Research Journal of Finance and Accounting www.iiste.org
ISSN 2222-1697 (Paper) ISSN 2222-2847 (Online)
Vol.9, No.12, 2018

The Influence of Trading Frequency on Lead-Lag Effect Between Index Futures and Stock Index in Malaysia

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Abstract
The presence of lead-lag effect between index futures and stock index has lead finance researchers to focus on identifying the source of such phenomenon. In general, index futures play an important role in the price discovery process since it is found that index futures leads the stock index in reacting to the arrival of new information. Such phenomenon is attributed to the problem of stale prices among some components of stock index. The problem arises due to nonsynchronous trading as well as infrequent trading among inactive component stocks, resulting in stock index reporting weightage value of past prices unlike index futures, which is being updated constantly. This study examines the influence of trading frequency among component stocks on the presence of lead-lag effect between the two markets in Malaysia. The period of study runs from January 2000 to October 2003. It employs regression analysis using system estimators approach. The result shows that index futures does not only lead the inactive component stocks but also the active component stocks. As such, the finding contradicts the proposed theory, which stipulates that the presence of lead-lag effect is due to the problem of infrequent trading among inactive component stocks. Therefore, consistent with Chan (1992) and Martikainen et al. (1995) who investigate the same issue in the United States and Finland, this study provides empirical evidence that trading frequency does not contribute towards the presence of lead-lag effect between index futures and stock index in Malaysia.

Introduction

The relationship between index futures and stock index has attracted considerable research interests among finance researchers, owing to the presence of lead-lag effect between the two markets. Modest and Sundaresan (1983), Herbst et al. (1987), Chan (1990), Kawaller et al. (1990), Tang et al. (1992), Wahab and Lashgari (1993), Board and Sutcliffe (1995), Pizzi et al. (1998), Racine and Ackert (1998), Min and Najand (1999), Frino and West (1999) and Brooks et al. (1999) have all documented empirical evidence that supports such phenomenon. Index futures is found to lead stock index in interacting with new information and this is claimed to be an important role played by index futures in facilitating the price discovery process within the financial markets.

In Malaysia, Ibrahim et al. (1999), Mat Nor and Tea (2000), Wong and Meera (2001), Abdullah et al. (2002), Muhammad et al. (2002), Tan (2002) and Yakob (2004) have also investigated the relationship between index futures and stock index. Their findings, nonetheless, are inconclusive. Ibrahim et al. (1999), Mat Nor and Tea (2000), Tan and Lim (2001) and Tan (2002), for instance, detect the presence of contemporary effect between the two markets. This suggests that each market influences one another simultaneously. However, Wong and Meera (2001) report the presence of lead-lag effect but surprisingly stock index is found to lead index futures. Abdullah et al. (2002) and Muhammad et al. (2002), on the other hand, also discover the presence of lead-lag effect between the two markets but it is the index futures that leads stock index. The result is consistent with the finding reported by Yakob (2004). Such finding goes to support the important role played by index futures in the price discovery process. In short, despite the inconclusivity of the empirical findings, the fact that evidence of lead-lag effect, where index futures leads stock index, is also detected in an emerging market like Malaysia shows that the phenomenon prevails worldwide.

Based on the cost of carry model, as proposed by Cornell and French (1983) as well as Modest and Sundaresan (1983), the value of index futures is derived from the value of stock index that is continuously compounded at the cost of carry. This relationship is explained by equation $F = Se^{(r-q)T}$, where F represents the value of index futures, S represents the stock index, r represents risk-free rate of return, q represents dividend yield, while T represents the time before maturity. Theoretically, within a complete integrated system, each market will react simultaneously towards the arrival of new information. Such reaction reflects the state of an informationally efficient financial system. Failure to behave in that manner would suggest that the financial system is not informationally efficient or integrated since one market is capable of leading another market. Within the context of lead-lag effect, the new information seems to have passed through the futures market before being transmitted to the stock market.

Stoll and Whaley (1990) posit that the lead-lag effect can be associated to the problem of stale prices, which is due to nonsynchronous trading among component stocks that make up the index. The index represents the weightage of component stock prices and since some component stocks face the problem of infrequent trading, the reported index, therefore, does not automatically reflect the up-to-date price information. Instead, it may contain lagged information due to the fact that some of the component stocks are being represented by stale prices. This is unlike index futures, which is being updated every minute to reflect the latest available information. As such, index futures is therefore said to be the leading factor that drives the stock index in the price discovery process, which explains the presence of lead-lag effect between the two markets.

On that premise, this study examines the influence of trading frequency (among component stocks) towards the presence of lead-lag effect in Malaysia. Despite the proposition offered by Stoll and Whaley (1990) that attributes the phenomenon to the problem of nonsynchronous trading among some of the component stocks, Chan (1992) fails to find empirical evidence that supports the claim. The findings from his study on the American markets show that the lead-lag effect does not only prevail among inactive stocks but also among active stocks. Similar finding is also reported by Martikainen et al. (1995) who investigate the same issue in Finland. They conclude that the lead-lag effect does not discriminate between active and inactive stocks. Thus, their findings bring doubts to the proposition that associates the issue to the problem of nonsynchronous trading. Within the same context, this study attempts to re-evaluate the proposition by investigating the issue in an emerging market like Malaysia. Given that Arif et al. (1998) have reported that the Malaysian index component stocks are plagued by the problem of infrequent trading, this study will examine whether the presence of lead-lag effect can be explained by the trading frequency of the component stocks that make up the index.

Background of the study

The Composite Index (KLCI) is a major indicator for Bursa Malaysia[1], the only stock exchange in Malaysia. It was introduced in 1986 and since then, it has been regarded as the main benchmark for the performance of the country's equity market. The index is constructed based on the weightage of market capitalization for each component stock. Although it was first introduced in 1986, the base year for the index is traced backward to 1977. In the beginning, the index only accounts for the performance of 86 selected companies listed on the Main Board of the exchange. However, the number of the component stocks has been increased to 100 companies starting from 18 April 1995, to reflect the liquidity and diversity of the companies listed on the exchange. The KLCI is calculated and announced by the exchange at every one-minute interval. To date, the index serves as an indicator for the Malaysian stock market. Inadvertently, it reflects the general performance of the country's economy since the index measures the stock prices of companies that are engaged in wide variety of economic activities in the country.

The Malaysian stock market gains attention not only from the local investors but also from the foreign investors and fund managers. The stock market benefits tremendously from the influx of foreign participants who stimulate the investment and trading activities in the country. Given the increased financial needs by the participants of the stock market and realizing the importance of developing an equity-based risk management mechanism, the government introduces the Futures Industry Act 1993 follows by the Futures Industry Act (Amended) 1995 to enable the establishment of the Kuala Lumpur Options and Financial Futures Exchange (KLOFFE) in 1995. The objectives of this exchange, among others, are to facilitate and promote derivatives trading in the country. With the introduction of the exchange, wider range of financial products and services are expected to be introduced, in line with the government's effort to boost Malaysia as a regional financial hub. As a result, the first product of the exchange, the Composite Index futures contract (FKLI), makes its debut on 15 December 1995.

There are four different FKLI contracts being traded on the exchange at any given time, and they are the spot month, next month, first quarter and second quarter contracts respectively. Each contract is traded in the multiple of RM100, i.e. the value of each contract is determined by multiplying the quotation of FKLI with RM100. All transactions at the exchange are executed electronically. Thus, it ensures transparency and fairness in addition to direct dissemination of information to market participants. The smooth running of the derivatives trading can also be attributed to the efficiency of Malaysian Derivatives Clearinghouse (MDCH), which plays an important role in complementing KLOFFE. Together, both organizations (i.e. KLOFFE and MDCH) have contributed significantly towards the development and progress of equity-based derivatives market in the country.

Although at the initial stage, the market participants responded poorly towards the introduction of the first index futures contract in the country, the situation changes gradually as market participants are becoming more informed about the latest financial product in the market. From a mediocre total volume of 672 contracts in December 1995, the total volume grows to 24,779 in the month of October 2002[2]. The relevant authorities continue to promote awareness and interests among market participants on the importance of risk management. It is expected that the formation of Malaysian Derivatives Exchange (MDEX), the result of a merger between KLOFFE and COMMEX (Commodity and Monetary Exchange) on 11 June 2001 will stimulate more trading activities in future. Derivatives activity seems to have a great potential to grow and it will therefore command better understanding on the nature of the market. This study seeks to provide some basic insights on the potential

[1] Formerly known as the Kuala Lumpur Stock Exchange (KLSE).
[2] Malaysian Derivatives Exchange http://www.mdex.com.my

contributing factor that can help explain the relationship between index futures and stock index in Malaysia.

Data and Methodology

This study employs time series data comprising of the highest and the lowest daily prices for the spot month index futures as well as the selected index component stocks. The use of daily data is in accordance to Brooks et al. (1999) who warns of the problem of inaccurate representation when employing high frequency data in the thin trading environments, like the Malaysian financial markets. Using the series of highest and lowest prices, the average price is calculated to represent the price for the day. By so doing, the problem of nonsynchronous trading due to different closing hour[1] between the two markets can be minimized as suggested by Leuthold et al. (1992). The study chooses to use prices from the spot month contract instead of the other three contracts since spot month contract is the most active contract that is traded continuously, unlike the other three. The data starts from January 2000 to October 2003 and this time frame is chosen to reflect a period of stable market condition after being hit by the regional financial crisis towards the end of the nineties[2].

In order to determine the influence of trading frequency on lead-lag effect, 20 stocks are selected from the total of 100 stocks that make up the Composite Index. The stocks are divided into two groups, each comprising of ten stocks that represent the active (and inactive) groups respectively. The stocks are selected based on two criteria. The first criterion is based upon the average daily volume for the whole period, similar to Karpoff (1986) who uses this measure as a proxy to account for trading activity. Under this method, the top (bottom) component stocks with the highest (lowest) number of average daily volume will be placed in the active (and inactive) groups respectively. The second criterion is adopted from the study by Chan (1992) and Martikainen et al. (1995), who resort to nontrading probability as a method to segregate stocks into the two groups. Under this criterion, the ratio of days without transaction over the overall trading days is calculated and the top (bottom) stocks with the lowest (highest) nontrading ratio is grouped into the active (and inactive) groups. In addition, to be eligible for selection under both criteria, each stock must be a component of the stock index throughout the period of study. Appendix A lists the name of companies selected for this study. Data are obtained from *Datastream*, www.mdex.com.my and finance.yahoo.com.

In this study, the return for each market is calculated based on the following equation:

$$R_{i,t} = \text{Ln}(P_{i,t}/P_{i,t-1}) \times 100 \quad [1]$$

where $R_{i,t}$ represents return for index futures (and component stocks) at time t, and P represents the daily price derived from the average of the highest and the lowest prices for the day. This method of calculating return has been widely employed by other researchers such as Herbst and Maberly (1987), Iihara et al. (1996), Sim and Zurbreugg (1999) as well as Gwilym and Buckle (2001). In addition, this study also adopts another method of measuring return to ensure the robustness of the result that is obtained from data analysis process. Stoll and Whaley (1990) propose a method which is based on the Autoregressive Moving Average - ARMA(p,q) method. This measurement, known as return innovation, is said to overcome the problem of thin trading. The return innovation, u_t, is a series of White noise that is free from the problem of serial correlation. It is obtained from the following equation:

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \ldots + \rho_p u_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \ldots + \theta_q \varepsilon_{t-q} \quad [2]$$

To determine the influence of trading frequency on the lead-lag effect, this study adopts the Multiple Regression Analysis that was first employed by Stoll and Whaley (1990) and has since been replicated by Chan (1990), Abhyankar (1995), Iihara et al. (1996) and Frino and West (1999). The regression model can be explained by the following equation:

$$i_t = a + \sum_{k=-1}^{1} b_i f_{t+k} + \varepsilon_t \quad [3]$$

where i represents series of return for component stock, f represents series of return for index futures, t represents time, k represents the lead (lag) period[3], b represents the estimated coefficient while ε is the White noise. In this study, the analysis is performed based on the systems estimator approach which enables the results obtained from each individual regression to be analyzed on aggregate for each group. The influence of trading volume on the lead-lag effect is determined by comparing the average value of the significant estimated coefficients, i.e. b, between the active and inactive groups.

For instance, if the value of b_0 for both groups is positive and significant, it suggests the presence of contemporary relationship between index futures and component stocks. And, if the average values of significant b_0 for active (and inactive) groups are found to be statistically the same, then the contemporary relationship between the two groups is similar in nature. However, if there is statistical difference between the average values

[1] The use of closing price will result in the problem of nonsynchoronous trading since the stock market closes earlier than the futures market.
[2] The decision to exclude the earlier period is to ensure that the study is free from the influence of the financial crisis.
[3] The value for k is determined by cross-correlation analysis and it is found that the data series are strongly correlated at k = +/-1.

of significant b_0 between the two groups, then the degree of contemporary relationship is not the same between the active (and inactive) groups. The group with the larger significant value of b_0 is said to have a stronger contemporary relationship than the group with the lower value of significant b_0. For the estimated coefficient, b_{-1}, a positive significant value suggests that the index futures leads the component stocks. Similarly, for the estimated coefficient, b_1, a positive significant value suggests that the component stocks lead the index futures. If the average values of the significant coefficients (for b_{-1} and b_1) for the two groups are found to be statistically different, then the nature of lead-lag relationship between the two groups is not the same. In this case, the group with the larger value of b_{-1} (and b_1) will have a stronger lagging (and leading) power over the index futures.

Findings and Discussion

The results from multiple regression analysis are presented in Table 1 and Table 2. Table 1 refers to the findings based on the first criterion, i.e. average daily volume, while Table 2 shows the results based on the second criterion, i.e. nontrading probability. Each table is divided into two panels, where Panel A reports the results involving the first measure of return while Panel B reports the result involving the second criterion, i.e. return innovation. The series of return innovation is generated from the ARMA(1,1) process.

In general, the reported results render support to the presence of contemporary effect as well as the lead-lag effect between index futures and the component stocks in Malaysia. For example, the contemporary effect is detected through the positive significant value of b_0 for all 20 stocks within the two groups. This result shows that both active and inactive stocks react simultaneously with index futures towards the arrival of new information. As for the coefficient for b_{-1}, eight of the active stocks (i.e. Active-1, 2, 3, 4, 5, 6, 7 and 10) are found to be significant as compared to only four component stocks from the inactive group (i.e. Inactive-1, 2, 9 and 10). This result suggests that the index futures not only leads the inactive stocks but also leads the active stocks. As a matter of fact, the number of active stocks being led by index futures is more than the number of inactive stocks. This suggests that the leading effect is more prevalent among the active stocks than inactive stocks which contradicts the proposed theory. For the b_1 coefficient, only four active stocks (i.e. Active-3, 4, 6 and 10) are found to be leading the futures index while only one (i.e. Inactive-8), among the inactive stocks, possesses this power. Once again, the leading effect is more prevalent among the active stocks than the inactive stocks but in this case, it is consistent with the proposed theory.

The results also show that four out of the eight significant active stocks (i.e. Active-3, 4, 6 and 10) carry a bi-directional causal relationship with the index futures. While the other four stocks, (i.e. Active-1, 2, 5 and 7) demonstrate uni-directional causal relationship with the causation running from the index futures to the stock index components. The remaining two stocks, (i.e. Active-8 and 9), do not manifest any significant causal relationship with index futures. On the other hand, among the inactive stocks, the uni-directional causal relationship running from index futures to stock index components is more prevalent as compared to the reverse direction. This can be judged by the fact that four stocks, (i.e. Inactive-1, 2, 9 and 10) are found to be significant as opposed to only one stock (i.e. Inactive-8) where the causal relationship is found to originate from the component stocks to index futures. But the result for inactive stocks fails to detect the presence of bi-directional relationship. This goes to suggest that bi-directional relationship is exclusively presence among active stocks. Similarly, judging by the number of significant stocks reported in this analysis, the lead-lag effect seems to be more dominant among active stocks than inactive stocks

There are some similarities between the results reported in Panel A as well as the results in Panel B as displayed in Table 1. For example, coefficient b_0 for all active and inactive stocks are found to be positive and significant. Once again, the result suggests the presence of contemporary effect between index futures and stock index components. As for coefficient b_{-1}, all active stocks recorded significant values in contrast to inactive stocks where only four stocks, (i.e. Inactive-1, 2, 8 and 10), are found to be significant. This finding, which is based on the second criterion of selecting component stocks, is consistent with the result presented in Panel A, which is based on the first criteria. It shows that index futures not only leads the inactive stocks but also the active stocks. And as a matter of fact, the effect is more prevalent among active stock than inactive stocks judging by the number of significant stocks. Again, the finding contradicts the theory proposed by Stoll and Whaley (1990) as well as Abhyankar (1995).

TABLE 1 Results from multiple regression analysis between active/inactive component stocks (based on average daily volume) and index futures.

Panel A: Dependent variable = return from active/inactive component stocks
Independent variable = return from index futures

	b_{-1}	b_0	b_1
Active-1	0.194738**	2.168889***	-0.047961
Active-2	0.061900*	0.732374***	0.035946
Active-3	0.056402*	0.776869***	0.093620***
Active-4	0.093589**	1.069136***	0.121567***
Active-5	0.145201***	1.228400***	-0.044357
Active-6	0.085665*	1.104674***	0.138245***
Active-7	0.071789**	0.736673***	0.002305
Active-8	0.044293	1.562375***	0.081276
Active-9	0.042968	0.713598***	-0.056796
Active-10	0.068272*	0.887512***	0.077560**
Inactive-1	0.141555*	0.973585***	0.012143
Inactive-2	-0.319644***	0.660633***	0.043973
Inactive-3	-0.022309	0.280772***	0.024092
Inactive-4	0.026631	0.623168***	0.019550
Inactive-5	0.057881	0.497813***	0.040365
Inactive-6	0.025451	0.535366***	0.036246
Inactive-7	-0.080055	0.768236***	-0.002552
Inactive-8	-0.038958	0.475248***	-0.019761*
Inactive-9	-0.161129**	0.497226***	0.128151
Inactive-10	0.092380**	0.356989***	-0.022739
	R^2 = 0.295439	F-Stat= 117.0334***	

Panel B: Dependent variable = return innovation from active/inactive component stocks
Independent variable = return innovation from index futures

	b_{-1}	b_0	b_1
Active-1	-0.374642***	2.079492***	0.032349
Active-2	-0.082317**	0.715546***	0.018260
Active-3	-0.158639***	0.757779***	0.075767**
Active-4	-0.166054***	1.038033***	0.115667**
Active-5	-0.256909***	1.226861***	-0.020065
Active-6	-0.202467***	1.068791***	0.130068**
Active-7	-0.070529**	0.713945***	0.014932
Active-8	-0.359409***	1.545267***	0.067349
Active-9	-0.104318**	0.720368***	-0.051674
Active-10	-0.173712***	0.869364***	0.067381*
Inactive-1	0.124896*	0.885554***	0.017762
Inactive-2	-0.275041***	0.552440***	0.034034
Inactive-3	0.020807	0.217379***	0.004068
Inactive-4	0.027527	0.513023***	0.027844
Inactive-5	0.012523	0.416377***	0.016299
Inactive-6	-0.032846	0.450772***	0.032167
Inactive-7	-0.049524	0.550942***	-0.004355
Inactive-8	0.063393*	0.438850***	-0.020908
Inactive-9	-0.023632	0.360899***	0.066427
Inactive-10	0.113188***	0.331122***	-0.019466
	R^2 = 0.258692	F-Stat= 108.8722***	

*** / ** / * significant at 1 / 5 / 10 percent

As for coefficient b_1, only four active stocks (i.e. Active-3, 4, 6 and 10) record significant values while none among the inactive stocks are found to be significant. The result echoes the earlier finding that suggests only active stocks have the power to lead index futures. This is, however, consistent with the theory since active stocks are expected to be traded continuously, thus reflecting the latest information in the market. In addition, among the active stocks, the four counters that have been identified to possess the leading power are also being led by the index futures. Therefore, these stocks carry a bi-directional relationship, unlike the remaining six active stocks, which only exhibit a uni-directional relationship with the causation running from index futures to stock index. While among the inactive stocks, the bi-directional relationship is not detected at all and only uni-directional relationship with the causation running from index futures to stock index is discovered. As such, the results reported in both panels seem to be consistent with one another.

The results reported in Table 2 are consistent with those in Table 1. For instance, Panel A of Table 2 reports that all the coefficients for b_0 are found to be positive and significant. This suggests that index futures and stock index react simultaneously towards new information. The presence of contemporary effect between the two markets implies that they are strongly integrated. And considering that this effect continues to prevail despite different measurements of return being used, this indicates that the two markets are informationally efficient across the board since contemporary effect persists not only among the active stocks but also among inactive stocks. Nonetheless, the contemporary effect is not the exclusive relationship that is presence between the two markets. The trace of lead-lag effect is also detected among index futures and the component stocks. It therefore suggests that the two markets, though exhibit some evidence of market integration, are not fully integrated. This is based on the fact that one market is found to lead another and vice versa.

As an illustration, Panel A of Table 2 shows that for all the coefficients of b_{-1}, they are found to be significant. In addition, six of the inactive stocks (i.e. Inactive-2, 3, 4, 5, 6 and 7) are also found to be significant. This implies that stock index futures seems to be leading the component stocks and obviously, it does not discriminate between active and inactive stocks. As for the coefficients of b_1, six active stocks (i.e. Active-1, 2, 3, 4, 7 and 10) and one inactive stock (i.e. Inactive-10) are found to be significant. This shows that some of the component stocks also lead the index futures. As such, the presence of lead-lag effect is found to be presence regardless of the measurement of return. In addition, the finding in Table 2 also confirms that the bi-directional causal relationship prevails mostly among active stocks since five of the active stocks (i.e. Active-1, 2, 3, 4, 7 and 10) carry that relationship compared to only one (i.e. Inactive-10) among the inactive stocks

TABLE 2 Results from multiple regression analysis between active/inactive component stocks (based on nontrading probability) and index futures..

Panel A: Dependent variable = return from active/inactive component stocks
Independent variable = return from index futures

	b_{-1}	b_0	b_1
Active-1	0.107538***	0.348036***	0.040943***
Active-2	0.157678***	0.479812***	0.053157***
Active-3	0.157640***	0.493114***	0.060721***
Active-4	0.131830***	0.393142***	0.034192**
Active-5	0.101162***	0.431612***	0.008041
Active-6	0.206639***	0.549043***	-0.040306
Active-7	0.242551***	0.597900***	-0.060299**
Active-8	0.167080***	0.630505***	-0.049115
Active-9	0.173901***	0.444169***	0.019159
Active-10	0.160681***	0.527974***	-0.041020*
Inactive-1	0.045596	0.252165***	0.005959
Inactive-2	0.167387***	0.423135***	0.006184
Inactive-3	0.059846***	0.237425***	0.015821
Inactive-4	0.085893***	0.216902***	0.000605
Inactive-5	-0.057627**	0.290969***	0.016122
Inactive-6	0.074800***	0.222816***	0.017522
Inactive-7	0.060693**	0.279300***	0.007224
Inactive-8	0.021724	0.124230***	0.010307
Inactive-9	0.037686	0.336682***	-0.001790
Inactive-10	-0.035970	0.236427***	0.054071*
	R^2 = 0.281869	F-Stat= 109.3254***	

Panel B:	Dependent variable = return innovation from active/inactive component stocks Independent variable = return innovation from index futures		
Active-1	0.011580	0.336638***	0.031862**
Active-2	0.038123**	0.466365***	0.048779**
Active-3	0.026187	0.476171***	0.055275**
Active-4	0.022234	0.383919***	0.028166*
Active-5	0.028720	0.426172***	0.016563
Active-6	0.132371***	0.553545***	-0.042947
Active-7	0.146569***	0.605823***	-0.063373**
Active-8	0.078945**	0.633250***	-0.037927
Active-9	0.037203**	0.437777***	0.017105
Active-10	0.079277***	0.532906***	-0.037350
Inactive-1	0.073065***	0.236126***	0.003140
Inactive-2	0.149353***	0.385968***	0.008540
Inactive-3	0.027330	0.199226***	0.013686
Inactive-4	0.042195**	0.195454***	-0.002912
Inactive-5	-0.052153**	0.242695***	0.013041
Inactive-6	0.050577***	0.181505***	0.007238
Inactive-7	0.054275**	0.229062***	0.011866
Inactive-8	0.031606**	0.091291***	0.002218
Inactive-9	0.028200	0.241271***	-0.002549
Inactive-10	0.015578	0.167223***	0.028291
	R^2 = 0.244313	F-Stat= 100.7564***	

*** / ** / * significant at 1 / 5 / 10 percent

Consistent results are also reported in Panel B of Table 2. The values of coefficient b_0 for all stocks, both active and inactive, are found to be significantly positive. As for coefficient b_{-1}, six active stocks (i.e. Active-2, 6, 7, 8, 9 and 10) and seven inactive stocks (i.e. Inactive-1, 2, 4, 5, 6, 7 and 8) are found to be significant. For coefficient b_1, five active stocks (i.e. Active-1, 2, 3, 4 and 7) are found to be significant while none of the inactive stocks recorded significant values. As such, the phenomenon of index futures leading the component stocks is once again documented and it goes across the board. And some of the active stocks have the power to also lead the index futures, and not among the inactive stocks. The bi-directional relationship is therefore prevails only among some of the component active stocks. The pattern of this finding is consistent with the results presented earlier.

A further investigation is performed to compare the mean values of the significant coefficients presented in Table 1 and 2. The average values of the significant coefficients are calculated and presented in Table 3. In general, the mean for b_0 are found to be stronger compared to the mean value of b_{-1} and b_1. This suggests that the contemporary effect is the most dominant relationship between the two markets in Malaysia. A further analysis on the mean value of b_0 for active and inactive groups reveals that the magnitude of mean value among active stocks are much larger than the inactive stocks for all cases. Also, among active stocks, the mean value of coefficient b_{-1} is found to be larger than the mean value of coefficients b_1, with the exception of return innovation series as reported in Panel A. This suggests that despite the presence of bi-directional relationship between the two markets, the causal relationship running from index futures to the component stocks is much stronger. Similarly, among the inactive stocks, the mean for coefficient b_{-1} is found to be greater than the value of coefficient b_1. This finding supports the claim that index futures does not discriminate in leading both the active and inactive stocks.

TABLE 3 Summary of average coefficients for significant active/inactive stocks

Panel A: Results of average coefficients for component stocks chosen based on average daily return

Coefficient	Return		Return Innovation	
	Active	Inactive	Active	Inactive
$\bar{b}_{-1}$	0.777556	-0.246838	-0.194900	0.026436
$\bar{b}_{0}$	1.09805	0.566903	1.073545	0.471736
$\bar{b}_{1}$	0.430992	0.128151	0.388883	0.000000

Panel B: Results of average coefficients for component stocks chosen based on nontrading probability

Coefficient	Return Active	Return Inactive	Return Innovation Active	Return Innovation Inactive
$\bar{b}_{-1}$	0.16067	0.065165	0.512488	0.345512
$\bar{b}_{0}$	0.489531	0.262005	0.485257	0.216982
$\bar{b}_{1}$	0.087694	0.054071	0.100709	0.000000

Table of 4 reports the results of a number of null hypotheses tested in order to determine whether the mean values for the estimated coefficients, for active and inactive groups of stocks, are similar in magnitude. It is found that the contemporary effect, despite being presence among both active and inactive stocks, is more dominant among the former than the latter. This is based on the fact that the average value of coefficient b_0 for active stocks is greater than that of the inactive stocks. As illustrated in Panel A and B of Table 4, the null hypothesis, which states that the average value of coefficient b_0 (for the return and return innovation series) is the same for both active and inactive stocks, is rejected for all cases. As such, this suggests that the contemporary effect is stronger among the active component stocks than the inactive group of stocks.

TABLE 4 Results of mean comparison test

Panel A: Results of average coefficients for significant component stocks based on average daily return

Return:		F-Statistic	Return Innovation:		F-Statistic
H_0:	$\bar{b}_{0,\ Active} = \bar{b}_{0,\ Inactive}$	433.7151***	H_0:	$\bar{b}_{0,\ Active} = \bar{b}_{0,\ Inactive}$	724.0108***
H_0:	$\bar{b}_{-1,\ Active} = \bar{b}_{1,\ Active}$	0.146199	H_0:	$\bar{b}_{-1,\ Active} = \bar{b}_{1,\ Active}$	124.4920***
H_0:	$\bar{b}_{-1,\ Inactive} = \bar{b}_{1,\ Inactive}$	6.233951**	H_0:	$\bar{b}_{-1,\ Inactive} = \bar{b}_{1,\ Inactive}$	0.070289
H_0:	$\bar{b}_{-1,\ Active} = \bar{b}_{-1,\ Inactive}$	19.20568***	H_0:	$\bar{b}_{-1,\ Active} = \bar{b}_{-1,\ Inactive}$	47.08250***
H_0:	$\bar{b}_{1,\ Active} = \bar{b}_{1,\ Inactive}$	0.079545	H_0:	$\bar{b}_{1,\ Active} = \bar{b}_{1,\ Inactive}$	21.07048***

Panel B: Results of average coefficients for significant component stocks based on nontrading probability

Return:		F-Statistic	Return Innovation:		F-Statistic
H_0:	$\bar{b}_{0,\ Active} = \bar{b}_{0,\ Inactive}$	390.4130***	H_0:	$\bar{b}_{0,\ Active} = \bar{b}_{0,\ Inactive}$	681.1943***
H_0:	$\bar{b}_{-1,\ Active} = \bar{b}_{1,\ Active}$	160.6501***	H_0:	$\bar{b}_{-1,\ Active} = \bar{b}_{1,\ Active}$	21.01080***
H_0:	$\bar{b}_{-1,\ Inactive} = \bar{b}_{1,\ Inactive}$	0.121644	H_0:	$\bar{b}_{-1,\ Inactive} = \bar{b}_{1,\ Inactive}$	33.56451***
H_0:	$\bar{b}_{-1,\ Active} = \bar{b}_{-1,\ Inactive}$	53.29979***	H_0:	$\bar{b}_{-1,\ Active} = \bar{b}_{-1,\ Inactive}$	6.597060**
H_0:	$\bar{b}_{1,\ Active} = \bar{b}_{1,\ Inactive}$	1.604763	H_0:	$\bar{b}_{1,\ Active} = \bar{b}_{1,\ Inactive}$	4.934742**

*** / ** / * significant at 1 / 5 / 10 percent

In addition to the contemporary effect, this study also detects the presence of lead-lag effect among the index futures and the stock index components. Among the active stocks, the results show that a one-way directional relationship running from index futures to stock index is present in three (i.e. for return innovation series as presented in Panel A as well as return and return innovation series as presented in Panel B) out of the four cases, with the exception of the return series in Panel A. In the three cases, the null hypothesis, which states that the average value of coefficients b_{-1} and b_1 are the same, is rejected. This suggests that the value for coefficient b_{-1} is greater that the value of coefficient b_1, thus implying the one-way causation running from index futures to stock index. It also implies that despite some evidence of bi-directional relationship between the two markets, the uni-directional relationship from index futures to stock index is found to be more dominant. As for the inactive stocks, a similar pattern can only be detected in two (i.e. the return innovation series in Panel A and return series in Panel B) out of four cases. Therefore, the evidence of uni-directional relationship where index futures leading the stock index is also present among inactive stocks.

Nonetheless, it is also found that the strength of uni-directional relationship between index futures and the two different groups of stocks are not the same. For example, the null hypothesis which tests for the same value of coefficient b_{-1} for active and inactive cannot be accepted in all four cases. Therefore, the lead-lag effect with the index futures leading the component stocks is found to be stronger among the active stocks than the inactive stocks. This finding contradicts with the proposed theory which suggests that the lead-lag effect should be more apparent among the inactive stocks due to the problem of infrequent trading. As such, this finding provides empirical evidence to reject the claim that trading frequency is a contributing factor towards the presence of lead-lag effect between index futures and stock index, at least within the context of Malaysia.

The average value for coefficient b_1 is also found not to be of the same magnitude. However, the result is only confined to the return innovation series but not for the return series. It is found that the null hypothesis which states that the value of coefficient b_1 for active and inactive stocks are the same cannot be accepted for return innovation series in Panel A and B. This suggests that active stocks have the leading power over the index futures, unlike the inactive stock. However, the result is not comprehensive since for the return series, none of the return series produces significant result to reject the hypothesis. Still, judging by the number of significant stocks reported in Table 1 and 2, the active stocks seem to have outnumbered the inactive stocks. Thus, the result suggests that some active stocks not only being led by the index futures, they also lead the index futures. This explains the bi-directional relationship that only prevails among the active stocks.

Conclusion

This study investigates whether trading frequency among components of stock index is the contributing factor that influences the presence of lead-lag effect between the index futures and stock index in Malaysia. The result shows that despite the strong presence of the contemporary effect, traces of lead-lag effect between the two markets are also documented. However, this effect cannot be associated to the trading frequency since the index futures is found to not only lead the inactive stocks but more so of the active stocks. Such finding contradicts the proposed theory which suggests that the problem of infrequent trading among inactive component stocks is the contributing factors towards the presence of such phenomenon. The result from this study is, nonetheless, consistent with that of Chan (1990) and Martikainen et al. (1992). Perhaps, future researchers should look for other possible factors to explain the presence of the lead-lag effect.

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APPENDIX A

Component stocks selected based on average daily volume:

Active	Inactive
1. Time Engineering Bhd	1. Kim Hin Industry Bhd
2. Public Bank Bhd	2. Ramatex Bhd
3. Maybank Bhd	3. Malaysian Oxygen Bhd
4. Commerce-Assets Holding Bhd	4. MNI Holdings Bhd
5. Magnum Corporation Bhd	5. Malaysian National Reinsurance Bhd
6. Berjaya Sports Toto Bhd	6. Tradewinds Bhd
7. Sime Darby Bhd	7. Aluminium Company of Malaysia Bhd
8. RHB Capital Bhd	8. Shangri-La Hotels (M) Bhd
9. IOI Corporation Bhd	9. John Hancock Life Insurance (M) Bhd
10. Tenaga Nasional Bhd	10. Shell Refining Co (FOM) Bhd

Component stocks selected based on nontrading probability:

Active	Inactive
1. Maybank Bhd	1. Jaya Tiasa Holdings Bhd
2. Commerce-Assets Holding Bhd	2. Kim Hin Industry Bhd
3. Berjaya Sports Toto Bhd	3. Tradewinds Bhd
4. Tenaga Nasional Bhd	4. Kian Joo Can Factory Bhd
5. Gamuda Bhd	5. Ramatex Bhd
6. Mulpha International Bhd	6. Malaysian National Reinsurance Bhd
7. TA Enterprise Bhd	7. MNI Holdings Bhd
8. Malayan United Industries Bhd	8.Malaysian Oxygen Bhd
9. Genting Bhd	9. Aluminium Company of Malaysia Bhd
10. Padiberas Nasional Bhd	10. John Hancock Life Insurance (M) Bhd