The Relationship Between Cash and Futures Market in An Emerging Malaysian Economy and The Impact of Financial Crisis on this Relationship

Dr. Taufiq Hassan *

Prof. Dr. Shamsher Mohamad **

Abstract

Several hypotheses concerning the pricing behaviour of futures contracts need to be tested to ascertain whether the pricing behaviour is consistent with theory in the context of an emerging market. One of the important issues is the informational role of futures contract, which tends to increase the integration between spot and futures market. In this regard, this study applied the Johansen co-integration and Error correction model to test whether Kuala Lumpur Composite Index futures (in short FKLI) contract showed any integration with cash market, which has relatively short history. This study also examined the impact of financial crisis on the integration between futures and cash market. Daily data on Kuala Lumpur stock index futures (in short FKLI) contracts for the calendar years 1996 through 1999 were used. The significant informational linkage between cash and futures prices is observed only *after* the financial crisis. There was no informational link between cash and futures markets *before* the crisis and financial crisis showed a significant impact on the futures and cash market relationship.

Keywords: Market integration, Johansen co-integration, Error Correction model, Financial Crisis.

* Taufiq Hassan is a Lecturer in Finance in the faculty of Economics and Management at University Putra Malaysia.

** Shamsher Mohamad is a Professor in Finance at the Graduate School of Management, University Putra Malaysia.

INTRODUCTION

Futures trading in an organized commodity market or exchange consist of trading in standardized futures contracts, which provide for the physical delivery (or cash settlement) of the defined asset at pre-defined dates. Two developments in the financial markets in recent years may have reduced the risk of trading securities in cash markets. First, institutional and other large investors have diversified their portfolios internationally. Second, the growth of the derivative markets has improved the ability of investors to hedge their exposure and provide speculators an opportunity to take highly leveraged positions against weak underlying assets.

However the popular belief is that derivative markets encourage speculation in the cash market through feedback to futures market and destabilize the cash prices. However, it is assumed that in a fairly efficient and well-developed derivative market with rational investors such opportunities are limited. While the futures markets in developed economies have been relatively free of controversies, the futures markets in other emerging economies have documented less conclusive evidence. This provides an opportunity for an empirical investigation to be initiated to understand the relationship between cash and futures market behavior with short history.

Malaysian Stock market and introduction of Stock index Futures:

Since Independence in 1957, Malaysia has been actively pursuing economic development through expansion of capital market. Thereafter, the number of listed firms on KLSE has increased by 148.4 percent from 1980 to 1996 and the total capitalization increased by 254.1 percent within a decade from 1990 to 1996 (based on today's ringgit value it is more than 400 percent). Share capitalisation was of 190 percent of GDP in 1993, and more than 350 percent of GDP in 1996. Table 1.6 shows the total listings on the Malaysian stock market from 1980 to 1998 and it's capitalisation from 1990 to 1998 based on current Ringgit value.

Table 1: Total Listings on the Malaysian Stock Market, 1980-1998

Year	Main Board	Second Board	Total	Capitalisation (RM billion)*
1985	284	-	284	
1986	288	-	288	
1987	291	-	291	
1988	295	-	295	
1989	305	2	307	
1990	271	14	285	181.89
1991	292	32	324	215.54
1992	317	52	369	347.59
1993	329	84	413	835.10
1994	347	131	478	722.61
1995	369	160	529	812.28
1996	413	208	621	1163.43
1997	444	264	708	354.06
1998	454	282	736	363.13

Notes: * Based on today's ringgit value
Sources: Kuala Lumpur Stock Exchange (Annual Handbook)

The impressive development of capital market also attracted the massive inflow of funds from abroad, feeding into the property and share markets. It is estimated that there was a net inflow of US$ 985 billion in private funds into the emerging markets (including Malaysia) during the 1994-98 period (International Financial Statistics). Malaysia had approximately US$150 billion or 15% of thus total inflow. The capital inflows reinforced the investment boom and rapid credit expansion in Malaysia as well as other emerging countries but at the same time increase the excessive risk.

The ratio of nominal GDP vs. KLSE's market capitalisation (MC) was very high in Malaysia. MC/GDP ratios since the 1993-94 period (exceeding 2.94) indicate the capital market moving too fast compared to the economy as a whole. As a result the risk in the cash market increased tremendously during the high economic growth period. Therefore institutional investors and international funds, which are important for the growth of capital market, would also require index futures contract to manage the high-risk exposure.

Since value line index futures has been listed for the first time in Kansas City Board of Trades (KCBT) in 1982, index futures were introduced in Hong Kong and Singapore in 1986 for the first time in Asia and subsequently in Japan in 1988. Malaysia is the fourth Asian country having the financial futures market by inaugurating the stock index futures contracts in 1995. Though Malaysia have learned from the examples of the other advanced countries such as US and Japan and more recently from the financial crisis (1997-8), it is important to observe the level of integration between futures and cash market and impact of the crisis on this integration.

Review of the Previous Studies:

The price discovery function of futures markets has long been recognized in theoretical literature for example, Garbade and Silber (1983), Grossman (1977), Working (1970). Recently, many studies have analyzed the price discovery function of futures prices in various futures markets. But the results are not so conclusive.

For example, Kawaller, Koch and Koch (1987) examined the intraday price relationship between the S&P 500 index and the index futures. He found that changes in the index futures lead changes in the cash index by 20 to 45 minutes and the feedback from cash market to the futures market is rather weak. Similarly, Stoll and Whaley (1990) and Chan (1992) studied both S&P 500 index futures and Major market index (MMI) futures and found that the futures lead the cash not other way around.

Fung and Leung (1993) found that there is a two-way feedback relationship between the cash and futures market for Eurodollar deposits futures. Similarly Wahab and Lashgari (1993) studied the cash and futures markets for both the S&P 500 and FT-SE 100 indexes. They found that although feedback exists between the cash and futures market, the spot to futures lead appears stronger than the other direction which is contrary to the theoretical assumption. Most of the studies are based on the developed market specially US and UK futures market. The evidence from relatively young futures market is relatively scarce. Therefore this study focused on Malaysian Stock index futures, which is relatively new and had experienced a financial crisis.

DATA AND METHODOLOGY

The KLSE CI index (FKLI) futures contract are trading 5 days a week and have four maturity periods – such as, spot and the next month contract and next two calendar quarterly month (quarterly months are March, June, September and December). The KLCI index futures contract is considered as an emerging futures contract from an emerging Malaysian futures market. Only two KLCI index futures contracts trade in a particular trading day. Daily closing prices for all contracts were obtained from daily diary published by KLSE from January 1996 to March 1999. Over 780 daily prices are available for 39 contracts and every contract is actively traded for two months. Daily closing price and the last trading price are almost similar and a small variation is assumed not to affect the results.

Trading volume and open interest of the contract indicate the liquidity level of the market. Trading volume of CI index futures contracts suddenly increased from 668 to more than 2000 contract during and after the crisis (Table2). Therefore it is appropriate to divide the full sample into two sub-samples: before and after the crisis in order to investigate the evaluation of pricing relationship between spot and futures contract.

Table 2: Descriptive statistics of volume & open interest for stock index futures

Period	Year	Volume		Open Interest		Percent Open interest to Vol.
		Mean	Std.	Mean	Std.	
Before crisis	1996	240.4	153.0	1389.6	543.2	2.19
Before crisis	1997*	668.9	386.2	2720.7	702.7	3.08
During crisis	1997**	2007.8	966.3	8644.5	2217.4	3.26
After crisis	1998	2496.2	1686.1	13963.6	9305.4	2.15
After crisis	1999	1398.1	836.6	3613.4	1058.4	1.31

Sources: Daily Dairy published by KLSE and KLOFFE.

Tests of Stationarity

First, the distributional properties of the four data series were analyzed. One of the main prerequisites for analysis is to describe the stationarity level of a series. Corbae and Ouliaris (1988), Nassir and Ariff (1994) and Baillie and Bollerslev (1989) argue that, in the presence of non-stationarity in many financial time series data, the unit root test provides unbiased and consistent results. Therefore this study will apply the Augmented Dickey-Fuller (ADF) unit roost test, which is in the following form:

$$\Delta Y_t = \beta_1 + {}_{2t} + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \qquad (1)$$

Where

$\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$,

β, δ, α = Regression coefficient of the drift, unit root and time trend, and

ε_t = residual term at time t.

The number of lagged difference terms is empirically determined. The null hypothesis corresponds to H_0: $\delta = 0$ will be tested with an F-statistics based on a distribution suggested by Dickey and Fuller (1981).

Test of Integration between Spot and Futures:

If two time series X_t and Y_t are both non-stationary in levels but stationary in the first difference, it is said that variables X_t and Y_t are integrated of order 1 that is I (1). If two variables are integrated of order 1, denoted as I (1), their linear combinations, $Z_t = X_t - \alpha Y_t$ are generally also I (1). However if there is an α, such as that Z_t is I (0), then Z_t is integrated of order 0 or stationary in level. If Z_t is I (0), then the linear combination of X_t and Y_t is stationary. It is said that the two variables are co-integrated.

Under the co-integration methodology, the maximum likelihood method is also used to estimate the co-integration relationship between variables developed by Johansen (1988) which is in the following form:

$$X_t = \Pi_t X_{t-1} + \Lambda + \Pi_k X_{t-k} + \varepsilon_t \qquad (2)$$

Where each II is a N*N matrix of parameters. The system in (2) can be expressed in the error correction form as:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \Lambda + \Gamma_{k-1} X_{t-k+1} + \Gamma_k \Delta X_{t-k} + \varepsilon_t \qquad (3)$$

Where

$\Gamma I = -I + \Pi 1 + \Pi 2 + \Lambda - \Pi I, \qquad i = 1,2, \Lambda\, k$

Johansen shows by use of a canonical correlation method how to estimate all the distinct combinations of levels of X that produce high correlations with the stationary elements of (3). These combinations are the co-integrating vectors. Johansen (1990) also shows how to test which of these distinct co-integration vectors statistically significant and derives critical values for this test.

Error Correction Model

By integrating the concepts of co-integration and causality in the Granger sense, it is possible to develop a model that allows for the testing of the presence of both a short-term and a long-term relationship between the variables. This model is known as the error correction model (ECM) proposed by Engle and Granger (1987) and is discussed in numerous papers. Key recent references include Zapata and Rambaldi (1996) and Giannini and Mosconi (1992). The ECM model investigates the potential long run and short-run impact of the variable such as Y_t on the variable X_t. Therefore four-error correction specification and two co-integration regression can be possible.

The ECM model represented in the above equation indicate the long run and a short run impact of S_t on F_t which can be decomposed into two component given by the co-integration term, $\beta_1 Z_{t-1}$, also known as the error correction term and second a short term component given by the first summation term on the right hand side of the above equation. Similarly, the long run and a short run impact of F_t on S_t can be expressed by the following ECM equation:

1st specification:

$$\Delta S_t = \alpha_0 + \beta_1 Z_{2t-1} + \sum_{i=1}^{T} a_i \Delta F_t + \sum_{j=1}^{T} b_i \Delta S_t + \varepsilon_{s,t} \qquad (4)$$

2nd specification:

$$\Delta F_t = \alpha_0 + \beta_2 Z_{2t-1} + \sum_{i=1}^{T} a_i^{/} \Delta F_t + \sum_{j=1}^{T} b_i^{/} \Delta S_t + \varepsilon_{f,t} \qquad (4.1)$$

Error correction term: $Z_{2t} = S_t - \alpha F_t$

Where F = Futures price; S= spot price

In terms of eq. (4) and eq. (4.1), unidirectional causality from Cash price to futures price requires:

- That some of the a'_i must be non-zero while all the b_i must be equal to zero.

  Or

- That the error correction coefficient β_2 (4.1) is statistically significant at conventional levels.

Similarly, for the futures price change to Granger cause subsequent change in the cash price if

- Some b_i must be non-zero and all a'_i are individually or jointly zero.

  Or

- The error correction term β_2 must be zero or negligible in magnitude which implies that β_1 in equation (4) must be statistically significant.

The interpretation of the equation is that the change in S_t is due to both short run effects from ΔF_t and ΔS_t and to last period equilibrium error, which represent adjustment to long run equilibrium. The coefficient β attached to the error correction term measures the single period response of the LHS variable to departures from equilibrium. If this coefficient is insignificant and small (eq.4), then the LHS variable (ΔS_t) has little tendency to adjust to correct a disequilibrium situation, therefore most of the adjustments may be accomplished by ΔF_t in equation (4.1). Similarly if the coefficient (eq.4.1) is insignificant and small, the LHS variable (ΔF_t) has little tendency to adjust to long run and therefore most of the adjustment may be accomplished by ΔS_t in equation (4).

Similarly, the long run and a short run impact of S_t on F_t can be expressed by the following ECM equation:

1st specification:

$$\Delta F_t = \alpha_0 + \beta_1 Z_{1t-1} + \sum_{i=1}^{T} b_i \Delta S_t + \sum_{j=1}^{T} c_j \Delta F_t \qquad (5)$$

2nd specification:

$$\Delta S_t = \alpha_0 + \beta'_1 Z_{1t-1} + \sum_{i=1}^{T} b_1^{/} \Delta S_t + \sum_{j=1}^{T} c_1^{/} \Delta F_t \qquad (5.1)$$

Error correction term: $Z_{1t} = F_t - \alpha S_t$

Where F = Futures price; S= spot price

Finally, in terms of the entire set of eq.(4) to eq.(5.1), if the error terms enter significantly into the error correction equations of 4.1 and 5.1, then neither variable can be considered weakly exogenous and feedback is said to exist.

RESULTS AND DISCUSSION

One of the important research issues in futures market is that whether the price movements in futures market lead the price movements in the cash market.[1] However, the evidence on price discovery function of futures market is not conclusive. One group of futures market researchers suggests that changes in the index futures lead to changes in the index and that the feedback from the cash market to the futures market is rather weak. Other group of researchers found that the spot-to-futures lead is stronger than the futures to spot lead. This study examines whether price movement in futures markets lead the price movements in cash markets in an emerging economy.

The results of the unit root test for the level and the first differences of the spot index and index futures contract are reported in Table3. The result suggests that both the futures and spot index are non-stationary in level form. This is consistent with documented evidence. For example, Goldenberg (1989), Herbst Mc Cormack and West (1987) and others found non-stationarity of futures and spot prices for the stock index. Therefore, the series are transformed to achieve stationarity by taking the first differences of the natural logarithm of each price series. Letting F(t,T) be the price at t

[1] Another function of futures markets is to provide a mechanism through which hedgers transfer price risk to speculators

of the index futures contracts maturing at T and S(t) be the spot of the underlying stock index at t, The transformed variables are given by-

$s_t = \ln S(t) - \ln S(t-1)$ (6)

$f_t = \ln F(t,T) - \ln F(t-1, T)$ (7)

Where s_t and f_t represent the instantaneous rate of price appreciation in the stock index and the instantaneous relative price change of the futures contract.[2] The results show that transformed variables are stationary at same level.

Table3: Augmented Dickey-Fuller Test for Spot and Futures Price series

Variables	$\mathbf{b_0}$	**t-value**
Spot Price (***Level form***) 4 Lag 10 Lag	 -.001 -.002	 -.779 -.753
Futures Price (***Level Form***) 10 Lag 15 Lag	 -.002 -.003	 -.904 -.999
Spot Price (***First Differences***) 3 Lag Futures Price (***First Differences***) 3 Lag	 -1.01 -1.18	 -14.96* -15.98*

Notes: A single asterisk (*) denotes significant at 5% level. Critical value at 5 percent level is 2.86 for no trend and 3.41 for trend regression.

But often, the observed price series (either transformed or level form) may not represent the true price levels due to bid-ask spreads or infrequent trading. Following Stoll and Whaley (1990) and Wahab and Lashgai (1993), the series are fitted first to purge the noise in s_t and f_t. The literature suggest that a ARIMA model with various parameterization, the following parsimonious MA (1) model fits s_t and f_t well:

$x_t = m^x + \mu_t^x + \phi^x \mu_{t-1}^x \qquad x_t = s_t, f_t$ (8)

Where m^x, ϕ^x and μ_t^s are the mean, the moving average parameter and the process innovation at time t (the error term of ARIMA model). Then μ_t^s will be used as a instruments for the cash and futures return series[3]. Table 4 presents the serial correlation structure before and after purging the noises in the transformed series, s_t and f_t. It can be

[2] Such stationarity inducing transformation should not affect the results since, first differencing and logarithmic transformations are causality preserving

[3]This procedure follows Stoll and Whaley (1990) who estimated ARIMA filters to remove noise induced by infrequent trading and bid/ask spread.

seen that the serial correlation coefficient is reduced substantially especially for initial lags after purging the noises in the observed series.[4] The estimated moving average parameters are statistically significant. The t- statistics of the moving average parameter for series s_t is much higher than that for futures series f_t. The regression R^2 for the index spot series is also much higher than that for the index futures series.

Table 4: Sample Autocorrelation Coefficients

	Transformed Spot Series		Transformed Futures Series	
	AC	Q-Stat	AC	Q-Stat
1	-0.313	78.715	-0.106	8.9713
2	-0.064	82.020	-0.029	9.6497
3	0.029	82.710	-0.003	9.6587
4	-0.015	82.882	-0.120	21.267
5	-0.006	82.913	0.048	23.137
6	-0.028	83.556	-0.011	23.234
7	0.007	83.597	-0.012	23.351
8	0.019	83.880	-0.046	25.050
9	0.006	83.907	0.074	29.510
10	-0.006	83.940	0.058	32.254
11	0.017	84.186	0.004	32.269
12	0.004	84.200	-0.039	33.502
13	0.055	86.685	0.029	34.172
14	-0.101	94.990	0.002	34.174
15	0.047	96.765	0.037	35.270
	Spot Innovation Series		**Futures Innovation Series**	
	AC	Q-Stat	AC	Q-Stat
1	-0.010	0.0860	0.000	3.E-05
2	-0.025	0.5704	-0.006	0.0281
3	-0.066	4.0420	-0.023	0.4400
4	-0.027	4.6316	-0.119	11.799
5	-0.022	5.0360	0.034	12.736
6	-0.037	6.1189	-0.014	12.889
7	0.005	6.1353	-0.014	13.052
8	0.024	6.6123	-0.038	14.238
9	0.019	6.8992	0.077	19.070
10	0.008	6.9454	0.066	22.578
11	0.034	7.9111	0.011	22.681
12	0.019	8.2198	-0.034	23.623

$$s_t = -.00052 + u_t^s \ -.379\, u_{t-1}^s$$
$$(-10.70)^*$$
$$f_t = -.00055 + u_t^f \ -.111\, u_{t-1}^f$$
$$(-3.11)^*$$

Notes: * denotes significant at 5% level.

[4] Some Correlation coefficient of the series are marginally significant at distant lags. It should not be assumed that it is because of bid/ask or infrequent trading.

This is consistent with other studies where the futures price is expected to be less contaminated by trading noises. A non-synchronous trading problem does not exist and an infrequent trading problem is much less serious in index futures since it is traded as a single asset.

Test of Co-integration

The full sample results presented in Table 5 indicate the existence of the co-integration relation between spot index and index futures. These results are validated using Johansen (1988) methodology presented Table 5.

Table 5: Johansen Cointegration Test (full sample)

LR Test (Based on Max. Eigen value)			**LR Test (Based on TraceValue)**		
Full sample (Panel B)					
r=0	r=1	66.35**	r=0	r>=1	67.62**
r<=1	r=2	.269	r<=1	r=2	.269
	Co-integration Vector				
Futures Price	.00171				
Spot	.07754				

The 1% and 5% critical value for Eigen value of Johansen test are 14.88 and 12.48 for r=0 and 8.07 and 6.50 for r≤1 respectively. Similarly The 1% and 5% critical value for Trace value of Johansen test are 17.86 and 15.75 for r=0 and 8.07 and 6.50 for r≤1 respectively.
** Null Hypothesis rejected at the 1% confidence level

The likelihood ratio test rejects the null hypothesis of no-cointegration between spot and futures prices. Thus co-integration methodologies offer strong evidence in support of the hypothesis that spot and futures prices are co-integrated. Having established the existence of co-integration between spot and futures, it is essential to test for causality. Two error correction regressions are estimated for the whole and each of the three sub-sample periods: a) Index spot innovations are regressed on last periods spot (Own Market) equilibrium error and lagged innovations in spot and futures series, b) index spot innovations are regressed on last periods futures (cross market) equilibrium error and lagged innovations of spot and futures series. If the co-integrated variable X_t adjusts towards the long run equilibrium, the error correction is expected to be negative for the own market equilibrium error term and positive for the cross-market equilibrium error term.

Temporal Causality based on ECM

The ECM model includes 4 lags based on lowest AIC criteria. Others lagged terms also tried but does not change the results and conclusions. The numbers in parentheses under the error correction equations are the associated t-statistics. The standard error, R^2 and F-Statistics are also reported.

Table 6 shows that all error correction coefficients are significantly different from zero at 5 percent or 1 percent level. It shows that (panel A) adjustment in spot market to remove the equilibrium error in the index futures is not achievable (instead of negative sign is positive). Whereas spot index adjustment to it own disequilibrium is achievable even though weak but statistically significant. The error correction coefficient shows that (-.195) about one fifth of the last periods spot index disequilibrium is removed within one day by subsequent spot index adjustment. Whereas it is about one twentieth of last period's futures equilibrium, instead removing, is increase within a day through the price change in the stock index. Therefore long run equilibrium never completed within a day. One important phenomenon of interest is the spot market response to last period futures innovation did not reduce the equilibrium error rather increase significantly, which is contrary to documented evidence of literature.

There are two possible explanation regarding the contrary evidence: First, the size of futures market is to small compare to the well established spot market in Malaysia. Therefore futures market's role to lead the spot market is very limited. Secondly, due to the financial crisis, which occurs in 1997, stock market fluctuation so rapidly that cause the increase in the futures market disequilibrium error. Because there is a limitation of futures price fluctuation within day imposed by the futures exchange authority[5].

[5] See the KLSE CI index futures contract specifications.

Table 6: Testing for Long and Short Run Causal Relationship of Spot and Index Futures Contracts (full sample).

$$\Delta s_t = \alpha_0 + \beta_2 Z_{2t-1} + \sum_{i=1}^{T} d_i \Delta F_t + \sum_{j=1}^{T} e_i \Delta S_t + \varepsilon_{s,t}; \quad \text{where } Z_{2t} = S_t - \alpha F_t$$

$$\Delta s_t = \alpha_0 + \beta'_1 Z_{2t-1} + \sum_{i=1}^{T} b_i \Delta S_t + \sum_{j=1}^{T} c'_i \Delta F_t + \varepsilon_{s,t}; \quad \text{where } Z_{2t} = F_t - \alpha S_t$$

Panel A

Dep.	Indep.	β_2	d_1	d_2	d_3	d_4	$\sum d_i=0$	R^2
Spot	Futures	-.195	.087	.236	.026	.044	3.21	.229
		(-7.45**)	(1.06)	(3.26)	(.375)	(.696)		
Dep.	**Indep.**	β'_1	c'_1	c'_2	c'_3	c'_4	$\sum c_i=0$	R^2
Spot	Futures	.010	.089	.237	.027	.045	3.28	.228
		(7.43**)	(1.08)	(3.26)	(.388)	(.707)		

$$\Delta f_t = \alpha_0 + \beta'_2 Z_{2t-1} + \sum_{i=1}^{T} d'_i \Delta F_t + \sum_{j=1}^{T} e'_i \Delta S_t + \varepsilon_{s,t}; \quad \text{where } Z_{2t} \ S_t - \alpha F_t$$

$$\Delta f_t = \alpha_0 + \beta_1 Z_{2t-1} + \sum_{i=1}^{T} b_i \Delta S_t + \sum_{j=1}^{T} c_i \Delta F_t + \varepsilon_{s,t}; \quad \text{where } Z_{2t} = F_t - \alpha S_t$$

Panel B

Dep.	Indep.	β'_2	e'_1	e'_2	e'_3	e'_4	$\sum e_i=0$	R^2
Future	Spot	-.019	.098	.071	.039	-.010	2.58	.030
		(-1.96**)	(1.70)	(1.72)	(106)	(-.277)		
Dep.	**Indep.**	β_1	b_1	b_2	b_3	b_4	$\sum b_i=0$	R^2
Future	Spot	.020	.087	.236	.026	.044	3.21	.229
		(1.94*)	(1.06)	(3.26)	(.375)	(.696)		

Notes: β_1 and β_2 are the residuals (ECM term) from regression when Ft and St are the LHS variable, correspondingly.
* Indicates the test statistics is significant at the 5% level
** Indicates the test statistic is significant at the 1% level.
Bold Indicates the second specification of Error correction model.

The coefficient for some lagged innovation, which measures the short run adjustment, is also significant. The existence of short run adjustment is measured by F-statistics as well as t-statistics. The t-statistics identifies the significance of each coefficient of the independent variables in the ECM equation and the F-statistics refers to the Wald test for causality. The short run relationship is particularly strong in both directions (measured by F-statistics).

The low R^2 values are not surprising because most of the price movements are contemporaneous. The ECM explains 22.9 percent of the variations in the index spot innovations by its own adjustment and 22.8 percent of the variations in the index futures innovations through spot index adjustment.

In panel B, first row indicate spot index error term as an independent variable and change in futures used as a dependent variable and second row indicate futures index error term as a independent and change in futures as a dependent variables. The result shows the leading effect of stock market. The magnitudes of the coefficient are similar to the panel A. It indicates that spot index mispricing (error term) trigger subsequent price reaction in the futures market and reduce the disequilibrium error. While index futures mispricing trigger the subsequent price reaction in the futures market but not reducing equilibrium error rather increasing. This is surprising to consider the well-established cost-advantage of futures markets. But strong financial crisis, very short history and small in size compare to the cash market are possible reasons to for this results that are contrary to expectations.

The ECM explains only 3.0 percent of the variations in the index spot innovations through futures price adjustment and 22.9 percent of the variations in the index futures innovations through its own price adjustment. This implies that futures have very insignificant role to eliminate the spot index disequilibrium.

Table 7: Error Correction Model with Dummy for Testing the Impact of Crisis on Spot and Index Futures (full sample).

$$\Delta s_t = \alpha_0 + \beta_2 Z_{2t-1} + \sum_{i=1}^{T} d_i \Delta F_t + \sum_{j=1}^{T} e_i \Delta S_t + Dum._{crisis} + \varepsilon_{s,t}\,; \quad \text{where } Z_{2t} = S_t - \alpha F_t$$

$$\Delta f_t = \alpha_0 + \beta'_2 Z_{2t-1} + \sum_{i=1}^{T} d'_i \Delta F_t + \sum_{j=1}^{T} e'_i \Delta S_t + Dum._{crisis} + \varepsilon_{s,t}\,; \quad \text{where } Z_{2t}\ S_t - \alpha F_t$$

Dep.	Indep.	β_1 / β'_1 β_2 / β'_2	b_1 / c'_1 d_1 / e'_1	b_2 / c'_2 d_2 / e'_2	b_3 / c'_3 d_3 / e'_3	b_4 / c'_4 d_4 / e'_4	$\sum b_i=0$ $\sum d_i=0$	Dum	R^2
Spot	Futures	-.050	.084	.234	.024	.043	3.08	2.96**	.228
		(-7.3)*	(.991)	(3.2)*	(.342)	(.671)			
Futures	Spot	.002	.077	.061	.033	-.015	1.55	1.79*	.032
		(1.44)	(1.31)	(1.49)	(.882)	(-.436)			

Notes: The double asterisk (**) denotes the significant at 5% significant level
The Single asterisk (*) denotes the significant at 10% significant level.

Table 7 reports the ECM results with dummy variable that captures the crisis period effect. It indicates the significant effect on the market (measured by F-statistics). Crisis period affected the spot index more strongly (ECM equation 2.96) than that of index futures. It implies that financial crisis impact on stock market is more significant compared to futures market.

The whole sample period is divided into three sub-samples to examine whether the co-integration and causality relation is stable for the whole period. Table 8 showed that there is no strong co-integrating relation between spot and futures prices in 1996. The likelihood ratio test cannot reject the null hypothesis of no-cointegration between spot and futures prices. For the second sub-sample, Johansen co-integration methodology also showed (Table 8) that there is no co-integration relationship between spot and futures price. However the third sub-sample (1998-1999) showed the significant co-integration relationship between spot and futures. Therefore the likelihood ratio test rejects the null hypothesis of no-cointegration between spot and futures prices.

Table 8: Johansen Cointegration Test for sub-sample

1996					
r=0	r=1	10.78	r=0	r>=1	13.68
r<=1	r=2	2.90	r<=1	r=2	2.90
	Co-integration Vector				
Futures Price		.01248			
Spot		.045567			
1997					
r=0	r=1	12.20	r=0	r>=1	12.25
r<=1	r=2	.049	r<=1	r=2	.049
	Co-integration Vector				
Futures Price		.002			
Spot		.049			
1998-1999					
r=0	r=1	31.52*	r=0	r>=1	32.37*
r<=1	r=2	.855			
			r<=1	r=2	.855
	Co-integration Vector				
Futures Price		.0025			
Spot		.0895			

The 1% and 5% critical value for Eigen value of Johansen test are 14.88 and 12.48 for r=0 and 8.07 and 6.50 for r≤1 respectively. Similarly The 1% and 5% critical value for Trace value of Johansen test are 17.86 and 15.75 for r=0 and 8.07 and 6.50 for r≤1 respectively.
** Null Hypothesis rejected at the 1% confidence level

Result of the error correction model for initial year (1996) is reported in Table 9. All the ECM coefficients have the expected sign but are not statistically significant. In the case of short run adjustment, cross-market coefficients (spot) of futures ECM equation are jointly significant. It implies unidirectional causality from spot to futures in short run. Though no long run adjustment trend is observed (informational inefficiency) but in short run, information are flowing from spot to futures not from futures to spot.

Table 9: Testing for Long and Short Run Causal Relationship for Spot and Index Futures Contracts for 1996.

$$\Delta s_t = \alpha_0 + \beta_2 Z_{2t-1} + \sum_{i=1}^{T} d_i \Delta F_t + \sum_{j=1}^{T} e_i \Delta S_t + \varepsilon_{s,t}; \quad \text{where } \boldsymbol{Z_{2t} = S_t - \alpha F_t}$$

$$\Delta s_t = \alpha_0 + \beta'_1 Z_{2t-1} + \sum_{i=1}^{T} b_i \Delta S_t + \sum_{j=1}^{T} c'_i \Delta F_t + \varepsilon_{s,t}; \quad \text{where } \boldsymbol{Z_{2t} = F_t - \alpha S_t}$$

Dep.	**Indep.**	$\boldsymbol{\beta_2}$	$\boldsymbol{d_1}$	$\boldsymbol{d_2}$	$\boldsymbol{d_3}$	$\boldsymbol{d_4}$	$\boldsymbol{\sum d_i=0}$	$\boldsymbol{R^2}$
Spot	Futures	-.006	-.033	.115	-.127	-.307	.655	.045
		(-.707)	(-.218)	(732)	(-.812)	(-2.28)**		
Dep.	**Indep.**	$\boldsymbol{\beta'_1}$	$\boldsymbol{c'_1}$	$\boldsymbol{c'_2}$	$\boldsymbol{c'_3}$	$\boldsymbol{c'_4}$	$\boldsymbol{\sum c_i=0}$	$\boldsymbol{R^2}$
Spot	Futures	.004	-.018	.128	-.115	-.300	.496	.044
		(.501)	(-.117)	(.816)	(-.740)	(-2.24)**		

$$\Delta f_t = \alpha_0 + \beta_1 Z_{2t-1} + \sum_{i=1}^{T} b_i \Delta S_t + \sum_{j=1}^{T} c_i \Delta F_t + \varepsilon_{s,t}; \quad \text{where } \boldsymbol{Z_{2t} = F_t - \alpha S_t}$$

$$\Delta f_t = \alpha_0 + \beta'_2 Z_{2t-1} + \sum_{i=1}^{T} d'_i \Delta F_t + \sum_{j=1}^{T} e'_i \Delta S_t + \varepsilon_{s,t}; \quad \text{where } \boldsymbol{Z_{2t} \; S_t - \alpha F_t}$$

Dep.	**Indep.**	$\boldsymbol{\beta_1}$	$\boldsymbol{b_1}$	$\boldsymbol{b_2}$	$\boldsymbol{b_3}$	$\boldsymbol{b_4}$	$\boldsymbol{\sum b_i=0}$	$\boldsymbol{R^2}$
Future	Spot	-.011	.435	-.003	.114	.192	2.13	.086
		(-.968)	(2.43)**	(-.018)	(.621)	(1.19)		
Dep.	**Indep.**	$\boldsymbol{\beta'_2}$	$\boldsymbol{e'_1}$	$\boldsymbol{e'_2}$	$\boldsymbol{e'_3}$	$\boldsymbol{e'_4}$	$\boldsymbol{\sum e_i=0}$	$\boldsymbol{R^2}$
Future	Spot	.007	.455	.011	.125	.198	2.39	.084
		(.729)	(2.51)**	(.059)	(.679)	(1.22)		

Notes: β_1 and β_2 are the residuals (ECM term) from regression when F_t and S_t are the LHS variable, correspondingly. Hypotheses are mentioned before.
* Indicates the t-value is significant at the 5% level
** Indicates the t-value is significant at the 10% level.
Bold Indicates the second specification of Error correction model.

The ECM results for second sub-samples (1997) shows similar results as first sub-sample (1996). Error corrections term have expected sign but are not significant. Though short run coefficients jointly are not significant, individually some of the lagged innovations are significant either positively or negatively. It indicates the random effect of lagged innovation on each market.

The third sub-sample results (Table 10) show some significant change in market behavior. Four error correction terms are significant. It implies bi-directional causality between two markets. The results are similar to the full sample results. It implies that co-integration relationship established only after the financial crisis. It can be argued that due to the high return in cash market (before the crisis) futures market was mostly ignored by investors and can be observed from the trading volume. However financial crisis slowly encouraged the investors to use of futures contract as a hedging instrument and thus establish the relationship between spot and futures market.

Table 10: Testing for Long and Short Run Causal Relationship of Spot and Index Futures Contracts for Third Sub-Sample (1998-1999)

$$\Delta s_t = \alpha_0 + \beta_2 Z_{2t-1} + \sum_{i=1}^{T} d_i \Delta F_t + \sum_{j=1}^{T} e_i \Delta S_t + \varepsilon_{s,t}; \quad \text{where } Z_{2t} = S_t - \alpha F_t$$

$$\Delta s_t = \alpha_0 + \beta'_1 Z_{2t-1} + \sum_{i=1}^{T} b_i \Delta S_t + \sum_{j=1}^{T} c'_i \Delta F_t + \varepsilon_{s,t}; \quad \text{where } Z_{2t} = F_t - \alpha S_t$$

Dep.	Indep.	β_2	d_1	d_2	d_3	d_4	$\sum d_i=0$	R^2
Spot	Futures	-.021	-.325	.015	-.160	-.054	1.75	.263
		(-5.94)**	(-1.96)*	(.107)	(-1.22)	(-.477)		
Dep.	**Indep.**	β'_1	c'_1	c'_2	c'_3	c'_4	$\sum c_i=0$	R^2
Spot	Futures	.016	-223	.083	-.103	-.021	.401	.245
		(5.39)**	(-1.37)	(.612)	(-.788)	(-.179)		

$$\Delta f_t = \alpha_0 + \beta_1 Z_{2t-1} + \sum_{i=1}^{T} b_i \Delta S_t + \sum_{j=1}^{T} c_i \Delta F_t + \varepsilon_{s,t}; \quad \text{where } Z_{2t} = F_t - \alpha S_t$$

$$\Delta f_t = \alpha_0 + \beta'_2 Z_{2t-1} + \sum_{i=1}^{T} d'_i \Delta F_t + \sum_{j=1}^{T} e'_i \Delta S_t + \varepsilon_{s,t}; \quad \text{where } Z_{2t} \; S_t - \alpha F_t$$

Dep.	Indep.	β_1	b_1	b_2	b_3	b_4	$\sum b_i=0$	R^2
Future	Spot	.019	.122	.055	.026	-.012	1.10	.047
		(1.52)	(1.22)	(.922)	(.484)	(-.230)		
Dep.	**Indep.**	β'_2	e'_1	e'_2	e'_3	e'_4	$\sum e_i=0$	R^2
Future	Spot	-.040	.179	.073	.036	-.006	2.15	.053
		(-1.90)	(1.68)	(1.20)	(.652)	(-.116)		

Notes: β_1 and β_2 are the residuals (ECM term) from regression when F_t and S_t are the LHS variable, correspondingly. Hypotheses are mentioned before.
* Indicates the t-value is significant at the 5% level
** Indicates the t-value is significant at the 10% level.

In summary, in the terminal month equilibrium spot and futures prices should cause each other and consequently improve the efficiency of arbitrage activity. First, the cash and futures markets are cointgerated so that error correction representation for each series is appropriate. Full sample results show the appropriateness of the significant error terms. Therefore, the results are generally consistent with market efficiency. Spot and futures prices appear to be mostly simultaneously related on a daily basis and with lagged interactions, although some are statistically significant and some are rather weak in a magnitude. This implies that the predictive content may not be economically viable.

Third, the relative magnitudes of the error correction and lagged coefficients suggest that although feedback relationship exists in short run between the cash and futures market for index futures but in long run, the spot to futures lead appears to be more pronounced across days.

Fourth, positive error correction term (in third sub-sample and also full sample) reveals that changes in spot prices subsequently widen the disequilibrium and then causes changes in futures prices to narrow down the disequilibrium. This is not consistent with existing evidence of the futures market efficiency. This result is a first such deviation, which may be consistent with the speculative trades dominated by individuals in emerging markets and unexpected fluctuation of the underlying market due to the serious financial crisis.

Fifth, only the last sub-sample (1998-1999) shows the bi-directional feedback relationship between spot and futures whereas other two sub-samples (1996 and 1997) did not show any long run causal relationship. This finding make this study unique in the sense that it documents the fact that financial crisis increased the participation (arbitrage as well as speculative activity) in the futures market, which make the futures and spot prices interdependent. Lastly the magnitude of error coefficients indicates the adjustment tendency. The magnitude of error coefficients are very small suggesting that tendency of adjustment (speed of adjustment) from both sides is very slow.

References:

Goldenberg, D.H (1989). “Memory and Equilibrium Futures Prices”. Journal of Futures Markets, 9: pp. 199-213.

Garbade, K.D and Silber, W.L (1983). “Price Movement and Price Discovery in Futures and Cash Markets.” Review of Economics and Statistics, 65: pp. 289-297.

Herbst, A.F., McCormack, J. and West, E. (1987). “ Investigation of a Lead-Lag relationship Between Spot Stock Index and Their Futures Contracts”. Journal of Futures Market. 7: pp. 373-381.

Dickey, D.A and Fuller, W.A (1979). “ Distribution of the Estimators for Autoregressive Time Series with a Unit Root.” Journal of the American Statistical Association. 74: pp. 427-431.

Nassir, A.N., M. Ariff and shamsher. M. (1994). “ Is Kuala-Lumpur’s Emerging Share Market Efficient?” Journal of International Financial Markets, Institutes and Money. 4: pp. 89-100.

Corbae, D. and Ouliaris. S. (1988). “ Co-integration and Purchasing Power Parity.” The Review of Economics and Statistics. 70: pp.508-511.

Baillie, R., and Bollerslev. T. (1989), "The Message in Daily Exchange Rates: A Conditional-Variance Tale," Journal of Business and Economic Statistics, 7: pp. 297-306.

Granger, C.W.J (1981). “ Some Properties of Time Series Data and Their Use in Econometric Model Specification.” Journal of Econometrics. 16: pp. 121-130.

Granger, C.W.J (1983). “ Cointegrated Variables and Error Correction Models”. Working Paper 83-13. University of California. San Diego. CA.

Johansen, S. (1988). “ Statistical Analysis of Co-integration Vectors.” Journal of Economic Dynamics and Control. pp. 231-254.

Johansen, S. (1991). “ Estimation and Hypothesis Testing of Co-integration Vectors in Gaussian Vector Autoregressive Models.” Econometrica. pp. 1551-1580.

IFS: International Financial Statistics, IMF, Different Issues.

Allingham, M. (1985). “ Futures Market and Economic Efficiency: A Theoretical Perspective”. Resources Policy. 11: pp. 43-48.

Bessler D.A and Covey T. (1991). “ Cointegration: Some Results on US Cattle Prices.” Journal of Futures Market. Pp. 461-474.

Chan K. and Chung Y.P. (1993). " A Further Analysis of the Lead-Lag Relationship Between the Cash Market and Stock Index Futures Market." Review of Financial Studies. 5: pp. 123-152.