Pertanika J. Soc. Sci. & Hum. 10(1): 73-84 (2002)

ISSN: 0128-7702
© Universiti Putra Malaysia Press

The Temporal Price Relationship between the Stock Index Futures and the Underlying Stock Index: Evidence from Malaysia

MAHDHIR ABDULLAH, ANNUAR MOHD. NASIR, SHAMSHER MOHAMAD, HUSON JOHER ALIAHMED & TAUFIQ HASSAN

Department of Accounting and Finance
Faculty of Economics and Management
Universiti Putra Malaysia
43400 Serdang
Selangor, Malaysia

Keywords: Stock index futures, lead and lag relationships

ABSTRAK

Kontrak niagaan ke depan telah diperkenalkan di pasaran derivatif Malaysia pada bulan Disember 1995 dengan pelancaran kontrak niaga ke hadapan di atas Indeks Komposit Bursa Saham Kuala Lumpur. Oleh kerana kontrak ini baru diniagakan di pasaran derivatif Malaysia (MDEX) banyak isu berkenaan produk kewangan ini masih belum sempat dikaji. Kajian ini meneliti kajian temporal (iaitu kaitan lat dan tunggu) antara harga kontrak ke depan (FKLI) yang berasaskan Indeks Komposit BSKL dan harga Indeks Saham Komposit BSKL (KLSE CI). Kajian ini yang meliputi jangka masa lima tahun dibahagikan kepada tiga jangka masa yang berlainan berasaskan tahap kemudahubahan harga yang berlainan, untuk meneliti pola kaitan pergerakan harga. Penemuan kajian ini menunjukkan pasaran kontrak ke depan mendahului pasaran BSKL selama sehari dalam keadaan ekonomi stabil dan tidak terdapat pola kaitan harga antara pasaran ini dalam keadaan di mana menghadapi kemudahubahan harga yang tinggi.

ABSTRACT

The stock index futures was introduced in Malaysia in December 1995 with the launching of the futures contract on the Kuala Lumpur Stock Exchange Composite Index. Due to its recentness in the country, many issues pertaining to this equity derivatives instrument have not been explored. Thus, the development of stock index futures opens many opportunities for research in this area. This study examines the temporal relationship between the price of the Kuala Lumpur Stock Exchange Composite Index futures contract (FKLI) and its underlying stock index, the Kuala Lumpur Stock Exchange Composite Index (KLSE CI). The five-year period under study is split into three subperiods to observe the price co-movement pattern under different volatility levels. The study finds that futures market tends to lead the spot market by one day during the periods of stable market, and there is a mixed lead-lag relationship between the two markets during the period of highly volatile market.

INTRODUCTION

This study examines the temporal price relationship between the Kuala Lumpur Stock Exchange Composite Index futures contract (FKLI) and the Kuala Lumpur Stock Exchange Composite Index (KLSE CI) for the period from 15th December 1995 to 31st December 2000. The objective of the research is to determine the lead and lag relationship between the futures market and the spot market particularly in the context of an emerging equity market like Malaysia. The lead and lag pattern between the futures and the spot markets exists when the information is processed at different speeds in the two markets. Price discovery takes place in the market that processes the information faster than it does in the other market. The findings of this study would be of benefit to investors to

make better and informed investment decisions whether they trade in both the futures and the cash markets or if they trade in only one of the markets.

LITERATURE

There are a number of related studies that have been done in this area but most of them are based on developed markets like the U.S. Very few have been done in emerging markets. Kawaller *et al.* (1987) undertook a study on price relationships between the S&P 500 futures contract and the S&P 500 index and found that the futures market tends to lead the spot market by between twenty and forty-five minutes. Herbst *et al.* (1987) investigated the lead and lag relationship between the stock indices and the futures contracts for the Value Line index and its futures, and for the S&P 500 index and the S&P 500 index futures. They first tested the relationship using daily data and found that there is a time lead of less than one day between the futures market and the spot market. To validate and refine the result, they extended the study using intraday data and found that the stock index futures prices lead those of their cash indices for both the Value Line and the S&P 500 indices. The Value Line index futures is found to lead the Value Line index between zero and sixteen minutes, while the S&P 500 index futures tends to lead its underlying stock index between one and eight minutes. Schwarz and Laatsch (1991) conducted a lead-lag study on Major Market Index Maxi futures in relation to market maturation. They found that the spot market dominates the futures market in price leadership in the first ten months of the MMI Maxi futures contract trading. The price leadership pattern did not change in the subsequent ten months of futures trading but was reversed in the following five months. The authors found that there is a large increase in price leadership for the futures market and there is a substantial increase in pricing efficiency as the futures market becomes more mature.

There are also studies that found bi-directional relationships between the stock index futures and the stock index. Stoll and Whaley (1990) performed a lead-lag study using the S&P 500 index and the S&P 500 index futures, and the Major Market Index (MMI) and MMI futures. They found that futures returns lead those of the cash indices by up to ten minutes and this relationship is found to be bi-directional. A study by Tse (1999) on Dow Jones Industrial Average (DJIA) index and DJIA index futures found that price discovery takes place in the futures market but there exists a significant bi-directional information flow between the two markets.

Outside the United States, investigation of the lead and lag relationship between the futures market and the spot market generally results in almost similar findings as the studies done in the United States. Shyy *et al.* (1996) performed a study in French markets and found that CAC 40 futures returns lead the CAC 40 index returns by three to five minutes when they used transaction data but the causality was reversed when they used the midpoint of bid and ask prices. A study by Frino and West (1999) on Australian markets found that the futures returns lead index returns by twenty to twenty-five minutes and there is some evidence of feedback from the cash market to the futures market. Twite (1991) performed a lead-lag study on the Australian All Ordinaries index and concluded that there is a strong contemporaneous relationship between the futures and the cash markets, and there is also evidence that futures returns lead the spot returns by one day. Grunbichler *et al.* (1994) studied the relationship between the screen-based DAX index futures and the floor-traded DAX index and found that the futures returns lead the spot returns by fifteen minutes and there is weak evidence that the spot returns lead the futures returns by five minutes.

In Asian markets, there have been a few studies on the lead-lag relationship between the futures market and the spot market. Tse (1995) performed a study on the Nikkei Stock Average futures traded on SIMEX and the underlying stock index. The author found that the spot price is influenced by the spot and futures price from up to two days previously, while the futures price is not affected by the past spot or futures prices. Min and Najand (1999) did a study on Korean futures and spot markets and found that the futures market leads the spot market by as long as thirty minutes.

In general, most of the studies cited above found that the stock index futures tends to lead the underlying stock index. However, there are studies that found bi-directional causality between the futures and the spot markets.

DATA AND METHODOLOGY

Two sets of data are used in this study namely the data for the FKLI futures contract and the data for the KLSE CI. The data set for the FKLI futures contract which consists of the daily settlement prices and the daily trading volume is gathered from the Malaysia Derivatives Exchange's (MDEX) historical database provided by its Strategic Planning and Product Development Department. The daily closing prices of KLSE CI are obtained from Thomson Financial Datastream. The sample of data is from 15th December 1995 until 31st December 2000. The sample is split into three subperiods to reflect the changing volatility levels throughout the five-year period under review. The subperiods are:

1) Subperiod 1 – from 15th December 1995 to 30th June 1997;
2) Subperiod 2 – from 1st July 1997 to 30th September 1998; and
3) Subperiod 3 – from 1st October 1998 to 31st December 2000.

The subperiods are arbitrarily selected based on the patterns of price fluctuations and the trading volume of the spot-month FKLI contract as reported in the descriptive statistics in subsection 3.1. Subperiod 1 is the period of stable prices and low trading volume, subperiod 2 is the period of highly fluctuating prices and high trading volume while subperiod 3 is the period of mildly volatile prices and fairly high trading volume. The graphical illustration of the FKLI settlement price and the contract's volume for the period under study is presented in *Fig. 1* below.

Descriptive Statistics

In this section, the descriptive statistics of the spot-month FKLI and the KLSE CI are discussed in greater detail. The mean, highest, lowest and standard deviation of the spot-month FKLI's settlement prices and trading volume during different subperiods are looked into. Similar statistics for the KLSE CI's closing prices are discussed in this section. Table 1 shows the descriptive statistics for the spot-month FKLI futures contract during the three different subperiods. Looking at the price level, it has been observed that subperiod 1 records the highest average settlement price of 1,140.59 index points. The average settlement price drops to 630.58 index points in subperiod 2 and bounces back to 740.31 points. In terms of the range of price fluctuation, subperiod 1 has the smallest range while subperiod 2 has the largest. Such observations are confirmed by the standard deviations of 14.62 percent, 76.49 percent and 44.37 percent in subperiod 1, subperiod 2 and subperiod 3 respectively.

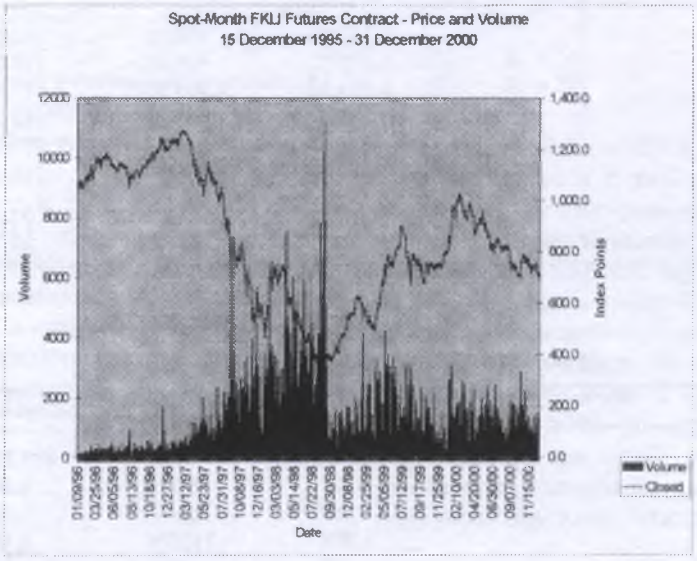

Fig. 1: Spot-month FKLI futures contract: Settlement price and volume from 15th December 1995 to 31st December 2000

With regards to the closing price of the KLSE CI, similar patterns are observed as shown in Table 2. The index is at above the 1,000 level in subperiod 1, then falls to 636.65 in the following subperiod and rebounds to 733.32 in subperiod 3. The KLSE CI fluctuates in a narrow band in subperiod 1 but the range widens in subperiods 2 and 3. The annualised standard deviations are 13.75 percent, 61.58 percent and 25.34 percent in subperiod 1, subperiod 2 and subperiod 3 accordingly.

The other variable that is of concern in this study is the trading volume of the stock index futures contract. The volume has been found to form a significant pattern during the five-year period under study. The spot-month FKLI contract trading volume is very low in the early stage of the index futures trading but jumps substantially in late 1997 until the third quarter of 1998. Thereafter, the volume drops but still remains at reasonably high levels. The descriptive statistics of the spot-month FKLI futures contract are presented in Table 3. From the summarised information, it can be seen that subperiod 1 has the lowest trading volume with an average daily turnover of 351 contracts. Subperiod 2 has an average daily volume of 2,507 contracts and records the highest daily volume of 11,238

TABLE 1
Descriptive statistics: Spot-month FKLI contract

	Subperiod 1	Subperiod 2	Subperiod 3	Whole Period
Mean	**1,140.59**	**630.58**	**740.31**	**835.32**
Median	1,133.55	608.90	750.50	799.00
Maximum	**1,272.50**	**1,076.10**	**1,026.50**	**1,272.50**
Minimum	**976.90**	**274.90**	**374.90**	**274.90**
Variance	4,194.32	35,804.60	21,923.57	62,867.06
Standard deviation	64.76	189.22	148.07	250.73
Mean of annualised returns	**6.52%**	**-42.21%**	**37.08%**	**2.419%**
Annualised standard deviation of returns	**14.62%**	**76.49%**	**31.67%**	**44.37%**

TABLE 2
Descriptive statistics: KLSE CI

	Subperiod 1	Subperiod 2	Subperiod 3	Whole Period
Mean	**1,140.83**	**636.65**	**733.32**	**833.78**
Median	1,135.17	623.98	745.25	799.54
Maximum	**1,271.57**	**1,084.88**	**1,013.27**	**1,271.57**
Minimum	**977.49**	**262.70**	**360.10**	**262.70**
Variance	4,071.65	37,243.27	22,297.75	63,401.10
Standard deviation	63.81	192.99	149.32	251.80
Mean of annualised returns	**6.60%**	**-48.15%**	**34.59%**	**-1.091%**
Annualised standard deviation of returns	**13.75%**	**61.58%**	**25.34%**	**35.92%**

TABLE 3
Descriptive statistics: Spot-month FKLI's volume

	Subperiod 1	Subperiod 2	Subperiod 3	Whole Period
Total	**132,820**	**777,116**	**693,211**	**1,603,147**
Mean	**351**	**2,507**	**1,247**	**1,289**
Median	266	2,277	1,091	957
Maximum	**1,965**	**11,238**	**4,171**	**11,238**
Minimum	**17**	**246**	**146**	**17**
Variance	89,268	2,290,314	490,426	1,453,430
Standard Deviation	299	1,513	700	1,206

contracts. The third subperiod records moderately high volumes with a daily volume of 1,247 contracts on average.

From the descriptive statistics discussed above, the three subperiods can be classified in the following manner:

1) Subperiod 1 is the period of stable prices and low futures trading volume;
2) Subperiod 2 is the period of a highly volatile market and high trading volume in the futures market; and
3) Subperiod 3 is the period of a mildly volatile market and fairly high futures trading volume.

The data sets are first tested for the properties of time series namely the test for stationarity and the test for autocorrelation. A unit-root test known as the Augmented Dickey-Fuller (ADF) method is used to test for stationarity of the KLSE CI and the FKLI series. The ADF method performs a simple test for stationarity by regressing the first-difference of a time series against its lagged series as shown in equation 1. First, the ADF is done at level term to test for the existence of a unit root. If there exists a unit root, the series is nonstationary. Therefore, ADF has to be performed at the first difference. The process is continued until the series is found to be stationary.

$$\Delta Y_t = (\rho\text{-}I)Y_{t-1} + \mu_t \qquad (1)$$

where ΔY_t is the difference or change in Y at time t, $(Y_t - Y_{t-1})$;
Y_{t-1} is a lag one observation in series Y;
ρ is the autocorrelation coefficient; and
μ_t is the white noise error term.

The second test is to check whether the KLSE CI and the FKLI series are autocorrelated. To test for autocorrelation, a measure known as Durbin-Watson *d* statistics is used. If there exists an autocorrelation, a corrective measure has to be taken to avoid spurious results. The Durbin-Watson *d* statistic is computed using the following equation:

$$d = \frac{\sum(\hat{u}_t - \hat{u}_{t-1})^2}{\sum \hat{u}_t^2} \qquad (2)$$

which is the ratio of the sum of squared differences in successive residuals to the residual sum of squared.

After cleaning for nonstationarity and autocorrelation, the test for lead-lag relationship between the FKLI futures and the KLSE CI is performed. In this study, a multiple regression model is employed with the KLSE CI returns being the dependent variable and the lagged, contemporaneous and lead FKLI returns being the explanatory variables. The equation of the multiple regression model is expressed as follows:

$$R_{St} = \alpha + \beta_{-4}R_{Ft-4} + \beta_{-3}R_{Ft-3} + \beta_{-2}R_{Ft-2} + \beta_{-1}R_{Ft-1} + \beta_0 R_{Ft} + \beta_1 R_{Ft+1} + \beta_2 R_{Ft+2} + \beta_3 R_{Ft+3} + \beta_4 R_{Ft+4} + \varepsilon_t \qquad (3)$$

Where R_{St} is the KLSE CI return at time t or $[\ln(KLSE_t / KLSE_{t-1})]$;
R_{Ft} is the FKLI return at time t or $[\ln(FKLI_t / FKLI_{t-1})]$;
R_{Ft+k} is the FKLI return at lag k;
R_{Ft+k} is the FKLI return at lead k;
α is the regression intercept;
β_k is the coefficient of the independent variable; and
ε_t is the error term.

The null hypothesis that there is no significant lead-lag relationship between the index futures returns and the stock index returns is developed and is then tested. The hypothesis is presented below:

$$H_0 : \beta_k = 0$$
$$H_1 : \beta_k \neq 0$$

The sign of the coefficient, β_k is expected to be positive since it is anticipated that the spot market and the futures market move in tandem with each other. Since the study attempts to determine the lead and lag relationship under different market volatility levels, the regression analysis is performed separately for all the three subperiods. In addition, the regression is run for the whole period from 15 December 1995 until 31 December 2000. In running the multiple regression for the whole period, two dummy variables are introduced and included in the regression equation. The inclusion of these

1 Gujarati Damodar N. 1995. *Basic Econometrics*, p. 506. Singapore: McGraw Hill.

dummy variables is to reflect the existence of qualitative variables, in this case the three different subperiods. Since there are three qualitative variables, the rule that "the number of dummies be one less than the number of categories of the variable" is followed[1]. The reason for including the dummies in the regression is to determine whether each subperiod is significant or dominant in explaining the variation in the KLSE CI. The multiple regression equation with dummy variables is re-arranged in the following manner:

$$R_{St} = C + \beta_{-4}R_{Ft-4} + \beta_{-3}R_{Ft-3} + \beta_{-2}R_{Ft-2} + \beta_{-1}R_{Ft-1} + \beta_0 R_{Ft} + \beta_1 R_{Ft+1} + \beta_2 R_{Ft+2} + \beta_3 R_{Ft+3} + \beta_4 R_{Ft+4} + \alpha_1 D_1 + \alpha_2 D_2 + \varepsilon_t \quad (4)$$

where C is the intercept;

R_{St} is the KLSE CI return at time t or $[\ln(KLSE_t / KLSE_{t-1})]$;

R_{Ft} is the FKLI return at time t or $[\ln(FKLI_t / FKLI_{t-1})]$;

R_{Ft-k} is the FKLI return at lag k;

R_{Ft+k} is the FKLI return at lead k;

b_k is the coefficient of the independent variable;

a_1 is the coefficient of dummy variable D_1;

a_2 is the coefficient of dummy variable D_2; and

e_t is the error term.

D1 = 1 if subperiod 1,
= 0 otherwise;

D2 = 1 if subperiod 2,
= 0 otherwise.

Again, a hypothesis is developed and tested. There are two sets of hypotheses in this model – the first is to test whether the lead and lag FKLI returns are significant and the second is to test whether the dummy variables are significant. The two sets of hypothesis are presented below:

Set 1
$H_0 : \beta_k = 0$
$H_1 : \beta_k \neq 0$

Set 2
$H_0 : \beta_k = 0$
$H_1 : \beta_k \neq 0$

RESULTS

The results of the tests are presented in the following sub-sections:

Test for Stationarity

The Augmented Dickey-Fuller (ADF) test for stationarity on KLSE CI provides a result that the absolute value of the computed τ(tau) statistic (|-1.062|) is less than the absolute value of the critical Dickey-Fuller t value (|-2.864| at 1 percent) when the test is performed on level terms. For the FKLI, a similar result is found where the absolute value of the computed Dickey-Fuller τ value (|-1.099|) is less than the absolute value of the critical τ (|-2.864| at 5 percent level of significance). When tested on the first-difference of both the KLSE CI and the FKLI series, the absolute value of the computed τ(tau) statistics is found to be greater than the absolute value of the critical Dickey-Fuller τ value. The computed τ(tau) statistics for the first-difference KLSE CI and the first-difference FKLI are –15.664 and –16.307, respectively. Therefore, it is not sufficient to reject the null hypothesis that the series are stationary. In simpler terms, it is said that both the KLSE CI and the FKLI series are stationary at first-difference, or statistically expressed as integrated of order 1, I(1). The results are presented in Tables 4 and 5.

Test for Autocorrelation

In testing for autocorrelation, the Durbin-Watson *d* statistics are computed to be 2.038 which suggests that there is no positive or negative autocorrelation.

Multiple Regression

First, the multiple regression is run separately for the three subperiods to see how the lead and lag pattern changes under different volatility levels. The result for sub-period 1 is presented in Table 6. From the summarised information in Table 6, it is reported that the regression model has a high adjusted R squared of 0.7976. In terms of the significance of the explanatory variables, the t-value for $FKLI_{t-0}$ (36.780) is found to be higher than the critical t-value at 1 percent level of significance (2.576). Therefore it is sufficient to reject the null hypothesis that the coefficient of $FKLI_{t-0}$ is equal to zero. Furthermore, the coefficient of $FKLI_{t-1}$ is found to be significant at a 5 percent level with its t-value (2.549) higher than the critical t-value at 5

TABLE 4
Augmented Dickey-Fuller (ADF) results for the level term

KLSE CI			
ADF Test Statistic	**-1.062**	1% Critical Value*	-3.438
		5% Critical Value	-2.864
		10% Critical Value	-2.568
*MacKinnon critical values for rejection of hypothesis of a unit root.			
Durbin-Watson Statistic		1.991	
FKLI			
ADF Test Statistic	**-1.099**	1% Critical Value*	-3.438
		5% Critical Value	-2.864
		10% Critical Value	-2.568
*MacKinnon critical values for rejection of hypothesis of a unit root.			
Durbin-Watson Statistic		1.991	

The KLSE CI and the FKLI series are nonstationary at the level term since the computed t(tau) statistics are less than the critical τ(tau) statistics.

TABLE 5
Augmented Dickey-Fuller (ADF) results for the first-difference

KLSE CI			
ADF Test Statistic	**-15.664**	1% Critical Value*	-3.438
		5% Critical Value	-2.864
		10% Critical Value	-2.568
*MacKinnon critical values for rejection of hypothesis of a unit root.			
Durbin-Watson Statistic		1.995	
FKLI			
ADF Test Statistic	**-16.30659**	1% Critical Value*	-3.4382
		5% Critical Value	-2.8642
		10% Critical Value	-2.5682
*MacKinnon critical values for rejection of hypothesis of a unit root.			
Durbin-Watson Statistic	1.997		

The KLSE CI and the FKLI series are stationary at the first-difference, or I(1) since the computed t(tau) statistics are greater than the critical t(tau) statistics.

percent (1.960). It is therefore safe to say that there exists a leading effect from the futures market to the spot market by one day at a 5 percent level of significance.

The results for subperiod 2 are reported in Table 7. This is the period of a highly volatile market and a high trading volume in the futures market. The regression model has a high adjusted R-squared of 0.8823 during this subperiod. From the table, it is observed that $FKLI_{t-2}$, $FKLI_{t-1}$, $FKLI_{t-0}$, $FKLI_{t+3}$, and $FKLI_{t+4}$ are significant at a 1 percent level, $FKLI_{t-4}$ is significant at a 5 percent level of significance while $FKLI_{t-3}$, $FKLI_{t+1}$ and $FKLI_{t+2}$ are not significant. Therefore, it is concluded that there is a mixed lead-lag relationship between the FKLI futures returns and the spot KLSE CI returns during the period of high volatility.

TABLE 6
Results: Subperiod 1 (from 15th December 1995 to 30th June 1997)

R Squared = 0.8022
Adjusted R Squared = 0.7976

Variable Name	Estimated Coefficient	Standard Error	T-Ratio	P-Value
$FKLI_{t-4}$	-0.24642E-01	0.2141E-01	-1.151	0.250
$FKLI_{t-3}$	-0.10149E-01	0.2240E-01	-0.453	0.650
$FKLI_{t-2}$	0.29200E-01	0.2230E-01	1.310	0.190
$FKLI_{t-1}$	0.56604E-01	0.2220E-01	2.549**	0.011
$FKLI_{t-0}$	0.81995	0.2229E-01	36.780*	0.000
$FKLI_{t+1}$	0.40191E-01	0.2217E-01	1.813	0.070
$FKLI_{t+2}$	-0.23667E-01	0.2224E-01	-1.064	0.287
$FKLI_{t+3}$	0.58897E-02	0.2249E-01	0.262	0.793
$FKLI_{t+4}$	0.18508E-02	0.2153E-01	0.859E-01	0.931
Constant	0.37793E-04	0.1543E-03	0.245	0.807

Durbin-Watson = 2.0546

* Significant at 1 percent
** Significant at 5 percent

TABLE 7
Results: Subperiod 2 (from 1st July 1997 to 30th September 1998)

R Squared = 0.8855
Adjusted R Squared = 0.8823

Variable Name	Estimated Coefficient	Standard Error	T-Ratio	P-Value
$FKLI_{t-4}$	0.32039E-01	0.1524E-01	2.102**	0.036
$FKLI_{t-3}$	-0.14835E-01	0.1553E-01	-0.956	0.339
$FKLI_{t-2}$	0.70569E-01	0.1558E-01	4.529*	0.000
$FKLI_{t-1}$	0.13014	0.1553E-01	8.380*	0.000
$FKLI_{t-0}$	0.73432	0.1565E-01	46.920*	0.000
$FKLI_{t+1}$	0.24602E-01	0.1552E-01	1.585	0.113
$FKLI_{t+2}$	-0.23609E-01	0.1558E-01	-1.516	0.130
$FKLI_{t+3}$	0.72408E-01	0.1552E-01	4.667*	0.000
$FKLI_{t+4}$	-0.67640E-01	0.1521E-01	-4.447*	0.000
Constant	-0.16871E-03	0.5373E-03	-0.3140	0.754

Durbin-Watson = 2.1010

* Significant at 1 percent
** Significant at 5 percent

Subperiod 3 is found to have a meaningful pattern with $FKLI_{t-1}$ and $FKLI_{t-0}$ being significant at a 1 percent level. The t-value for $FKLI_{t-1}$ and $FKLI_{t-0}$ are calculated to be 9.492 and 42.880, respectively. These values are higher than the critical t-value of 2.576 at a 1 percent level of significance. Thus, it is sufficient to reject the null hypothesis for b_{-1} and b_0. This means that there is evidence that the futures market leads the spot market by one day during this subperiod, the period of mildly volatile markets and fairly high trading volume. The results are presented in Table 8.

The multiple regression model is then extended to include the whole period from 15 December 1995 until 31 December 2000. The result shows that the model has a high goodness of fit with an adjusted R-squared of 0.8448 (Table 9). In terms of the significance of the independent variables, the following variables are found to be significant at a 1 percent level - $FKLI_{t-0}$, $FKLI_{t-1}$, $FKLI_{t-2}$, $FKLI_{t+3}$, $FKLI_{t+4}$. Variables

TABLE 8
Results: Subperiod 3 (from 1st October 1998 to 31st December 2000)

R Squared = 0.7711
Adjusted R Squared = 0.7675

Variable Name	Estimated Coefficient	Standard Error	T-Ratio	P-Value
$FKLI_{t-4}$	-0.13358E-01	0.1609E-01	-0.830	0.406
$FKLI_{t-3}$	0.28946E-01	0.1612E-01	1.796	0.073
$FKLI_{t-2}$	0.24236E-01	0.1617E-01	1.498	0.134
$FKLI_{t-1}$	0.15407	0.1623E-01	9.492*	0.000
$FKLI_{t-0}$	0.69464	0.1620E-01	42.880*	0.000
$FKLI_{t+1}$	-0.24204E-02	0.1624E-01	-0.1490	0.882
$FKLI_{t+2}$	-0.12831E-02	0.1619E-01	-0.793E-01	0.937
$FKLI_{t+3}$	-0.13061E-02	0.1612E-01	-0.8101E-01	0.935
$FKLI_{t+4}$	0.24450E-01	0.1617E-01	1.512	0.131
Constant	0.93208E-04	0.3096E-03	0.3010	0.763

Durbin-Watson = 1.9858

* Significant at 1 percent
** Significant at 5 percent

TABLE 9
Results: Whole period (from 15th December 1995 to 31st December 2000)

R Squared = 0.8461
Adjusted R Squared = 0.8448

Variable Name	Estimated Coefficient	Standard Error	T-Ratio	P-Value
$FKLI_{t-4}$	0.19943E-01	0.8866E-02	2.249**	0.024
$FKLI_{t-3}$	-0.74357E-02	0.8957E-02	-0.8322	0.405
$FKLI_{t-2}$	0.57447E-01	0.8958E-02	6.413*	0.000
$FKLI_{t-1}$	0.13199	0.8945E-02	14.76*	0.000
$FKLI_{t-0}$	0.72720	0.8981E-02	80.97*	0.000
$FKLI_{t+1}$	0.19325E-01	0.8945E-02	2.160**	0.031
$FKLI_{t+2}$	-0.19904E-01	0.8955E-02	-2.223**	0.026
$FKLI_{t+3}$	0.55266E-01	0.8955E-02	6.172*	0.000
$FKLI_{t+4}$	-0.49475E-01	0.8862E-02	-5.583*	0.000
D1	-0.36694E-04	0.4457E-03	-0.8233E-01	0.934
D2	-0.33290E-03	0.4843E-03	-0.6667	0.505
Constant	0.69549E-04	0.2845E-03	0.2445	0.807

Durbin-Watson = 2.0380

* Significant at 1 percent
** Significant at 5 percent

$FKLI_{t-4}$, $FKLI_{t+1}$ and $FKLI_{t+2}$ are found to be significant at a 5 percent level. However, lag 3 days FKLI ($FKLI_{t-3}$) is found to be insignificant. It is therefore concluded that there is a bi-directional relationship between the futures market and the spot market. However, the results cannot be taken as meaningful since the whole period consists of the period of high volatility (subperiod 2) that may cause the markets to deviate from their true behaviours. To investigate whether any of the subperiods is dominant in explaining the relationship for the whole period of study, dummy variables D1 and D2 are included in the regression model. From the results, it is found that both D1 and D2 are not significant in explaining the variation in the KLSE CI returns.

ANALYSIS OF RESULTS

From the analysis of lead and lag relationship between FKLI futures returns and the KLSE CI returns, it is found that the lead-lag pattern between the two markets changes under different volatility levels. In subperiod 1, the period of stable prices, it is found that the futures market leads the spot market by one day. During the period of a highly volatile market (subperiod 2), there is a mixed lead-lag relationship between the futures market and the spot market. The futures market is found to lead the spot market by two days and on t-4, and to lag the spot market on t+3 and t+4. In subperiod 3, the futures market is found to lead the spot market by one day. Finally, the analysis on the whole period found that there is a leading and lagging effect from the futures market to the spot market.

Since subperiod 2 is the period of high volatility, the mixed results that were obtained cannot be taken as meaningful to explain the true relationship between the futures and the spot markets. The same situation applies to the whole period. The other two subperiods are found to have a one-day lead coming from the futures market to the spot market. Therefore, it is safe to conclude that the futures market leads the spot market by one day during the stable price periods but the lead-lag relationship is mixed during the period of price instability. The leading effect from the futures market to the spot market is reckoned to be due to three reasons, namely, the infrequent trading of KLSE CI's component stocks; low transaction costs and capital requirement to trade futures; and finally, the absence of short-selling restrictions in the futures market. The elaboration of the above reasons are discussed below:

The Infrequent Trading of KLSE CI's Component Stocks

The KLSE CI consists of one hundred stocks listed on the Kuala Lumpur Stock Exchange (KLSE). It must be noted that not all the one hundred component stocks of KLSE CI are traded simultaneously at any point in time. Some stocks may react to the new information immediately, some may take a longer time, and some may not react at all. The stock index futures, on the other hand, reacts to new information immediately since the buying and selling of a futures contract is done in a package. In other words, when buying the FKLI contract, the buyer is purchasing a contract that consists of one hundred component stocks of KLSE CI. Due to infrequent trading of the KLSE CI component stocks, it is anticipated that the stock index will react to new information more slowly than the stock index futures. Hence, the stock index futures price tends to lead the spot stock index.

Lower Transaction Costs and Capital Requirement to Trade in Futures

In the futures market, the brokerage fee and commission is RM60 per contract, or RM120 per round-trip. This is equivalent to about 0.1 percent to 0.2 percent of the contract value per round-trip. The transaction cost is relatively lower than the transaction costs to buy or sell stocks in the cash market which average around 0.75 percent of the transaction value. Because of lower transaction costs in the futures market, it is easier for investors to trade the futures contract. In addition, investors do not have to pay the full amount of the contract value to trade futures. They only have to pay an initial margin of RM4,000 and have to top up any daily losses through the mark-to-market process. This small capital requirement also promotes inexpensive trading in the futures market. Both low transaction costs and small capital requirement make trading in the futures market cheaper than trading in the spot market, cause the futures market to process new information faster, and thus induce the futures price to move earlier than the spot price.

The Absence of Short Selling Restrictions in the Futures Market

Unlike the stock market, the futures market allows short-selling activities. Investors can sell the futures contract although they do not hold it. Without any restrictions on short selling, futures market should be more liquid than the spot market. Due to higher liquidity, the futures market processes information faster than the spot market, hence the initial price movement should take place in the futures market.

The above are the most prominent reasons why the futures market processes the information faster than the spot market does. Hence, the price discovery takes place in the futures market.

CONCLUSION

The findings of the temporal price relationship between the FKLI futures contract and its underlying stock index can be summarised as follows:

1) Subperiod 1 (15 December 1995 to 30 June 1996) – there is a one-day lead coming from the futures market to the spot market;
2) Subperiod 2 (1 July 1996 to 30 September 1998) – there is a mixed lead-lag relationship between the two markets;
3) Subperiod 3 (1 October 1998 to 31 December 2000) – there is a lead-lag relationship where the futures market is found to lead the spot market by one day; and
4) Whole period (15 December 1995 to 31 December 2000) – there is a bi-directional relationship between the futures and the spot markets.

Because of a very high volatility and unstable market condition during subperiod 2, the results for subperiod 2 and the whole period are not regarded as meaningful in explaining the true relationship between the two markets. The results for subperiod 1 and subperiod 2 are taken and it is concluded that there is evidence of a lead-lag relationship between the futures and the spot markets in the context of emerging equity markets of Malaysia with the futures market leading the spot market by one day.

REFERENCES

ABHYANKAR, A. 1998. Linear and nonlinear granger causality: Evidence from the U.K. stock index futures market. *The Journal of Futures Markets* **18(5):** 519-540.

BOOTH, G.G., R.W. So and Y. TSE. 1999. Price discovery in the German equity index derivatives market. *The Journal of Futures Markets* **19(6):** 619-643.

BROOKS, C., I. GARRET and M. HINICH. 1999. An alternative approach to investigating lead-lag relationships between stock and stock index futures markets. *Applied Financial Economics* **9:** 605-613.

CHOUDHRY, T. 1997. Short-run deviations and volatility in spot and futures stock returns: Evidence from Australia, Hong Kong, and Japan. *The Journal of Futures Markets* **17(6):** 689-705.

FINNERTY, J.E. and H.Y. PARK. 1987. Stock index futures: Does the tail wag the dog? *Financial Analysts Journal* **43(2):** 57-61.

GORDON, J.D., E.J. MORIARTY and P.A. TOSINI. 1987. Stock index futures: Does the dog wag the tail? *Financial Analysts Journal* **43(6):** 72.

HERBST, A.F, J.P. MCCORMACK and E.N. WEST. 1987. Investigation of a lead-lag relationship between spot stock indices and their futures contracts. *The Journal of Futures Markets* **7(4):** 373-381.

KAWALLER, I.G., P.D. KOCH and T.W. KOCH. 1987. The temporal price relationship between S&P 500 and S&P 500. *The Journal of Finance* **42(5):** 1309-1329.

KAWALLER, I.G., P.D. KOCH and T.W. KOCH. 1988. The relationship between the S&P 500 index and S&P 500 index futures prices. *Federal Reserve Bank of Atlanta Economic Review* **73:** 2-10.

MIN, J.H. and M. NAJAND. 1999. A further investigation of the lead-lag relationship between the spot market and the stock index futures: Early evidence from Korea. *The Journal of Futures Markets* **19(2):** 217-232.

MARTIKAINEN T., J. PERTTUNEN and V. PUTTONEN. 1995. On the dynamics of stock index futures and individual stock returns. *Journal of Business Finance & Accounting* **22(1):** 87-100.

MODEST, D.M. and M. SUNDARESAN. 1983. The relationship between spot and futures prices in stock index futures markets: Some preliminary evidence. *The Journal of Futures Markets* **3(1):** 15-41.

PIZZI, M., A.J. ECONOMOPOULOS and H.M. O'NEILL. 1998. An examination of the relationship between stock index cash and futures markets: A cointegration approach. *The Journal of Futures Markets* **18(3):** 297-305.

SHYY, G., V. VIJAYRAGHAVAN and B. SCOTT-QUINN. 1996. A further investigation of the lead-lag relationship between the cash market and stock index futures market with the use of bid/ask quotes: The case of France. *The Journal of Futures Markets* **16(4):** 405-420.

STOLL, H.R. and R.E. WHALEY. 1990. The dynamics of stock index and stock index futures returns. *Journal of Financial and Quantitative Analysis* **25(4):** 444-468.

TSE, Y. 1999. Price discovery and volatility spillovers in the DJIA index and futures markets. *The Journal of Futures Markets* **19(8):** 911-930.