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Relationship between Stock Futures Index and Cash Prices Index: Empirical Evidence Based on Malaysia Data

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Abstract

The empirical relationship between cash price index and future price index has been studied extensively. However, only few studies have been carried out in case of emerging markets. The main focuses of the previous studies were to investigate the lead-lag or causality relationship between these two indexes. In perfect markets, returns on derivative and underlying securities should be perfectly and contemporaneously correlated. However, due to market imperfections, one of these markets may reflect information faster. This paper examined this issue based on daily data of Malaysian stock market by using cointegration and Granger causality regression. The results from cointegration tests show that cash price index and futures price indexes in Malaysia are cointegrated indicating the existence of long run relationship between these two variables. Meanwhile the results from Granger causality tests found that the direction of causality relationship is unidirectional that running from cash market to futures market. The finding suggests that in the emerging market like Malaysia where the futures market is less active compared to the cash market, the cash market reflects to the new information faster than the futures market. Therefore, spot market plays a role as price discovery vehicle for the stock market instead of futures market.

Key words: Cointegration, Causality, Stock market, Futures Price Index, Cash Price Index, Malaysia.

1.0 Introduction

Since the introduction of stock index futures in the United States in 1982, the relationships and interactions between stock market spot price index and stock market futures price index have been an area of intense investigation. Many theoretical and empirical studies have been conducted with regard to this relationship, especially to investigate the role of futures index as price discovery and the lead-lag relationship between these two indexes. In general, the focus of investigation is to determine whether the cash market leads the futures market, whether the futures market leads the cash market or whether the bi-directional feedback between the two markets exists. It is very important to understand the lead-lag relationship since it may indicate how well the two markets are linked together, as well as providing information on how fast one market reacts to the new information from the other market. This information is crucial for the investors in their decision making process. For example, if a feedback relationship from cash price to futures price exists, then it is possible for the investors to use past information to predict prices in the future. Meanwhile, if a bi-directional causality exists between the two indexes, then both cash and futures prices have an important discovery role.

Most of the studies to investigate the lead-lag relationship between spot and futures prices have been carried out in the case of developed market and only few were focused on the emerging markets. Different in the level of economic as well as the stock market development, make findings from the developed markets cannot be generalised to the emerging markets. Therefore, this paper focuses in investigating the causality relationship between cash index and futures index in case of Malaysia. In Malaysia, trading on stock index futures contracts is relatively new to financial investors. The Kuala Lumpur Stock Exchange Composite Index Futures (FKLI) contract was introduced on December 1995. Initially, the index was based on the Kuala Lumpur Composite Index (KLCI), which made up of 100 most actively traded stocks from approximately 500 to 650 companies listed in the Main Board of Bursa Malaysia (formerly known as Kuala Lumpur Stocks Exchange). The Kuala Lumpur Composite Index (KLCI) is a market value weighted index. The index is one of the most widely followed by the investors because KLCI represents the overall performance of the stocks listed in Bursa Malaysia. The index has generally been accepted as the local stock market barometer. The KLCI which was introduced in 1986 is to serve as a performance indicator of the Malaysian stock market as well as the Malaysian economy as a whole.

As part of Bursa Malaysia's strategic initiative, the KLCI was enhanced to ensure that it remains robust in measuring the Malaysian economy and its growing linkage to the global economy. With this respect, Bursa Malaysia together with FTSE, its index partner, have integrated the KLCI with internationally accepted index calculation methodology to provide a more investable, tradable and transparently managed index. The enhanced index known as the FTSE Bursa Malaysia KLCI has been implemented on 6th July, 2009. In contrast with KLCI, the FTSE Bursa Malaysia KLCI only comprises 30 largest companies listed on the main board of Bursa Malaysia. However, FTSE Bursa Malaysia KLCI maintains the continuity of the KLCI index value, therefore preserves the historical movements of Malaysian stock market.

Meanwhile, FKLI is basically the futures contract of the overall health of the Bursa Malaysia and its underlying instrument is FTSE Bursa Malaysia KLCI. Since stock indices are not company shares, they are traded in the futures exchange, rather than the stock exchange. Future Exchange is basically a market where traders and investors trade futures contract (as apposed to stocks and shares). Futures contracts are standardized contract obligation to buy/sell a particular investment instruments between two parties, at a certain date in the future, at an agreed price.

Empirically, little is known about the nature of relationship that exists between FTSE Bursa Malaysia KLCI and FKLI. This is due to the fact that systematic studies on this relationship are very limited. Therefore, this paper intends to fill the gap. The purpose of this paper is to investigate empirically the dynamic of interdependence relationship between Malaysia's cash price stock index (FTSE Bursa Malaysia KLCI) and future prices stock index (FKLI). There are two main objectives of this paper. The first objective is to examine the existence of long run, steady-state equilibrium between spot and futures prices index in Malaysia by using cointegration analysis. The use of cointegration analysis enables us to distinguish between short-run deviations from equilibrium indicative of price discovery and long-run deviations that account for efficiency and stability. The second objective is to test the causality relationship between cash index prices and index futures prices of Bursa Malaysia by using Granger causality test. The causality analysis enables us to understand the interdependence relationship between these two indexes especially their lead-lag relationships.

2.0 Literature Review

Theoretically, in a perfect market where no arbitrage opportunities exist, returns on derivative securities such as stock index futures contracts should neither lead nor lag returns on the spot stock index, and the contemporaneous returns of these two indexes should be perfectly correlated. Meanwhile, in imperfect markets, with the existence of private information and transaction costs, traders will prefer the cheaper market affording the highest leverage. Since a trade in the futures markets only requires little upfront cash (usually for initial margin deposits which just a fraction of the stocks' market value compared with to purchase the basket of stocks composing the index), the preference for cost efficiency could cause the futures market to lead the spot market. There are also several technical reasons that could explain why returns on a particular market seem to lead the returns on other markets. For example, if futures markets instantaneously reflect new information and if the stocks within the index trade infrequently, futures returns will lead stock index returns. Cornell and French (1983) argued that an equilibrium condition exists between futures prices and cash index prices. Meanwhile, study by Modest and Sundaresan (1983), and Mackinlay and Ramaswamy (1988) found that futures prices deviate substantially from their theoretical prices. The above studies found that movements in the futures markets index will lead movements in the stock market. In this respect, the futures market has been described as a vehicle for price discovery in the stock market.

Empirically, the lead-lag relationship between spot and futures markets has been examined extensively by using a causality regression. In the causality regression, the prices in one market are explained by lagged, contemporaneous and lead prices in the other market. This approach has been used in the several empirical studies investigating the causality relationship between cash market index and futures market index such as by Kawaller, Koch and Koch (1987), Chan (1990), Stephan and Whaley (1990) and Stoll and Whaley (1990), Chan, Cheung and Johnson (1993), Finnerty and Park (1987), Ng (1987), Chan (1992) and Huang and Stoll (1994). In general, the results from these studies suggest that the futures returns lead the cash return and the effect is stronger when there are more stocks moving together. The results indicate that futures market serves as a price discovery vehicle for the stock prices. However, the relationship is not completely unidirectional; some studies show that cash market may also lead futures market although this lead is always much shorter.

The role of futures markets as a main source of market information is usually explained by transaction costs, restrictions on short sales in the cash market and the higher degree of leverage that can be attained by using futures. Black (1975) was the first to suggest that the higher leverage available in the futures market might induce informed traders to transact in futures rather than in stocks. Study by Gardbade and Silber (1983) also suggests that futures markets lead the spot. Herbst *et. al* (1987) examine the lead-lag relationship between the spot and futures markets for S&P500 and VLCI indices. They find that for S&P500 the lead is between zero and eight minutes, while for VLCI the lead is up to sixteen minutes. Pizzi *et al.* (1998) examine the relationship between the S&P500 stock index and the three-month and six-month futures contracts expiration over the same period. The results show that both the three- and six-month futures markets lead the spot market by at least 20 minutes.

Empirical studies by using more sophisticated methods of causality (such as VECM) models also support that futures prices lead spot prices. Kawaller *et al.* (1987), for example, found that futures price movement consistently led the spot index movement by 20-45 minutes. Similarly, Stoll and Wheley (1990) who examined the causal relationship between intra-day returns of stock index and stock index futures contracts found that the S&P500 and MM index futures returns tend to lead stock market returns by about five minutes on an average. Brooks *et al.* (2001) investigate the lead-lag relationship between the cash and futures contract for the FTSE 100 index. Their results from the Engle-Granger method show that there is a strong relationship between cash and futures prices. They also find that changes in cash index depend on the lagged changes in the cash index and futures price, while the lead-lag relationship between cash and futures markets do not last for more than half an hour. Tang *et al.* (1992) investigated the relationship between the Heng Seng index futures contracts traded in Hong Kong and the underlying Heng Seng index. The result shows that futures prices cause cash index price to change in the pre-crash period. In the post-crash period, the study found that a bi-directional causality exists between the two variables.

More recently, Athanasios (2010) examined the dynamic relationship between the FTSE/ASE-20 spot price index, the FTSE/ASE-20 futures price index and their respective volatilities. The results revealed contemporaneous and interactions as well as unidirectional and bi-directional causal effects running between the examined market indices and their volatilities. Hernandez and Torero (2010) examined the dynamic relationship between spot and futures prices of agricultural commodities. The used Granger causality tests to empirically uncover the direction of information flows between spot and futures prices. The results indicate that spot prices are generally discovered in futures markets. In particular, they find that changes in futures prices lead changes in spot prices more often that the reverse.

Meanwhile, in the case of Malaysia, Pok (2007) has investigated the impact change of the composition of market agents on the timing of the arrival of information in Bursa Malaysia. In his study, the price discovery role of futures trading on the spot market was examined using three distinct sub-periods: pre-crisis, crisis, and after capital control. The Johansen, VECM and Granger causality tests were used in the analysis. The results from the analysis shows that there is no significant long-run relationship, but for a short run, the results indicate that futures lead spot index. In addition, futures' lead is shorter in pre-crisis and crisis periods where foreign institutional investors dominate the market. Therefore, in line with the study by Pok (2007), this paper is intends to provide more empirical evidence on this issue based on more recent data.

3.0 Methodology

In this paper, the relationship between spot price index and future prices indexes will be examined by using Granger causality test. These tests require that the variables used in a given model be stationary, that is, their stochastic properties are time invariant. The standard Granger tests are also only valid if the original time series are not cointegrated. Thus, the time series analysis that is appropriate for this study includes unit root tests to test the stationary properties of the series, cointegration test and causality tests. This section gives a brief explanation of these tests and their appropriateness for this study.

The data used in this study are daily stock prices of the FTSE Bursa Malaysia KLCI (KLCI) and Kuala Lumpur Options and Financial Futures Exchange (KLOFFE) Composite Index Future (FKLI) for the period from January 2006 to November 2011 (1460 observations). All prices used in this study are the closing prices of each trading day. There are three types of contracts traded at the KLOFFE; the spot month contract (FKLI), the next month contract (FKLINM), and the next two calendar quarterly months (FKLINM2). The calendar quarter months are March, June, September and December. Since most of trading occurs in spot month and next month contracts, this study concentrates on these two futures contracts only. Data for composite index are collected from Bursa Malaysia, while data for futures contract price index are collected from Research and Development, KLOFFE. For estimation, all index series are transformed to logarithm.

3.1 Unit Root Tests

The purpose of unit root tests is to establish the stationarity properties of the time series. Existence of unit roots in a variable denotes that a series is not stationary. A number of alternative tests are available for testing whether a series is stationary. In this paper, the unit root tests will be performed using the Augmented Dickey-Fuller (ADF) tests. The ADF test for unit roots indicates whether an individual series is stationary by running an OLS regression on the following regression equation.

$$\Delta y_{i,t} = \alpha_i y_{i,t-1} + \sum_{i=1}^{m} \beta_{ij} \Delta y_{i,t-i} + \delta_i + \varepsilon_{it} \qquad (1)$$

In the ADF tests, the null hypothesis H_o:$\alpha_i = 0$, is to test that the series contains a unit root and is therefore non-stationary. If the t-statistic associated with the estimated coefficient α_i is greater than the critical values, we reject the null hypothesis of a unit root in favour of stationarity. The optimal lag lengths of the process will be chosen by the Akaike Information Criteria (AIC) described in Pantula *et al*. (1994).

3.2 Cointegration Tests

A cointegration test can be applied to determine the existence of a long-run relationship between economic variables. From a statistical point of view, a long-term relationship means that the variables move together over time so that short-term relationship disturbances from the long-term trend will be corrected (Manning and Andrianacos, 1993). The basic idea behind cointegration is that, if in the long-run two or more series move closely together, even though the series themselves are trended, the difference between them is constant. It is possible to regard these series as a long-run equilibrium relationship, as the difference between them is stationary. Meanwhile, a lack of cointegration suggests that such variables have no long-run relationship: In principal, they can wander arbitrarily far away from each other (Dickey *et al.* 1991). There are two tests for cointegration usually used in empirical studies; the single equation based Engle and Granger (1987) test, and the systems based Johansen (1988) tests.

The Engle and Granger (1987) two-step procedure for modelling the relationship between cointegrated variables has received a great deal of attention in recent years. This approach is attractive because it reduces the number of coefficients to be estimated, thus reduces the problem of multicollinearity. The procedure used to establish the existence of a cointegrating relationship is as follows: first, the long-run relationship ($y_{1t} = \beta_1 + \beta_2 y_{2t} + \varepsilon_t$) is estimated by OLS. This is called the cointegrating regression. Second, the residuals ($\mu = y_{1t} - \beta_1^{OLS} - \beta_2^{OLS} y_{2t}$) from this regression are retained and the ADF/PP test is applied to the residual as follows.

$$\Delta \mu_t = \theta \mu_{t-1} + \sum_{i=1}^{m} \phi_i \Delta \mu_{i-1} + \nu_t \qquad (2)$$

In ADF tests, the null hypothesis H_o: $\theta = 0$ is tested against the alternative H_a:$\theta < 0$ using the appropriate critical value (MacKinnon, 1991). The null hypothesis of the cointegration test is that the series formed by the residuals of each of the cointegrating regressions is not stationary. In other words, if there exists cointegration between y_1 and y_2, the residual μ_t is a I(0) process. Meanwhile, if there is not cointegration between y_1 and y_2, μ_t is a unit root process. Thus, whether y_1 and y_2 are cointegrated corresponds to whether μ_t follows a unit root process or not.

The system method suggested by Johansen (1988) enables us to determine the number of cointegration relations and estimate them by Maximum Likelihood Estimation in a unified framework. Specifically, Johansen provides a multivariate alternative approach, which tests for multiple cointegrating vectors and examines long run causality between variables. It relies on the relationship between the rank of a matrix and its characteristic roots (eigenvalues). Specifically, if the system has *r* independent cointegrating relations, the test for the number of characteristic roots that are not significantly different from unity is given by $\lambda_{trace}(r) = -T\sum \ln(1-\lambda_I)$, where, λ_i is the number of estimated values of the characteristic roots and T is the number of usable observations. The Johansen trace tests for cointegration is testing the null that there are less then or equal to *h* cointegrating relations ($r \leq h$) against the alternative hypothesis that there are more than *h* cointegrating relations ($r > h$). Meanwhile, the maximum Eigen value test statistic $\lambda_{max(r,r+1)}$=-Tln(1-λ_{it+1}) can be used to test the null that the number of cointegrating vectors is $r \leq h$ against the alternative that $r = h + 1$ Since, the trace test is more robust than the maximum Eigen value test, as pointed out by Cheung and Lai (1993); this paper will use the trace statistic.

3.3 Granger Causality

In order to test the causality relationship empirically, it is common to apply the Granger causality test that was initially introduced by Granger (1969). In a bivariate framework, the variable y_1 is said to cause the variable y_2 in the Granger sense if the forecast for y_2 improves when lagged variables y_1 are taken into account in the equation. In general, conventional Granger causality can be represented by the following bivariate system.

$$y_{1t} = \delta_1 + \sum_{i=1}^{m} \beta_i y_{1t-i} + \sum_{i=1}^{n} \psi_i y_{2t-i} + \varepsilon_{1t} \qquad (3)$$

$$y_{2t} = \delta_2 + \sum_{i=1}^{q} \pi_i y_{1t-i} + \sum_{i=1}^{r} \phi_i y_{2t-i} + \nu_t \qquad (4)$$

Where, δ_1 and δ_2 are drifts. The coefficient ψ_is are relevant for testing Granger causality running from y_2 to y_1 while the coefficient π_is are appropriate for Granger causality test running in the opposite direction. Four findings are possible in a Granger causality test. First, neither variable Granger causes the other. In other words, independence is suggested when the set of y_1 and y_2 coefficients are not statistically significant in both regressions. Second, unidirectional causality from y_2 to y_1, which means y_2 causes y_1 but not vice versa. Third, unidirectional causality from y_1 to y_2 that means y_1 causes y_2 but not vice versa. Fourth, bilateral causality between two variables, which means y_1 and y_2 Granger cause each other (feedback effect). According to the above equations, the null hypothesis that y_2 does not Granger cause y_1 is rejected if the coefficients of ψ_is in Equation (3) are jointly significant. The null hypothesis that y_1 does not Granger cause y_2 is rejected if the π_is are jointly significant in Equation (4). If both some $\psi_i \neq 0$ and some $\pi_i \neq 0$ then there is feedback between y_1 and y_2. Usually, the standard F-test has been to determine the joint significant and hence the causal relationship between variables.

4.0 Findings

4.1 Unit Root Tests

Results from the unit root tests are presented in Table 1. We found that all computed values of ADF statistics for all series at level are not significant at five percent significant levels. Therefore, the test fails to reject the null hypothesis of unit root of the series at level, which indicates that all series being studied are not I(0). Subsequently, the unit root test has been carried out at first difference of the series. We find that all ADF statistics for first difference series are significant at 5 percent. The results from unit root tests indicate that the series are stationary at first difference or I(1).

Table 1: Results from Unit Root Tests

Series	ADF			
	Level	Critical Value (5%)	1^{st} Diff.	Critical Value (5%)
KLCI	-1.377723	-2.863365	-8.975184*	-2.863365
FKLI	-1.977481	-2.863323	-29.70853*	-2.863323
FKLINM	-1.732736	-2.863333	-15.61806*	-2.863333

* Significant at 5% level

4.2 Cointegration Tests

The cointegration tests in this study have been carried out between FTSE Bursa Malaysia KLCI (KLCI) and two futures contract indexes FKLI and FKLINM, separately. The results from the tests are presented in Table 2. Statistics in Table 2 for the cointegration rank tests between KLCI and FKLI indicate that at least there is one cointegration equation exist between the two variables at 5 percent levels. Similarly, the trace test also found that there is at least one cointegration equation between KLCI and FKLINM. These results confirm the existence of a long-run relationship between KLCI and FKLI, and between KLCI and FKLINM, respectively.

Table 2: Cointegration Rank Test (Trace) between KLCI, FKLI and FKLINM

Futures Index	Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical value (5%)	Conclusion
FKLI	None* At most 1	0.168053 0.001269	268.4368 1.840243	15.49471 3.841466	1 cointegrating equation
FKLINM	None* At most 1	0.157627 0.001268	250.3899 1.839066	15.49471 3.841466	1 cointegration equation

*Denotes rejection of the hypothesis at the 0.05 level

4.3 Granger Causality

Based on the results from unit root tests and cointegration tests, the pairwise Granger causality tests were conducted between KLCI, FKLI and FKLINM at first difference of the series. The results from the test are presented in Table 3. F-Statistics in Table 3 reject the null hypothesis that KLCI does not Granger cause FKLI. In other words, the test supports the hypothesis that KLCI does cause FKLI. In contrast, we found that FKLI does not Granger cause KLCI, indicating the direction of causality between KLCI and FKLI is unidirectional which running from KLCI to FKLI only. Similar results also can be observed in the causality relationship between KLCI and FKLINM where the direction of causality is also unidirectional from KLCI to FKLINM. Results from Granger causality tests indicated that in the case of Malaysia, cash market leads the future market.

Further testing has been carried out to investigate the existence of causality relationship between two future indexes used in this study, FKLI and FKLINM. We found that F-Statistics reject the null hypothesis that FKLI does not Granger cause FKLINM, and also the hypothesis FKLINM does not cause FKLI. The results indicate that the two variables cause each other or in other words the direction of causality between these two variables is bidirectional.

Table 3: Results of Pairwise Granger Causality Tests between KLCI, FKLI and FKLINM

Null Hypothesis	F-Statistic	Probability
KLCI does not Granger cause FKLI	6.28760*	0.00000
FKLI does not Granger cause KLCI	1.00140	0.41545
KLCI does not Granger cause FKLINM	6.10810*	0.00000
FKLINM does not Granger cause KLCI	2.19163	0.05283
FKLI does not Granger cause FKLINM	16.2490*	0.00000
FKLINM does not Granger cause FKLI	10.2117*	0.00000

* Significant at 5 percent level

5.0 Discussion and Conclusion

The main objective of the paper is to empirically investigate the cointegration and causality relationship between stock market cash prices index and stock market futures price index in Malaysia. For this purposes, three statistical tests namely unit root tests, cointegration test and Granger causality tests have been conducted. The tests have been carried out based on the daily closing prices of FTSE Bursa Malaysia KLCI with their two futures index contracts; spot month futures contract (FKLI) and next month futures contract (FKLINM). The findings from unit root tests show that all series used in this study are stationary at first difference.

The results from the cointegration tests indicate the existence of long rung stable relationship between spot index and futures contract indexes of Malaysian stock market. Meanwhile, the Granger causality tests suggest that the direction of causality is unidirectional running from cash market index to futures market indexes. The finding implicates that in case of Malaysia, the cash prices lead the futures prices. This is contradicted with the findings from the previous studies in the case of developed stock markets which generally found that futures prices lead stock spot prices. However, the finding from this study is consistent with the findings from other studies such as by Stephen and Whaley (1990) that found the opposite, cash prices lead futures prices. Chan et al. (1991) argued that this result can be explained as spurious leads induced by infrequent trading of futures contract.

The results from Granger causality tests of this study suggest that in case of Malaysia stock market, the flow of information is from cash market to futures market. This may suggests that spot market in Malaysia reflects to information faster than the futures market. In other words, futures market in Malaysia did not play a role as price discovery vehicle for stock price. This role, however, played by cash market. As a result, the futures stock prices cannot be used as indicator for the movements in the stock market prices in Malaysia. The results could also suggest that financial investors in Malaysia used information in cash market to trade in futures market, and not vice versa. This may due to the fact that stock market in Malaysia is more actively traded as compared to futures market which can be considered as new to Malaysian investors.

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