

## Tests of Random Walk Hypothesis under Drift and Structural Break-A Nonparametric Approach

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**Abstract:** This paper evaluated the most restrictive IID random walk (RW) under the conditions of drift and structural break. We implemented the runs and sequences-reversals tests to examine the presence of IID increments for nine Malaysian stock exchanges. With the inclusion of drift and structural break, the empirical results evidenced IID RW processes in all the indices. These results are in sharp contrast with the tests of IID RW without drift where the miss-accounted drift may interpret as the predicted components in the returns series. Finally, the tests of IID RW with structural break provided a better view in the long spanning returns series especially in the directions of drifts before and after the financial crisis or currency control.

**Key words:** Random walk hypothesis . nonparametric test . structural break

### INTRODUCTION

The early study by French economist Louis Bachelier [1] suggested that the presence of random walk theory in the French commodity markets where the random nature of the stock prices is unforecastable. Paul Samuelson [2] has conducted similar study of the Random Walk Hypothesis (RWH) to financial markets and concluded that price changes must be unpredictable if they are properly anticipated by all the market participants. The randomness of price changes are the results of instantaneous responses from an enormous investors who seeking for greater wealth. Investors incorporated their available (even a tiny piece of information) information into the market price and caused rapid prices adjustment. As a result, these actions have eliminated the possible of profit opportunities in the financial markets.

Fama [3] summarized this concept into three categories according to the information efficiency degree namely the weak-form efficiency (history of prices/returns), semi-strong efficiency (publicly available information) and strong efficiency (private information) respectively. He stated that financial market is a martingale where information is not helpful to provide any abnormal returns. Martingale is commonly referred to 'fair game' where a game is not in favour in any of the players. This early model of financial asset prices has long considered to be a necessary condition for an

efficient asset market. One of the literatures by Roberts [4] defined that the martingale hypothesis as weak form market efficiency. However, the early study of this model does not account for risk in the expected return. The improved martingale model with risk adjustment [5, 6] has become more successful in capturing the behavior of asset pricing. Risk and expected return trade-off is a nature phenomenon in financial market where if an asset's expected return is positive, the investor is deals with greater risk of holding it. Moreover, the nature of the martingale increment may show non-linear dependency in their higher conditional moments such as conditional variances. Due to the relaxations of risk and higher statistical properties [5, 7] claimed that martingale property is neither a necessary nor a sufficient condition for rationally determined asset prices.

The extension of martingale is replaced by the random walk hypothesis [3, 8] in the empirical analysis of financial markets. [9] distinguished the random walk model into three sub-hypotheses. The random walk 1(RW1) is the most restrictive model which requires independent and identically distributed (IID) of the price changes:

$$P_t = \omega + P_{t-1} + \varepsilon_t, \quad \varepsilon_t \sim \text{IID}(0, \sigma^2) \quad (1)$$

$$P_t - P_{t-1} = \omega + \varepsilon_t, \quad R_t = \omega + \varepsilon_t \quad (2)$$

Where  $\omega$  is the drift. This is the most restrictive RW because the independent increment is not correlated even in any nonlinear functions of the increments. If we asserted the natural logarithm to the price, we are dealing with continuously compounded returns. The recursive substitution of RW1 produced the conditional mean and variance conditional on arbitrary initial value  $P_0$ :

$$E[P_t | P_0] = P_0 + \omega t, \quad (3)$$

$$V[P_t | P_0] = \sigma^2 t, \quad (4)$$

Under the IID assumption, the RW1 is a nonstationary time-linear (in term of conditional mean and variance) process.

According to the above framework, we focused on the IID assumptions of RW hypothesis under the drift and structural break. Although the implications from IID RW may not fully portrayed the actual behaviour of the financial stock exchange, nevertheless the result allowed us to gain the insight understanding in the perspective of market efficiency as well as econometrics modelling. The tests for independent but not identical distributed increments (RW2) and dependent but uncorrelated increments (RW3) are not further discussed due to the huge possible tests such as filter rules, technical analysis, variance ratios test, LM-ARCH test, etc. The nonparametric approaches namely the runs and sequences-reversal tests have the advantages of no specific distributional assumptions on the returns series. Such procedures are very suitable for financial time series analyses because most of world-wide asset prices displayed non-normal heavy-tail distribution [10] with excess kurtosis. In addition, in parametric tests, a small departure from the hypothesized assumption may influence the power and inference of the tests in finite samples.

We included the drift parameter in the RW test to avoid the misinterpretation of spurious predictable components [9] which may cause by the drift (positive or negative). Another salient issue in financial asset pricing is the structural break that caused by drastic changes of foreign exchange scheme (from fixed to float or vice-versa), fiscal policy (increase in government expenditure), monetary policy (injection of extra money supply), terrorism, nature disasters, etc. Especially in long-run asset pricing, the longer the data period applied to data generating process estimations, the more likely the structural changes will occur. This study used the Andrews approach [11] to identify the unknown location of the structural break. We run the

subperiod analyses before and after the drastic events for all the selected indices.

## DATA SOURCE

As an emerging stock market, Kuala Lumpur stock exchange (KLSE) has received great attentions [12,13] from researchers and investors as the case studies and potential investment alternatives. Great interests also focused on the structural change [14, 15] in KLSE especially during the Asia financial crisis, changes of currency policy, stock market liberalization, etc. All the data are taken from *Datastream* from 1<sup>st</sup> Aug 1998 until 30 Jun 2006 with a total of 2447 observations for each series. During these periods, the Malaysian stock exchange encountered some important events such as Asian Financial Crisis, implementation of currency control (1 USD pegged to 3.80 RM), liberalization of local financial markets, among others. A wide range of sectoral indices are included because it is important for us to investigate the possible similarities and divergences in their returns series. The data sets of Kuala Lumpur Stock Exchange (KLSE) consisted of composite index (CI) and the eight major sectoral indices namely the industrial (IND), industrial product (INP), consumer products (COP), construction (CON), mining (MIN), finance (FIN), properties (PRO) and plantation (PLA). The continuous compounded interday returns can be expressed as:  $r_t = \ln P_{t,close} - \ln P_{t-1,close}$ .

## METHODS

### Quandt and Andrew unknown structural break test:

There are voluminous alternatives of unknown break location tests [16,17]. Due to the similar ordinary least squares (OLS) approaches are used in identifying the structural break, we have selected Andrews[11] methodology in our empirical study. Andrews extended Quandt test by deriving the asymptotic distribution of the LR-like test for one shift based on first order autoregressive model:

$$p_t = \rho_I p_{t-1} + \varepsilon_{It}, \quad t = 1, \dots, m. \quad (5)$$

$$p_t = \rho_{II} p_{t-1} + \varepsilon_{It}, \quad t = m+1, \dots, T. \quad (6)$$

Where  $\varepsilon_t \sim N(0, \sigma_t^2)$ . We allow the OLS estimations under the possibility of heteroscedasticity. The estimated parameters remain unchanged but not the estimated standard errors. According to White [18], the covariance matrix in a general case is given by:

$$\text{var}(\hat{p}) = (p'p)^{-1} \left( \sum_{t=1}^{\tau} \hat{\varepsilon}_t^2 p_t p_t' \right) (p'p)^{-1} \quad (7)$$

Where the square roots of the diagonal components are White standard errors. Andrews performs a single Chow test at every observations between  $t = 1, \dots, i$  and the maximum Chow's F-statistic is selected as the most possible location of structural change as follows:

$$\text{Sup LR-F} = \max_{1 \leq i \leq \tau} \frac{(\hat{\varepsilon}'\hat{\varepsilon} - (\hat{\varepsilon}'_I\hat{\varepsilon}_I + \hat{\varepsilon}'_II\hat{\varepsilon}_II))/k}{(\hat{\varepsilon}'_I\hat{\varepsilon}_I + \hat{\varepsilon}'_II\hat{\varepsilon}_II)/(T - 2k)}, \quad (8)$$

$$\text{Exp LR-F} = \log \left( \frac{1}{k} \sum_{t=1}^i \exp \left( \frac{(\hat{\varepsilon}'\hat{\varepsilon} - (\hat{\varepsilon}'_I\hat{\varepsilon}_I + \hat{\varepsilon}'_II\hat{\varepsilon}_II))/k}{(\hat{\varepsilon}'_I\hat{\varepsilon}_I + \hat{\varepsilon}'_II\hat{\varepsilon}_II)/(i - 2k)} \right) \right), \quad (9)$$

To avoid the distribution degeneration of these statistics, it is customary trims out the 7.5% for the first and last of the overall observations. Andrews suggested 15% of trimming to obtain a reliable statistical inference. However, the trimming may vary due to the sample size accordingly. Therefore, to be more precise, the null hypothesis indicates no breakpoints within the trimmed observations. We calculated both the Sup LR-F and exponential LR-F for the comparison purpose. The details of the numerical approximations of these asymptotic distributions p-values can be found in Hansen [19] where p-values are more preferable than the predefined significance tests.

**The runs test:** The null hypothesis of randomness relied on the number of runs as a sequence of the price changes with the same sign. The return in each period is categorized according to its position with the reference of the mean returns. In short, the positive sign indicated the return is greater than the mean return, whereas the negative sign indicates the return smaller than its mean and finally no changes when return is equivalent to the mean. In this test, we assign + to each returns equal or above the mean and - for the returns below the mean. Let  $n_+$  and  $n_-$  be the sample sizes of items of + and - in the returns series. The number of runs is indicated by  $R$ . Under normality approximation of the single-sample runs test for large sample sizes ( $n_+$  and  $n_-$  larger than 20), the test statistics can be written as follows:

$$Z = \frac{R - \mu_R}{\sigma_R} = \frac{R - \left[ \frac{2n_+n_-}{n_+ + n_-} + 1 \right]}{\sqrt{\frac{2n_+n_-(2n_+n_- - n_+ - n_-)}{(n_+ + n_-)^2(n_+ + n_- - 1)}}} \quad (10)$$

Under the null hypothesis, the driftless IID RW maximized the expected number of runs for the given return series. Alternately, the presence of drift will decrease the expected number of runs. We included the drift in the next nonparametric test. The comprehensive analysis can be found in [20].

**Sequences-reversals (S-R) test:** This approach has been used by Cowles and Jones [21] in IID RW test in stock returns. The sequences referred to pairs of consecutive returns with same signs whereas the reversals indicated the opposite signs. We examined the IID RW without and with drift as follows:

$$p_t = p_{t-1} + \varepsilon_t, \quad r_t = \varepsilon_t, \quad (11)$$

$$p_t = \omega + p_{t-1} + \varepsilon_t, \quad r_t = \omega + \varepsilon_t, \quad (12)$$

Where,  $\varepsilon_t \sim \text{IID}(0, \sigma^2)$ ,  $p_t$  is the logarithm of  $P_t$ . The dummy variable,  $D_t$ , is defined as Bernoulli coin-toss:

$$D_t = \begin{cases} 1, & r_t > 0 \\ 0, & \text{otherwise} \end{cases}, \quad (13)$$

Considered a realization of  $i+1$  returns  $r_1, r_2, \dots, r_{i+1}$ , the values of sequences  $V_s$  and reversals  $V_r$  can be expressed as follows:

$$V_s = \sum_{t=1}^i A_t \quad \text{and} \quad V_r = i - V_s \quad (14)$$

Where  $A_t = D_t D_{t+1} + (1 - D_t)(1 - D_{t+1})$ . For IID process without drift, we expected the numbers of negative and positive  $r_t$  are equivalent (almost). Thus the Cowles-Jones ratio ( $\hat{C}$ ) should be quantified as one which is similar to the outcome of a fair coin-toss. From the statistical viewpoint,

$$\hat{C} = \frac{V_s}{V_r} = \frac{\hat{\pi}_s}{\hat{\pi}_r}, \quad (15)$$

Where, probability  $\hat{\pi}_s = V_s/i$  and  $\hat{\pi}_r = V_r/i = 1 - \hat{\pi}_s$ . The estimated  $\hat{C}$  is convergence in probability to one. On the other hand, the IID assumption with drift (either positive or negative) has the tendency to create more sequences than reversals. One needs to redefine the dummy variable that followed the direction of drift:

$$D_t^d = \begin{cases} 1, & \pi \\ 0, & 1-\pi \end{cases} \quad (16)$$

Where,

$$\pi = \begin{cases} > 1/2 & \omega > 0 \\ < 1/2 & \omega < 0 \end{cases}$$

with the probability  $P(r_t > 0)$  which is equivalent to a standardized normal cumulative distribution  $\Phi(\omega/\sigma)$ . The nonzero drift of  $\hat{C}_d$  is defines as:

$$\hat{C}_d = \frac{\hat{\pi}_s}{1 - \hat{\pi}_s}, \quad (17)$$

Where  $\hat{\pi}_s = \hat{\pi}^2 + (1 - \hat{\pi})^2$ . The statistical comparison between the  $\hat{C}$  and  $\hat{C}_d$  can be obtained from the normal asymptotic approximation for the distribution of  $V_s$ :

$$\hat{C} \sim N \left( \frac{\pi_s}{1 - \pi_s}, \left( \frac{\pi_s(1 - \pi_s) + 2(\pi^3 + (1 - \pi)^3 - \pi_s^2)}{i(1 - \pi_s)^4} \right)^2 \right) \quad (18)$$

The variance of the  $V_s$  does not follow a binomial distribution  $i\pi_s(1 - \pi_s)$  because the dependent exist at the pairs of  $A_t$ .

## EMPIRICAL RESULTS

**Descriptive statistics and structural break identifications:** Table 1 reported the descriptive statistics for all the nine selected indices. The non-zero skewness and significant excess kurtosis indicated non-normality distributed returns series. Moreover, the Jacque-Bera normality tests are against the presence of normal distribution in all the indices. Thus,

the nonparametric approach has the advantage in the RW IID tests.

For graphical illustrations, we compared the kernel density estimates (adjusted histogram) of the probability distribution and QQ plot for KLCI return with a simulated normal distribution. Fig. 1 evidenced the high peak, heavy tail and slightly asymmetric behaviour compared to a standardized normal distribution. Similar results are observed for all others indices.

Figure 2 illustrated the plots of natural log price index for all the studied indices and indicated that a similar structural change happened in all the indices within the year of 1997 to 1998. Other than that, the movements of the prices indices seem to be stable in general. In order to determine the exact location of the break date due to the Asian financial crisis and current control, we run the Andrews (1993) test. In Table 2, the earliest break is experienced by the Property index (12/25/1997) during the crisis, followed by Finance (8/18/1998) and simultaneously by other indices at 9/1/1998, after the Malaysian government imposed the currency policy.

**The random walk hypothesis tests:** As indicated in Table 3, all the runs test statistics (overall, before and after break) are statistically significant at 5% level and against the presence of driftless IID RW. However, the rejection may cause by the unaccounted drift in the returns series.

Under the null hypothesis of randomness of S-R test, the probability  $\pi$  is  $1/2$  with the  $C$  equivalent to unity. Table 4 shown that the driftless Cowles-Jones statistics,  $\hat{C}_s$ , are all against the RW hypothesis at 5% significance level. These results are similar to the previous runs test. On the hand, the tests of RW with drift evidenced mostly negative drifts except for indices COP and PLA. After take into account the drift, the Cowles-Jones statistics indicated sharp contrast results where none of the indices reject the RW hypothesis.

Table 1: Descriptive statistics

	KLCI	INP	IND	COP	CON	MIN	PRO	PLA	FIN
Mean	-0.0001	-0.0003	0.0000	0.0000	-0.0004	-0.0002	-0.0006	0.0001	-0.0001
Med	0.0000	-0.0004	0.0000	0.0000	-0.0009	0.0000	-0.0011	0.0000	-0.0001
Max	0.2082	0.1897	0.1725	0.1613	0.2392	0.3074	0.2090	0.1523	0.2263
Mini	-0.2415	-0.2479	-0.2270	-0.1648	-0.2278	-0.4204	-0.1892	-0.1666	-0.2057
Std. Dev.	0.0171	0.0161	0.0153	0.0130	0.0225	0.0316	0.0189	0.0137	0.0191
Skewness	0.5936	-0.6542	-0.1172	0.3461	0.9416	0.0984	0.8543	-0.0923	1.3524
Kurtosis	45.2875	46.2530	46.9961	45.7948	27.4315	25.4215	24.4068	27.3373	30.5573
JB test	182394*	190843*	197281*	186698*	61195*	51240*	47001*	60369*	78142*

\*Denotes 5% level of significance

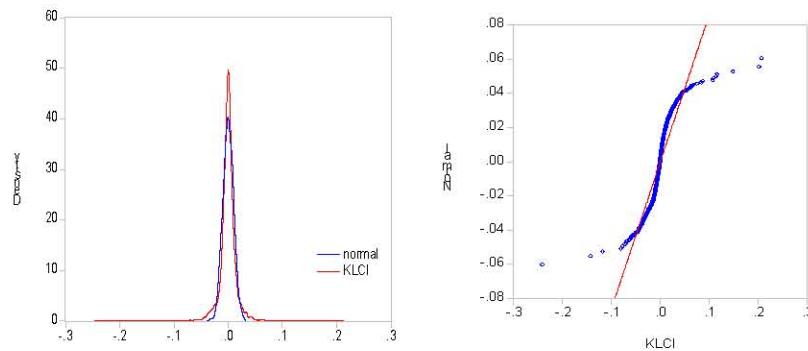


Fig. 1: Kernel density distribution and Q-Q plot for KLCI

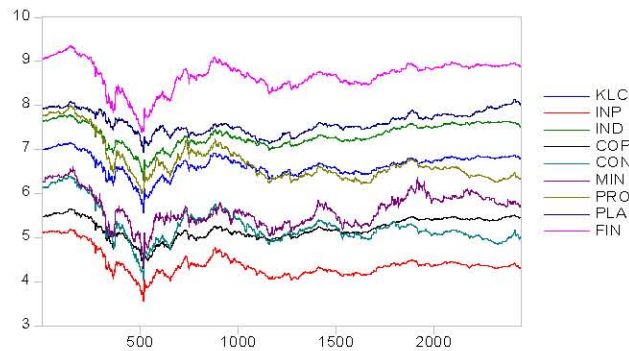


Fig. 2: Logarithm prices indices

Table 2: Andrews unknown break point identification

Index	Date		LR F-stat	p-value
KLCI	9/1/1998	Max F	23.9950	0.000 <sup>c</sup>
		Exp F	4.6130	0.012 <sup>b</sup>
INP	9/1/1998	Max F	20.0535	0.002 <sup>c</sup>
		Exp F	2.7857	0.082 <sup>a</sup>
IND	9/1/1998	Max F	22.4163	0.001 <sup>c</sup>
		Exp F	3.7892	0.028 <sup>b</sup>
COP	9/1/1998	Max F	23.8056	0.000 <sup>c</sup>
		Exp F	4.4128	0.015 <sup>b</sup>
CON	9/1/1998	Max F	20.4601	0.002 <sup>c</sup>
		Exp F	3.2743	0.048 <sup>b</sup>
MIN	9/1/1998	Max F	10.4428	0.079 <sup>a</sup>
		Exp F	2.7553	0.091 <sup>a</sup>
PRO	12/24/1997	Max F	16.0544	0.011 <sup>b</sup>
		Exp F	2.7877	0.084 <sup>a</sup>
PLA	9/1/1998	Max F	14.3136	0.024 <sup>b</sup>
		Exp F	2.4353	0.088 <sup>a</sup>
FIN	8/17/1998	Max F	21.8397	0.001 <sup>c</sup>
		Exp F	5.2126	0.007 <sup>c</sup>

Note: Asymptotic distributions p-values are based on Hansen (1995); a, b and c denote 10%, 5% and 1% level of significance

This implied that the driftless RW tests have misinterpreted the drift as possible predictable components in all the returns series. Next, we tested whether the Cowles-Jones statistics under the drift and

without drift are statistically distinguishable. Using the normal asymptotic approximation for  $N_s$ , we obtained the estimated standard error for KLCI as 0.2470. From Table 4, the  $\hat{C}$  is statistically different from  $\hat{C}_d$  with the test statistic -39.7524. Similar conclusions are also evidenced from the other eight indices.

Finally, we examined the RW hypothesis under the structural break condition. In Table 5, the drift directions shown opposite sign before and after the break which caused by the financial crisis or currency control. Before the crisis, most of the indices indicated negative drifts. However, exceptional is observed in FIN index. During this period, the Asian crisis and currency turmoil hit Malaysian stock markets severely. The drastic increased of volatility are due to the sudden shifts in market expectations and loss of confidence to the financial chaos in East-Asian region. Panic-stricken investors and traders radically pulled out the short-term capital and created further currency crisis and hikes of interest rate. These are evidenced from the dropped of KLCI from 1271 (25<sup>th</sup> Feb 1997) to 266 (1<sup>st</sup> Sep 1998), GDP contracted by 7.5% (1998), ringgit (RM) depreciated 35% to USD (Jul-Dec 1997) and etc. As a result, the uncertainties of volatile exchange rate and poor performance of stock market are the major contributors to the negative drift in Malaysian stock markets.

Table 3: The runs test

Sector		$n$	$n_+$	$n_-$	$R$	$Z(R)$
KLCI	All	2447	1227	1220	1115	-4.4277*
	Before	507	221	286	210	-3.3057*
	After	1930	1000	930	899	-2.9766*
INP	All	2447	1210	1237	1093	-5.3123*
	Before	507	221	286	202	-4.0505*
	After	1930	984	946	885	-3.6529*
IND	All	2447	1228	1219	1163	-2.4863*
	Before	507	222	285	208	-3.5114*
	After	1930	1001	929	947	-3.7830*
COP	All	2447	1224	1223	1117	-4.3472*
	Before	507	218	289	220	-2.3088*
	After	1930	999	931	891	-3.3447*
CON	All	2447	1191	1256	1097	-5.1247*
	Before	507	233	274	196	-4.7898*
	After	1930	953	977	895	-3.2065*
MIN	All	2447	1253	1194	1143	-3.2689*
	Before	507	223	284	230	-2.4863*
	After	1930	1025	905	909	-2.4142*
PRO	All	2447	1155	1292	1056	-6.6798*
	Before	507	214	293	210	-3.1494*
	After	1930	935	995	839	-5.7279*
PLA	All	2447	1209	1238	1096	-5.1902*
	Before	507	215	292	202	-3.9236*
	After	1930	991	939	889	-3.4569*
FIN	All	2447	1219	1228	1079	-5.8833*
	Before	507	224	283	184	-5.7761*
	After	1930	990	940	887	-3.5503*

Table 4: S-R with drift and driftless tests

Index	Without drift				With drift				Comparison $\hat{C}$ and $\hat{C}_d$
	$N_s$	$\hat{\pi}_s$	$\hat{C}$	$Z(\hat{C})$	$\hat{\pi} = \Phi(x)$	$\hat{\pi}_s$	$\hat{C}_d$	$Z(\hat{C}_d)$	
KLCI	1334	0.5451	1.1985	4.9111*	0.4983	0.5000	1.0000	0.0005	-39.7524*
INP	1344	0.5492	1.2185	5.4041*	0.4923	0.5001	1.0005	0.0117	-43.7316*
IND	1284	0.5247	1.1040	2.5733*	0.4991	0.5000	1.0000	0.0002	-20.6693*
vCOP	1330	0.5435	1.1907	4.7164*	0.5002	0.5000	1.0000	0.0000	-38.1508*
CON	1358	0.5549	1.2470	6.1095*	0.4922	0.5001	1.0005	0.0121	-49.6010*
MIN	1334	0.5451	1.1985	4.9111*	0.4976	0.5000	1.0000	0.0011	-39.6797*
PRO	1403	0.5733	1.3438	8.5051*	0.4879	0.5003	1.0011	0.0289	-69.7856*
PLA	1361	0.5562	1.2532	6.6263*	0.5016	0.5000	1.0000	0.0005	-50.9995*
FIN	1368	0.5590	1.2678	6.6246*	0.4989	0.5000	1.0000	0.0002	-54.0509*

\*Denotes 5% level of significance

In 1<sup>st</sup> September 1998, Malaysia has implemented the selective capital control where RM is pegged at 3.80 to the USD. This action has stabilized the RM where non-residents from Malaysia and abroad are restricted to trade the RM. In addition, Securities Commission and the KLSE implemented recovery strategic such as strengthening market intermediaries, improving market

transparency and improving liquidity in corporate sectors. After the implementation of currency control, most of the indices rebounded significantly immediately after the announcement, for example, the KLCI radically increased by 12%, Construction 13%, Finance, Plantation, Industrial product, 9% and the lowest is 3% by Property. All the constructive actions

Table 5: S-R test under structural break

Sector	Break	$\hat{\pi} = \Phi(x)$	$\hat{\pi}_s$	$\hat{C}_d$	$Z(\hat{C}_d)$
KLCI	Before	0.4557	0.5039	1.0157	0.1791
	After	0.5179	0.5006	1.0025	0.0294
INP	Before	0.4442	0.5062	1.0252	0.2867
	After	0.5115	0.5002	1.0009	0.0113
IND	Before	0.4516	0.5046	1.0188	0.2142
	After	0.5191	0.5007	1.0029	0.0334
COP	Before	0.4520	0.5046	1.0185	0.2113
	After	0.5222	0.5009	1.0039	0.0450
CON	Before	0.4486	0.5052	1.0213	0.2427
	After	0.5105	0.5002	1.0008	0.0101
MIN	Before	0.4603	0.5031	1.0126	0.1437
	After	0.5097	0.5001	1.0007	0.0086
PRO	Before	0.4283	0.5102	1.0419	0.3971
	After	0.4981	0.5000	1.0000	0.0005
PLA	Before	0.4587	0.5034	1.0137	0.1560
	After	0.5196	0.5007	1.0030	0.0350
FIN	Before	0.5417	0.5034	1.0140	0.1583
	After	0.5191	0.5007	1.0029	0.0646

taken by the government after the crisis have triggered the positive drift which can be observed in all the indices in Table 5.

For IID RW tests, all the  $\hat{C}_d$ s are closed to unity for all the selected indices. In Table 5, all the test statistics are not statistically significant at 5% level which concluded that the increments are random processes in all the studied indices. It is worth noted that although the increment is IID, nevertheless the squared increments are not necessary independent to their lags. This correlated squared increments is known as the conditional heteroscedasticity introduced by Engle [22,23]. We run the Ljung-Box serial correlation (Q-statistic) and Lagrange Multiple ARCH tests for squared residuals to all the indices and found rejection of null hypothesis with no correlation. For instance, the KLCI shown Q(12) and LM ARCH F-statistic with the values of 1112.1(p-value=0.000) and 4.9878 (p-value=0.000) respectively. One may relate this property as the risk premia [24] to the returns series because the RW hypothesis can only be treated as equivalent to efficiency market hypothesis under the risk neutrality condition.

### CONCLUSION

This paper investigated the random walk hypothesis for the Malaysian stock exchanges under the conditions of drift and structural break. Our results demonstrated that Asian Crisis and currency control

shown instantaneous impacts to the Malaysian stock market. For all sectoral indices we found significant structural change during the Asian crisis (Property and Finance), after the currency control (KLCI, Industrial Product, Consumer Product, Construction, Mining and Plantation). Our empirical results evidenced the misinterpretation of RW hypothesis under the driftless framework. Under the structural break, we observed the tendency of drift's direction changes from negative to positive before and after the financial crisis and currency control. The identification of breaks allowed us to have a better view to the KLCI and eight sectoral indices in Malaysia stock exchange.

Finally, it is worth noted that although the empirical results provided little evidence against the random walk hypothesis, nevertheless we are not able to conclude that the Malaysian stock markets are informationally efficient since RW hypothesis can only be treated as equivalent to efficiency market hypothesis under the risk neutrality condition. In future work, we intended to relate the conditional heteroskedasticity volatility and risk premium to the returns series to further support the efficiency market hypothesis.

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