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Intraday Price Discovery in KLCI Markets and the Impact of MCO 3.0

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Abstract

Purpose: This study examines the price discovery process among the FTSE Bursa Malaysia Kuala Lumpur Composite Index (KLCI) and its two derivatives—the FTSE Bursa Malaysia KLCI Futures (FKLI) and the FTSE Bursa Malaysia KLCI Exchange-Traded Fund (ETF)—during the Movement Control Order (MCO) 3.0 which ended on June 28, 2021.

Design/methodology/approach: The analysis covers 156 trading days from April 19, 2021, to December 20, 2021, yielding 1,248 hourly observations. The Vector Error Correction Model (VECM), Granger causality tests and Hasbrouck Information Shares model are used for data analysis.

Findings: Before the implementation of MCO 3.0, FKLI held a dominant position, with the ETF serving a secondary role. However, after MCO 3.0, the ETF's influence grew, underscoring its rising significance during periods of market uncertainty.

Research limitations/implications: Granger causality and Information Share estimates reveal direct causal links and market interconnectedness. Despite discrepancies between measures, further research should address gaps considering market sentiment, liquidity, and macroeconomic conditions.

Practical implications: The findings emphasize the dynamic nature of price discovery, especially after significant regulatory changes. These insights enhance the understanding of futures and ETF markets' roles in price discovery, offering valuable implications for market participants and policymakers.

Originality/value: Despite extensive research on KLCI and FKLI, the role of ETF remains largely unexplored. Including ETF offers a more comprehensive view of price discovery in the KLCI markets. While the Granger Causality test is widely used in the Malaysian context, the Hasbrouck Information Share model is less frequently applied, providing a unique perspective in this analysis.

Keywords: Price Discovery, KLCI, ETF, FKLI, Hasbrouck Information Share, MCO3.0

Introduction

Intraday price discovery is a fundamental aspect of financial markets, as it determines how new information is reflected in asset prices. This process is crucial for traders, investors, and policymakers who rely on accurate and timely information to make informed decisions.

This study seeks to evaluate the intraday price discovery mechanisms within the KLCI market and its two derivatives—namely, the FKLI and ETF covering the period from April 19, 2021, to December 10, 2021. Given the need for constant monitoring in price discovery, the implementation of MCO 3.0 to curb Covid-19 provides a unique opportunity to analyze disruptions and their effects on KLCI market interactions.

Previous research indicates that futures often lead spot markets in reflecting new information due to lower transaction costs and higher leverage. For instance, studies on the Nifty index futures (Khan et al., 2022; Sundararajan & Balasubramanian, 2023) demonstrate that futures markets significantly contribute to price discovery. However, in Malaysia, futures markets may not be as efficient (Taunson et al., 2018). While KLCI and FKLI have been extensively studied, the ETF's role in price discovery is underexplored. Including ETFs, which trade like stocks and track indices with lower costs, offers a comprehensive view of price discovery, particularly during high market volatility (Atilgan et al., 2020).

Therefore, this paper aims to examine the contributions of KLCI, FKLI, and ETF to price discovery and the impact of Malaysia's MCO 3.0 which ended on June 28, 2021 on these contributions.In addition to using the well-known Granger Causality model to study price discovery, we also use the Hasbrouck Information Share model. While many researchers rely on the Granger Causality model, fewer studies use the Hasbrouck Information Share model, especially for the Malaysian market.

The findings reveal that price discovery in Malaysian financial markets evolved significantly. Before MCO 3.0, FKLI led the market with ETFs in a secondary role. After MCO 3.0, ETFs became central and change the market interactions and information flow. This underscores the impact of events like MCO 3.0 on market structures and the importance of ongoing monitoring for effective regulation and investment strategies.

The remainder of this paper is organised as follows: Section 2 provides institutional details. Section 3 provides a literature review, highlighting the hypotheses development. Section 4 details the data and methodology used in this study. Section 5 presents the empirical results and their implications. Finally, Section 6 offers concluding remarks and suggests directions for future research.

Institutional details

The FKLI and ETF are derivatives of the KLCI, making them fundamentally identical instruments. Established in 1986, the KLCI benchmarks Malaysian equities by tracking the largest 30 companies on Bursa Malaysia. This capitalization-weighted index is recalculated every 15 seconds, providing real-time data and serving as a key market indicator. Regular updates and liquidity screenings maintain its relevance and accuracy. Launched in 1995, the FKLI index futures is a KLCI-based contract on Bursa Malaysia Derivatives Exchange (BMD), facilitating hedging, arbitrage, and speculation with continuous price signals and liquidity. The FKLI’s growing trading volume and open interest underscore its role in price discovery and hedging. Introduced in 2007, the FTSE Bursa Malaysia KLCI ETF mirrors KLCI performance, offering a diversified, liquid, and cost-effective investment option popular among retail and institutional investors. It serves as a pricing reference for FKLI futures contracts, with increasing trade volume and investor participation reflecting its reliability and accessibility. The interactions among the KLCI, FKLI, and ETF influence the efficiency of new information incorporation into prices, affecting investment strategies, hedging activities, and market stability. Thus, examining their role in price discovery, which involves identifying the market equilibrium price, is crucial.

Literature Review

Intraday price discovery is a critical process in financial markets that involves the incorporation of new information into asset prices within a single trading day. Unlike interday price discovery which occurs over longer periods, intraday price discovery captures the real-time flow of information and its immediate impact on market prices.

The current study aims to investigate the price discovery role of KLCI and its two derivatives i.e., the FKLI and ETF in the emerging Malaysian market and the impact of MCO 3.0 introduced to curb the spread of the COVID-19 pandemic on these roles. Previous research has primarily focused on the contributions of the underlying index and index futures. Empirical evidence suggests that futures markets often lead spot markets in reflecting new information due to their higher liquidity, lower transaction costs, and the leverage they provide to traders (Khan et al., 2022; Sundararajan & Balasubramanian, 2023). However, research focused on the Malaysian market has highlighted that futures may not serve their role as the bellwether instrument as efficiently as expected (Taunson et al., 2018). The evidence suggests that while futures markets generally lead in price discovery due to their structural advantages, this is not a universal rule.

Similar to futures, ETFs offer liquidity, diversification, and lower transaction costs, which have made them increasingly popular among investors. Recent studies suggest that ETFs can also serve as price discovery leaders due to their growing liquidity and trading volumes. Atilgan et al., (2020) find the significant role that ETFs play in price discovery particularly in volatile market conditions suggesting that ETFs are effective in incorporating and reflecting new information promptly. However, not much research has looked at the role of ETFs in price discovery in the Malaysian market. Including the ETF in this analysis gives us a fuller picture of how prices are determined.

Regulatory changes have a profound impact on the price discovery process by altering market behavior, affecting liquidity, and shifting the dynamics of information flow. Yang et al. (2021) examined the effects of global financial uncertainties on market dynamics, demonstrating that significant events can have profound effects on price discovery processes. The implementation of Malaysia's MCO 3.0 provides a natural experiment to study such impacts.

Based on the literature review and the objectives of this study, the following hypotheses are formulated:

Hypothesis 1: The FKLI futures market leads the KLCI spot market in price discovery due to its higher liquidity and lower transaction costs (Khan et al., 2022).

Hypothesis 2: The ETF contributes significantly to the price discovery process, potentially rivaling or surpassing the FKLI and KLCI (Atilgan et. al., 2020).

Hypothesis 3: The implementation of MCO 3.0 significantly impacts the price discovery contributions of KLCI, FKLI, and ETF (Yang et al., 2021).

In summary, this literature review highlights the critical aspects of intraday price discovery, the dominant role of futures markets, the emerging significance of ETFs, and the impact of regulatory events on market dynamics. This study aims to provide a comprehensive understanding of these elements within the KLCI markets, with a particular focus on the often-overlooked ETF and the effects of MCO 3.0.

Data and Methodology

Data

The data used in this study consists of intraday price quotes for the FTSE Bursa Malaysia Kuala Lumpur Composite Index (KLCI), FTSE Bursa Malaysia KLCI Futures (FKLI) and the FTSE Bursa Malaysia KLCI Exchange-Traded Fund (ETF). The sample period extends from April 19, 2021 to December 20, 2021. The price quotes are collected with timestamp precision to the second i.e. whenever a transaction occurs to allow for a detailed capture of market dynamics in intraday price discovery research.

As the trading hours for FKLI differ from KLCI and ETF, we excluded the first and last 15 minutes of FKLI trading data. We also removed FKLI data from 12:30pm to 12:45pm since KLCI and ETF stop trading at 12:30pm and all three platforms resume at 2:00pm. For data consistency, observations were synchronized to one-hour intervals, from 9:00am to 5:00pm, with a lunch break from 12:30pm to 2:00pm.[1] This gives eight one-hour observations each trading day. The sample has 156 trading days, totaling 1248 observations. The data for this study is sourced from ShareInvestor.

The selected time frame aims to provide a comprehensive and recent assessment of the interactions between the KLCI, the FKLI, and the ETF particularly in the context of the COVID-19 pandemic and the associated MCO 3.0. The sample period is divided into two segments:

- Before MCO 3.0: From April 19, 2021, to June 28, 2021, encompassing 351 observations.
- After MCO 3.0**:** From June 29, 2021, to December 10, 2021, encompassing 896 observations.

Figure 1 below shows the daily KLCI price/volume from April to December 2021. The KLCI experienced a significant downward trend throughout the sample period, which can be attributed to the economic impact of the MCO 3.0 and ongoing uncertainties related to the COVID-19 pandemic. The price movements display considerable volatility with pronounced peaks and troughs indicating periods of market instability and investor uncertainty. This is particularly evident in mid-2021 and late 2021. The periodic spikes in trading volume, particularly towards the latter part of the year, suggest heightened market activity, possibly due to investor reactions to new information, or policy changes related to the on-going pandemic.

Similar to the underlying, both FKLI and ETF show a general downward trend over the sample period reflecting the broader market conditions and the impact of regulatory changes such as MCO 3.0, as shown in Figure 2 below. The price movements of FKLI and ETF appear to be highly correlated, indicating that both instruments react similarly to market conditions and news over the long run. The trading volumes for both instruments show significant spikes at various points, suggesting periods of increased market activity.

[1] The ETF prices were multiplied by 1000 to make them comparable to the FKLI and KLCI prices.

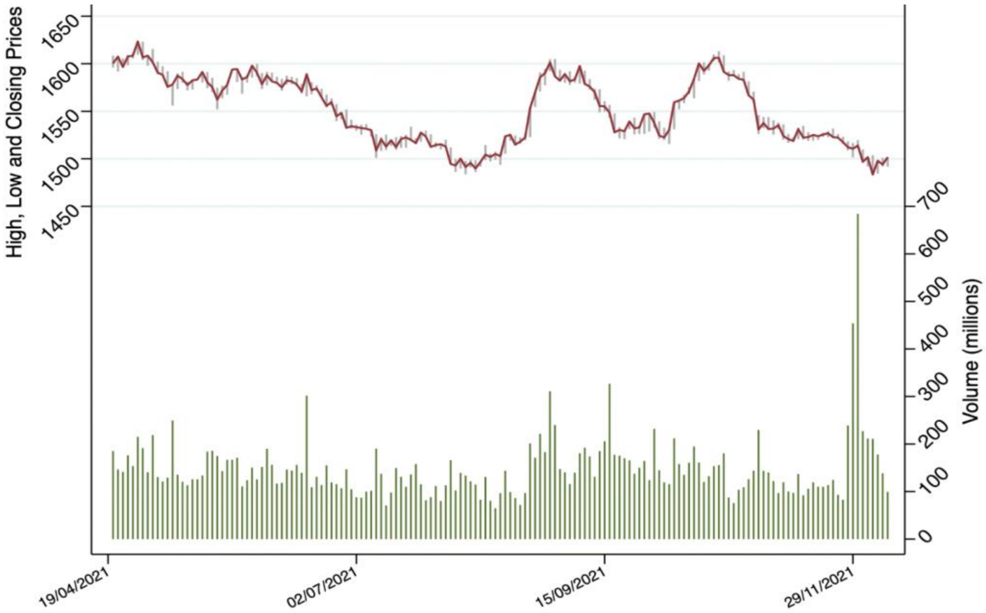

Figure 1: Daily Price/Trading Volume of the KLCI (Apr to Dec 2021)

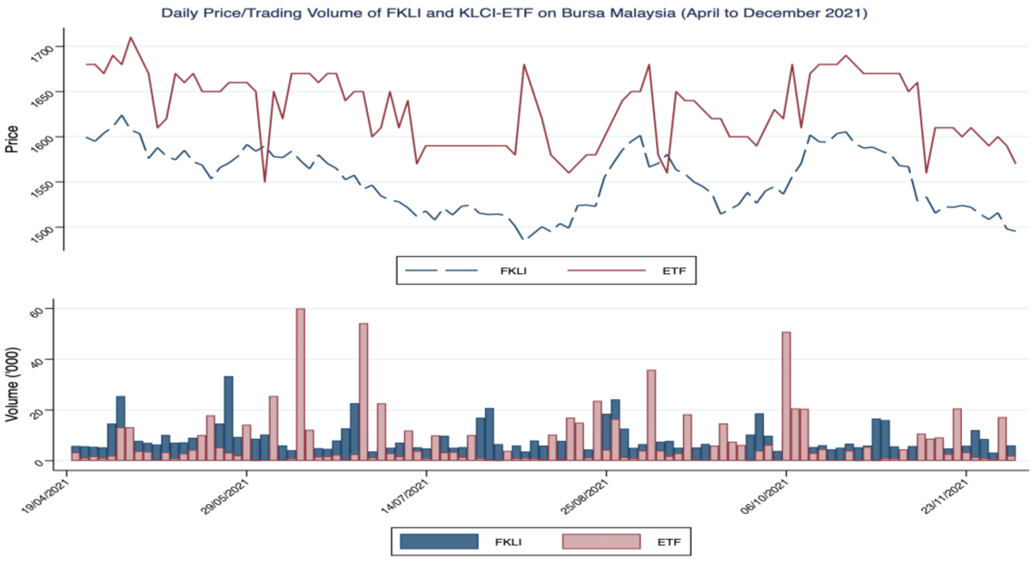

Figure 2: Daily Price/Trading Volume of the FKLI and ETF (Apr to Dec 2021)

For analysis purposes, the price series are transformed into log return series as follows:

$$r_t = \log(X_t) - \log(X_{t-1}) \quad (1)$$

where X_t and X_{t-1} are the prices at time t and $t-1$, respectively. The one-hour returns for the KLCI, ETF and FKLI returns are as plotted in Figure 3.

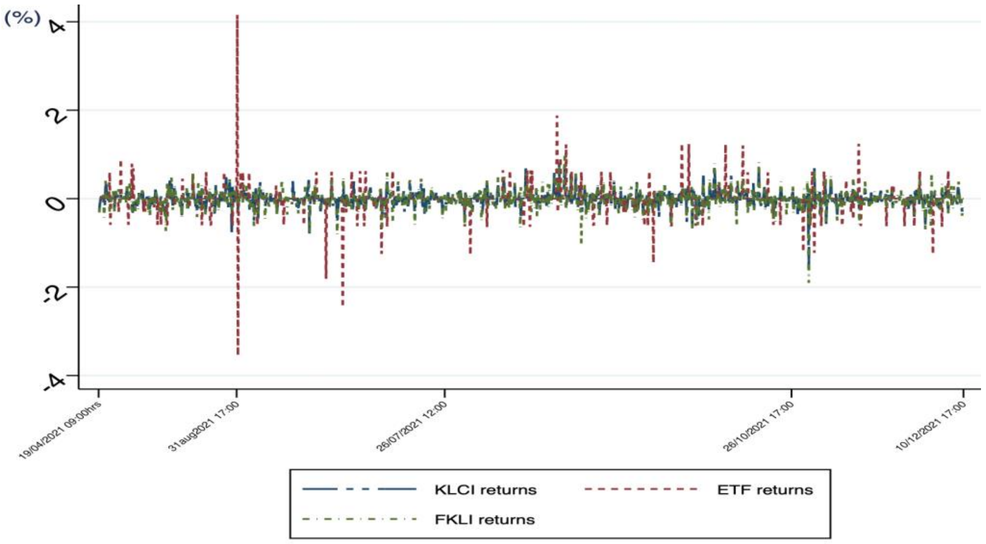

Figure 3: Hourly Returns for KLCI, ETF and FKLI (Apr to Dec 2021).

The correlation coefficient between the returns of KLCI and FKLI is a strong and positive, approximately 0.85 as shown in Table 1. However, both KLCI and FKLI have very low correlations with the ETF which are 0.07 and 0.035 respectively. The weak correlations between the ETF and both the KLCI and FKLI suggest that short-term price movements are not being processed similarly by these instruments. This implies that the ETF does not follow the same return pattern as the KLCI index or the FKLI futures. Consequently, the ETF may respond differently to new information, indicating a distinct price discovery process compared to the KLCI index and FKLI futures.

Table 1: Correlations of Hourly Returns for KLCI, ETF and FKLI (Apr to Dec 2021).

	KLCI	FKLI	ETF
KLCI	1.0000	0.8543	0.0715
FKLI	0.8543	1.0000	0.0353
ETF	0.0715	0.0353	1.0000

Methodology

The Johansen cointegration test is vital for this study as it determines the existence of a long-term equilibrium relationship among the KLCI, FKLI, and ETF. If cointegration exists, the Vector Error Correction Model (VECM) is appropriate as it accounts for both short-term dynamics and long-term relationships providing more accurate and meaningful results (Johansen, 1991). The Johansen cointegration test involves estimating the following VECM model of order *p*:

$$\Delta X_t = \prod X_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \, \Delta X_{t-i} + \epsilon_t \quad (2)$$

where, Δ is the difference operator, X_t is a vector of the non-stationary time series variables (i.e,. log returns of KLCI, FKLI and ETF in this case), $\prod$ is a matrix that contains information about the long-term relationships between the variables. It can be decomposed into $\alpha\beta'$, where; α represents the speed of adjustment coefficients to the long-term equilibrium. β is the cointegration matrix cointegration vectors. Γ_i are the short-term adjustment matrices capturing the short-term dynamics between the variables. ϵ_t is a vector of error terms (white noise).

The rank of the matrix $\prod$ determines the number of cointegrating relationships. If the rank r is greater than zero but less than the number of variables, there are r cointegrating vectors indicating long-term equilibrium relationships.

Table 2 shows the result of the Johansen cointegration test. The results reveal two cointegrating vectors among the KLCI, FKLI and ETF series, indicating two long-term equilibrium relationships. This suggests that, despite short-term fluctuations, the prices of these series will align in the long run, reflecting their interconnectedness and preventing them from drifting apart indefinitely.

Table 2: Johansen Cointegration Results

H_0	λtrace	p-value
r = 0	156.1238	< 0.001
r ≤ 1	37.4447	< 0.001
r ≤ 2	1.9765	> 0.100

Note: The Johansen trace tests results evaluate the hypothesis that the system has at most r cointegrating vectors. The λ_{trace} is calculated as $\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \log(1-\lambda_i)$ where λ_i is the i-th largest eigenvalue.

Having established the existence of two cointegrating relationships among the KLCI, FKLI, and the ETF, the next step is to estimate the Vector Error Correction Model (VECM). The VECM allows for both short-term dynamics and long-term equilibrium relationships among the variables, making it a suitable model for analysing the interactions and the lead-lag relationships between these markets (Engle & Granger, 1987).

We estimate the following VECM model for the three variables with p = 8 lags as determined by the Akaike Information Criterion (AIC) and with two cointegrating relationships (rank r = 2):

$$\Delta X_t = \alpha(\beta' X_{t-1}) + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \epsilon_t \quad (3)$$

where, Δ is the difference operator, X_t is a vector of the log returns of the KLCI, FKLI and ETF. α is a matrix of adjustment coefficients that represent the speed of adjustment to the long-term equilibrium. β is the cointegration matrix containing the cointegrating vectors. Γ_i are the short-term adjustment matrices capturing the short-term dynamics among the variables. ϵ_t is a vector of error terms (white noise).

The Ljung-Box test results suggest that the residuals of the VECM model for KLCI, FKLI, and ETF do not exhibit significant autocorrelation. Additionally, a GARCH(1, 2) model with robust standard errors is employed to address heteroscedasticity in the VECM residuals. This implies that the model has adequately captured the dynamics of the data, and the residuals are behaving as white noise (Bollerslev, 1986). The Johansen test and VECM have been widely used in investigating the lead-lag relationship between KLCU and FKLI in Malaysia. Studies have shown that these models are effective in capturing the dynamics and interrelationships between these markets (Taunson et al., 2018).

The Information Share model operates within a cointegrated VECM system where multiple price series share a long-term equilibrium relationship. However, we find less evidence of this model specifically addressing the issues at hand in the Malaysian market. The key objective of Hasbrouck's IS model is to estimate the contribution of each market to the efficient price

(Hasbrouck, 1995). Assuming the error term ϵ_t follows a multivariate normal distribution with covariance matrix Σ, we can decompose Σ using a Cholesky factorization:

$$\sum = LL' \quad (4)$$

where L is a lower triangular matrix. The innovation in the efficient price, υ_t can be expressed as:

$$\upsilon_t = \sum_{i=1}^{N} \omega_i \epsilon_{it} \quad (5)$$

Here, ω_i represents the weights derived from the Cholesky factorization. The Information Share (IS) for market i is given by:

$$IS_i = \frac{(\omega_i L_{ii})^2}{\sum_{j=1}^{N} (\omega_j L_{jj})^2} \quad (6)$$

where $\omega_i L_{ii}$ is the contribution of market i to the variance of the common efficient price innovation. The sum of the information shares across all markets equals 1, i.e.,

$$\sum_{i=1}^{N} IS_i = 1 \quad (7)$$

Results and Findings

Table 3 below presents the descriptive statistics for the KLCI, ETF, and FKLI, with the analysis periods divided into before and after MCO 3.0 phases.

Table 3: Descriptive statistics for KLCI, ETF and FKLI returns

	19/04/2021 to 28/06/2021			29/06/2021 to 10/12/2021			19/04/2021 to 10/12/2021		
Statistics	KLCI	ETF	FKLI	KLCI	ETF	FKLI	KLCI	ETF	FKLI
n	351			896			1,247		
ADF (log prices)	-0.96	-2.14	-0.678	-1.908	-1.784	-1.946	-1.357	-1.7884	-1.7708
ADF (returns)	-15.8	-16.7	-8.0461	-5.150	-29.95	-27.30	-30.53	-12.60	-7.4917
Mean	-0.01	-0.005	-0.0115	-0.003	-0.004	-0.004	-0.006	-0.0049	-0.0062
Std Dev	0.160	0.354	0.1850	0.1723	0.2349	0.2128	0.1691	0.2736	0.2053
Skewnes	-0.68	1.448	-0.5150	-0.512	-0.831	-0.769	-0.550	0.5008	-0.7145
Excess Kurtosis	3.578	84.23	2.7545	10.576	28.998	9.2057	8.9940	77.425	8.1456

Note. 1-hour returns are generated by $r_t = \log(X_t) - \log(X_{t-1})$ where X_t and X_{t-1} are prices. The mean and standard deviations are expressed in percentage form. ADF figures are Augmented Dickey–Fuller unit root tau-statistics. The 5% critical value from MacKinnon (1991) is 2.8628 to reject the null of a unit root.

The mean returns for KLCI, FKLI, and ETF decreased after MCO 3.0, indicating reduced profitability. Specifically, KLCI's mean returns dropped from -0.0112% to -0.0039%, FKLI from -0.0115% to -0.0041%, and ETF from -0.0051% to -0.0048%. Volatility, as measured by standard deviation, increased for KLCI (0.1608% to 0.1723%) and FKLI (0.1850% to 0.2128%), indicating higher market risk after MCO 3.0. However, ETF volatility decreased from 0.3542% to 0.2349%, suggesting lower risk for this instrument. Skewness became less negative for KLCI (-0.6872 to -0.5124) and more negative for FKLI (-0.5150 to -0.7692), implying a continued higher probability of negative returns. The ETF's skewness shifted from positive (1.4484) to negative (-0.8310), indicating a shift from positive to negative return tendencies. Excess kurtosis increased for KLCI (3.5787 to 10.5760) and FKLI (2.7545 to 9.2067), suggesting more frequent extreme returns. The ETF's excess kurtosis decreased significantly (84.2360 to 28.9990), indicating fewer extreme return occurrences after MCO 3.0. The ADF test for the returns series confirmed the stationarity of all indices across periods, indicating mean-reverting behavior.

The Granger causality tests for the entire sample period in Table 4 indicate significant relationships. The results reveal that FKLI returns can predict KLCI returns, and that both FKLI and KLCI returns can predict ETF returns. However, ETF does not significantly cause either FKLI or KLCI. The error correction terms highlight that deviations from the equilibrium between FKLI and KLCI are corrected significantly, with FKLI showing a negative coefficient (-0.5515) and KLCI a positive coefficient (1.5397). This suggests a robust long-term equilibrium relationship where FKLI adjusts to correct disequilibrium.

Table 4: Granger Causality and Error Correction Analysis for the Whole Sample Period

H_0	F-statistics	Error Correction
FKLI futures does not cause KLCI	13.6451**	-0.5515 (-2.421)
KLCI spot does not cause FKLI	7.6013	1.5397 (0.1389)
ETF does not cause KLCI spot	16.2433	-1.5917 (-7.326)
KLCI spot does not cause ETF	13.0602***	1.6490 (-4.613)
FKLI futures does not cause ETF	12.4721***	0.4607 (-6.765)
ETF does not cause FKLI futures	41.3667	-0.2751 (-5.968)

Note: ***Indicates significance at the 1% level, **at the 5% level, *at the 10% level. Figures in parenthesis are t-statistics

The Granger causality tests for the period before MCO 3.0 in Table 5 reveal that FKLI significantly cause KLCI returns. Additionally, KLCI returns significantly cause ETF returns. However, there is no significant evidence of ETF influencing either FKLI or KLCI returns. The error correction terms further illustrate the dynamics, with FKLI adjusting to deviations from equilibrium with a coefficient of -0.0261, though not highly significant. KLCI shows a positive adjustment coefficient of 0.0551 towards FKLI, and ETF returns exhibit a significant adjustment towards KLCI, indicating a feedback mechanism that maintains long-term equilibrium.

Table 5: Granger Causality and Error Correction Analysis for the Period Before MCO 3.0

H_0	F-statistics	Error Correction
FKLI futures does not cause KLCI	6.674577**	-0.0261 (-1.0529)
KLCI spot does not cause FKLI	1.539749	0.0551 (1.8076)
ÊTF does not cause KLCI spot	1.591749	-0.0251 (-0.6032)
KLCI spot does not cause ETF	7.568370**	0.0371 (1.4223)
FKLI futures does not cause ETF	7.786316**	-0.0575 (-1.7943)
ETF does not cause FKLI futures	1.568289	0.1085 (2.4810)

Note:**Indicates significance at the 1% level, **at the 5% level, *at the 10% level. Figures in parenthesis are t-statistics

After MCO 3.0, market dynamics exhibit notable changes. The Granger causality tests in Table 6 show that ETF returns now significantly predict KLCI returns. This marks a significant shift in the price discovery role of the ETF, suggesting an increased influence in the market after MCO 3.0. KLCI returns also continue to significantly cause ETF returns, with an F-statistic of 11.0139 at the 5% level. The error correction terms after MCO 3.0 show notable changes, with the ETF having a stronger correction towards FKLI (-0.0643) compared to its correction towards KLCI (-0.0195), indicating that the ETF is now more central in maintaining long-term equilibrium with FKLI.

Table 6: Granger Causality and Error Correction Analysis for the Period After MCO 3.0

H_0	*F*-statistics	Error Correction
FKLI futures does not cause KLCI	5.269905	-0.0154 (-0.5384)
KLCI spot does not cause FKLI	1.477646	0.0554 (1.5470)
ETF does not cause KLCI spot	1.901401***	-0.0195 (-0.5261)
KLCI spot does not cause ETF	11.01395**	0.0231 (0.7607)
FKLI futures does not cause ETF	9.924503***	-0.0643 (-1.6832)
ETF does not cause FKLI futures	2.565626	0.0868 (2.1928)

Note:**Indicates significance at the 1% level, **at the 5% level, *at the 10% level. Figures in parenthesis are t-statistics

In summary, the analysis reveals that before MCO 3.0, FKLI significantly influenced KLCI returns, and KLCI influenced ETF returns. After MCO 3.0, the ETF emerged as a significant predictor for KLCI returns, marking an increased role in price discovery. The error correction terms indicate that the ETF has become more central in maintaining long-term equilibrium, suggesting a shift in market dynamics after MCO 3.0.

Table 7 presents the Hasbrouck Information Share (*IS*) results for the KLCI, FKLI and ETF across three periods for the whole sample, before and after MCO 3.0. Over the whole period, KLCI's *IS* was 26.72%, indicating its role in price discovery. ETF had an *IS* of 33.73%, showing a more substantial influence. Meanwhile FKLI had the highest *IS* of 39.55% which makes it the principal contributor to price discovery. This hierarchy underscores FKLI's dominant role in shaping market prices during the period.

Before MCO 3.0, price discovery in Malaysian financial markets showed distinctive patterns. The KLCI had an *IS* of 28.23%, slightly higher than the overall sample period and indicates its growing role in price discovery. The ETF had an *IS* of 34.8%, reflecting its significant and increasing influence, while the FKLI led with an *IS* of 36.97% even though slightly reduced from the overall period. Collectively, these figures suggest FKLI was dominant, with KLCI and ETF gaining importance in price discovery before MCO 3.0.

Table 7: Hasbrouck Information Share Results

	Whole sample	Before MCO3.0	After MCO3.0
KLCI	26.72	28.23	26.28
ETF	33.73	34.8	40.41
FKLI	39.55	36.97	33.31

Note. Information share results are calculated as the proportion of the variance in the innovations to the implicit efficient prices attributed to each series. A VECM with 8 lags and 2 cointegrating relationships was used, and GARCH(1,2) errors were included to account for volatility clustering. The model was applied to the whole sample period, as well as to the sub-periods before and after MCO 3.0. Only the mean information share values are reported.

After MCO 3.0, KLCI's *IS* decreased to 26.28%, showing a reduced contribution to price discovery. In contrast, ETF's *IS* rose significantly to 40.41%, making it the most influential in price discovery after MCO 3.0. FKLI's *IS* declined to 33.31%, indicating a reduced role compared to before MCO 3.0. This period saw ETF surpass FKLI, suggesting a shift in market dynamics that was likely driven by increased trading activity or changes in market sentiment towards ETFs. These changes highlight the evolving nature of price discovery in the Malaysian market and the rising importance of ETFs after MCO 3.0, with implications for investors and policymakers.

Summary and concluding remarks

This study examines the price discovery roles of the KLCI, FKLI, and ETF markets before and after MCO 3.0 using Granger causality tests and Hasbrouck Information Share (*IS*) estimates. Before MCO 3.0, FKLI futures led KLCI spot returns, indicating FKLI's dominance in price discovery. KLCI returns led ETF returns, as confirmed by both Granger causality and *IS* estimates, despite the ETF's high *IS* estimate showing a moderate role in price discovery. This finding aligns with Sifat et al. (2020), which also identified FKLI futures as pivotal before MCO 3.0. After MCO 3.0, ETFs gained prominence in price discovery, predicting KLCI returns and adjusting to equilibrium more significantly, as shown by Granger causality tests and Hasbrouck *IS* estimates. Despite a reduced causal influence, FKLI's *IS* estimate remained high, indicating continued market significance. KLCI maintained its essential role, influencing ETF returns and showing a bidirectional relationship.

These findings reveal significant shifts in price discovery in Malaysian financial markets, with FKLI and KLCI leading before the MCO 3.0 and ETFs becoming central after the MCO 3.0. This underscores the impact of major events like MCO 3.0 on market structures and highlights the importance of continuous monitoring for effective regulation and investment strategies. The study supports Chia et al. (2020), who observed substantial impacts of significant events on the Malaysian stock market. While Granger causality and *IS* estimates provide a comprehensive view of market dynamics, further research should address discrepancies and consider factors such as market sentiment, liquidity, and macroeconomic conditions, as noted by Patel et al., (2020).

In summary, this study highlights the evolving roles of KLCI, FKLI, and ETFs in price discovery before and after MCO 3.0, offering critical insights for investors, policymakers, and market participants.

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