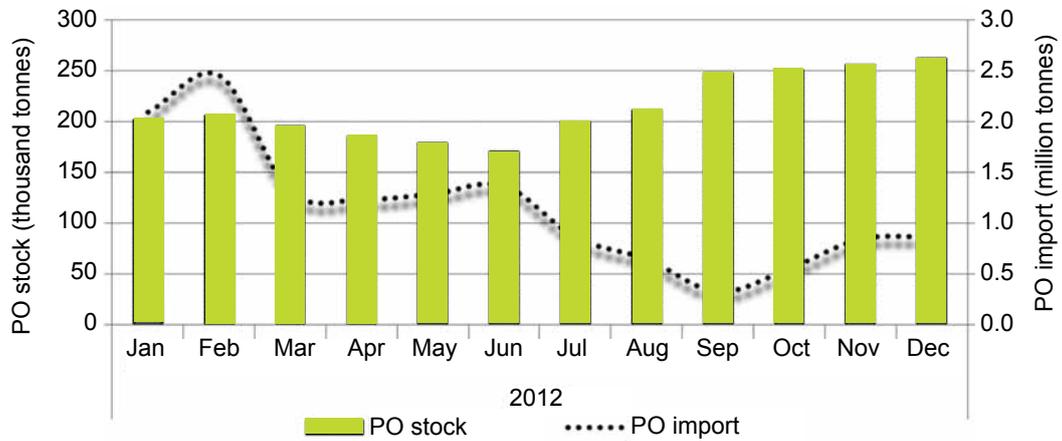

Source: MPOB (2012).
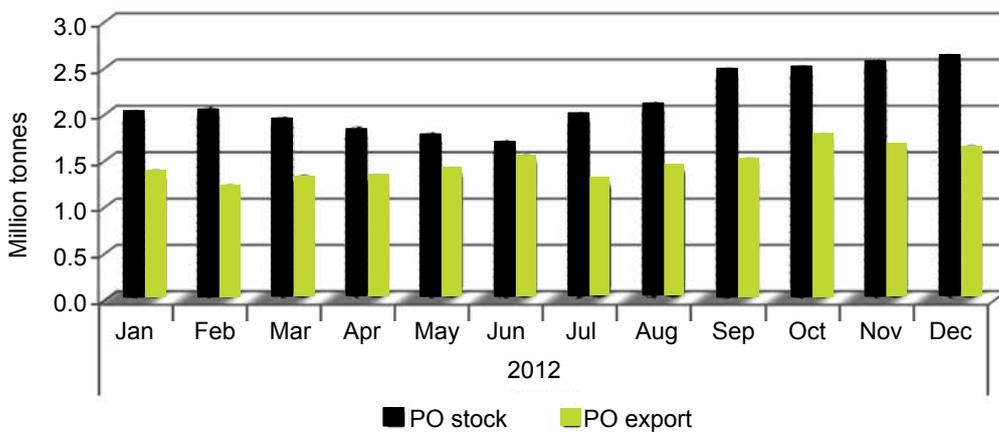
Figure 4. Monthly palm oil stock trends in 2012.
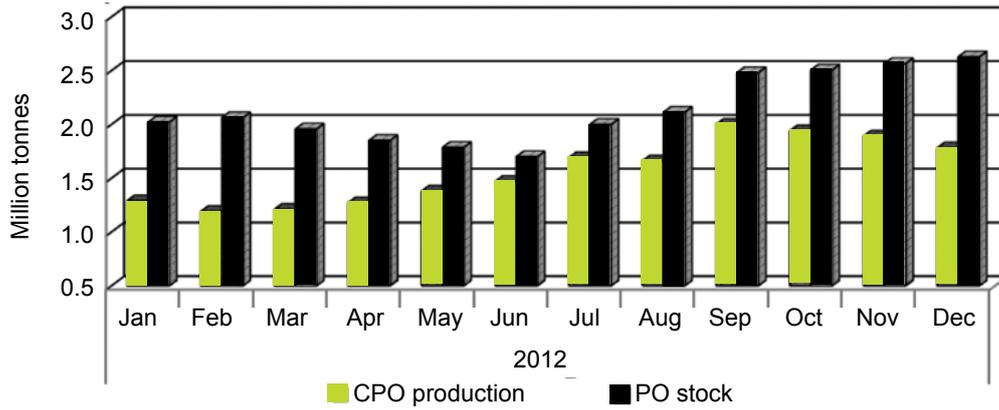
Source: MPOB (2012).

Figure 5. Relationship between palm oil (PO) stock and crude palm oil (CPO) production in 2012.

Source: MPOB (2012).

Figure 6. Relationship between palm oil (PO) stock and palm oil imports in 2012.

Source: MPOB (2012).

Figure 7. Relationship between palm oil stock and (PO) palm oil exports in 2012.

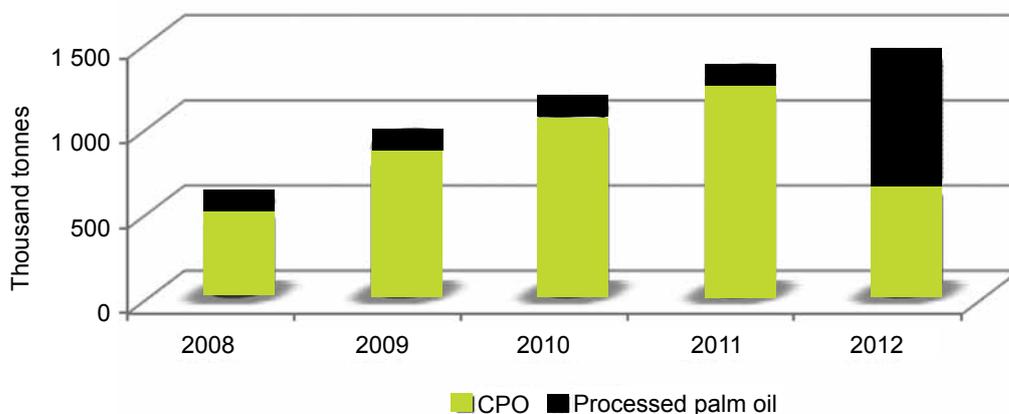*Figure 8. Relationship between palm oil stock and CPO price, 2012.*

Figure 9 shows that the Malaysian palm oil import was uptrending between 2008 and 2012, with an average growth rate of 18.6% for the five-year period. In 2012, PPO imports recorded more than that of CPO, with volumes of 795 000 t and 596 000 t, respectively. This was because the export duty on Indonesian PPO was lower than that imposed on CPO. In 2012, the export duty on Indonesian PPO ranged between 3% and 10%. In comparison, the export duty on CPO in January was 18%, February and March at 16.5%, April at 18%, May and June at 19.5%, July and August at 15%, September and October at 13.5%, and November and December at 9%.

Figure 10 shows the monthly palm oil import trends in 2011 and 2012. The highest volume of palm oil imports was recorded in February at 189 411 t and 246 419 t in 2011 and 2012, respectively. The high volume of palm oil imports during this month was due to the low CPO production in Malaysia resulting from the effect of the monsoon rains. In 2011 and 2012, the lowest volume of palm oil imports were recorded in October and September at 45 478 t and 32 830 t in 2011 and 2012, respectively. The low

volume of palm oil imports during these two months was due to the peak CPO production season in Malaysia. This indicates a negative relationship between palm oil imports and CPO production.

Figure 11 clearly shows that when CPO production decreases, the volume of palm oil imports increases and *vice versa*. For example, in February, CPO production was low at 1.19 million tonnes, while the volume of palm oil imports was at its highest at 0.25 million tonnes. Meanwhile, during the peak CPO production season in September at two million tonnes, palm oil imports were
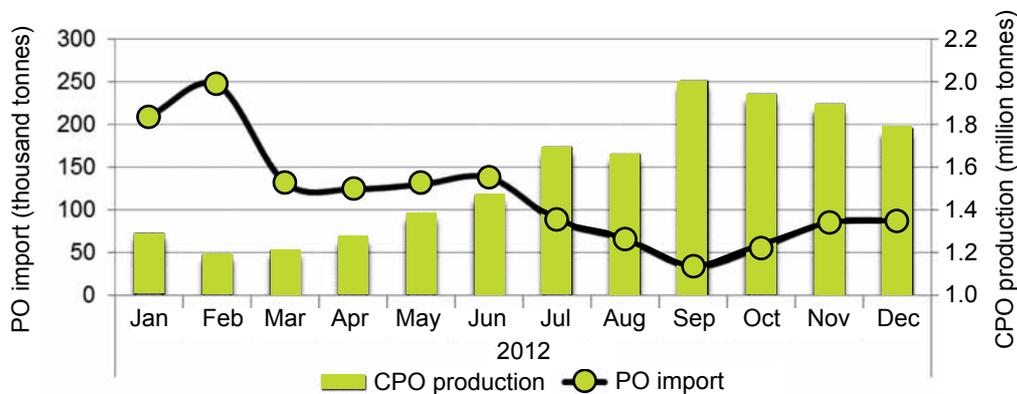
Figure 9. Annual palm oil import trends (2008-2012).
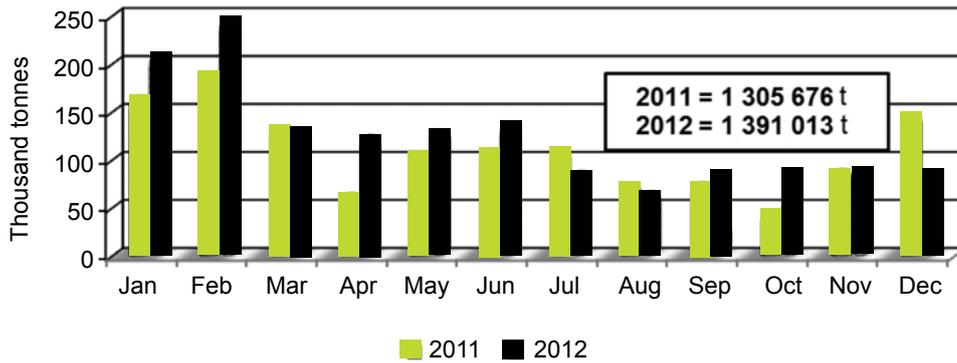
Source: MPOB (2012).

Figure 10. Monthly palm oil import trends in 2011 and 2012.

Source: MPOB (2012).

Figure 11. Relationship between palm oil (PO) import and crude palm oil (CPO) production in 2012.

lowest at 0.03 million tonnes. The correlation index was recorded at -0.8364, which indicates a strong negative relationship between the variables.

Figure 12 shows the relationship between palm oil imports and CPO prices in 2012. Based on this figure, there is no evidence that palm oil imports has any negative relationship with CPO prices even though it is a component of palm oil supply. This is because its volume was not large enough to make an impact on the CPO price behaviour in the market place.

Palm oil imports are expected to continue to increase marginally in 2013. Arising from the relatively low export tax imposed on PPO by the Indonesian government

in 2013, Malaysia is expected to continue to export more PPO than CPO.

DEMAND FOR OIL PALM PRODUCTS

The demand for oil palm products comprises the demand for both semi-processed and end products. *Table 3* shows the total export volume and the value of the oil palm products. Arising from the low palm oil prices in 2012 compared with 2011, the export value of the oil palm products in 2012 decreased to RM 71.40 billion as compared with RM 80.41 billion in 2011, *i.e.* a decline by about 11.2%. However, in 2012 the total export volume of the oil

palm products increased to 24.56 million tonnes as compared with 24.27 million tonnes, an increase of about 1.2%.

Malaysian palm oil is exported to more than 100 countries, and the major importing countries in 2012 were China, P R, India, European Union, Pakistan and USA (*Table 4*). However, exports to the three major destinations showed decreasing trends in 2012 as compared with 2011, with the volume to China, P R declining by 12.1%, Pakistan down by 26.2%, and USA decreased by 2.4%. Meanwhile, the volume of palm oil imports by two other major market destinations, *i.e.* both European Union and India, showed increases. Imports of palm oil by
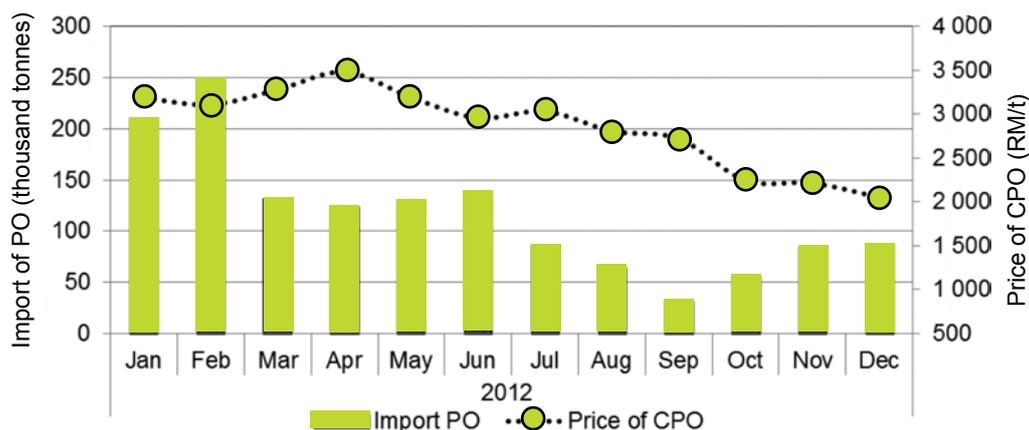
Source: MPOB (2012).

Figure 12. Relationship between palm oil (PO) imports and crude palm oil (CPO) prices in 2012.

TABLE 3. EXPORT VOLUME AND VALUE OF OIL PALM PRODUCTS				
Product	**2011**		**2012**	
	Volume (t)	**Value (RM million)**	**Volume (t)**	**Value (RM million)**
Crude palm oil	3 477 599	11 103.4	4 633 686	13 450.82
Processed palm oil	14 515 666	49 368.4	12 929 155	39 506.41
Total palm oil	17 993 265	60 471.9	17 562 841	52 957.24
Crude palm kernel oil	205 457	908.4	220 132	653.27
Processed palm kernel oil	970 746	5 188.9	863 344	3 441.09
Total palm kernel oil	1 176 203	6 097.4	1 083 476	4 094.35
Palm kernel cake	2 227 410	924.7	2 459 526	1 021.16
Oleochemicals	2 181 430	10 846.9	2 600 812	11 455.66
Biodiesel	49 999	179.7	28 983	98.44
Finished products	402 909	1 717.1	360 795	1 492.98
Others	240 456	173.8	465 197	275.95
Total oil palm products	24 271 672	80 411.4	24 561 620	71 395.77

Source: MPOB (2012).

TABLE 4. PALM OIL EXPORTS FROM MALAYSIA TO MAJOR DESTINATIONS				
No.	**Country**	**2011**	**2012**	**Difference (%)**
1.	China, P R	3 982 128	3 501 677	(12.1)
2.	European Union	2 006 093	2 220 794	10.7
3.	Pakistan	1 821 009	1 343 254	(26.2)
4.	India	1 667 908	2 631 406	57.8
5.	USA	1 054 997	1 029 443	(2.4)
6.	Others	7 461 130	6 836 284	(8.4)
	Total	17 993 265	17 562 858	(2.4)

Source: MPOB (2012).

European Union increased to 2.22 million tonnes in 2012 from 2.00 million tonnes in 2011, an increase by 10.7%. Meanwhile, imports of palm oil by India increased to 2.63 million tonnes in 2012 from 1.67 million tonnes in 2011, an increase of 57.8%.

The Malaysian palm oil industry is very export-oriented. This is because a large proportion of palm oil is exported as PPO in relation to CPO production, ranging between 86% and 98% for the period from 2005 to 2012 (*Table 5*). In 2005, Malaysian CPO production was recorded at 14.96 million tonnes and PPO exports at 13.45 million tonnes, or 89.9%

out of the total CPO production. By 2010, PPO export in relation to CPO production was 98.1% with PPO export at 16.66 million tonnes and CPO production at 16.99 million tonnes. In 2012, Malaysian CPO production was 18.79 million tonnes and PPO export was 17.56 million tonnes, or 93.5% of CPO production. Therefore, it can be concluded that Malaysian CPO price behaviour was more dependent on world demand factors rather than domestic factors.

Based on economic theory, the volume of oil palm export products (as a proxy for palm oil demand) and CPO prices is

negatively correlated. *Figure 13* shows the relationship between the monthly volume of oil palm export products and CPO prices in 2011 and 2012. Based on this figure, the negative relationship between the two variables can be witnessed from July to November 2012, which was when CPO prices declined while the volume of oil palm exports increased. The correlation index for the variables was -0.6568, which indicates a moderate negative relationship.

The demand for palm oil in the world market is also dependent on the price behaviour of the substitute products, *e.g.* soyabean and rapeseed oils (RSO). *Figure*

TABLE 5. CRUDE PALM OIL (CPO) PRODUCTION AND PROCESSED PALM OIL (PPO) EXPORTS (t)			
Year	CPO production	PPO exports	PPO exports in relation to CPO production (%)
2005	14 961 654	13 445 511	89.9
2006	15 880 786	14 423 168	90.8
2007	15 823 745	13 746 823	86.9
2008	17 734 441	15 412 512	86.9
2009	17 564 937	15 880 744	90.4
2010	16 993 717	16 664 068	98.1
2011	18 911 520	17 993 265	95.1
2012	18 785 139	17 562 841	93.5

Source: MPOB (2012).
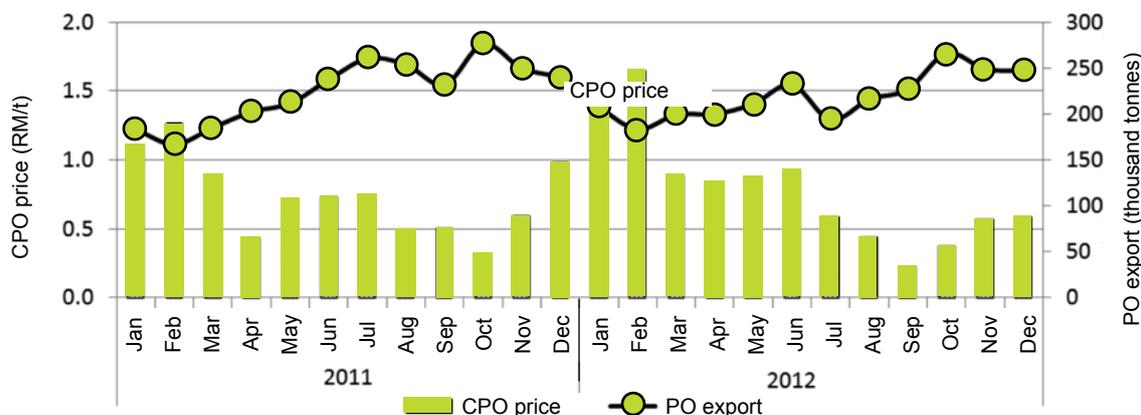
Source: MPOB (2012).
Figure 13. Relationship between volume of oil palm export products and CPO prices in 2011 and 2012.

14 clearly shows that CPO price moves in tandem with those of soyabean and RSO, but with CPO price always at a discount to soyabean. Arising from the fact that CPO is a close substitute of soyabean, the wider the gap between CPO and soyabean prices, the higher is the palm oil demand, and this will lead indirectly to an increase in CPO price in the world market.

Equation (2) shows that palm oil demand is significantly dependent on CPO price (CPO), SBO price (SBO), CPO production (PDO), palm oil stock (STO) and oil palm export products at lagged 1. The analysis proves that CPO price and palm oil stock have a negative impact on the export volume of oil palm products. Based on the analysis, when either CPO price or palm oil stock increased by 1%, the exports of oil palm products are expected to decline by about 0.11% and 0.08%, respectively. Meanwhile, if either SBO price or CPO production increased by 1%, the volume of oil palm export products is expected to increase by about 0.10% and 0.75%, respectively.

Exports of oil palm products are expected to increase marginally in 2013. The expected gradual world economic recovery during the first half of 2013 will contribute to the marginal increase in the export of oil palm products. The introduction of Malaysia's new CPO export tax structure, of between 4.5% and 8.5% effective on 1 January 2013, will contribute to the increase in palm oil exports. Meanwhile, the wider price discount between CPO and SBO prices will continue to boost palm oil exports, especially during the first quarter of 2013.

After Malaysia began exporting palm oil methyl esters as biodiesel and implemented the B5 programme, there has been a strong positive relationship between CPO and Brent crude oil (BCO) prices. *Figure 15* shows that from 2007 until now, CPO and BCO prices move in tandem. The correlation index between the two prices was recorded at 0.7428, which indicates a high correlation.

FACTORS AFFECTING CPO PRICE BEHAVIOUR: EMPIRICAL EVIDENCE

Equation (3) shows that the CPO price behaviour is significantly dependent on all independent variables in the model. This analysis proves that the CPO price behaviour has a negative relationship with CPO production and palm oil stock. When either CPO production or palm oil stock increased by 1%, CPO price is expected to decline by about 0.21% and 0.35%, respectively. However, when either palm oil demand,

Equation (2):

$$DD_t = -0.2236 - 0.1129CPO_t + 0.1022SBO_t + 0.7478PDO_t - 0.0833STO_t + 0.3453DD_{t-1}$$
$$(-0.8867) \quad (-1.9276)^* \quad (1.7956)^* \quad (6.0805)^{**} \quad (-1.3354) \quad (3.5796)^{**}$$

Note: **, * Indicates *t*-statistics significance at 1% and 10%, respectively.
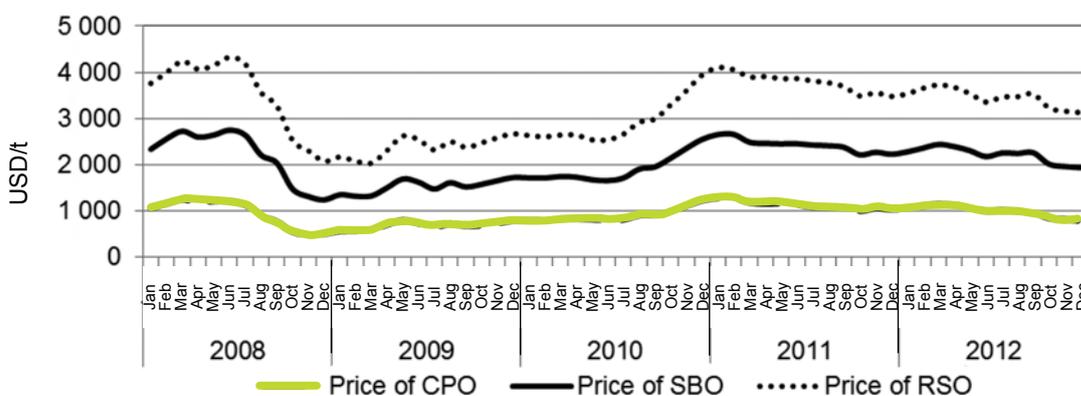$R^2 = 0.9965$; *F*-stat = 1759 (significant at 1%); DW = 2.1606

Equation (3):

$$CPO_t = 6.2540 - 0.2063PDO_t - 0.3466STO_t + 0.1465DD_t + 0.5541SBO_t$$
$$(4.5333)^{**} \quad (-2.8679)^{**} \quad (-4.1662)^{**} \quad (2.0034)^* \quad (4.2179)^{**}$$
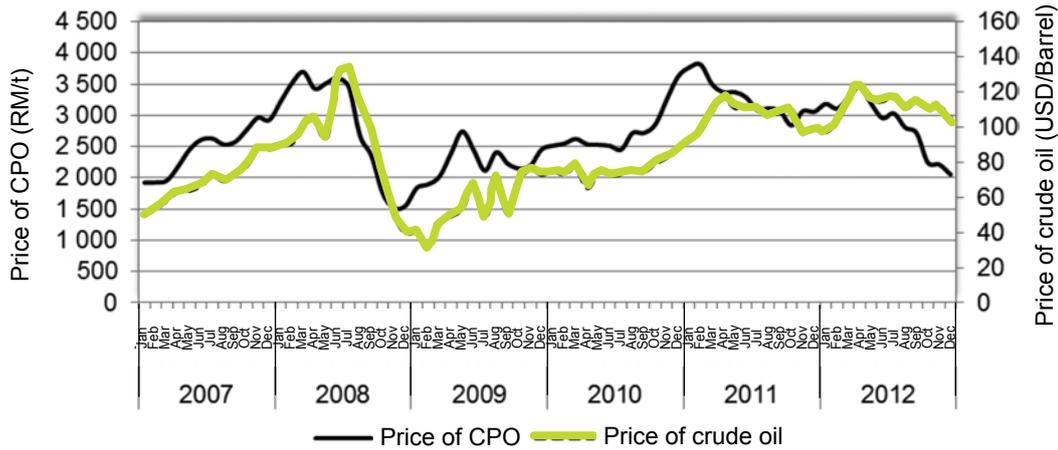$$+ 0.0357BCO_t + 0.4389CPO_{t-1}$$
$$(0.5536) \quad (3.5352)^{**}$$

Note: **, * Indicates *t*-statistics significance at 1% and 5%, respectively.
$R^2 = 0.9020$; *F*-stat = 98.22 (significant at 1%); DW = 1.7825

Source: Oil World (2012).
Figure 14. Relationship between soyabean oil (SBO), rapeseed oil (RSO) and crude palm oil (CPO) prices, 2008-2012.

Source: MPOB (2012).

Figure 15. Relationship between Brent crude oil and crude palm oil (CPO) prices, 2007-2012.

SBO price or BCO price increased by 1%, CPO price is expected to increase by about 0.15%, 0.55% and 0.04%, respectively.

Based on the demand and supply factors, it is evident that CPO price is likely to be firmer in 2013. Palm oil supply is expected to increase moderately due to the introduction of the oil palm replanting scheme. Meanwhile, palm oil demand is expected to be on an upward trend due to the world economic recovery and the new export tax structure that will lead to palm oil being exported more competitively. Meanwhile, the B5 implementation programme throughout the country will create additional demand for palm oil. The wider price discount of CPO *vis-à-vis* SBO price is expected to boost palm oil demand in the short-term, and this can lead to an increase in CPO price in the short-term.

CONCLUSION

CPO price behaviour is crucially dependent on both the supply and demand factors. On the supply side, both CPO production and palm oil stock play a significant role in terms of influencing the CPO price behaviour. On the demand side, exports of oil palm products is a key factor influencing CPO price behaviour. CPO price behaviour will result in a 'shock' reaction if the element of market sentiment becomes unpredictable. The combination of fundamental and market sentiment factors are considered the 'rule of thumb' that will determine CPO price equilibrium in the world market.

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