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**AN EMPIRICAL STUDY ON WEAK-FORM OF MARKET EFFICIENCY OF BSE BANKEX STOCKS**

**ASHA NADIG**  
**ASST. PROFESSOR**  
**MANIPAL UNIVERSITY**  
**BANGALORE**

**DR. B. SHIVARAJ**  
**PROFESSOR**  
**BAHADUR INSTITUTE OF MANAGEMENT STUDIES**  
**UNIVERSITY OF MYSORE**  
**MYSORE**

**ABSTRACT**

*Efficient Market Hypothesis (EMH) states that stock prices incorporate all relevant information as and when such information becomes available. This implies that there cannot be a systematic way of exploitation of trading opportunities to earn excess profits. This paper empirically examines the efficient market hypothesis in its weak form (random walk model) for the banking index BSE BANKEX in India. Stock prices of 14 banks constituting BANKEX are considered for the period June 2003 to Dec 2012. The random walk hypothesis is examined using Auto Correlation test, Runs test, Augmented Dickey-Fuller Unit Root test. The null hypothesis of unit root is convincingly rejected, suggesting that the banking stocks in India do not show characteristics of random walk and as such are not efficient in the weak form. The rejection of weak form efficiency means that investors can better predict stock price movements and earn abnormal profits.*

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**KEYWORDS**

Augmented Dickey-Fuller Unit Root test, Auto Correlation, Efficient Market Hypothesis, Runs test, Weak form market efficiency.

**INTRODUCTION**

Economic liberalization has brought in an unprecedented growth and improvement in the Indian banking industry. The banking industry has moved gradually from a regulated environment to a deregulated market economy. The new market developments have seen changes in the intermediary role of banks. With the banking stocks emerging as a major segment in equity markets, the BSE designed an index exclusively for bank stocks—BSE Bankex. This index tracks the leading stocks of the banking sector. With the base date for Bankex being 1<sup>st</sup> Jan 2002 and the base value being 1000 points, this index disseminated on a real-time basis through BSE Online Trading (BOLT) terminals from 23<sup>rd</sup> June, 2003.

Several studies have established complementarity between economic growth and financial development. Finance capital plays an important role in an economy's growth. Banking companies stocks have a weightage of 14.26% in the BSE Sensex, represented by one public sector bank—SBI and two private sector banks—ICICI bank and HDFC bank. The chart below depicts the performance of BSE Bankex and BSE Sensex.

**PERFORMANCE OF BSE BANKEX VIS-À-VIS BSE SENSEX**

(Source: ACE MF, PersonalFN Research)

The chart above depicts that the growth of BSE Bankex is fast-tracked than the BSE Sensex, and has outperformed Sensex many a time. The performance of Bankex intensified during the period 2006 to March 2008 and decelerated during March 2008 – March 2009. However, the trend has reversed thereafter.

**EFFICIENT MARKET HYPOTHESIS**

Fama (1970) defines an efficient market as a market in which prices always reflect the recent available information, at any given time, the prices in the market already reflect all known information, and also change fast to reflect new information. He further states that three different levels of efficiency exist based on 'available information' – the weak, semi-strong, and strong forms.

Weak form efficiency or the Random Walk Theory states that prices of stocks can never be predicted because of the random nature of the stock price movements. This means at any given time there is an equal chance of a stock's price rising or falling. The stock market is "informationally efficient." The investors buying and selling stocks consist of a large number seek and gain access to relevant information. The long term prices will reflect performance of the company over time and the short term movements in prices can best be described as a random walk. According to random walk theory in an efficient market, historical patterns cannot be used to predict future movements in any kind of meaningful way. At any one point in time, the movement of a stock is random. Share prices exhibit no serial dependencies, that is, there are no "patterns" to asset prices. The next minute prices could be anyone's guess and therefore it is not possible to make profits. When investors buy stocks, they usually do so because they believe the stock is worth more than they are paying. In the same

way, investors sell stocks when they believe the stock is worth less than the selling price. If the efficient market theory and random walk hypothesis are true, then an investor's ability to outperform the stock market is more a luck than an analytical skill.

**LITERATURE REVIEW**

The random walk hypothesis has been proven through a number of empirical studies. By examining real data, researchers such as Fama and Malkiel (1970) found there was no correlation between successive price changes. In other words, the next movement of a stock is completely independent of its prior movements. In fact, Malkiel (1973) states that the movement of the stock market and the individual stocks, is just as random as flipping a coin.

Extensive empirical researches have been carried out to study the weak form efficiency traits of the Indian stock markets. Some of the studies relevant to this paper are summarized as below. Sharma and Kennedy (1977), Sharma (1983), Barua (1987), Ramachandran (1986), Vaidyanathan and Gali (1994) tested the market efficiency in Indian capital market, and provided evidence in favour of weak-form efficiency. A study by S K Choudhuri, (1991) finds that the markets are not weak form efficient. Srinivasan (1993) studied the efficiency of the market in assimilating the information content of rights issues and concluded that the market was by and large efficient. Sunil Poshakwale (1996), Rakesh Gupta, and Parikshit K. Basu (2007), Batool Asiri (2008), P K Mishra and B B Pradhan (2009) also conclude by their studies that Indian capital market is weak form inefficient. Prusty (2007) tested the market efficiency in Indian capital markets, and provided evidence in favour of weak-form efficiency. Nikunj R. Patel, Nitesh Radadia and Juhi Dhawan (2012) investigate the weak form of market efficiency of 4 markets in Asia—BSE India, Hong Kong's Hang Seng index, Tokyo's Nikkei and Shanghai's SSE composite index and conclude that the stock markets are weak form inefficient. Bhanu Pant and Dr. T. R. Bishnoi(2001) analyse the behavior of daily and weekly returns of five Indian stock market indices for random walk during April-1996 to June-2001 using Q-statistic & Dickey-Fuller test and conclude that Indian stock market indices do not follow randomwalk. N.K. Totala, H.S. Saluja, Dr. Ira Bapna and Vishal Sood (2012) examine the market efficiency of the BSE Bankex companies to check the randomness of the price movements of the banking companies and find that Bankex and a majority of the banking companies' stock prices walk randomly.

The above literature proves that the EMH and the random walk theory have featured in financial economics for many years. There is mixed evidence regarding the weak form efficiency in the random walk model. Debates take place on the role of past stock prices for predicting the future returns. This paper examines the weak form efficiency of Efficient Market Hypothesis (EMH) in Indian banking sector in the random walk framework.

**OBJECTIVES OF THE STUDY**

- To study whether the Bankex and stock prices of Bankex Banking Companies are stationary or not
- To apply various statistical tests of market efficiency
- To identify the level of market efficiency of Bankex

**RESEARCH METHODOLOGY**

**HYPOTHESIS**

*H<sub>0</sub>1: BSE Bankex stocks are not informationally efficient*

*H<sub>0</sub>2: BSE Bankex stock prices are not random and there is no influence of current prices on subsequent price changes*

**SCOPE OF THE STUDY**

The study is based on daily prices of the BSE Bankex stocks listed in BSE were taken for 9 financial years from 23<sup>rd</sup> June 2003 to 31<sup>st</sup> Dec 2012. BSE Bankex has an equal composition of both public (7) and private sector banks (7). A public bank is one which has many shareholders, and they elect from their own body who are entrusted with its management. A private bank is one which has few partners, and the bank's management is attended to personally by them.

**SAMPLE/DATA**

Daily closing prices of BSE Bankex and the 14 BSE Bankex Companies have been considered, the data ranging between 23<sup>rd</sup> June 2003 and 31<sup>st</sup> Dec 2012. The secondary data is collected from the annual reports, published research reports by banking industry, etc. and websites like, www.bseindia.com, www.moneycontrol.com, www.rediff.com, www.sebi.gov.in and www.yahoofinance.com .

**STATISTICAL TESTS FOR ANALYSIS**

Log normal prices have been considered to perform the various tests to check the weak form of market efficiency. Stock prices can never go below 0 as a result of which the distribution of stock prices tends to be skewed to the right. This is because while it cannot fall below 0, it can theoretically keep rising towards infinity (mathematically this means that the distribution has bounds of 0 to +∞). Hence, the lognormal distribution of stock prices is considered more appropriate to perform statistical tests. As the lognormal distribution is skewed to the right, the mean is always greater than the median. There is a difference between the symmetric normal distribution (bounded at [-∞ to +∞]) and the non-symmetric right skewed lognormal distribution.

Tests like the Runs test, Auto correlation test and Augmented Dickey Fuller test are conducted to test the hypothesis.

**RUNS TEST**

Runs analysis is a non-parametric test and is independent of the normality and constant variance of data. Runs test determines if successive price changes are independent. It is a strong test to check the randomness and in investigating serial dependence of share price movements. It compares the expected number of runs with the observed number of runs by a random process. The objective of performing a runs test is to test whether weak form of efficient market hypothesis holds good or not in the Bankex stocks.

**RUNS TEST RESULTS**

Bank	Test Values	Cases < Test Value	Cases >= Test Value	Total Cases	Number of Runs	Z	Asymp. Sig. (2-tailed)
Axis	0	1192	1185	2377	1135	-2.236	0.025
BOI	0	1234	1144	2378	1147	-1.697	0.09
BOB	0	1196	1182	2378	1156	-1.393	0.164
Canara	0	1197	1181	2378	1118	-2.952	0.003
Federal	0	1184	1194	2378	1122	-2.789	0.005
HDFC	0	1222	1156	2378	1160	-1.194	0.232
ICICI	0	1215	1163	2378	1119	-2.891	0.004
IDBI	0	1190	1188	2378	1153	-1.518	0.129
Indusind	0	1180	1198	2378	1160	-1.228	0.219
Kotak	0	1232	1146	2378	1157	-1.292	0.196
PNB	0	1204	1174	2378	1145	-1.839	0.066
SBI	0.159	2377	1	2378	3	0.029	0.977
Union bank	0	1199	1179	2378	1128	-2.54	0.011
Yes bank	0	913	942	1855	860	-3.172	0.002
Bankex	0.145	2377	1	2378	3	0.029	1

Runs Test was applied on daily closing stock prices of the 14 banking companies (Table above). The test is employed on the total number of runs in the transformed data. A total of cases ranging between 1855 and 2378 were observed. Large significance values (>0.05) indicate that the data are not randomly



ordered. The results of BOI, BOB, Federal, IDBI, Indusind, Kotak, PNB and SBI show that the **significance (2 tailed)** value are **greater than 0.05** (95% level of confidence) and the difference is therefore, not statistically significant. The **null hypothesis (H<sub>0</sub>—successive price changes are not random) cannot be rejected.**

**AUTO CORRELATION TEST**

Auto-correlation (AC) test is a reliable measure for testing of either dependence or independence of random variables in a series.

**AUTO CORRELATION TEST RESULTS**

BANKEK	AC	0.134	-0.025	-0.006	-0.023	-0.058	-0.07	0.004	0.045	0.022	0.039	0.025	-0.006
	Prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Axis	AC	0.011	-0.038	-0.014	0.022	-0.024	-0.025	0.002	0.000	0.057	0.033	0.006	-0.043
	Prob	0.596	0.153	0.237	0.253	0.239	0.218	0.307	0.405	0.067	0.046	0.067	0.027
BOB	AC	0.085	-0.037	-0.041	-0.012	-0.045	-0.053	-0.02	-0.004	0.034	0.046	0.003	-0.02
	Prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BOI	AC	0.084	-0.008	-0.01	-0.015	-0.064	-0.045	0.011	0.002	-0.001	0.053	-0.004	-0.044
	Prob	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Canara	AC	0.082	-0.019	-0.008	-0.061	-0.033	-0.025	-0.008	0.006	0.007	0.031	0.000	-0.007
	Prob	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Federal	AC	0.046	-0.049	-0.013	0.009	-0.042	-0.01	-0.003	-0.031	0.000	0.031	0.013	0.007
	Prob	0.025	0.005	0.011	0.024	0.009	0.016	0.028	0.021	0.035	0.026	0.036	0.052
HDFC	AC	-0.005	-0.012	0.004	-0.006	-0.011	-0.011	-0.011	0.011	-0.008	0.021	-0.004	-0.002
	Prob	0.789	0.822	0.934	0.973	0.978	0.982	0.987	0.99	0.994	0.984	0.992	0.996
IDBI	AC	0.082	-0.012	-0.016	-0.028	-0.032	-0.049	0.024	0.031	0.021	0.03	0.006	0.000
	Prob	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Indusind	AC	0.052	-0.046	-0.044	-0.011	-0.009	-0.005	-0.005	0.028	0.031	0.028	-0.021	-0.017
	Prob	0.01	0.003	0.001	0.002	0.005	0.01	0.018	0.016	0.013	0.011	0.013	0.017
Kotak	AC	0.022	0.013	-0.007	0.007	-0.026	-0.016	-0.008	0.004	0.031	-0.012	-0.015	0.016
	Prob	0.287	0.451	0.638	0.768	0.632	0.658	0.737	0.82	0.68	0.741	0.772	0.796
PNB	AC	0.062	-0.008	-0.018	-0.013	-0.025	-0.013	0.026	0.012	0.02	0.019	0.018	-0.03
	Prob	0.002	0.009	0.017	0.032	0.035	0.054	0.052	0.074	0.084	0.097	0.113	0.09
SBI	AC	0.091	-0.028	-0.01	-0.012	-0.061	-0.047	0.015	0.043	0.02	0.024	0.019	0.011
	Prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
UBI	AC	0.094	-0.042	-0.027	-0.027	-0.028	-0.031	-0.018	-0.026	0.024	0.022	0.003	0.007
	Prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Yes Bank	AC	0.147	-0.054	0.018	-0.043	-0.059	-0.047	0.017	0.038	0.03	0.029	0.017	-0.038
	Prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

The serial correlation coefficient measures the relationship between the values of a random variable at time t and its value in the previous period. Auto correlation test evidences whether the correlation coefficients are significantly different from zero. AC tests were performed upto 12 lags for the daily stock returns. The table shows the results of AC coefficients for the daily returns of the BSE Bankex stocks.

The analysis of the table reveals that Bankex and banks like BOB, BOI, Canara, Federal, IDBI, Indusind , PNB, SBI, UBI and Yes bank are significantly correlated. This indicates that share prices of these banks do not walk randomly. Axis bank earned its significance value in the 8<sup>th</sup> and 10<sup>th</sup> lag. All the data prove that they are serially and significantly correlated, and there is an existence of autocorrelation between them and with the Bankex. The AC coefficients computed for the log of the market return series shows significant auto-correlation at different lags for the sample period. The null hypothesis **H<sub>0</sub>: there is no significant relationship between BSE Bankex and BSE Bankex Banking Companies is rejected.** As per the AC results, the Bankex and the **14 banks constituting Bankex do not walk randomly, i.e., their prices are not independent to each other.**

**UNIT ROOT TEST**

The Unit Root test verifies the stationary mode of the series under consideration. It also determines the order of the series' integration. A stationary process is one whose statistical properties do not change over time. Non-stationary processes are unpredictable and cannot be modelled or forecast. The results of Augmented Dickey Fuller (ADF, 1979) unit root test are depicted as below.

**UNIT ROOT TEST RESULTS**

Bank name	Intercept and trend		Intercept and no trend	
	ADF t statistic	critical value	ADF Critical value (26 lags with intercept and no trend)	p value
Axis	-35.6444	0.000	-35.5978	0.000
BOB	-34.4596	0.000	-34.4655	0.000
BOI	-44.8667	0.000	-44.8082	0.0001
Canara	-44.8667	0.000	-44.8713	0.0001
Federal	-46.5488	0.000	-46.5578	0.0001
HDFC	-49.0305	0.000	-49.0028	0.0001
ICICI	-44.2332	0.000	-44.2205	0.0001
IDBI	-44.9685	0.000	-44.9681	0.0001
Indusind	-46.2319	0.000	-46.2416	0.0001
Kotak	-47.7122	0.000	-47.7134	0.0001
PNB	-45.7906	0.000	-45.7788	0.0001
SBI	-44.4754	0.000	-44.4706	0.0001
UBI	-44.3745	0.000	-44.3652	0.0001
Yes Bank	-30.3634	0.000	-30.3708	0.0000

**H<sub>0</sub>:** Series does not contain unit root and is not stationary

**H<sub>1</sub>:** Series does contain unit root and is stationary

The Unit Root Test verifies the stationary mode of the series under consideration. Further, their order of integration is being determined. The results of Augmented Dickey Fuller (ADF, 1979) unit root test are depicted in the table. The ADF test was carried out in two situations—(a) intercept and trend and (b) intercept and no trend.

**INTERCEPT AND TREND**

The t-statistic critical values at 1%, 5% and 10% level of significance for intercept and trend are -3.96191, -3.4117 and -3.12773 respectively. The calculated ADF critical values for all banks range between -30.36 and -49.03 which are all smaller than the t statistic. This clearly indicates that the data is stationary. The null hypothesis  $H_0$ : Series does not contain a unit root is therefore rejected. The p values are also below 0.05 which also proves that the null hypothesis should be rejected.

**INTERCEPT AND NO TREND:** The t-statistic critical values at 1%, 5% and 10% level of significance for intercept and no trend are -3.43291, -2.86256 and -2.56736 respectively. The critical ADF values range between -30.37 and -49.00 indicating that they are much lower than the t statistic. This proves that the data is stationary. The null hypothesis  $H_0$ : Series does not contain a unit root is hence rejected. The p values are also less than 0.05 which also proves that the null hypothesis should be rejected.

**CONCLUSION**

This paper revisits the weak form of efficiency of EMH by testing the same on BSE Bankex stocks and adds to the literature the evidence of its weak form inefficiency. This inefficiency may be due to stock market irregularities and market volatility. To verify the weak-form of efficiency of BSE Bankex stocks, Runs test, Auto-correlation and Unit Root test were applied.

The results of Runs test provide evidence that random movement of shares prices are not influenced by successive price changes and the null hypothesis— successive price changes of shares of BSE Bankex Companies are not random is not rejected. Auto correlation tests performed on the Bankex stocks with 12 lags also prove that the stocks are serially and significantly correlated and the null hypothesis that there is no significant relationship between BSE Bankex and BSE Bankex Banking Companies is rejected. The Unit Root test established that the Bankex series does contain a unit root and hence was stationary. All the results confirm that the prices of BSE Bankex stocks are not weak form efficient. The BSE Bankex stock prices are random.

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