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## TESTING THE WEAK FORM EFFICIENCY IN WORLD STOCK MARKET: A CASE STUDY IN AUSTRALIA

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### ABSTRACT

*In this paper weak form efficiency are tested on Australian stock market. For this purpose Run test and Autocorrelation test are used. Run test clearly supported the independent behavior after 2008-09 and the notion of weak form market efficiency. Run test has inherent weakness as only sign are conceded not how much amount of increase or decrease. The coefficients are obtained for 1-16 time lags to examine results for varying periodicity. Serial correlation coefficient statistics clearly indicates weak form efficiency does not exist. This study also shows that significant auto correlated exist up to 6 or 11 day lag after 2008-09.*

### KEYWORDS

Run test, Serial correlation coefficient and Weak form efficiency.

### I INTRODUCTION

In an efficient market, a set of information is fully and immediately reflected in market prices so that no investor is able to make excess profits based on any existing information. An efficient market is one where market price is an unbiased estimate of the true value of investment. All that is required is that errors in the market price be unbiased, i.e., prices can be greater than or less than true value, as long as these deviations are random. The fact that the deviation from true value are random implies that there is an equal chance that stocks are under or over valued at any point of time, and that these deviations are uncorrelated with any observable variable. If the deviations of market prices from true values are random, it follows that no group of investors should be able to consistently earn excess return using any investment strategy. Inefficient market on the other hand offers opportunities for abnormal return to the investors. In such markets, stock which had outperformed the market in the past should continue to outperform the market in the future. Similarly, stock that has done poorly should continue to perform poorly. Eugene Fama (1965) noted that markets could be efficient at three levels based on what information was reflected in prices. A market would be described as being weak-form efficient if it is impossible to make abnormal profits by using past prices to formulate buying and selling decision. Similarly, a market would be described as being semi strong-form efficient if it is impossible to make abnormal profits by using publicly available information to formulate buying and selling decisions. Last, a market would be described as being strong-form efficient if it is impossible to make abnormal profits by using any information whatsoever to make buying and selling decisions. A large majority of studies favor prevalence of weak form stock market efficiency. They observe that prices in the Indian stock market do not follow random walk model. They support the market efficiency proposition in its weak form both in India and abroad. Bodla (2005) has tested the weak form of efficiency with two tests, namely the runs test and serial correlation test using daily data for three year period commencing January 2001 through December 2003. The sample size consisted of 47 scrip's of S&P CNX of nifty. In order to test the null hypothesis that share prices follow the random walk behavior, the random walk model has been applied in the study. This is a suitable data transformation procedure, which is used to make the original series stationary. The results of the runs test have given a clear-cut inkling of the existence of weak form market efficiency in the Indian securities market. Similarly, the serial correlation analysis based on its coefficients confirms the weak form hypothesis of efficient market. This finding, thus, reduces the probability of continuously making extra profit by forecasting the security prices. Mahapatra and Biswasroy (2007) are an attempt in this direction. The study is based on weekend share price data of BSE 30 scrip's covering a time period of two years i.e. from 1<sup>st</sup> April 2000 to 31<sup>st</sup> March 2002. Rank correlation analysis has been extensively used in the study to examine the rank of performance of the above 30 stocks at different time intervals. They reveal that the Indian stock market is more efficient in the weak form in the longer run but inefficient in the short run. Ramesh, Kiran and Renuka (2008) have made an attempt to study documents extensive on price behavior in the Indian stock markets. One of the striking features of the results is that runs analysis too exuberates weak form efficiency further and the instances of return drift noted earlier have disappeared. On the whole, the results signify that trading strategies based on historic prices cannot be relied for abnormal gains consistently, except when these coincide with underlying drifts in the stock price movements. Satish and Sonal (2009) have analyzed the weak form of efficiency and the efficient market hypothesis on Indian stock market in the form of random walk, during the period of 2007-08 based on closing prices and daily returns on the Indian stock market three representative indices: S&P CNX 500, CNX 100 and BSE 200. Serial correlation and run test support the Random Walk theory and market efficiency hypothesis. Some studies deny its existence to keep the academic debate alive on the subject. O.P and Vandana (1997) have studied the weak-form efficiency in Indian stock market during a period July 1988 to Jan 1996. The results of autocorrelation analysis as well as run analysis carried out in respect of each of the fifty shares included in the sample were not supportive of the random walk hypotheses. Some of the observed efficient were larger than those obtained in other studies. Thus the results reported here do not lend support to the view that the Indian stock market is weak form efficiency in pricing share where market efficiency is understood as generating security prices which fully reflect information contained in their historical records. This study has aimed at re-examining the weak form efficiency proposition. In the previous studies Run and auto correlation test have been used but more emphasis is laid on Run test. But in present study more preference is given to Autocorrelation test because this test considered sign as well as absolute change.

### II HYPOTHESES

In order to examine market efficiency in weak form, historical sequences of stock prices are studied for independence and randomness to test the following null hypothesis:

**H<sub>0</sub>: Successive stock price movement are independent of past stock prices.**

**H<sub>A</sub>: Stock price movement are identical to that of random numbers.**

### III DATA

In order to examine the validity of null hypothesis, daily price data for All ordinary index is compiled from April 2004-05 to March 2011-12. Data used in this study are obtained from yahoo finance website.

### IV METHODOLOGY

To test independence and randomness of stock prices, Run test has been used. The number of runs is computed as a sequence of the price changes of the same sign. For testing the significance of the difference between observed and expected number of runs, standardized normal variate Z has been used. Since the alternative hypothesis says nothing about the direction of the deviation from a random series, a two-tailed test is applied. Accordingly, null hypothesis will be rejected at five per cent level of significance if the observed value of Z is >1.96. Expected numbers of runs of all types are computed by using the method:

$$M = \frac{2(n_1n_2 + n_1n_3 + n_2n_3)}{n_1n_2n_3} + 1$$

where:

$M$  = Expected number of runs;  
 $n_1$  = Number of Positive Signs;  
 $n_2$  = Number of Negative Signs; and  
 $n_3$  = Number of zeros.

Wherein, standard error (S.E.) is given as:

$$\sigma = \left\{ \frac{[2(n_1n_2+n_1n_3+n_2n_3)]}{(n_1+n_2+n_3)^2 - (n_1+n_2+n_3 - 1)} - \frac{2(n_1n_2+n_1n_3+n_2n_3 + 6n_1n_2n_3)}{(n_1+n_2+n_3)(n_1+n_2+n_3 - 1)} \right\}^{\frac{1}{2}}$$

The difference between the actual and expected number of runs is expressed by a standard normal Z variate as:

$$Z = [(R - M)/S.E.]$$

Adjusted Z variate is as follows:

$$Z = [(R + 0.5 - M)/S.E.]$$

where:

$R$  = Actual number of runs;  
 $M$  = Expected number of runs; and  
 $SE$  = Standard Error.

In run test, there is one limitation that is only sign is considered but not the absolute change. In order to overcome this limitation autocorrelation test is used in which raw values and direction are considered. Hence the inferences are also drawn through autocorrelation. Serial correlation is a measure of relationship between a random variable in time ( $P_t$ ) and its value ( $P_{t-n}$ ) periods earlier. It indicates whether price changes at time ( $t$ ) are influenced by the price changes occurring ( $t-n$ ) periods earlier. In order to hold weak form stock market efficiency, observed serial correlation should be statistically insignificant. Serial correlation coefficients are computed for a 1-16 periods lag(s). If the autocorrelations are close to zero or insignificant at a given significant level, the price changes are said to be serially independent. A significant positive correlation indicates the presence of a trend while the negative correlated depicts the existence of random reversals in the stock prices. The serial correlation coefficient is estimated by:

$$r_k = \frac{C_k}{C_0}$$

where:

$$C_k = \frac{1}{n} \sum_{t=1}^{n-k} (P_t - \bar{P})(P_{t+k} - \bar{P});$$

$$K = 0, 1, 2, \dots, n;$$

$$\bar{P} = \frac{1}{n} \sum_{t=1}^m P_t \text{ is mean of the whole series;}$$

$C_0$  is variance of  $P_t$ ; and  
 $n$  is number of observations.

Statistical testing of the serial correlation coefficient requires the standard error of estimated coefficient, which is explained below:

$$Z = r_k \sqrt{n - k}$$

## V RESULTS

The results of run test are presented in table- I in which runs are obtained from mean, median and mode. It can be seen that statistics of index are insignificant up to 2008-09. It is curious to note that similar tendency prevailed even when the runs are obtained through median and mean. Results are different when runs are obtained from mode. The outcome supports randomness in the stock prices because in Australia index Z values are found to be insignificant up to 2008-09. Thereafter, the year 2009-10, index correlation coefficient is showing significant at one and five per cent level. It reveals that weak form efficiency pattern does not exist in Australia market after 2008-09.

Results of correlation coefficient of price changes are also used to examine the validity of null hypothesis to test the independence of successive stock prices. The coefficients are obtained for 1-16 time lags to examine results for varying periodicity. A significant interdependence in stock returns invalidates weak form market efficiency. Autocorrelation obtained for stock returns are tabulated in tables- II (from 2004-05 to 2011-12) for varied time lags. It can be seen from tables II that all Australia index correlation coefficient found to be significant at five percent and one percent level for up to one day lags. There are correlations coefficients are significant up to 6 or 11 day lag after 2008-09. Thus, the result of autocorrelation test of price changes clearly supports the not applicability of random walk model in order to describe share price behaviors in Australia stock markets. Thus, the overall significance of autocorrelation coefficient points to the efficiency of some markets is not in its weak form. It reveals that weak form efficiency does not exist in Australian stock market. Both tests present the same result after 2008-09. One of the features of the result based on autocorrelation analysis is that this analysis overcomes the limitations of run test.

## VI CONCLUSIONS

Thus, the result of Run test of price changes supports the randomness in the stock prices because Z values are found to be insignificant up to 2008-09. In run test, there is one limitation that is only sign is considered but not the absolute change. In order to overcome this limitation autocorrelation test is used in which raw value and sign are considered. Serial correlation coefficient statistics clearly indicates that weak form efficiency does not exist in all Australian country indices. On comparing the present study with the previous studies, it has been found that there is variation in the results of various studies. Some studies totally states that there is existence of weak form efficiency and some studies totally opposes it. The present study does not show weak form efficiency.

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TABLES

TABLE-I: RUN TEST STATISTICS

YEARS		Median	Mean	Mode
2004-05	Test Value	0.001	0.000524	0.000000
	Number of Runs	108	114	104
	Z	-2.858	-2.011	-2.686
	Sig. (2-tailed)	0.004	.044	.007
2005-06	Test Value	0	0.001020	0.011372
	Number of Runs	119.000	109	3
	Z	0.000	-.969	.092
	Sig. (2-tailed)	1.000	.333	.926
2006-07	Test Value	0	0.000580	0.018526
	Number of Runs	126.000	120	3
	Z	-0.251	-.946	.089
	Sig. (2-tailed)	0.801	.344	.929
2007-08	Test Value	0	-0.000924	0.000000
	Number of Runs	124.000	108	118
	Z	-1.169	-2.783	-1.862
	Sig. (2-tailed)	0.242	.005	.063
2008-09	Test Value	0	-0.002105	0.056420
	Number of Runs	124.000	124	3
	Z	-1.463	-1.410	.086
	Sig. (2-tailed)	0.143	.158	.931
2009-10	Test Value	0	0.000655	0.022625
	Number of Runs	108.000	104	3
	Z	-3.305	-3.709	.087
	Sig. (2-tailed)	0.001	.000	.931
2010-11	Test Value	0	-0.000584	0.024953
	Number of Runs	110.000	102	3
	Z	-2.949	-3.793	.087
	Sig. (2-tailed)	0.003	.000	.931
2011-12	Test Value	0	-0.000978	0.052513
	Number of Runs	94.000	92	3
	Z	-5.018	-5.263	.087
	Sig. (2-tailed)	0.000	.000	.931

TABLE-IV: SERIAL AUTO CORRELATION STATISTIC

YEARS	Lag	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2004-05	Autocorrelation	0.14	0.04	0.02	0.01	-0.07	0.03	-0.07	-0.01	0.1	0.13	0.09	0.01	0.03	0.02	-0.02	0.02
	Value	4.99	5.37	5.5	5.51	6.99	7.22	8.59	8.61	11.69	16.14	18.45	18.46	18.78	18.9	19.02	19.18
	P Value	0.03	0.07	0.14	0.24	0.22	0.3	0.28	0.38	0.23	0.1	0.07	0.1	0.13	0.17	0.21	0.26
2005-06	Autocorrelation	0.11	0.02	-0.01	-0.02	-0.03	-0.01	-0.04	0.01	0.01	0.01	0.04	-0.01	-0.03	-0.06	-0.02	-0.04
	Value	2.91	3.01	3.03	3.17	3.36	3.4	3.84	3.85	3.9	3.91	4.33	4.34	4.56	5.4	5.47	5.86
	P Value	0.09	0.22	0.39	0.53	0.65	0.76	0.8	0.87	0.92	0.95	0.96	0.98	0.98	0.98	0.99	0.99
2006-07	Autocorrelation	0.19	-	0.077	-	-	-	0.022	0.01	0.006	-	-	0.054	0.019	-	-	-
	Value	9.70	10.13	11.66	12.77	14.50	15.37	15.50	15.53	15.54	16.38	16.53	17.30	17.40	18.66	19.36	20.11
	P Value	0.00	0.006	0.009	0.012	0.013	0.018	0.03	0.05	0.077	0.089	0.123	0.138	0.181	0.178	0.198	0.215
2007-08	Autocorrelation	0.15	-0.03	-0.07	0.04	-0.03	-0.06	-0.12	-0.03	-0.01	0.05	0.05	0	0.08	-0.11	0.05	0.04
	Value	6.18	6.35	7.8	8.16	8.36	9.43	13.67	13.98	14.02	14.81	15.38	15.38	17.27	20.67	21.31	21.86
	P Value	0.01	0.04	0.05	0.09	0.14	0.15	0.06	0.08	0.12	0.14	0.17	0.22	0.19	0.11	0.13	0.15
2008-09	Autocorrelation	0.16	-0.03	0.02	0.04	0	-0.12	-0.08	-0.02	0.02	-0.02	-0.03	-0.11	-0.04	-0.03	-0.04	0.01
	Value	7.34	7.55	7.68	8.16	8.16	12.1	14.01	14.12	14.18	14.33	14.58	17.77	18.34	18.62	19.04	19.07
	P Value	0.01	0.02	0.05	0.09	0.15	0.06	0.05	0.08	0.12	0.16	0.2	0.12	0.15	0.18	0.21	0.27
2009-10	Autocorrelation	0.21	0.03	-0.03	0.02	0	-0.02	-0.01	0.01	-0.06	-0.02	0.02	0.01	-0.04	-0.07	-0.02	0.01
	Value	12.3	12.64	12.92	13.04	13.04	13.15	13.16	13.22	14.35	14.49	14.64	14.66	15.01	16.34	16.42	16.44
	P Value	0	0	0.01	0.01	0.02	0.04	0.07	0.11	0.11	0.15	0.2	0.26	0.31	0.29	0.36	0.42
2010-11	Autocorrelation	0.15	0.058	0.053	-	-	-	-	-	-	0.037	-	-	-	0.063	-0.03	0.035
	Value	6.64	7.542	8.318	8.335	12.19	13.98	14.55	16.07	16.10	16.48	16.64	16.94	18.01	19.12	19.37	19.72
	P Value	0.01	0.023	0.04	0.08	0.032	0.03	0.042	0.041	0.065	0.087	0.119	0.152	0.157	0.16	0.197	0.233
2011-12	Autocorrelation	0.19	0.04	-0.1	-0.11	-0.1	-0.03	-0.03	-0.04	-0.04	0.02	-0.01	-0.02	0.01	0.02	0.02	0.05
	Value	9.7	10.16	12.61	15.81	18.59	18.87	19.14	19.58	19.94	20.05	20.1	20.25	20.26	20.32	20.46	21.06
	P Value	0	0.01	0.01	0	0	0	0.01	0.01	0.02	0.03	0.04	0.06	0.09	0.12	0.16	0.18

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