A Study on the Relationship between the Futures and Physical Prices of Palm Oil

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ABSTRACT

The difference between cash and futures prices is known as basis. It represents the local demand and supply situation as well as the risk factors associated with the physical commodity trade. Forecast basis can be used with the futures prices to predict the cash price of palm oil. In addition, using the expected trends in basis can improve hedging by both buyers and sellers. Forecasts for other crops using basis from simple historical averages compare favourably with the results from more complex forecasting models. This work investigated the behaviour of crude palm oil (CPO) basis and compared practical methods of forecasting CPO basis by regions in Malaysia using multi-year historical averages.

INTRODUCTION

Price volatility is an important risk to producers, traders, consumers and others involved in the production, marketing and trading of palm oil. In situations of considerable uncertainty and, therefore, high risk, accurate and reliable price forecasting is necessary to facilitate decision-making. Hence, futures trading, or specifically futures crude palm oil (FCPO) contract was introduced in 1980 in the country to serve as a mechanism for price discovery as well as for hedging in order to lock in prices.

Price discovery is the process for determining a reasonable price of a good based on its demand and supply. In addition, it is assumed that the market is efficient. The futures price is realized on an aggregate level through arbitrage between multiple buyers and sellers. The futures price was found to perform better than other techniques, including moving average, Holt's Winter Smoothing technique, Box Jenkins technique and Econometric models in forecasting the crude palm oil (CPO) price (Fatimah *et al*., 1994). As a result, the FCPO price is accepted as a readily available, simple, low-cost and relatively good predictor of the CPO price in the future.

Hedging is a process of transferring risk from a person with the physical commodity to a speculator for profit. The futures trade is a temporary substitute for the cash or physical transaction that will occur sometime later. The central theory of hedging is that if the price of the good changes, either up or down, the futures price should change in the same direction with an equal amount. An accomplished hedge occurs when the futures position equals in size, but is opposite to the cash position. The futures exchange exists and successful based on the principle

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that the hedger forgoes some potential profit in exchange for a reduced risk, which is assumed by the speculator to earn his keep. Basically, hedging provides a mechanism to minimize the price risk by stabilizing costs and profit margins.

An oft-pondered relationship in hedging is that between the cash and futures prices. The cash price of CPO and the FCPO price should be closely related because they are mostly affected by the same economic factors simultaneously. However, small differences do occur, known as 'basis'.

Generally, basis reflects the local supply and demand for the good relative to the futures market. The cash price provides a measure of the local supply and demand condition, while the futures price depicts the aggregate supply and demand situation at a higher level, *i.e.* national level. Understanding basis makes it possible to compare the futures price with the cash and forward contract prices, particularly for determining the likely local cash price. On top of that, basis behaviour is generally considered to be the major determinant of hedging success or failure (Peterson *et al.,* 2004).

In the developed countries, information on basis, especially for crops such as soyabean, wheat and corn, is analysed in-depth and provided to agricultural producers and buyers to help them in their trading. Therefore, the basis of CPO should be similarly investigated for information to help local producers and buyers of palm oil make their marketing decisions more effectively.

OBJECTIVE

The main purpose of this study was to investigate the pattern of CPO basis in Malaysia. The study encompasses both the national and regional perspectives of the country, *i.e.* north, south, central, east coast and Sabah.

The second objective was to determine the length of data required for obtaining a historical average that can reliably predict the future prices for each region. Only a simple model will be used so that it can be understandable by all and sundry in the palm oil trade.

METHODOLOGY

Basis is the difference between the cash price of a commodity and its futures price. Using palm oil as an example, basis is defined as follows:

$$Basis_{t,k} = Cash\ Price_{t,k} - Futures\ Price_t \quad (1)$$

where

t refers to the time period either days, weeks or months; and
k refers to the region - north, south, central, east coast and Sabah.

The basis used in this analysis was the monthly average local delivered price of CPO (published by MPOB) less the monthly average futures settlement for the same month. The average monthly futures price is the simple average of the daily FCPO settlement price over the month sourced from Bursa Malaysia Derivatives Berhad (BMDB). Monthly prices for both from 2001 to 2004 were used in this study.

The expected basis for each month was based on historical averages (Taylor *et al*., 2004) and given as:

$$\hat{Basis}_{k,j,i} = \frac{1 \sum Basis_{k,j}}{i} \quad (2)$$

where

$\hat{Basis}$ represents the expected basis;
Basis refers to the observed basis;
k refers to the region - north, south, central, east coast and Sabah,
j refers to the month, *i.e.* January, February,….., December, and
i refers to the number of years included in the historical average.

Equation (1) can be rearranged with cash price as the dependent variable:

$$Cash\ Price_t = Basis_t + Futures\ Price_t \quad (3)$$

The basis can be derived from the historical basis for a particular time of the year. The expected cash price can be obtained using the formula below:

$$Expected\ Cash\ Price_t = Expected\ Basis_t + Futures\ Price_t \quad (4)$$

Historical monthly averages from one to four years over 2001 to 2004 were derived and used to compare against its futures price. Another method of forecasting basis was also used, although considered a naïve forecast, *i.e.* the basis for the previous month taken as the basis for the current month, *e.g.*, the expected basis for February would be the basis of the previous month, *i.e.* January.

The expected monthly CPO prices in 2005 were then compared with the actual ones. A series of forecasts or expected values was made with their errors. For evaluation, a single test statistic, such as the sum of squared errors or root mean square error (RMSE), was used to compare the different forecasts in a general manner. The 'best' technique was that giving the lowest RMSE.

RESULTS AND DISCUSSION

Figure 1 shows the parallel movement of monthly physical and futures prices of CPO that allows the commodity to be hedged. The price of palm oil is known to be volatile, making it particularly attractive for futures trading.

Figure 2 shows the CPO basis from 2001 to 2004. The fluctuation appears random with no discernable trend. Factors affecting the basis for agricultural commodities include: (1) overall supply and demand for the commodity, (2) geographical disparities in supply and demand, (3) transport and its pricing structure, (4) storage cost and space availability, and (5) price expectations (Johnson and McElmury, 1982).

A positive basis, or 'over', indicates a cash price higher than the futures price, while a negative basis, or 'under', means the opposite. The monthly average basis was RM 5.59/t over, *i.e.*, the physical price usually higher than the FCPO price.

Table 1 shows the basis categorized in value bands. The average 'under' was –RM 13.21/t, and the average 'over' RM 16.47/t. Approximately 90% of the monthly bases ranged from RM 20 'under' to RM 30 'over'.

Table 2 shows the average monthly-deferred basis with the more distant ones higher than those for the nearer months because of higher storage charges.

The CPO price can be estimated also from *Table 2*. For example, in

TABLE 1. MONTHLY BASIS BY VALUE BANDS (2001-2004)

Basis category		Percentage
Under	Lower than RM -20	6.7
	RM -20 to RM -10	10.0
	RM -10 to RM 0	20.0
Over	RM 0 to RM 10	23.3
	RM 10 to RM 20	16.7
	RM 20 to RM 30	18.3
	Higher than RM 30	5.0

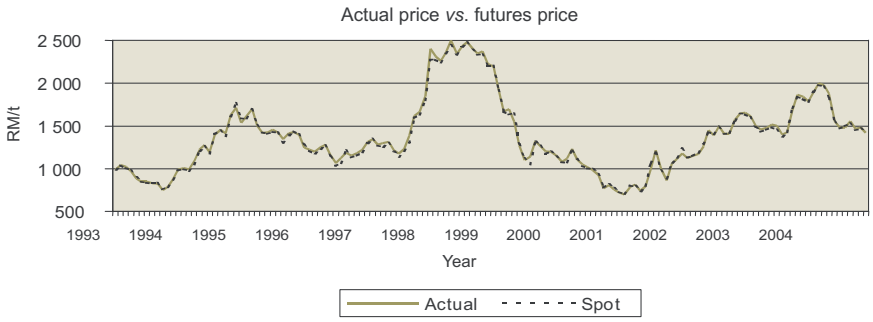

Figure 1. Actual price of crude palm oil (CPO) and futures palm oil (FCPO) price (1993 –2004).

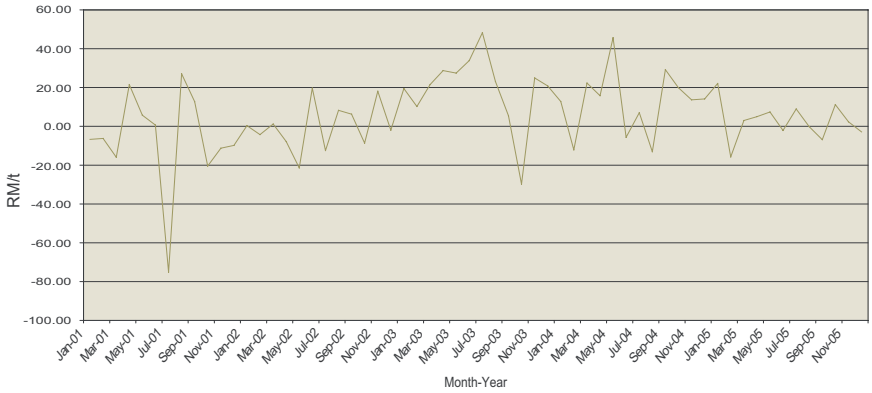

Figure 2. Crude palm oil (CPO) basis (2001-2005).

TABLE 2. AVERAGE MONTHLY DEFERRED BASIS (RM/t)

Contract period	Spot month	Next				
		1-month	2-month	3-month	4-month	5-month
Basis	5.59	15.42	20.68	24.33	29.77	30.62

April, if the FCPO prices for May, June and July are quoted at RM 1400/t, RM 1430/t and RM 1450/t, then by applying Equation (4), the physical prices in the same months should be RM 1415.42/t, RM 1450.68/t and RM 1474.33/t, respectively. This simple technique should only be used if information on other relevant factors is not available.

In the past, the high demand for palm oil ensured that every drop produced locally was gobbled up. Thus, storage and domestic transport were but minor costs to the producers and buyers of CPO. However, storage is becoming more important due to large carry of stocks, exacerbated by the large volume of production by Indonesia. Therefore, understanding the current and future bases is important for maximizing profit with storage and transport costs factored in.

Table 3 shows the average regional bases and their standard deviations. South, central and north regions had positive bases, while east coast and Sabah were negative. The difference was due to

TABLE 3. REGIONAL BASES (2001 – 2005)

Region	South	Central	North	E. coast	Sabah
Average	6.19	5.87	2.06	-19.81	-35.99
Standard Deviation	21.05	18.44	22.11	25.59	27.82

the quirks of the market location. In the former group, there are roughly equal numbers of CPO buyers and sellers, while in the latter group, there are considerably fewer buyers than sellers. For instance, there is only one refinery buying CPO in the east coast, and in Sabah only nine refineries with a total capacity to process 4.2 million tonnes CPO in 2004 as against 101 mills producing 4.8 million tonnes. In addition, the geographical constraints impose higher transport and storage costs in the east coast and Sabah. Hence, the physical CPO price has to be offered at the lower level in order to compete in the particular market, thus making for the negative basis.

In terms of volatility or risk, central is the safest with its basis having the lowest standard deviation, followed by south, north, east coast and Sabah.

Table 4 shows monthly average bases for each region. In the east coast and Sabah, they were 'under' throughout the year, while the north, south and central were mixed, sometimes 'over' and sometimes 'under'.

The movement of basis can be categorized as either strengthening or weakening, depending on its direction. If the basis is becoming more positive, then it has strengthened, and if the value of basis is becoming more negative, then it has weakened.

Basically, there are two types of hedging - short and long. Short hedging is a mode to protect CPO producers such as millers and exporters in a falling market. The miller sells a futures contract and buys it back later, expecting that the profit from the futures position will offset the loss in the physical position. The gain will be optimized if the basis strengthens, *i.e.* the FCPO price falls more than the physical price, whereby the profit from FCPO trading is higher than the loss in the physical CPO trading.

Long hedging offers protection against a rising prices, particularly for CPO buyers such as refiners, by buying the futures contract first and sell later. The profit from the futures trading will absorb any loss in the physical trade. The profit will be maximized if the basis weakens, *i.e.* the FCPO price increases faster than the physical price, which provides higher profit from futures position as compared to the loss in the physical CPO trading. Therefore, the trends in basis, whether strengthening or weakening, are important in hedging.

Figure 3 shows the monthly patterns of regional bases. They move in tandem through the year, strengthening in February to

TABLE 4. MONTHLY AVERAGE REGIONAL BASES (2001 – 2004)

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
South	5.10	-3.09	7.53	15.17	11.87	13.51	-12.45	13.09	18.18	-6.99	10.48	6.54
Central	7.23	-0.84	9.66	11.79	17.49	11.26	-0.07	10.84	9.68	-13.99	11.86	6.04
North	2.60	-15.09	-1.09	19.67	17.62	9.89	-15.32	10.59	7.56	-14.62	13.73	4.17
E.coast	-15.90	-30.96	-17.59	-6.96	-7.38	-8.74	-41.57	-12.66	-16.32	-30.74	-23.39	-23.46
Sabah	-42.45	-47.38	-20.32	-23.78	-14.93	-28.37	-22.73	-29.23	-22.50	-67.34	-31.61	-35.83

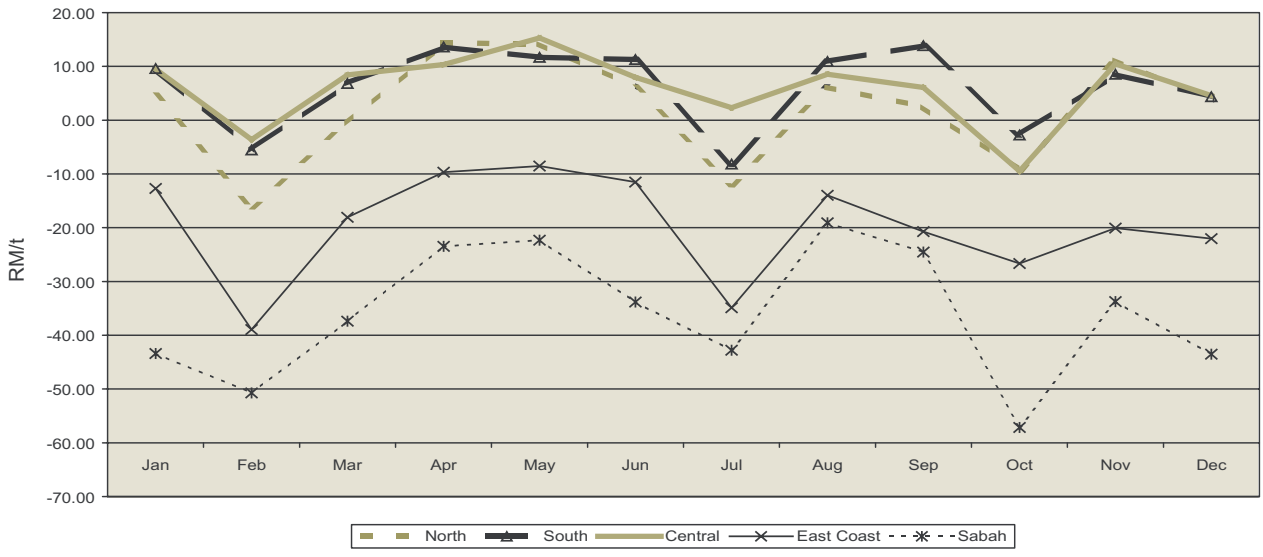

Figure 3. Monthly patterns of regional bases (2001 –2004).

April/May, and then weakening to July. There is also weakening period from August to October, and from November to January. Therefore, if the palm oil price is expected to decrease from February to April, the profit from short hedging can be maximized because the expected strengthening in basis then. On the other hand, the weakening basis in the third- and fourth-quarters can be made use of to maximize profit from long hedging if the price moves upwards.

Tables 5 to *9* show RMSE from using different methods to estimate the monthly CPO price in 2005, which include the multi-year historical average, previous month basis and the futures price itself. For the spot month, the nearby, or spot futures price, is clearly the better one in all the regions except east coast with the two-year average. Usually, the cash price and futures price converge at maturity of the FCPO. The role of basis in deriving the potential cash price can be seen in the estimates for the next one-month price, next two-month price and next three-month price. Overall, the previous one year basis provided better estimates than the rest in most of the regions, except Sabah for the next one-month price, which is better predicted using the two-year average.

CONCLUSION

The FCPO prices can provide good estimates of the palm oil price in the future. The estimates can be further refined into regional or local prices by adding the local basis, which represents the supply and demand factors of the region. Incorporating the CPO basis will also improve the forecasts, nationally as well as regionally.

For hedging using futures, the trend in CPO basis is important and should be use together with

TABLE 5. ROOT MEAN SQUARE ERROR (RMSE) FOR FORECASTING CPO PRICE IN THE NORTH

Methods of calculating basis	Spot month	Next 1-month	Next 2-month	Next 3-month
4-year average	17.37	68.15	72.20	63.92
3-year average	14.15	65.94	71.83	62.25
2-year average	16.42	65.14	72.19	61.77
Previous 1-year	19.67	57.80	66.12	52.68
Previous 1-month	16.73	73.95	80.35	74.60
Futures price	10.44	64.57	74.53	69.25

TABLE 6. ROOT MEAN SQUARE ERROR (RMSE) FOR FORECASTING CPO PRICE IN THE SOUTH

Methods of calculating basis	Spot month	Next 1-month	Next 2-month	Next 3-month
4-year average	15.09	64.83	73.25	65.70
3-year average	12.82	62.70	73.30	64.97
2-year average	12.48	61.55	71.88	62.44
Previous 1-year	16.40	55.54	67.01	56.99
Previous 1-month	16.68	72.23	80.46	73.97
Futures price	10.66	63.14	74.07	68.30

TABLE 7. ROOT MEAN SQUARE ERROR (RMSE) FOR FORECASTING CPO PRICE IN THE CENTRAL

Methods of calculating basis	Spot month	Next 1-month	Next 2-month	Next 3-month
4-year average	12.77	65.76	74.58	65.90
3-year average	11.63	64.96	75.22	65.81
2-year average	14.52	64.84	74.43	62.44
Previous 1-year	17.44	60.93	71.65	57.56
Previous 1-month	15.86	72.48	80.72	73.94
Futures price	9.10	63.39	74.33	68.23

TABLE 8. ROOT MEAN SQUARE ERROR (RMSE) FOR FORECASTING CPO PRICE IN THE EAST COAST

Methods of calculating basis	Spot month	Next 1-month	Next 2-month	Next 3-month
4-year average	20.55	66.97	76.97	71.65
3-year average	18.87	63.39	75.78	69.22
2-year average	14.80	61.71	71.86	62.47
Previous 1-year	24.90	56.00	68.05	52.91
Previous 1-month	24.89	74.99	85.27	80.82
Futures price	18.58	65.44	78.58	74.93

TABLE 9. ROOT MEAN SQUARE ERROR (RMSE) FOR FORECASTING CPO PRICE IN SABAH

Methods of calculating basis	Spot month	Next 1-month	Next 2-month	Next 3-month
4-year average	22.24	70.16	77.90	69.62
3-year average	19.25	66.20	77.35	67.60
2-year average	23.25	66.86	76.97	63.68
Previous 1-year	31.02	67.88	75.31	57.23
Previous 1-month	20.62	75.32	84.64	77.59
Futures price	14.25	66.22	78.23	71.80

the movement of palm oil's price. The period of strengthening basis, *i.e.*, usually from February to April, can be exploited by CPO producers to maximize their profits if the price is expected to fall. On the other hand, buyers should take advantage of weakening basis in the third- and fourth-quarters if they expect the CPO price to rise.

Finally, the previous one year basis was generally found to be adequate for estimating the cash price in the next one to three months. The exception was Sabah, for which prediction of the next one-month price should use the basis based on a two-year average.

ACKNOWLEDGEMENT

The authors wish to thank the Director-General of MPOB for permission to carry out this study. Appreciation is also recorded for Jamil Nordin, Director of the Economics and Industry Development Division, Kamaruddin Mohd Idris of Industry Development Unit and Techno-Economic Unit staff for their cooperation and assistance.

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