*Jurnal Pengurusan 21(2002) 21-57*

# Volatility, Expiration Day Effect and Pricing Efficiency: Kuala Lumpur Composite Index Futures

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*ABSTRAK*

*Satu kajian telah dilakukan ke atas isu yang berkait dengan pengenalan dan urusniaga niagaan ke depan indeks komposit Kuala Lumpur di Malaysia. Kajian ini melibatkan isu kemeruapan, kesan hari perlupusan dan kecekapan harga. Ujian (dengan menggunakan ujian Levene) menunjukkan penurunan dalam kemeruapan selepas permulaan urusniaga pasaran niagaan ke depan. Kebanyakan saham komponen indeks komposit menunjukkan penurunan yang besar dalam kemeruapan selepas wujudnya pasaran niagaan ke depan berbanding dengan saham-saham lain. Perubahan ini tidaklah seragam tetapi bergantung kepada saham individu dan sektor industrinya. Ini berkemungkinan akibat daripada kewujudan pasaran niagaan ke depan yang memberi kestabilan harga dengan cara meningkatkan aliran maklumat dan kecairan pasaran, di samping mengurangan risiko pasaran dengan mewujudkan peluang lindungan nilai. Kajian ini juga membawa kesimpulan bahawa kemeruapan pasaran niagaan ke depan adalah nyata lebih tinggi apabila berlaku pergerakan harga yang besar pada aset asas. Kajian juga mendapati tiada kesan hari perlupusan. Ujian kecekapan harga menunjukkan terkurang harga lebih kerap berbanding dengan terlebih harga. Jika kos urusniaga dimasuk kira, terlebih dan terkurangnya harga adalah kecil.*

*ABSTRACT*

*A study was conducted on issues related to the introduction and trading of Kuala Lumpur Composite Index futures contract in Malaysia. Issues related to volatility, expiration day effect and pricing efficiency were examined. The test (using Levene test) indicated that a decrease in volatility was observed after the futures trading. Most component stocks in KLSE CI show a significant decrease in volatility in the post-futures period than their non-KLSE CI components. These noted changes were not uniform and were dependent upon individual stocks and industry sectors. It might be due to the existence of futures market which led to a stability effect by increasing information flow and market liquidity, as well as by reducing market risk by providing hedging opportunities. It is concluded that futures volatility is* *significantly higher, especially where there are big price movements of the underlying assets. No evidence of any expiration day effect was found. The test of mispricing shows frequent underpricing than overpricing. If transaction costs is included, it shows very little mispricing.*

## INTRODUCTION

Several studies have examined the impact of futures trading on the underlying assets and many of them provide conflicting arguments for that effect. The transaction costs in futures market are in fact lower than those in the spot market. Futures market also allows arbitraging and hedging opportunities and it might attract additional traders to the market. Therefore, conventional wisdom suggests, futures trading should bring more traders to the spot market and make it more liquid and less volatile. However, some literature view that futures market brings in uninformed speculators, who then trade in the spot market as well as futures market to increase volatility (Edward 1988).

In the early 1980s, almost the entire volume of futures trading transacted was concentrated in the United States. However, by the mid 1980s, the situation was vastly different, with a host of new exchanges operating throughout Europe, South America and the Asia Pacific region. Today futures is a global industry with more than 60 exchanges operating world-wide.

Derivative securities in general and index futures and options in particular have been blamed for stock market crash of October, 1987 and the mini crash of 1989, and some recent highly publicized financial disasters have created the impression that derivatives threaten the stability of the international financial system. The huge losses of Procter and Gamble, Orange County Metallgesellschaft and the Barings have created a great deal of controversy. Consequently, tighter regulation and supervision are heard with higher frequency. On the other hand, as reported in "Starting out in Futures Trading" by Randall, Fortenbery and Hector (1997), they have identified four social benefits of futures trading. These include:

1. competitive price discovery,
2. hedging (or management) of industry price risks,
3. facilitation of financing, and
4. more efficient resource allocation.

In today's business environment, Malaysia faces the challenge of keeping up with greater economic and financial interdependence among nations. Exposure from economic globalization creates a greater need for Malaysia to have risk management tools to cope with the increasing volatility of financial assets and investment instruments. This need, combined with Malaysia's ambition to promote itself as a regional financial center in the

Asia Pacific region has led to the development of the Kuala Lumpur Options and Financial Futures Exchange (KLOFFE) in the early 1990s. The legal framework was completed in 1993 to bring into existence a well regulated, financially sound and credible derivatives industry.

On 15th December 1995, the birth of KLOFFE heralded a significant event in the development of the nation's capital market with the launch of KLOFFE's KLCI futures contract. With its introduction, Malaysia became the third Asian economy after Hong Kong and Japan to offer domestic equity derivatives products.

As in the case of major stock index futures contracts in the US, such as the S&P 500 contract traded on the Chicago Mercantile Exchange, the settlement prices of the Malaysian contracts are determined 15 minutes after the close of trading in the underlying stocks. KLOFFE is a fully electronic exchange which operates an integrated trading and clearing. Its fully automated system will ensure transparency and fairness in that all traders will have access to the same information set. It will also help minimize manual efforts which in turn reduces cost in the long run.

The objective of this study is to measure and analyze the several issues related to the introduction and trading of KLCI futures. The issues being (1) related to volatility of the futures and underlying, (2) expiration day effect of the underlying and (3) pricing efficiency of the futures. This paper also analysed a number of minor issues that may be related to the above main research questions.

In Malaysia, there are very few studies which have explicitly studied any aspects of the KLCI futures market (see Ibrahim, Othman and Bacha 1999). In contrast, there have been various studies on developed countries' futures market. Therefore, as also cited by Ibrahim, Othman and Bacha (1999), besides the need to understand these issues for future policy making, it will be interesting to examine the impact of index futures introduction in a market at a lower stage of development, with incomplete markets and no short selling. In fact this study extends the study by Ibrahim, Othman and Bacha (1999) which covered the period until December 1997.

The complexity of risk and returns in financial market has increased dramatically with the advent of global markets and the pace of financial innovation. Therefore, volatility in financial markets has become an important research topic. Besides, the public perception of increases in risk in the financial markets and derivatives securities in particular provides substantial motivation for research in these markets.

## REVIEW OF LITERATURE

This section provides an overview of existing literature relevant to the research questions mentioned in the previous section.

## IMPACT OF FUTURES INTRODUCTION ON UNDERLYING STOCK MARKET VOLATILITY

Stock market volatility refers to the variability of stock prices. An increase in stock market volatility brings an increased chance of large stock price changes of either sign. For supporters of market efficiency, volatility reflects the incorporation of new information. However, those with less confidence in market efficiency view volatility as a measure of speculative excess in the market as reported by Cutler et al. (1989).

The impact of index futures introduction on underlying stock market volatility is well researched and documented; especially in the case of US, UK, Japan and Hong Kong. There is little agreement as to the effect of futures contracts have on the underlying market. In the most recent of such studies, Pericli and Koutman (1997) examine S&P 500's returns over the period of 1953 to September 1994. They find no incremental effect on underlying market volatility as a result of the introduction of index futures nor options. This confirmed the findings of Santori (1987) who used daily and weekly returns for S&P 500 over a 10 years period. In addition, Miller and Galloway (1997), examined the Mid Cap 400 index for evidence of volatility change following the introduction of futures contract on the index. The authors found no evidence of any increased volatility, if any, and their results point to a possible reduction in underlying volatility.

Earlier study on other US indices by Edwards (1988a, 1988b) using daily and intraday data for the period 1973-1987 for both the S&P 500 and the Value Line Composite Index (VLCI). He found no evidence linking futures trading to an increase in underlying stock market volatility. Similarly, Choi and Subramaniam (1994) found no significant changes in the intraday volatility in the underlying stock markets around the introduction of the MMI futures.

Lee and Ohk (1992) studied the daily returns data for two years before and after the introduction of futures in Australia, Hong Kong, Japan, UK and US. They found that volatility increases significantly with the exception of the Australian and Hong Kong stock markets. This implied a decrease in volatility in Hong Kong and no change in volatility in Australia. However, volatility on US and UK were mixed. They also found evidence of increased volatility in Japan's Nikkei-225 Index for the two years following futures introduction on SIMEX. This confirmed the results of Freris (1990) and Hogson and Nicholls (1991).

## RELATIVE VOLATILITY

The linkages and interactions of stock market returns and future market returns have been an area of major interest to researchers since the inception of future contracts in 1982. Koutmas and Tucker (1996) examine the volatility for a 10 years period from 1984 to 1993. They found futures volatility to be higher by using Augmented Dickey-Fuller test and the Engle-Granger statistics. Daily volatility in both markets is highly persistent and predictable on the basis of past innovations and the correlation is remarkably stable. A similar finding made by Chu and Bubnys (1990), who examined the relative volatility using the natural logarithm of daily closing prices for the S&P 500 and the NYSE for the six years period from 1982 to 1988, found futures volatility to be higher.

Yadav and Pope (1990) also examined the volatility using the natural logarithm of both interday and intraday prices to compare FTSE 100 index and futures volatility. They found futures volatility to be higher. Additionally, a similar findings was made by Yau et. al. (1990) for its futures contracts and the Hong Kong's Hang Seng index.

Interesting results are found on studies of the Japanese index and its futures contract. Brenner et. al. (1990) examined daily closing prices of the Nikkei futures contract traded on SIMEX and Osaka and compared it to the TOPIX index of the Tokyo Stock Exchange. They found lower futures volatility (0.492% and 0.497% respectively compared to 0.548% for the underlying index).

Bacha and Villa (1993) used the same volatility measures as Yadav and Pope (1990) to test the volatility of the Nikkei Futures traded on SIMEX, Osaka and the CME with the Nikkei Stock Index. They found no difference of volatility of the underlying Nikkei Stock Index from the SIMEX, but marginally higher than the futures traded in Osaka. The argument made by the authors is due to tighter regulatory framework on the OSE relative to SIMEX. Similar findings also found by Choudry (1997), who studied short run relative volatility on the Hang Seng, the Australian All Ordinaries and the Nikkei. With the exception of Nikkei, the other future contracts were found to be more volatile than the underlying markets.

## FUTURES EXPIRATION DAY EFFECT

The logic assumes that futures prices become less volatile as expiration is approached. However, Samuelson (1965) theorizes that futures become more volatile as expiration is reached. Edwards (1988) did find that volatility of stock returns was higher, on average, for futures expiration days than for non-expiration days from 1983 to 1986, particularly in the last hour of trading. The results are supported by Hancock (1991) who finds an expiration day effect for the S&P 500.

Similarly, Stoll and Whaley (1987) have studied the volatility which include the triple witching days and find that the S&P 500 index volatility increases on expiration days especially during the last hour of trading. Furthermore, prices tend to fall at the end of the day and to reverse at the opening of trading on the next day. They draw a comparison with block trades, where volume and volatility are temporary high and followed by small price reversals. They argued that the effects of expiration are small and confined to brief periods of time, and reflect the costs of providing liquidity to futures traders.

In addition, Karakullukcu (1992) finds no expiration day effect on the FTSE 100. He argues that this could be due to the FTSE futures contracts' settlement prices are calculated based on mid morning rather than closing prices. Similar results are obtained by Bacha and Villa (1993), for the Nikkei stock and futures contracts. However, they argue that these could be due to the staggered expiration dates and the use of different final settlement prices.

Therefore, it can be concluded that the evidence of an expiration day effect on the underlying stock market volatility is mixed.

## EVIDENCE ON MISPRICING

Mispricing represents price deviates from its fair value adjusted for net carrying costs. However, the existence of index arbitrage should keep these deviations to a minimum. In contrast, this sorts of risk free opportunities do frequently exist for short period of time. Arbitrageurs' trade quickly correct the mispricing though. Their actions ensure that cash and futures prices remain highly correlated and converge towards contract expiry. Studies on index futures traded in the US by Bhatt and Cakici (1990), Morse (1988), Billingsley and Change (1988) find deviations from fair-values that were significantly large, that transaction cost alone would not be sufficient to explain the deviations.

Figlewski (1984) notes in the first year of trading stock index futures prices were persistently too low. He concludes that underpricing were "a transitory phenomenon caused by unfamiliarity with the new markets and institutional inertia in developing systems to take advantage of the opportunities presented". In other words;

1. Investors were unfamiliar with the marking to market of stock index futures contract.
2. Investors were uncertain about legal aspects and accounting procedures from futures trading.
3. Investors were unsure about how these contracts should be theoretically priced.
4. The pricing improved as markets matured.

Interestingly, foreign stock index futures prices exhibited similar mispricing in earlier years. Studies on S&P 500 that included transaction cost, such as those by Kipnis and Tsang (1984) and Arditti et al. (1986) found considerable mispricing. Though both over and mispricing were evident, there appeared to be a greater tendency for underpricing. The underpricing was particularly in evidence in the initial period of contract. Though the inclusion of transaction costs creates no arbitrage bound resulting in less net mispricing, Klemkosky and Lee (1991) who also include indirect costs such as marking to market and futures taxes found mispricing in about 5% of the time.

Brenner, Subrahmanyam and Uno (1989) find that Japanese stock index futures sold at a discount during the first two years. The size of mispricing declined over time. In the study, they find that approximately 42% of the observations are found in excess of the estimated transaction costs. The authors argue that the mispricing is due to the regulatory relaxation. This confirmed the earlier results of Kipnis and Tsang (1984) and Arditti et al. (1986). Furthermore, Bacha and Villa (1993) replicate the Brenner et. al. (1989) study over a longer period to include the Nikkei futures traded in OSAKA and SIMEX. By dividing their study into three sub-periods, they find mispricing in the first period, little mispricing in the second period and near consistent overpricing in sub-period three. The authors argued that this mispricing changes had to do with regulatory change in Japan.

Yadav and Pope (1990) find that before Great Britain deregulated its financial markets in 1986, the FTSE-100 trading on the London International Financial Futures Exchange (LIFFE) was usually too low relative to its theoretical price, mispricing, however, reduces as the contract approaches maturity.

## DATA AND METHODOLOGY

### DATA DESCRIPTION

Daily price data of the Kuala Lumpur Stock Exchange Composite Index (KLSE CI) for the 7 years period from July 1993 to June 1999 is used. These are daily high, low, open and close prices. The information is obtained from HA Options & Financial Futures Sdn. Bhd., a trading member of KLOFFE. Similarly, daily stock prices from 15 December 1994 to 14 December 1996 are also collected from the above mentioned trading member of KLOFFE. This section of study excludes the data in 1997 due to the unstable market conditions especially during the second quarter of 1997. Daily high, low, open and close prices for KLCI futures spot month contract from the first day of trading, 15 December 1995 to 30 June 1999 is used. Fifteen minutes high, low, open and close price, volume and number of ticks for KLCI futures spot month contract are also gathered. The data sets are also obtained from the same source. The dividend yield for the three and the half year period are obtained from various issues of Investors Digest. Three month KLIBOR rates are obtained from the Bank Negara database accessible via the internet. Beta and market capitalization is taken from Corporate Handbook: Malaysia (1996). The beta is collected from 28th September 1994 to 28th September 1996 (average for 104 weeks). The market capitalization of each stock is measured on the 28th September 1996.

## METHODOLOGY

### *Measure of Volatility*

Several measures of volatility were estimated and compared to determine the sensitivity of the conclusions to the measure of volatility used. This study employed three measures of volatility, which are as follows:

1. Close to Close method

The logarithmic return of daily closing prices is

$$\text{In}(C_t \;/\; C_{t-1})$$

where $C_t$ = closing price on day t.

The standard deviation of this return is used as the measure of intraday volatility. Standard deviation is useful because it summarizes the probability of seeing extreme values of return. When standard deviation is large, the chance of a large positive and negative return is large.

2. High Low Method

The natural logarithm of the day's highest and lowest prices is

$$\text{In}\ (H_t \;/\; L_t)$$

The mean and the standard deviation of the return series is the two key variables used to test the changes in volatility.

Parkinson's Estimator (1980) showed that under certain restrictive assumptions, it is more efficient than the traditional close-to-close variance. The difficulty of estimating true volatility occurs because of the lack of continuous price observations; the closing price is only one observation each day. In addition, Beckers (1983), empirically compared the two estimates and found that, in general, Parkinson's estimator contained new information and was a more accurate estimator of true volatility.

To assess the impact of futures introduction on underlying market volatility, cash market daily volatility for both before and after the induction on 15 December 1995 are computed and tested to see if there is a statistically significant change in volatility. In addition to the entire period, this study examines a ± 15 days, 30 days, 60 days, 1.5 years, 2.5 years and 3.5 years window surrounding KLCI futures introduction.

3. KLSE CI and Non KLSE CI Group Comparison

In addition to the above two methods, this research also use the cross-sectional sample which includes a set of KLSE CI firms and a matched control set to examine whether there will be a difference in volatility before and after the futures trading.

Many factors may cause the change in volatility of stock price beside the introduction of futures trading. Among others are beta, price level, firm size and trade frequency (Harris, 1989). Therefore, this research involves a careful selection of the non-KLSE CI firm sample as it serves as a control for the variation by making two stock sample as comparable as possible.

The beta is computed by using the formula, b = log (return of stock/ return of KLSE CI). Other relevant parameter such as market activity and company's business activities are also considered to improve the accuracy in selection of a matching stock. The matching list of component stocks in KLSE CI with their corresponding stocks in Non-KLSE CI can be requested from the authors. It is impossible to have two perfectly matched firms that will suit to all the above mentioned criterias due to a limitation of available listed firms in KLSE Main Board. Although two firms are categorized under a same sector, their nature of business might not be the same because they are engaging in different kinds of business. Furthermore, many firms are holding companies, which have diverse interest and their actual core business cannot be easily determined. According to Kok (1992), the new business activities are also not clearly defined within the board classifications adopted by the KLSE. Therefore, for convenient matching, priority will be based on the same industry and similar firm beta. New listed firms are excluded from the matching list because those stocks will not be able to provide sufficient range of data for the testing period of pre and post futures trading. This further reduced the available stocks for matching purposes. In addition, those firms with some period of stable price might not be representative of the price volatility behavior of the stocks in the Non-KLSE CI and might give an error to the study.

From Table 1, the average firm beta and standard deviation for KLSE CI and Non-KLSE CI samples are 1.0798 (0.3910) and 1.1095 (0.4163) respectively. From this table, the beta for the two samples set are almost similar, therefore, this study assumes that they have similar sensitivity to any changes in the market.

TABLE 1. Descriptive statistics of tested samples

| Sample | Firm Beta ($\beta$) | | Market Capitalization (RM'million) | |
|---|---|---|---|---|
| | Mean | $\sigma$ | Mean | $\sigma$ |
| 100 stocks from the components of KLSE CI | 1.0798 | 0.3910 | 3524.8 | 6373.3 |
| 100 stocks of Non-component of KLSE CI | 1.1095 | 0.4163 | 1083.7 | 1070.8 |

The variances of daily stock returns serve as a barometer for volatility. Therefore, a comparison of variance is made by SPSS Program software. It has been known for some time that F test is quite sensitive to the data's departure from normality, therefore, it is quite satisfactory to test the normality of a sample (Levene 1960). When the underlying distribution are non-normal, F test can have an actual size several times larger than their level of significance (Brown & Forsythe 1974). Early researches has confirmed that unconditional distributions of security price changes are leptokurtic, skewed and volatility clustered (Taufiq 1996). Here, Levene test will be used to test the assumption in analysis of variance (ANOVA) that the sample variances are equal. The null hypothesis (Ho) states that there is no difference in the variance in pre-futures period ($\sigma^2_{pre}$) and post-futures period ($\sigma^2_{post}$). Therefore,

$$Ho: \sigma^2_{pre} = \sigma^2_{post}$$

*Relative Volatility Between Futures Market and Underlying Stock*

Inter-market volatility comparison is determined by comparing the volatility measures on a contemporaneous basis. This study employed two measures, which are Bacha and Villa (1993) and Parkinson Extreme Value Estimator (1980). If the variance of the KLCI Futures and KLSE CI is the same, we can conclude that the volatility between two markets is equal. In addition, F ratio (parametric) is used to test the statistical significance.

*Futures Expiration Day Effect*

To test the existence of expiration day effect, this study employed Feinstein and Goetzmann's (1988) non parametric median test. By using this test, firstly, all the non-expiration days are determined. There are 830 non-expiration days in the period of study from December 1995 to June 1999. Secondly, the 1st quartile, median and 3rd quartile ranges of stock volatility are determined by the use of the two volatility measures mentioned above. Here, half of the non-expiration days should fall inside and half should fall outside the inter-quartile range. In order to see whether expiration days deviate from this pattern, cumulative binomial distribution is used to test the probability that expiration days volatility are different from that non-expiration days. A low probability indicates that expiration days are statistically different from non-expiration days, and thus is a significant event. However, a high probability shows that the different between the two is not significant.

*Evidence On Futures Mispricing*

A stock index futures contract can be priced by using the 'replication principle'. According to this, the 'fair' price is related to the price of a portfolio that replicates its futures payoffs.

1. Mispricing
In measuring the deviation of actual price from 'fair' price, i.e. the extent of mispricing on the KLCI futures, mispricing is computed. The mispricing can be expressed as a percentage deviation, given by:

$$M_t = ( FA_t - F_t ) / F_t . \tag{1}$$

Where $M_t$ is the mispricing, express as the difference between the actual futures price, $FA_t$, and the fair futures price, $F_t$, as a percentage of the fair price.

2. Standard Cost of Carry Model
Two sets of mispricing analysis are carried out in this model; that is with and without transaction cost. In the absence of transaction cost, the fair price is computed using this model on an annualized basis.

$$F_t = S_t * (1 + r - d)^{t,T}. \tag{2}$$

Where $S_t$ = price of the stock index on day t,
r = 3 month annualized KLIBOR rate on day t
d = annualized dividend yield
t,T = time remaining to maturity (T – t / 365)

In order to take transaction cost into account, let $C^+$ be the cost of a cash and carry strategy and $C^-$ as cost of a reverse cash and carry. We estimate a higher cost for a reverse cash and carry transaction and so add an additional 0.10% to $C^+$ to arrive at $C^-$. The details of transaction costs estimation is as follows:

TABLE 2. Transaction cost estimation

| | KLSE | KLCI Futures |
|---|---|---|
| Commission | 0.6% | 0.06% |
| Bid/ask | 0.4% | 0.05% |
| Tax | Nil | Nil |
| Total | 1.0% | 0.11% |

*Source:* HA Options and Financial Futures Sdn. Bhd.

These transaction costs imply that it is profitable to execute a buy spot-sell futures transaction only if the actual futures price exceeds the fair value given in equation ( 2 ) by more than the percentage $C_t^+$. And only if the futures price is below the spot price by more than the percentage $C_t^-$ buying futures-sell spot arbitrage become viable. Transaction costs create a band with an upper bound of $F_t^+$ and a lower bound of $F_t^-$ with no arbitrage opportunities as follows:

$$F_t^+ = S_t(1 + C^+)(1 + r - d)^{t,T}, \quad (3)$$

$$F_t^- = S_t(1 - C^-)(1 + r - d)^{t,T}.$$

Using these bounds, mispricing inclusive of transaction cost, $M_t$ is as follows, if

$$F_t \rangle F_t^+ \qquad M_t = \frac{F_t - F_t^+}{F_t^+}$$

$$F_t^- \langle F_1 \langle F_t^+ \qquad M_t = 0$$

$$F_t \rangle F_t^- \qquad M_t = \frac{F_t - F_t^-}{F_t^-}.$$

## RESULTS AND ANALYSIS

### IMPACT OF FUTURES INTRODUCTION ON UNDERLYING MARKET

*Close to Close and High Low Method* To assess the impact of futures contract introduction on underlying assets, this study examines the volatility of the underlying stock market before and after the start of future trading.

Table 3 shows the alternative measures of volatility estimate for individual sub-period for daily data from 15 June, 1992 to 15 June, 1999. This table extends the analysis by looking at the 15 days, 30 days, 60 days, 1.5 years, 2.5 years and 3.5 years pre and post futures trading. It reports the intraday highs and lows as well as close-to-close daily prices. Three conclusions emerge from this table:

1. both the volatility measures for post introduction show marginally higher volatility except for the window of 1.5 years, where Bacha and Villa (1993) measures experienced a significant decreased in volatility of 0.88%.
2. both the 30 and 60 days of pre and post futures introduction show relatively lower volatility; and

3. both the 2.5 years to 3.5 years window periods have significantly higher volatility post introduction.

TABLE 3. Volatility before and after futures tradings: Stock index (July 1992 To June 1999)

| Line | | Date | Close to Close Method | High Low Method | |
|---|---|---|---|---|---|
| | Pre-Futures | | SD (%) | Mean | SD (%) |
| 1 | 15 days | 24/11/95 to 14/12/95 | 0.99 | 0.0113 | 0.60 |
| 2 | 30 days | 3/11/95 to 14/12/95 | 1.06 | 0.0119 | 0.57 |
| 3 | 60 days | 21/9/95 to 14/12/95 | 1.03 | 0.0111 | 0.53 |
| 4 | 1.5 years | 1/6/94 to 14/12/95 | 1.18 | 0.0099 | 0.45 |
| 5 | 2.5 years | 14/6/93 to 14/12/95 | 1.44 | 0.0136 | 0.99 |
| 6 | 3.5 years | 15/6/92 to 14/12/95 | 2.14 | 0.0120 | 0.92 |
| | Post-Futures | | | | |
| 7 | 15 days | 16/12/95 to 9/1/96 | 1.20 | 0.0120 | 0.70 |
| 8 | 30 days | 16/12/95 to 30/1/96 | 1.21 | 0.0129 | 0.78 |
| 9 | 60 days | 16/12/95 to 20/3/96 | 1.15 | 0.0120 | 0.71 |
| 10 | 1.5 years | 16/12/95 to 17/6/97 | 0.88 | 0.0100 | 0.60 |
| 11 | 2.5 years | 16/12/95 to 15/6/98 | 2.08 | 0.0181 | 1.65 |
| 12 | 3.5 years | 16/12/95 to 15/6/99 | 2.54 | 0.0219 | 2.16 |

The results are obvious from Figure 1 and 2. Figure 1 plots the standard deviation of volatility measure $\ln(C_t/C_{t-1})$ for several window periods before and after KLOFFE's opening. It shows that standard deviation decrease marginally from 2.14% (15 June 1992) to 1.15% (20 March 1996). By extending the window period to 17 June 1997, standard deviation drop significantly to 0.88%. This may be due to the commencement of currency crisis. Again, it increase to 2.54% in 15 June 1999 as the capital control measures took place in September 1998.

It is obvious that this statistical procedure is quite crude in that it does not account for factors that might influence daily price volatility. It is doubtful that the rise in stock volatility is due to anything associated with the futures trading. Therefore, it seems that the more reliable results are based on window periods 15 days, 30 days and 60 days. As a result, one can concludes that KLOFFE's opening had no meaningful impact on stock market volatility.

Figure 2 plots the standard deviation of volatility measure $\ln(H_t/L_t)$ for the same window period as Figure 1. Again, it shows no increase in volatility after KLOFFE's opening.

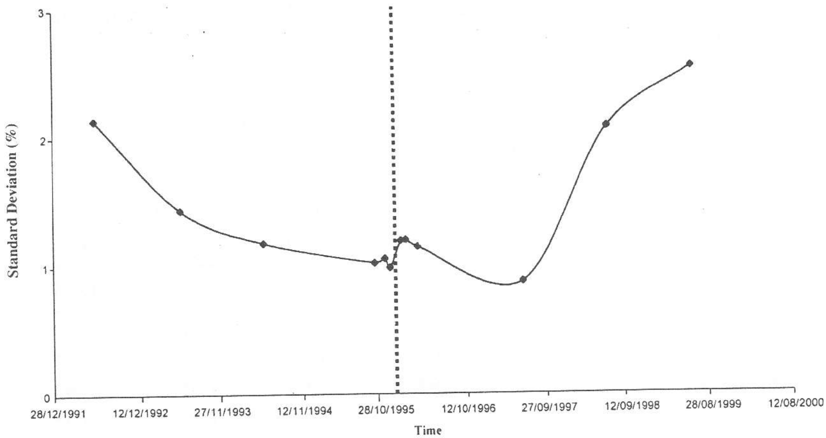


FIGURE 1. KLSE Volatility In $(C_t/C_{t-1})$, Pre and Post Futures Trading

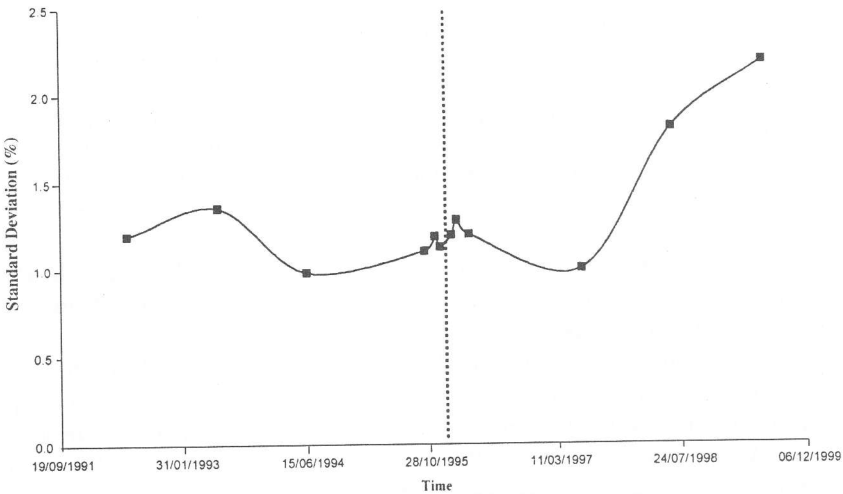


FIGURE 2. KLSE Volatility In $(H_t/L_t)$, Pre and Post Futures Trading

Overall, the introduction of stock futures trading in KLOFFE had no measurable effect on the stock price volatility. This is consistent with the most recent research done by Pericli and Koutman (1997), which examined S&P 500 returns over period of 1953 to September 1994.

## KLSE CI AND NON KLSE CI GROUP COMPARISON

*Volatility of Pre and Post Futures Period For All Tested Stocks* In this section, we will examine the volatility of every component stock in both the KLSE CI (subject sample) and non KLSE CI (control sample) for the pre and the post-futures period. A comparison of volatility in pre and post-futures period for all component stock in KLSE CI with their matching stocks of non-KLSE CI is made.

From the above, we then make a comparison regarding to the magnitude of changes in volatility for those stocks by computing the percentage changes in variance ($PCV_i$) before and after the futures trading.

The mean percentage change in variance ($MPCV_j$) for every sector and the group sample is as stipulated in Table 4.

TABLE 4. Mean percentage change in variance for all stocks (Pre15/12/94 to 14/12/95 and Post 15/12/95 to 14/12/96)

| Sector | No. of stocks | $MPCV_j$ KLSE CI | $MPCV_j$ Non KLSE CI |
|---|---|---|---|
| Consumer product | 14 | 0.396 | 0.242 |
| Construction | 7 | -0.270 | 0.119 |
| Hotel | 2 | 1.807 | 0.415 |
| Finance | 14 | -0.289 | 3.011 |
| Industrial product | 23 | -0.213 | 0.136 |
| Trading services | 18 | -0.066 | 0.135 |
| Property | 15 | -0.252 | -0.147 |
| Mining | 2 | -0.314 | 1.051 |
| Plantation | 5 | -0.224 | 1.498 |
| Group | 100 | -0.084 | 0.718 |

From the above table, we can notice that majority of the KLSE CI sample show a decrease in volatility after the KLOFFE's opening (i.e. Construction, Finance, Industrial product, Mining, Plantation, Property and Trading and Services) except two sectors (i.e. Consumer product and Hotel). However, this result is not shown in the non KLSE CI sample. In the non KLSE CI group, only Property sector reports a decrease in volatility whereas others show an increase in volatility. The reasons for the increase in volatility after the futures trading for the two sectors in the subject group may be as follows:

1. Nestle (M) Berhad, one of the stocks in the Consumer Product sector, has 700% increase in volatility in the post-futures period;
2. The Hotel sector consists of only two stocks and both of them have a *p-value* of significance more than 0.10, which indicates that the difference in volatility before and after the futures trading is not significant.

As a whole, the subject group reports a decrease in volatility by 8.4% and the control group however shows an increase in volatility by 71.8% after the

KLOFFE's opening. Therefore, the actual decrease in volatility for the subject group due to the futures trading is the difference between the volatility of the subject and the control group is 80.2%.

*Volatility of Pre and Post Futures Period* To test whether the changes in volatility of pre and post-futures period is significant or not, this study uses Levene test.

TABLE 5. Mean percentage change in variance for all significant stocks (Pre 15/12/94 to 14/12/95 and Post 15/12/95 to 14/12/96)

| Sector | Significant α = 0.05 | | | Significant α = 0.10 | | |
|---|---|---|---|---|---|---|
| | No. stocks | Subject | Control | No. stocks | Subject | Control |
| Consumer product | 7 | 0.837 | 0.561 | 8 | 0.698 | 0.415 |
| Construction | 3 | -0.567 | 0.076 | 3 | -0.567 | 0.076 |
| Finance | 8 | -0.486 | 0.190 | 8 | -0.486 | 0.190 |
| Industrial product | 12 | -0.426 | 0.239 | 13 | -0.369 | 0.188 |
| Trading services | 6 | -0.275 | -0.280 | 6 | -0.275 | -0.280 |
| Property | 9 | -0.354 | -0.092 | 11 | -0.338 | -0.136 |
| Mining | 1 | -0.313 | 1.057 | 1 | -0.313 | 1.057 |
| Plantation | 2 | -0.540 | 1.300 | 2 | -0.540 | 1.300 |
| Group | 48 | -0.231 | 0.202 | 52 | -0.222 | 0.153 |

Table 5 shows the mean percentage change in variance (PCV) for all the significant stocks by sector in KLSE CI sample and compared to their corresponding matched stocks. Hotel industry is excluded from the above table due to the difference in variance is not significant. In subject sample, seven sectors show a decrease in volatility and one sector shows an increase in volatility at both a = 0.05 and 0.10. However, only two sectors in control group show a decrease in volatility whereas the rest shows an increase in volatility after the futures trading.

Alternatively, if the Consumer product sector is disregarded due to an exceptional stock, which is abnormally volatile, we could notice that all the sectors in subject group show a decrease in volatility after the KLSE CI Futures trading at both a = 0.05 and 0.10. Moreover, majority of the sectors in non KLSE CI sample report an increase in volatility.

Overall, after the KLOFFE's opening, at a = 0.05, the significant stocks in the subject group have a decrease in volatility of 23.10% compared to the matched control group of an increase of 20.20%. On the other hand, if at a = 0.10, the sample subject group has a decrease in volatility of 22.20% compared to its control group which has an increase of 15.30%. The amount of decrease in volatility for KLSE CI sample is slightly less at a = 0.10 compared to at a = 0.05.

*Volatility of Pre and Post Futures Period for the KLSE Composite Index* Table 6 shows the pre and post futures trading volatility for KLSE CI and non-KLSE CI.

TABLE 6. $PCV_i$ of KLSE CI and Non-KLSE CI

| Index | KLSE CI | Non-KLSE CI |
|---|---|---|
| $\sigma^2_{pre}$ | 0.000137 | 0.000172 |
| $\sigma^2_{post}$ | 0.000066 | 0.000142 |
| $PCV_I$ | -0.520710 | -0.174815 |

From the above table, we notice that KLSE CI has $\sigma^2_{pre}$ = 0.000137 and $\sigma^2_{post}$ = 0.000066, which shows a decrease of 52.10% in volatility after the introduction of futures trading. However, its corresponding matched index has $\sigma^2_{pre}$ = 0.000172 and $\sigma^2_{post}$ = 0.000142, which shows a decrease in volatility of 17.50% after the futures introduction.

Here, assuming other things being equal, the magnitude of decrease in volatility due to futures trading for the components of KLSE CI is larger than its corresponding matched stocks. This might be due to KLSE CI is the underlying asset of KLSE CI Futures and therefore, the trading of index futures gives a direct impact on its underlying index and its components.

*Volatility of 1st Post-Futures and 2nd Post-Futures Period* Immediately after the KLOFFE's opening, the trading volume and frequency might be low, therefore, the effect of futures trading on its underlying stocks might not be obvious. This is to say that the volatility of the pre and post-futures trading may not show much difference. Therefore, a comparison of 1st post-futures period (within six months immediately after the introduction of KLSE CI Futures) and the 2nd post-futures period (after six months from the introduction of KLSE CI Futures) is made.

*Number of Stocks that Decrease in Volatility* Table 7 shows the number of stocks that decrease in volatility at a = 0.05 for the 1st post-futures period and the 2nd post-futures period for all the component stocks in the KLSE CI. The results show that 24 and 53 stocks significantly decrease in volatility in the 1st and 2nd post-futures period respectively as compared to the pre-futures period. In other words, the number of stocks which shows a decrease in volatility is double after the six months period of the KLOFFE's opening. This might be due to the inactive trading in the futures market immediately after the futures trading or the investors are not familiar with the new futures market. On the other hand, after sometime, when the investors gain more

TABLE 7. Number of stocks significantly decrease in volatility at $\alpha = 0.05$

| Sector | No. of stocks Decrease In Volatility at a = 0.05 | |
|---|---|---|
| | 1st post-futures period | 2nd post-futures period |
| Consumer product | 4 | 6 |
| Construction | 3 | 3 |
| Hotel | 0 | 2 |
| Finance | 7 | 7 |
| Industrial product | 3 | 12 |
| Trading services | 3 | 6 |
| Property | 4 | 13 |
| Mining | 0 | 1 |
| Plantation | 0 | 3 |
| Total | 24 | 53 |

information and more confidence in the futures market, they participate more. Thus it leads to more stocks fall in volatility in 2nd post-futures period.

*Magnitude of Decrease in Volatility* From Table 8, the results show that there are seven sectors indicate a decrease in volatility and only two sectors show an increase in volatility in the 1st post-futures period. However, in the 2nd post-futures period, there are eight sectors show a decrease in volatility and only one sector shows an increase in volatility. If we look at the result as a whole, it shows a 4.50% increase in volatility in the 1st post-futures period compared to a 20.0% decrease in volatility in the 2nd post-futures

TABLE 8. Mean percentage change in variance in subject sample by sectors

| Sector | No. of Stocks | 1st Post-futures Period | 2nd Post-futures Period |
|---|---|---|---|
| Consumer product | 14 | -0.124 | 0.861 |
| Construction | 7 | -0.157 | -0.389 |
| Hotel | 2 | 4.199 | -0.329 |
| Finance | 14 | -0.188 | -0.334 |
| Industrial product | 23 | -0.075 | -0.342 |
| Trading services | 18 | 0.269 | -0.267 |
| Property | 15 | -0.028 | -0.509 |
| Mining | 2 | -0.067 | -0.512 |
| Plantation | 5 | -0.118 | -0.368 |
| Group | 100 | 0.045 | -0.200 |

period. Therefore, this indicate that futures trading tend to decrease the volatility of its underlying stocks in the later period compared to the period immediately after the KLOFFE's opening.

## DISCUSSION

The result of this study shows that there is a significant decrease in volatility of the KLSE CI underlying stocks compared to their corresponding matched stocks after the futures trading. All others being equal, the decline in volatility might be due to the KLOFFE's opening, which both increase the information available to traders and enhances the information flow. Spot market speculators with access to information reflected in futures prices will take an action in the futures market when they expect the movement of the futures prices. Therefore, the futures trading reduce its underlying spot price fluctuation.

Furthermore, trading in the futures market reduced the cost of transaction. The relative low cost of transaction in the futures market makes it worthwhile for more traders to trade and communicate information. Arbitrage in stock index futures also involves minimal storage cost condition where speculators could easily bear price risks and act on information transmitted through spot price. This enhances the stabilizing effect on the stock index spot market (Lam 1988). Therefore, there is a reduction of the volatility of the index's underlying stocks after the futures trading.

Investor who has a portfolio of stocks can hedge market risk by selling KLSE CI Futures contract. If the market falls, the investors will suffer a loss because the value of his portfolio will also fall. However, the KLSE CI Futures will fall as well, which allows the investor to make profit from the falling futures prices to offset the loss on his portfolio. Similarly, when the market rises, the losses on the futures contract at least can be partly offset by the profits on the original stock portfolio. Thus, by selling KLSE CI Futures, investors can reduce the volatility of their portfolios caused by market-wide events.

If the investor holds a stock portfolio, which consists of KLSE CI underlying stocks, the hedging process will be more effective. This is because the fluctuation of KLSE CI futures prices is closely correlated with its underlying stocks. Therefore, the risk of a portfolio of KLSE CI underlying stocks is certainly less compared to a portfolio of Non-KLSE CI underlying stocks if both are hedged with KLSE CI futures. Consequently, the volatility of the portfolio of KLSE CI underlying stocks will be far lower compared to the portfolio of Non-KLSE CI underlying stocks. This may be one of the reasons why KLSE CI underlying stocks show a large decrease in volatility compared to their corresponding matched stocks after the futures trading.

RELATIVE VOLATILITY BETWEEN FUTURES AND STOCK MARKETS

Table 9 and 10 show the price volatility comparison between futures and stocks under different measurement.

*Close to Close Method (Bacha & Villa 1993)* Table 9 reports the volatility by month based on daily close-to-close volatility measure. Each contract expires at the end of the month. The table also tells us that futures volatility is higher for 33 out of the 43 months period, but only 5 is significant. Futures volatility is lower for 10 contract months only, and none of which is significant.

Figure 3 plots the standard deviation of monthly returns to the KLSE CI and the futures contract from 1995 to 1999. Daily returns are used to calculate the standard deviation for each month. There are 12 points per year in the plot.

Figure 3 shows that the level of stock volatility has not increased during the period of the study, but it highlights the dramatic increase in volatility in September, 1997 to February, 1998 and also September, 1998. It also shows that the standard deviation of futures returns is usually higher than that of stock returns, most noticeably in September 1998. There are two concerns in interpretating this result. One is that "noise traders" are more active in the futures market, so temporary price swings are exaggerated (the term "noise traders" refers to people who do not have correct information about value of securities they trade) as reported by Black (1986). The alternative is that futures contract prices react more quickly to new information

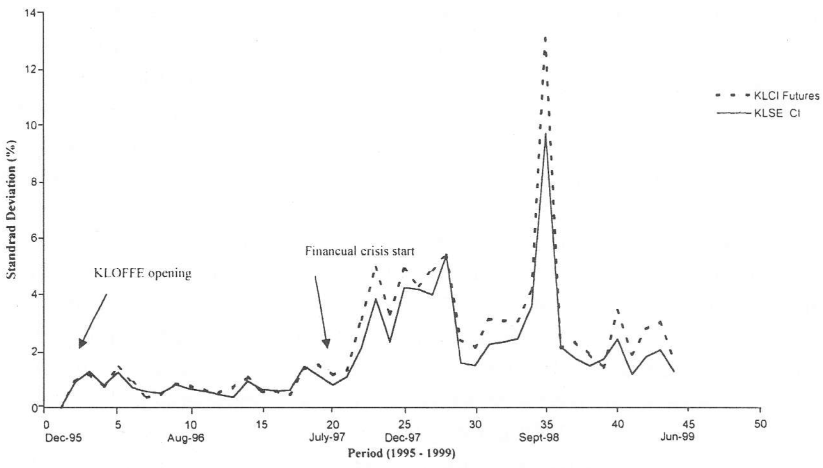


FIGURE 3. Volatility for KLSE and KLOFFE, $In(C_t/L_{t-1})$

TABLE 9. Daily price volatility for KLCI Futures and KLSE CI

| | In(Ct/Ct-1) | Observation No. | KLCI Futures SD (%) | KLSE CI SD (%) |
|---|---|---|---|---|
| 1 | Dec-95 | 10 | 0.95 | 0.92 |
| 2 | Jan-96 | 23 | 1.21 | 1.29 |
| 3 | Feb-96 | 15 | 0.77 | 0.81 |
| 4 | Mac-96 | 21 | 1.44 | 1.26 |
| 5 | Apr-96 | 21 | 0.91 | 0.72 |
| 6 | May-96 | 20 | 0.39 | 0.6 |
| 7 | Jun-96 | 20 | 0.49 | 0.53 |
| 8 | Jul-96 | 22 | 0.87 | 0.83 |
| 9 | Aug-96 | 22 | 0.79 | 0.68 |
| 10 | Sep-96 | 21 | 0.63 | 0.6 |
| 11 | Oct-96 | 23 | 0.55 | 0.49 |
| 12 | Nov-96 | 20 | 0.73* | 0.39 |
| 13 | Dec-96 | 21 | 1.08 | 0.95 |
| 14 | Jan-97 | 22 | 0.57 | 0.66 |
| 15 | Feb-97 | 16 | 0.59 | 0.61 |
| 16 | Mac-97 | 21 | 0.48 | 0.64 |
| 17 | Apr-97 | 21 | 1.36 | 1.47 |
| 18 | May-97 | 19 | 1.53* | 1.15 |
| 19 | Jun-97 | 21 | 1.17 | 0.82 |
| 20 | Jul-97 | 22 | 1.33 | 1.1 |
| 21 | Aug-97 | 21 | 3.1 | 2.14 |
| 22 | Sep-97 | 21 | 4.94 | 3.83 |
| 23 | Oct-97 | 22 | 3.28 | 2.33 |
| 24 | Nov-97 | 20 | 4.89 | 4.21 |
| 25 | Dec-97 | 22 | 4.29 | 4.16 |
| 26 | Jan-98 | 17 | 4.85 | 3.97 |
| 27 | Feb-98 | 19 | 5.37* | 5.35 |
| 28 | Mac-98 | 22 | 2.39 | 1.57 |
| 29 | Apr-98 | 20 | 2.12 | 1.49 |
| 30 | May-98 | 19 | 3.09 | 2.24 |
| 31 | Jun-98 | 22 | 3.05 | 2.32 |
| 32 | Jul-98 | 22 | 3.03 | 2.42 |
| 33 | Aug-98 | 20 | 4.1 | 3.56 |
| 34 | Sep-98 | 21 | 13.08* | 9.7 |
| 35 | Oct-98 | 21 | 2.11 | 2.15 |
| 36 | Nov-98 | 21 | 2.32 | 1.73 |
| 37 | Dec-98 | 22 | 1.88 | 1.47 |
| 38 | Jan-99 | 16 | 1.4 | 1.7 |
| 39 | Feb-99 | 17 | 3.4 | 2.4 |
| 40 | Mac-99 | 22 | 1.87* | 1.17 |
| 41 | Apr-99 | 22 | 2.74 | 1.78 |
| 42 | May-99 | 21 | 2.98 | 2.02 |
| 43 | Jun-99 | 22 | 1.71 | 1.27 |
| | Total Period | 873 | 3.18 | 2.34 |

*indicates KLOFFE is significantly more volatile than KLCI at KLSE at 5% level, using F-test

TABLE 10. Daily price volatility for KLCI Futures and KLSE CI

| | IN(Ht/Lt) | Observation No. | KLCI Futures Mean | KLSE CI Mean |
|---|---|---|---|---|
| 1 | Dec-95 | 10 | 0.0083 | 0.01 |
| 2 | Jan-96 | 23 | 0.0117 | 0.014 |
| 3 | Feb-96 | 15 | 0.0092 | 0.009 |
| 4 | Mac-96 | 21 | 0.0127 | 0.0122 |
| 5 | Apr-96 | 21 | 0.0084 | 0.0081 |
| 6 | May-96 | 20 | 0.0072 | 0.0087 |
| 7 | Jun-96 | 20 | 0.0055 | 0.0065 |
| 8 | Jul-96 | 22 | 0.0086 | 0.0093 |
| 9 | Aug-96 | 22 | 0.0088 | 0.0072 |
| 10 | Sep-96 | 21 | 0.0094 | 0.0064 |
| 11 | Oct-96 | 23 | 0.0065 | 0.0068 |
| 12 | Nov-96 | 20 | 0.0071 | 0.0068 |
| 13 | Dec-96 | 21 | 0.0115 | 0.0108 |
| 14 | Jan-97 | 22 | 0.0075 | 0.0092 |
| 15 | Feb-97 | 16 | 0.0081 | 0.01 |
| 16 | Mac-97 | 21 | 0.0069 | 0.0096 |
| 17 | Apr-97 | 21 | 0.0191 | 0.0204 |
| 18 | May-97 | 19 | 0.02 | 0.0159 |
| 19 | Jun-97 | 21 | 0.0178 | 0.0122 |
| 20 | Jul-97 | 22 | 0.0184 | 0.015 |
| 21 | Aug-97 | 21 | 0.0401 | 0.0291 |
| 22 | Sep-97 | 21 | 0.0522 | 0.0401 |
| 23 | Oct-97 | 22 | 0.0363 | 0.0242 |
| 24 | Nov-97 | 20 | 0.0563 | 0.0433 |
| 25 | Dec-97 | 22 | 0.0582 | 0.0422 |
| 26 | Jan-98 | 17 | 0.0593 | 0.0443 |
| 27 | Feb-98 | 19 | 0.0535 | 0.0401 |
| 28 | Mac-98 | 22 | 0.0272 | 0.0183 |
| 29 | Apr-98 | 20 | 0.0283* | 0.0213 |
| 30 | May-98 | 19 | 0.0389 | 0.0261 |
| 31 | Jun-98 | 22 | 0.0381 | 0.0278 |
| 32 | Jul-98 | 22 | 0.0401 | 0.0291 |
| 33 | Aug-98 | 20 | 0.0551 | 0.0448 |
| 34 | Sep-98 | 21 | 0.1377* | 0.0822 |
| 35 | Oct-98 | 21 | 0.0283 | 0.0238 |
| 36 | Nov-98 | 21 | 0.0322 | 0.026 |
| 37 | Dec-98 | 22 | 0.0235 | 0.0296 |
| 38 | Jan-99 | 16 | 0.0190* | 0.0189 |
| 39 | Feb-99 | 17 | 0.0366 | 0.0276 |
| 40 | Mac-99 | 22 | 0.0267 | 0.0201 |
| 41 | Apr-99 | 22 | 0.0355 | 0.0261 |
| 42 | May-99 | 21 | 0.0321 | 0.0275 |
| 43 | Jun-99 | 22 | 0.0219 | 0.0174 |
| | Total Period | 873 | 0.0279 | 0.0218 |

*indicates KLOFFE is significantly more volatile than KLCI at KLSE at 5% level, using F-test

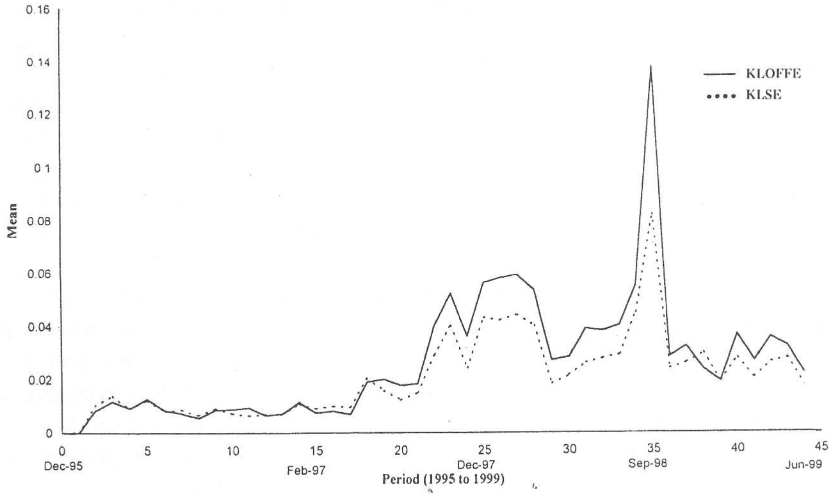


FIGURE 4. Daily mispricing at KLCI futures (with transaction cost)

because the contract have lower transaction costs and they price the bundle of underlying stock simultaneously. Amihud and Mendelson (1989) conclude that both these explanations contribute to the higher volatility of futures returns.

*High Low Method [Parkinson Extreme Value Estimator (1980)]* Table 10 and Figure 4 report the same day volatility measure as Table 9 and Figure 3 but using the In($H_t/L_t$) measure. By using this measure, future volatility is higher for 32 out of 43 contract periods. This exhibit similar results as the first measure. However, only 3 is significant. Futures volatility is lower for 11 contracts only and none of which is significantly lower. The plot in Figure 4 shows similar pattern as Figure 3.

Overall, futures volatility is significantly higher by both measures. The plots show higher levels of volatility following the currency crisis period. The conclusions are the same for both measures of volatility. Finally, the evidence indicates that futures returns are more volatile than stock index returns when there are big price movements. The result is consistent with earlier studies in other countries.

## FUTURES EXPIRATION DAY EFFECT

Table 11 shows the KLOFFE expiration day volatility on cash market using In(Ct/Ct-1) and In(Ht/Lt). Each contract expires at the end of the month. In($C_t/C_{t-1}$) reports standard deviation of interday measure while In(Ht/Lt) reports means of intraday measure. As from Table 12, the 1st quartile, median and 3rd quartile ranges of stock volatility for non-expiration days by using lose-to-close volatility measure is –0.009, -0.001 and 0.08 respectively. However, it reports the figure of 0.09, 0.016 and 0.029 respectively by using the second volatility measure. The inter-quartile range is then plot in Figure 5 and 6 respectively. The graphical presentation for Table 11 for KLOFFE expiration day volatility on cash market is shown in Figure 5 and 6. Table 12 shows the summary results for the period under study. It shows that 20 and 26 respectively out of the 43 sample of expiration days by using the respective measures fall within the inter-quartile range, while 23 and 17 samples fall outside the inter-quartile range.

To assess whether the expiration day volatility is statistically different from that of the sample of non-expiration day, cumulative binomial distribution is used to test the likelihood that the observed expiration day volatility would occur in a sample of non-expiration day. A low probability indicates a significant different event and thus denotes expiration days as unusual. As we can see from Table 12, the cumulative binomial probability for the two respective measures are 16.3% and 71.6%. It is obvious that the probabilities are much higher than the 5% or 10% level of significant test.

The main conclusion of this study is that futures expiration day has no impact on underlying stock volatility because the stock market volatility has no different in future expiration day relative to non-expiration day. This could be due to the KLCI futures contracts settlement prices are calculated based on the average value of the stock index for the last half hour of the trading, that is from 4.45pm to 5.15pm. This determination of settlement price is quite different from the Nikkei or FTSE 100. Lastly, the result reported is consistent with the studies conducted in other countries such as by Stoll and Whaley (1987), Karakullukcu (1992), and Bacha and Villa (1993).

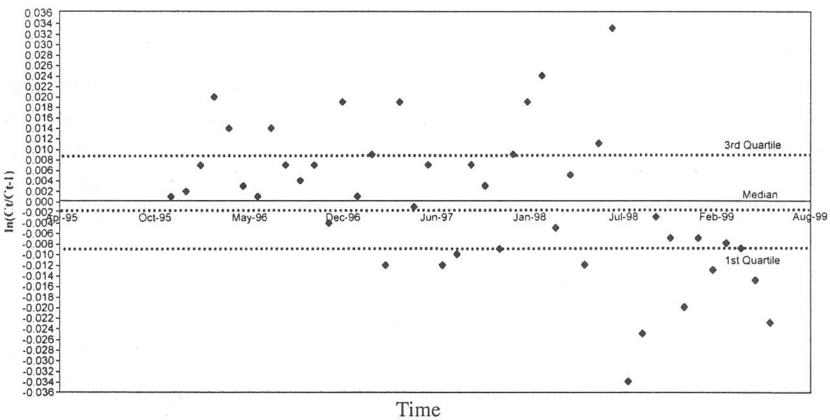


FIGURE 5. KLOFFE expiration day volatility on cash market, $\ln(C_t/C_{t-1})$

TABLE 11. KLCI futures expiration day volatility on cash market

| | Contract Month | In(Ct/Ct-1) | In(Ht/Lt) |
|---|---|---|---|
| 1 | Dec-95 | 0.001 | 0.006 |
| 2 | Jan-96 | 0.002 | 0.011 |
| 3 | Feb-96 | 0.007 | 0.007 |
| 4 | Mar-96 | 0.02 | 0.007 |
| 5 | Apr-96 | 0.014 | 0.014 |
| 6 | May-96 | 0.003 | 0.007 |
| 7 | Jun-96 | 0.001 | 0.011 |
| 8 | Jul-96 | 0.014 | 0.015 |
| 9 | Aug-96 | 0.007 | 0.012 |
| 10 | Sep-96 | 0.004 | 0.005 |
| 11 | Oct-96 | 0.007 | 0.006 |
| 12 | Nov-96 | -0.004 | 0.01 |
| 13 | Dec-96 | 0.019 | 0.019 |
| 14 | Jan-97 | 0.001 | 0.007 |
| 15 | Feb-97 | 0.009 | 0.009 |
| 16 | Mac-97 | -0.012 | 0.019 |
| 17 | Apr-97 | 0.019 | 0.019 |
| 18 | May-97 | -0.001 | 0.009 |
| 19 | Jun-97 | 0.007 | 0.008 |
| 20 | Jul-97 | -0.012 | 0.015 |
| 21 | Aug-97 | -0.01 | 0.044 |
| 22 | Sep-97 | 0.007 | 0.017 |
| 23 | Oct-97 | 0.003 | 0.032 |
| 24 | Nov-97 | -0.009 | 0.051 |
| 25 | Dec-97 | 0.009 | 0.026 |
| 26 | Jan-98 | 0.019 | 0.019 |
| 27 | Feb-98 | 0.024 | 0.017 |
| 28 | Mac-98 | -0.005 | 0.012 |
| 29 | Apr-98 | 0.005 | 0.014 |
| 30 | May-98 | -0.012 | 0.022 |
| 31 | Jun-98 | 0.011 | 0.021 |
| 32 | Jul-98 | 0.033 | 0.033 |
| 33 | Aug-98 | -0.034 | 0.024 |
| 34 | Sep-98 | -0.025 | 0.02 |
| 35 | Oct-98 | -0.003 | 0.009 |
| 36 | Nov-98 | -0.007 | 0.03 |
| 37 | Dec-98 | -0.02 | 0.05 |
| 38 | Jan-99 | -0.007 | 0.019 |
| 39 | Feb-99 | -0.013 | 0.016 |
| 40 | Mac-99 | 0.008 | 0.025 |
| 41 | Apr-99 | 0.009 | 0.015 |
| 42 | May-99 | -0.015 | 0.015 |
| 43 | Jun-99 | -0.023 | 0.026 |

TABLE 12. Summary results of expiration day effect

| | In(Ct/Ct-1) | In(Ht/Lt) |
|---|---|---|
| Interquartile Range | | |
| 1st Quartile | -0.009 | 0.009 |
| Median | -0.001 | 0.016 |
| 3rd Quartile | 0.008 | 0.029 |
| Expiration days | 20 | 26 |
| Inside IQR | 23 | 17 |
| Outside IQR | 43 | 43 |
| Non Expiration days | 830 | 830 |
| Total | 873 | 873 |
| Probability | 16.3% | 71.6% |

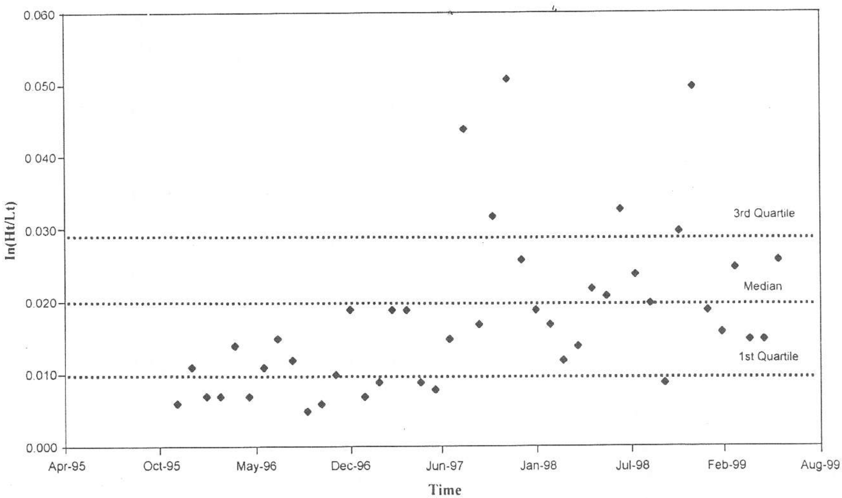


FIGURE 6. KLOFFE expiration day volatility on cash market, In($H_t/L_t$)

## FUTURES MISPRICING

*Without Transaction Cost* Table 13 shows the summary results of average daily mispricing for each contract month for the period under study with no transaction cost. The table also reports overall mispricing, being the average of under and overpricing. It also shows that 25 of the 43 contracts studied had mean underpricing of which 16 were significant. On the other hand, only 17 contracts had mean overpricing and 9 were significant. The standard deviation of mispricing shows a steady increase over the later contracts. The mispricing is graphed and presented in Figure 7.

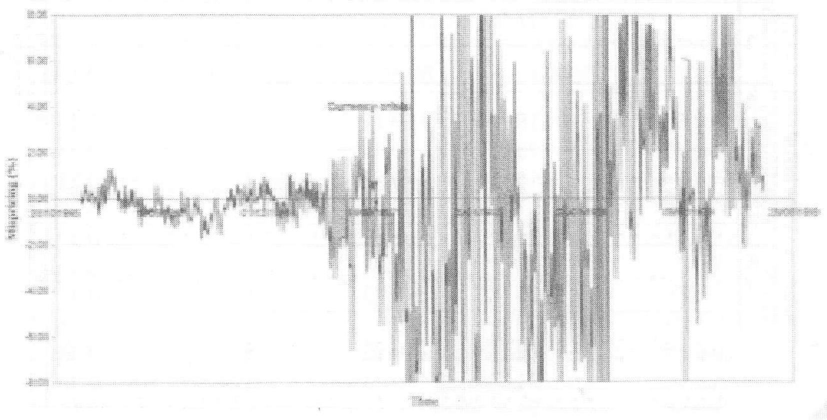

FIGURE 7. Daily mispricing at KLCI futures (without transaction cost)

From the above observation, three conclusions can be drawn. First, there appears to be much more frequent underpricing than overpricing for the period before crisis. Second, the percentage and magnitude of underpricing is larger. Overpricing appears to be of a lower magnitude. Third, there appears to be stretches of very little or no overpricing (i.e. March to September 1996). The result also shows mispricing is larger in the later period of the study. This contradict with the findings of Brenner et al. (1989) and Bacha and Fremault (1993) which shows reduced mispricing over time. If one ignored the currency crisis starting from July 1997, there is clearly no declining trend in mispricing over the one and the half year period before crisis. Table 14 shows the breakdown of mean underpricing and overpricing with the number of days on which underpricing and overpricing. The earlier observation of higher frequency of underpricing before currency crisis is explained and summarised in Table 15.

We can see obviously that 64% (256 out of 400 days) of the observed mispricing was negative. This is in contrast to the early research by Yau et al. (1990) on S&P 500 futures contract whose prices were constantly at a premium. The average size of the negative mispricing, -0.86% of the spot index is greater than that of the positive mispricing, 0.56%. Similarly the standard deviation of the negative mispricing is higher than that of the positive (0.94% versus 0.60%). Extreme overpricing did happen, though not frequently. It is observed that most of the positive mispricing are clustered around five months: January and February 1996, October and November 1996, and February 1997.

TABLE 13. Daily mispricing summary statistics

| | Contract | Observation No. | Mean (%) | Significant | SD (%) |
|---|---|---|---|---|---|
| 1 | Dec-95 | 10 | 0.11 | | 0.26 |
| 2 | Jan-96 | 23 | 0.09 | | 0.34 |
| 3 | Feb-96 | 15 | 0.53 | * | 0.52 |
| 4 | Mac-96 | 21 | -0.08 | | 0.29 |
| 5 | Apr-96 | 21 | -0.39 | * | 0.3 |
| 6 | May-96 | 20 | -0.3 | * | 0.42 |
| 7 | Jun-96 | 20 | -0.73 | * | 0.37 |
| 8 | Jul-96 | 22 | -0.5 | * | 0.33 |
| 9 | Aug-96 | 22 | -0.92 | * | 0.53 |
| 10 | Sep-96 | 21 | -0.43 | * | 0.56 |
| 11 | Oct-96 | 23 | 0.11 | | 0.32 |
| 12 | Nov-96 | 20 | 0.22 | * | 0.39 |
| 13 | Dec-96 | 21 | -0.07 | | 0.5 |
| 14 | Jan-97 | 22 | -0.21 | | 0.7 |
| 15 | Feb-97 | 16 | 0.19 | | 0.55 |
| 16 | Mar-97 | 21 | -0.31 | | 0.72 |
| 17 | Apr-97 | 21 | -0.99 | * | 1.57 |
| 18 | May-97 | 19 | -0.56 | | 2.54 |
| 19 | Jun-97 | 21 | -0.67 | | 1.51 |
| 20 | Jul-97 | 22 | -1.44 | * | 2.15 |
| 21 | Aug-97 | 21 | -3.51 | * | 4.32 |
| 22 | Sep-97 | 21 | -3.08 | * | 6.67 |
| 23 | Oct-97 | 22 | -2.74 | * | 5.2 |
| 24 | Nov-97 | 20 | -3.54 | * | 5.07 |
| 25 | Dec-97 | 22 | 0.32 | | 6.92 |
| 26 | Jan-98 | 17 | 1.68 | | 9.7 |
| 27 | Feb-98 | 19 | -0.25 | | 4.27 |
| 28 | Mar-98 | 22 | -0.97 | | 3.48 |
| 29 | Apr-98 | 20 | -4.45 | * | 2.65 |
| 30 | May-98 | 19 | -3.85 | * | 4.3 |
| 31 | Jun-98 | 22 | -1.3 | | 4.51 |
| 32 | Jul-98 | 22 | -2.07 | * | 3.71 |
| 33 | Aug-98 | 20 | -3.56 | * | 5.83 |
| 34 | Sep-98 | 21 | 6.53 | | 17.56 |
| 35 | Oct-98 | 21 | 3.95 | * | 4.17 |
| 36 | Nov-98 | 21 | 4.17 | * | 2.86 |
| 37 | Dec-98 | 22 | 3.23 | * | 1.89 |
| 38 | Jan-99 | 16 | 2.67 | * | 3.63 |
| 39 | Feb-99 | 17 | -0.3 | | 3.94 |
| 40 | Mar-99 | 22 | 0.54 | | 3.59 |
| 41 | Apr-99 | 22 | 4.62 | * | 2.87 |
| 42 | May-99 | 21 | 1.57 | * | 2.19 |
| 43 | Jun-99 | 22 | 1.53 | * | 1.21 |

*indicates that mispricing is significantly different from 0 using t-test at 10% level

TABLE 14. Daily Mispricing Without Transaction Cost

| Contract | Observation No. | Underpricing (Mt<0) No. days | Underpricing (Mt<0) Mean (%) | | Overpricing (Mt>0) No.days | Overpricing (Mt>0) Mean (%) | |
|---|---|---|---|---|---|---|---|
| Dec-95 | 10 | 5 | -0.1 | * | 5 | 0.33 | * |
| Jan-96 | 23 | 8 | -0.27 | * | 15 | 0.25 | * |
| Feb-96 | 15 | 3 | -0.13 | | 12 | 0.77 | * |
| Mar-96 | 21 | 15 | -0.25 | * | 6 | 0.28 | * |
| Apr-96 | 21 | 19 | -0.4 | * | 2 | 0.07 | |
| May-96 | 20 | 14 | -0.53 | * | 6 | 0.21 | * |
| Jun-96 | 20 | 19 | -0.77 | * | 1 | 0.3 | * |
| Jul-96 | 22 | 20 | -0.55 | * | 2 | 0.08 | * |
| Aug-96 | 22 | 21 | -0.96 | * | 1 | 0.04 | |
| Sep-96 | 21 | 15 | -0.69 | * | 6 | 0.21 | * |
| Oct-96 | 23 | 9 | -0.22 | * | 14 | 0.33 | * |
| Nov-96 | 20 | 5 | -0.17 | * | 15 | 0.35 | * |
| Dec-96 | 21 | 12 | -0.39 | * | 9 | 0.36 | * |
| Jan-97 | 22 | 15 | -0.63 | * | 7 | 0.58 | * |
| Feb-97 | 16 | 6 | -0.36 | * | 10 | 0.52 | * |
| Mac-97 | 21 | 14 | -0.7 | * | 7 | 0.48 | * |
| Apr-97 | 21 | 15 | -1.86 | * | 6 | 1.2 | * |
| May-97 | 19 | 10 | -2.57 | * | 9 | 1.45 | * |
| Jun-97 | 21 | 16 | -1.26 | * | 5 | 1.21 | * |
| Jul-97 | 22 | 16 | -2.49 | * | 6 | 1.35 | * |
| Aug-97 | 21 | 17 | -4.99 | * | 4 | 2.81 | * |
| Sep-97 | 21 | 14 | -6.73 | * | 7 | 4.21 | * |
| Oct-97 | 22 | 16 | -4.1 | * | 6 | 4.22 | * |
| Nov-97 | 20 | 15 | -5.76 | * | 5 | 3.12 | * |
| Dec-97 | 22 | 10 | -5.86 | * | 12 | 5.48 | * |
| Jan-98 | 17 | 9 | -5.48 | * | 8 | 9.74 | * |
| Feb-98 | 19 | 11 | -3.02 | * | 8 | 3.56 | * |
| Mac-98 | 22 | 13 | -2.97 | * | 9 | 1.93 | * |
| Apr-98 | 20 | 19 | -4.69 | * | 1 | 0.19 | |
| May-98 | 19 | 16 | -5.22 | * | 3 | 3.47 | |
| Jun-98 | 22 | 15 | -3.71 | * | 7 | 3.85 | * |
| Jul-98 | 22 | 16 | -3.91 | * | 6 | 2.83 | * |
| Aug-98 | 20 | 16 | -6.05 | * | 4 | 6.39 | * |
| Sep-98 | 21 | 7 | -4.38 | * | 14 | 11.99 | * |
| Oct-98 | 21 | 6 | -1.32 | * | 15 | 6.06 | * |
| Nov-98 | 21 | 2 | -0.39 | * | 19 | 4.66 | * |
| Dec-98 | 22 | 1 | -0.5 | * | 21 | 3.41 | * |
| Jan-99 | 16 | 4 | -1.54 | * | 12 | 4.42 | * |
| Feb-99 | 17 | 9 | -3.33 | * | 8 | 2.72 | * |
| Mar-99 | 22 | 13 | -1.56 | * | 9 | 3.57 | * |
| Apr-99 | 22 | 1 | -0.77 | * | 21 | 4.88 | * |
| May-99 | 21 | 5 | -1.04 | * | 16 | 2.44 | * |
| Jun-99 | 22 | 1 | -0.54 | * | 21 | 1.63 | * |
| | 873 | 493 | | | | 380 | |

*indicates mispricing is significant at 10% level.

TABLE 15. Futures mispricing from 15/12/95 to 31/7/97

| | Underpricing | Overpricing |
|---|---|---|
| Overall mean | -0.86 | 0.56 |
| Overall standard deviation | 0.94 | 0.60 |
| Observation no. (400) | 256 | 144 |

*With Transaction Costs* Table 16 shows the mean over and underpricing with transaction costs with the number of days of overpricing and underpricing as defined by $M_t$. The mean is calculated for the days on which underpricing and overpricing was large enough to violate the transaction cost upper and lower bounds. Figure 8 shows the graph of daily mispricing with transaction of KLCI Futures. One obvious observation is that positive mispricing have disappeared up to March 1997 except for one contract month of February 1996. This is due to the fact that before the transaction costs, the magnitude of positive mispricing was not large. The average size of the positive mispricing is about 0.44% of the spot index. With a transaction costs of 1.11%, all of the positive mispricing were considered within bounds up to March 1997 (i.e. the futures contract were priced fairly according to the cost of carry model). However, 246 cases of negative mispricing remained after the transaction costs. In addition, majority of the mispricing for April 1997 to September 1998 contracts still experienced negative mispricing even after the transaction costs. However, September 1998 to June 1999 contracts was overvalued most of the time.

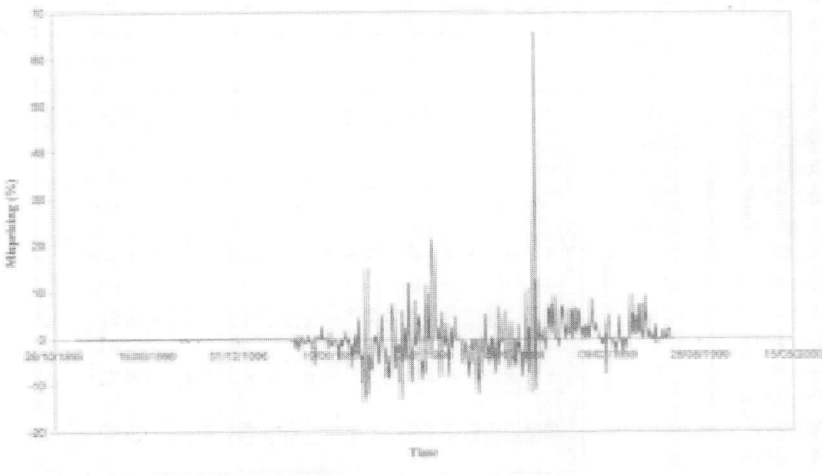

FIGURE 8. Daily mispricing at KLCI Futures (with transaction cost)

TABLE 16. Daily Mispricing With Transaction Cost

| Contract | Observation No. | Underpricing ($M_t<0$) No. days | Underpricing ($M_t<0$) Mean(%) | | Overpricing ($M_t>0$) No. days | Overpricing ($M_t>0$) Mean(%) | |
|---|---|---|---|---|---|---|---|
| Dec 95 | 10 | 0 | 0.00 | | 0 | 0.00 | |
| Jan-96 | 23 | 0 | 0.00 | | 0 | 0.00 | |
| Feb-96 | 15 | 0 | 0.00 | | 2 | 0.18 | |
| Mar-96 | 21 | 0 | 0.00 | | 0 | 0.00 | |
| Apr-96 | 21 | 0 | 0.00 | | 0 | 0.00 | |
| May-96 | 20 | 0 | 0.00 | | 0 | 0.00 | |
| Jun-96 | 20 | 1 | -0.02 | | 0 | 0.00 | |
| Jul-96 | 22 | 0 | 0.00 | | 0 | 0.00 | |
| Aug-96 | 22 | 7 | -0.25 | * | 0 | 0.00 | |
| Sep-96 | 21 | 3 | -0.18 | | 0 | 0.00 | |
| Oct-96 | 23 | 0 | 0.00 | | 0 | 0.00 | |
| Nov-96 | 20 | 0 | 0.00 | | 0 | 0.00 | |
| Dec-96 | 21 | 0 | 0.00 | | 0 | 0.00 | |
| Jan-97 | 22 | 1 | -0.05 | | 0 | 0.00 | |
| Feb-97 | 16 | 0 | 0.00 | | 0 | 0.00 | |
| Mar-97 | 21 | 2 | -0.44 | | 0 | 0.00 | |
| Apr-97 | 21 | 13 | -0.82 | * | 3 | 0.60 | * |
| May-97 | 19 | 9 | -2.02 | * | 5 | 1.12 | |
| Jun-97 | 21 | 7 | -1.16 | * | 3 | 0.59 | |
| Jul-97 | 22 | 13 | -1.68 | * | 2 | 1.00 | |
| Aug-97 | 21 | 17 | -3.84 | * | 4 | 2.30 | |
| Sep-97 | 21 | 13 | -6.03 | * | 6 | 3.64 | |
| Oct-97 | 22 | 14 | -3.88 | * | 5 | 4.30 | * |
| Nov-97 | 20 | 15 | -4.62 | * | 4 | 2.05 | |
| Dec-97 | 22 | 10 | -4.71 | * | 10 | 5.21 | * |
| Jan-98 | 17 | 8 | -4.99 | * | 6 | 11.51 | * |
| Feb-98 | 19 | 6 | -3.90 | * | 7 | 2.88 | * |
| Mar-98 | 22 | 7 | -3.73 | * | 6 | 1.65 | |
| Apr-98 | 20 | 17 | -3.77 | * | 0 | 0.00 | |
| May-98 | 19 | 14 | -4.42 | * | 3 | 2.34 | |
| Jun-98 | 22 | 11 | -3.69 | * | 5 | 3.34 | * |
| Jul-98 | 22 | 15 | -3.00 | * | 5 | 2.26 | * |
| Aug-98 | 20 | 16 | -4.91 | * | 4 | 5.23 | |
| Sep-98 | 21 | 6 | -3.90 | * | 11 | 13.84 | * |
| Oct-98 | 21 | 3 | -0.67 | | 15 | 4.91 | * |
| Nov-98 | 21 | 0 | 0.00 | | 18 | 3.74 | * |
| Dec-98 | 22 | 0 | 0.00 | | 21 | 2.28 | * |
| Jan-99 | 16 | 3 | -1.05 | | 10 | 4.09 | * |
| Feb-99 | 17 | 6 | -3.07 | | 5 | 2.92 | * |
| Mar-99 | 22 | 7 | -1.23 | * | 6 | 4.05 | * |
| Apr-99 | 22 | 0 | 0.00 | | 20 | 3.94 | * |
| May-99 | 21 | 2 | -0.87 | * | 12 | 1.78 | * |
| Jun-99 | 22 | 0 | 0.00 | | 12 | 1.32 | * |
| | 873 | 246 | | | 210 | | |

*indicates mispricing is significant at 10% level

## CONCLUSIONS AND RECOMMENDATIONS

### IMPACT OF FUTURES TRADING ON ITS UNDERLYING STOCKS

The main conclusion of this study is that the introduction of financial futures trading has not destabilized cash markets. Both the day to day and intra-day price volatility of the stock and futures markets over the seven year period from 1992 to 1999 were examined. No evidence was found which links future trading to an increase in general market volatility. If anything, the one and the half years period following the futures introduction had lowered the volatility. However, this may be due to the currency crisis.

In this study, we also provide an empirical investigation of the volatility of 100 component stocks in KLSE CI and non KLSE CI before and after the KLSE CI futures introduction and we find evidence of decrease in volatility. Seven industry sectors in KLSE CI have declined in volatility (8.40%) whereas its corresponding matched group shows an increase of 71.80% in the post compared to the pre-futures period. At the significant level of a = 0.05 and 0.10, the decrease in volatility of KLSE CI group are 23.10% and 22.20% respectively compared to its corresponding matched group, which shows an increase by 20.20% and 15.30% respectively.

Fifty-three stocks have decreased in volatility in the 2nd post-futures period compared to only 24 stocks in the 1st post-futures period. In the 1st post-futures period, KLSE CI sample shows slight increase in volatility, but in the 2nd post-futures period, it shows a decrease of 20%. This might be due to relatively more active trading in the futures market sometimes after from the introduction date. An increase in involvement of market participants tends to stabilize the underlying spot market and subsequently reduces the volatility.

KLSE CI Futures trading might decrease its underlying stock price volatility by three reasons. It increases information flow, increases market liquidity and provides hedging opportunities. The existence of futures trading in a market should increase the speed with which information is disseminated, the area over which it is disseminated and the degree of saturation within the area. It should tend to equalize the flows of information to current and potential futures and cash market participants. Therefore, the decrease in volatility of KLSE CI underlying stocks could be due to the improvement in the information flows fostered by the KLSE CI Futures trading.

In this study, we are dealing with the stock price volatility where the fluctuations of the stock prices might be due to both internal (firm-specific characteristics) and external factors (economic, technological, political and legal), which are not predictable, therefore, this study might involve various practical difficulties that cannot be completely resolved. To isolate the unrequired volatility, this study has constructed a sample of matching stocks as group and chose a short test period to minimize the time variation of stock price. The matching of the stocks might not be perfect due to the small number of stocks available for matching.

The volatility of financial markets has become increasingly important for market participants, regulators and academicians. Innovations in the financial products offered to the market have increased the complexity of the financial environment. Some of these recent innovations such as financial derivative securities have received considerable media attention. Market participants are keen to know whether this kind of innovations will have any impact to the markets especially for their underlying stocks to enable them to make an economic profit in this complex market.

From this study, it shows that the trading in futures market will eventually reduce the volatility of its underlying stocks. An increase in a well-informed speculative trading may decrease the volatility and increase liquidity because informed traders provide liquidity in such events (Harris 1989).

The results are important for the regulators and markets, especially the KLSE and KLOFFE, because the evidence is inconsistent with the public perception that derivatives increase risk. At the same time, these results are important to the academicians who seek to understand more on how derivative securities may be related to financial risk. Besides, the research results provide a general reference for those market participants who would benefit from understanding the relationship of price volatility behavior between the futures trading and its underlying stocks. This is particularly important for those investors and speculators who are continuously seeking for better ways of estimating the volatility of underlying stocks. For portfolio managers, they might be able to perform better planning and implementation of their investment decision and better selection of investment portfolio with the guideline of this research.

To further test the hypothesis developed in this research, more studies need to be conducted on a wider range of periods and with different model such as GARCH. Looking at a trading range alone is insufficient because it takes no account of price fluctuations between the high and the low, while variance around a long run mean could be misleading when prices contain a trend. GARCH models are appropriate to be of used since they are capable of capturing the three most empirical features observed in stock return data: leptokurtosis, skewness and volatility clustering (Taufiq 1996).

## RELATIVE VOLATILITY BETWEEN FUTURES AND STOCK MARKETS

Inter-market comparison shows futures market volatility is higher. The conclusions are the same when volatility is measured by both method. The result is consistent with earlier studies in other countries.

The interpretation for the higher futures volatility are (a) "noise traders" are more active in the futures market, so temporary price swings are exaggerated by Black (1986). (b) The future contract prices react more quickly to new information because the contract has lower transaction costs and (c) they price the bundle of underlying stock simultaneously. It is concluded that both these explanations contribute to the higher volatility of futures returns.

## FUTURES EXPIRATION DAY EFFECT

The test shows no evidence of increase stock market volatility on futures expiration days. This could be due to the KLCI futures contracts settlement prices are calculated based on the average value of the stock index for the last half hour of the trading, that is from 4.45pm to 5.15pm. This is consistent with studied conducted by Bacha and Villa (1993), Stoll and Whaley (1987) and Karakullukcu (1992).

The size of the futures market is estimated to be 25% of the stock market Ringgit volume. The relative size is still small and not significant. So, the no evidence of an expiration day effect should not be surprising given the perspective of size.

## FUTURES MISPRICING

The test of the mispricing shows frequent mispricing. There appears to be much more underpricing (64%) than overpricing before the start of financial crisis. This is in contrast to the early research by Yau et.al (1990) on S&P500 futures contract whose prices were constantly at a premium. Furthermore, overpricing appears to be of a lower magnitude. There appears to be stretches of very little or no overpricing (i.e. March to September 1996). The result also shows mispricing is larger in the later period of the study. This contradicts with the findings by Brenner et al. (1989) and Bacha and Fremault (1993) which show reduced mispricing over time. If one ignored the currency crisis starting from July 1997, there clearly is no declining trend in mispricing over the one and the half year period before crisis. If transaction cost is taken into account, the results exhibit less mispricing.

While transaction costs would affect arbitrageable opportunities on both over and underpricing. We believe that this has partly to do with the regulatory framework. In essence, the regulation is biased against Reverse Cash and Carry arbitrage. In Malaysia, short selling is prohibited. When a contract is underpriced, the index arbitrage strategy would be to long futures and short the underlying stocks, but the regulatory framework is against this. However, when futures are overpriced, there is no regulation preventing whosoever to go short futures and long stocks. We believe the short selling regulation is the major reason for the underpricing.

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