CHAPTER 3 : RESEARCH METHODOLOGY

3.1 Objective And Scope Of Study.

From the literature review, it is evident that there has been an increasing number of empirical evidence confirming the existence of seasonality in stock price behaviour. However, despite the existence of these anomalies in the price data as early as 1904 (See Rozeff and Kinney, 1976), efficient market researchers continued to accumulate empirical evidence of weak-form market efficiency and in some cases semi-strong form market efficiency in most global stock markets when conducting autocorrelation tests, spectral analysis, unit root analysis, runs tests, etc. using similar historical price data. Could these be mere illusions caused by biased empirical procedures or measurement errors? Are there possibilities that these are efficient market anomalies that could be explained by the inherent modus operandi, market structure or institutional arrangements specific to stock markets?

In addition, stock markets are known to learn from past experiences. Market efficiency tends to improve as trading volume grows; timely information disclosures improve with advent of information technology; transactional cost declines with market liberalization; and pool of specialized fund managers and investors grows. Any exploitable market anomalies could be taken advantage of by these specialists and eventually gets arbitraged away over time. If this assumption is valid, then the size and impact of this idiosyncratic price behaviour would diminish over time. Have the trading volume explosion over the past five years on the domestic as well as international stock markets diminished the size of these two calendar effects?

Thus, the objective of this study is three fold, namely :-

1) To determine if Monday effect and January effect continue to persist on the local bourse after seeing tremendous volume expansion from 1992-1996.
2) To determine the evolutionary patterns over the past 20 years for these two calendar effects via a ten year and five year sub-period analysis.
3) To compare the significance of these two calendar effects on the domestic front vis-à-vis international stock exchanges, namely USA, Tokyo, London, Hong Kong and Australia.

3.2 Sources Of Data and Data Selection.

The following daily and monthly market closing levels of stock indices were extracted from various sources namely, Investor Digest, KLSE Daily Diary, and Nanyang newspapers for the purpose of conducting this research.

Stock Index	Starting	Ending	Type	No. Of Observations. Day	Month
1. KLSE Composite	3/1/77	3/1/97	Day/Month	5220	240
2. KLSE Finance	5/1/76	3/1/97	Day/Month	5480	252
3. KLSE Industrial	5/1/76	3/1/97	Day/Month	5480	252
4. KLSE Properties	5/1/76	3/1/97	Day/Month	5480	252
5. KLSE Plantations	5/1/76	3/1/97	Day/Month	5480	252
6. KLSE Tin/Mining	5/1/76	3/1/97	Day/Month	5480	252
7. Aust. All Ord.	5/1/76	3/1/97	Day/Month	5480	252
8. Dow Jones Ind.	5/9/77	3/1/97	Day/Month	5045	228
9. FTSE 100 Ind.	5/9/77	3/1/97	Day/Month	5045	228
10. Hang Seng Index	5/1/76	3/1/97	Day/Month	5480	252
11. Nikkei 225 Index	3/1/83	3/1/97	Day	4386	
Nikkei 225 Index	1/1/50	3/1/97	Month	564	
12. KLSE EMAS	21/10/91	3/1/97	Day/Month	1360	60
13. KLSE 2nd Board	4/2/91	3/1/97	Day/Month	1545	72
14. KLSE Consumer	30/8/93	3/1/97	Day/Month	875	36
15. KLSE Construction	30/8/93	3/1/97	Day/Month	875	36
16. KLSE Ind. Product	30/8/93	3/1/97	Day/Month	875	36
17. KLSE Trad./Serv.	30/8/93	3/1/97	Day/Month	875	36

3.3 Limitations And Assumptions .

The use of stock indices for the purpose of determining stock returns has been argued as an incomplete measure as stock dividends, bonus issues, rights issues, etc., which are other forms of returns besides capital appreciation cannot or is difficult to be factored in returns calculations for indices. These can be factored into returns calculations if the individual stock prices are being used for analysis. However, stock prices are known to discount these other cash flows via changes in prices before (cum) and after (ex) these issues as postulated by the efficient market hypothesis. Hence, stock indices itself can be assumed to be a good and close approximations of the market returns for the purpose of this research.

3.4 Computation For Daily And Monthly Stock Returns.

A linear model in fixed effect for stock returns is used in this study whereby the total returns is a summation of an overall or grand mean, specific effect of the day or month and the random error associated with that effect. In addition, the random error term is assumed to follow a normal distribution. Here, the daily and monthly stock returns are computed as follows :-

$$R_t = \frac{(P_t - P_{t-1}) \times 100}{P_{t-1}}$$

whereby, R_t = Returns for Day $_t$ or Month $_t$,

P_t = Daily or Monthly Closing For Day $_t$ or Month $_t$,

P_{t-1} = Daily or Monthly Closing For Previous Day $_{t-1}$ or Month $_{t-1}$.

3.5 Parametric Test Hypothesis.

The parametric tests used here are the independent samples t-Test, One-way ANOVA, Tukey's test for pairwise comparisons of means and Bartlett's test for testing homogeneity of variances .

3.5.1 Independent Samples t-Test

For the comparison of the means of two samples of unequal sample sizes or independent random samples whereby the number of observations are not too small and not too different, we can adopt the following t-test statistic. This test is remarkably robust against departures from the normal distribution.

$$t = \frac{|\bar{X}_1 - \bar{X}_2|}{\sqrt{\left[\frac{n_1 + n_2}{n_1 n_2}\right]\left[\frac{((n_1 - 1) S_1^2) + (n_2 - 1) S_2^2)}{n_1 + n_2 - 2}\right]}}$$

We test the null hypothesis (μ 1 = μ d) for equality of the means of the populations with unknown but equal variances as follows:-

H_o : $\mu 1 = \mu d$

H_a : $\mu 1 \neq \mu d$

whereby μ 1 = Monday's mean return or January's mean return.

μ d = Tuesday's to Friday's or February's to December's mean returns.

If we reject the null hypothesis at the 0.05 significance level, then we conclude that there is a statistically significant difference in the mean returns implying seasonality in daily or monthly returns respectively.

3.5.2 One Way Analysis Of Variance (ANOVA).

The essential aspect of one way analysis of variance in the comparisons of k independent samples (where $k \geq 2$) is the decomposition of the sum of squares of observed values from the overall mean, SST into two components, namely error sum of squares or " within sample sum of squares" (SS_{within}) and "between samples (groups) sum of squares" ($SS_{between}$). Subsequently, the mean sum of squares (MS) are derived from dividing these sums of squares by the respective degrees of freedom. If all the groups originate from the same population, then the variances i.e. $MS_{between}$ and MS_{within} should be of about the same size. If this is not so, ($MS_{between}$ / MS_{within} is larger than the critical value of F-distribution determined from $v_1 = k - 1$, $v_2 = n - k$, and α), then certain of the groups have different mean μ_i .

The null hypothesis that the population means of k treatment groups are all equal i.e. $\mu_{d1} = \mu_{d2} = \ldots\ldots = \mu_{dk}$ would have higher possibility of rejection if the F ratio becomes larger and we can conclude that the populations are of different means, implying seasonality in the daily or monthly mean returns respectively. The oneway analysis of variance is used to test the following sets of hypotheses.

For Day Effects :- $H_o : \mu_{d1} = \mu_{d2} = \mu_{d3} = \mu_{d4} = \mu_{d5}$

H_a : at least 2 μ are different.

whereby d1=Monday ; d2=Tuesday; d3=Wednesday; d4=Thursday; d5=Friday.

μ = mean daily return for each day of the week.

For Month Effects :-

$H_o : \mu_{m1}=\mu_{m2}=\mu_{m3}=\mu_{m4}=\mu_{m5}=\mu_{m6}=\mu_{m7}=\mu_{m8}=\mu_{m9}=\mu_{m10}=\mu_{m11}=\mu_{m12}$

H_a : at least 2 μ are different.

whereby m1=January; M2=February; M3=March; M4=April; M5=May; m6=June; m7=July; M8=August; M9=September; M10=October; m11=November; and m12=December.

μ = mean monthly return for each month of the year.

The null hypothesis would be tested at 0.05 significance level, and a rejection would imply that at least two of the daily or monthly mean stock returns are different, thus exhibiting daily or monthly seasonality according to the day of the week or month of the year respectively.

3.5.3 Bartlett's Test For Homogeneity Of Variances.

The Bartlett's test is a combination of a sensitive test of normality, more precisely the "long-tailedness" of a distribution, with a less sensitive test of equality of the variances. The test statistic is given by :-

$$\chi^2 = \frac{1}{C}\left[2.3026\left(v\log S^2 - \sum_{i=1}^{k} v_i \log S_i^2\right)\right] \sim \chi^2_{(k-1)}$$

whereby, $C = \dfrac{\sum_{i=1}^{k} \frac{1}{v_i} - \frac{1}{v}}{3(k-1)} + 1$ and $S^2 = \dfrac{\sum_{i=1}^{k} v_i S_i^2}{v}$

v = n-k = total number of degrees of freedom

n = overall sample size

k = number of groups (each group must include at least 5 observations)

S^2 = estimate of the common variance = $(\sum (n_i - 1) S_i^2)/(n-k)$

v_i = number of degrees of freedom in the ith sample = $n_i - 1$

S_i^2 = estimate of the variance of the ith sample.

If the test statistic χ^2 exceeds $\chi^2_{k-1;\alpha}$, then the null hypothesis $\sigma_1^2 = .. = \sigma_5^2 = \sigma^2$ is rejected and alternative hypothesis that at least two σ^2 are not equal at the 100α % significance level.

3.5.4 Tukey's Test

Tukey's test is adopted to test the difference between any pair of means as part of the unplanned comparison of means technique. It conducts comparison of all the possible pairs of means to determine if there is significant difference. A pair of means is deemed to be significantly different at $\alpha = 0.05$ if their difference is equal or greater than the critical difference MSD_{ij}, i.e., if $|Y_j - Y_i| \geq MSD_{ij}$, where MSD_{ij} is given by:-

$$MSD_{ij} = Q_{\alpha(k,v)} \sqrt{\frac{MS_{within}\left(\frac{1}{n_i} + \frac{1}{n_j}\right)}{2}}$$

whereby $Q_{\alpha(k,v)}$ = critical value of studentized range.

n_i = sample size of group i.

n_j = sample size of group j.

α = 0.05 significance level.

k = no. of groups (for day effect, k=5 ; for month effect, k=12)

v = degree of freedom, $\Sigma (n_i - 1)$

3.6 Non Parametric Test Hypothesis : The Several Independent Samples H-Test Of Kruskal And Wallis.

The H-test of Kruskal and Wallis (1952) used to test the null hypothesis that the k independent samples originate from the same population against the alternative hypothesis that the k samples do not originate from a common population, is adopted for this research. Under this test, the n = $\sum$ ni observations of measured data, of sample sizes n1, n2, ...nk from a large population, identical in form, with continuous or discrete distributions are ranked 1 to n where Ri is the sum of the ranks in the ith sample. The test statistic has, for a large n, a χ^2-distribution with k-1 degrees of freedom given by :-

$$H = \left[\frac{12}{N(N+1)} \right] x \left[\sum_{d=1}^{k} \frac{R_i^2}{n_i} \right] - 3(N+1)$$

whereby k = number of days in the week or number of months in the year,

N = $\sum$ ni , the number of cases in all days or all months combined,

n_i = no. of observations in the day ith of the week or month.

R_i = sum of ranks in the day ith of the week or month of the year.

The null hypothesis Ho is rejected whenever H test statistic > $\chi^2_{k-1\,;\,\alpha}$.

For day-of-the-week effects, we reject Ho if the test statistic H > $\chi^2 (4 , \alpha)$.

In month-of-the-year effects, we reject Ho if the test statistic $H > \chi^2(11, \alpha)$.

It is not uncommon for ties to occur whereby two or more scores in a sample have the same score. This is corrected in the test statistic as follows:-

$$H = \frac{\left[\frac{12}{N(N+1)}\right] \times \left[\sum_{d=1}^{k} \frac{R_i^2}{n_i}\right] - 3(N+1)}{1 - \frac{\sum T}{N^3 - N}}$$

where $T = t^3 - t$ (when t is the number of tied observations in a tied group scores,

$\sum T$ = summation of all groups of ties.