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WEAK FORM EFFICIENCY OF INDIAN STOCK MARKET: AN EMPIRICAL ANALYSIS

DR. BABU JOSE
ASST. PROFESSOR
DEPARTMENT OF COMMERCE
ST. THOMAS COLLEGE
PALA

SURESH T.S
M. Phil. SCHOLAR
DEPARTMENT OF COMMERCE
S.H. COLLEGE
THEVARA

ABSTRACT

Market efficiency of Indian stock market based on the daily return of NSE Nifty and BSE Sensex form 1 January 1994 to 31 December 2015 is tested by applying Unit root, Autocorrelation, Run test and Variance ratio methodologies based on the trends and patterns in the movements of Indian market. The unit root tests like ADF and PP proved that the Indian stock market is non-stationary and contains a unit root. The auto correlation results are also revealed high degree of dependence on previous prices, which means that previous prices are related with current prices. The strong autocorrelation behaviour of the variable leads to non stationarity situation in data series. The run test results also proved that there is no randomness in Indian stock market. From the results, it is clear that the Indian stock market does not follow random walk and it is in inefficient in its weak form.

KEYWORDS

NSE, BSE, market efficiency, weak form, dependency behaviour of market, independent movements, random movements.

INTRODUCTION

Capital market is an institutional arrangement which facilitates long term borrowing and lending of funds where the investors are always interested for capital appreciation and dividend returns. An efficient capital market is one where the security prices reflect all the relevant information. Information of capital market efficiency is very important for the investors. In financial literature the term 'Stock Market Efficiency' is used to explain the relationship between information and share prices movement in the capital market of any economy. Fama (1970) provided the formal definition of 'Market Efficiency' into three categories. Market efficiency has an influence on the investment strategy of an investor because since in an efficient market, the prices of securities will reflect the markets best estimate of their expected return and risk, taking into account all that is known about them. Therefore, there will not be any undervalued securities. If, however markets are not efficient and excess returns can be made by correctly picking winners, then it will pay investors to spend time finding these undervalued securities.

The weak form efficiency of the market is to be analysed to give clarification on the real behaviour of stock market and help the investors to take appropriate decision on their investment strategies. Studies by Gagan Deep Sharma et al (2007), Sharma (2011) and Alan (2012) revealed the inefficiency of Indian market and it emphasises the importance of one study which should test the weak form efficiency of Indian stock market.

NEED OF THE STUDY

India is one of the fastest growing economies of the world. It has a vibrant stock market that has attracted a lot of foreign institutional investments. The institutional changes such as online trading, availability of real time data and instant execution of transactions have led to increase volume of trading in Indian stock markets. Still the level of sophistication in terms of market participation and techniques is nowhere near to the developed markets (Sapate, 2013). A study to measure the market efficiency will be very relevant, if a market is efficient, stock price movements should follow a random walk and the price movements in the past should be not related to future price movements. But if the market is not efficient and price movements are not random, some investors can exploit the inefficiency by gaining abnormal returns (Alan 2012). They may be able to correctly predict the future price movements by examining the historical price movements. Especially the speculators will take such advantages.

Since there are three forms of market efficiency, but working on all the three forms is not possible in this study because of unavailability of the data and usefulness of the results for attaining the objectives of the study. Testing the strong form of market efficiency is not possible on account of data unavailability because it considers private or insider information which is not easily accessible, and the results of testing semi-strong form does not measure the randomness in the market returns, which is only possible through testing the weak form of market efficiency (Sharma 2011). There are many studies testing the market efficiency of Indian stock market. Majority of the study are either based on and single index, i.e Nifty or Sensex and one or two basic tools. This study is a comprehensive study of market efficiency of Indian stock market based on NSE Nifty and BSE Sensex using various tools applied in literature.

REVIEW OF LITERATURE

Eugene F. Fama (1969) developed the theory of random walk and efficient market is defined as a market where there are large numbers of rational profit-maximizers actively competing, and as a market where successive price changes in individual securities are independent. R Vaidyanathan & Kanti Kumar Gali (1994) has conducted a research to test the weak form of efficiency of the Indian Capital Market. The randomness is tested using run test, serial correlation and filters rule and the results provided supportive evidence for the weak form of efficiency of the Bombay Stock Exchange. This result was supported by Sunil Poshakwale in 1996. Eugene F Fama (1997) made another theoretical analysis which gave explanations to the challenges of the literature on long-term return anomalies. Elory Dimson and Massoud Mussavian (2000) made a descriptive research on the concept of market, Asma Mobarek & Professor Keavin Keasey (2000) studied on weak form efficiency of an emerging market like the Dhaka stock exchange of Bangladesh. The results of both non-parametric test and parametric test provide evidence that the share return series do not follow random walk model. The efficient market hypothesis was analysed by Gagan Deep Sharma & Mandeep Mahendru in 2007, Samuel Dupernex (2007) defined a random walk and discussed how the random walk model is associated with the idea of market efficiency. Rakesh Gupta & Parikshit K Basu (2007), P K Mishra (2009), P Srinivasan (2010), A Q Khan & Sana Ikram (2010), Victor K Gimba (2010) made studies on the week form efficiency of Indian stock market by using different methodology. Ambuj Gupta (2011) conducted a critical analysis of weak form efficiency in Indian stock market based on the four Indian indexes. The empirical results of A.Q. Khan, Sana Ikram & Mariyam Mehtab (2011), Anil K Sharma & Neha Seath (2011), Rakesh Guptha & Junhao yang (2011), M Bharath & H Shankar (2012) and Zabiulla (2012) revealed that the market does not follow random walk and as such are not efficient in weak form. Divyanag J Joshi (2012) showed the evidence of inefficient form of the Indian Stock Market in long run but efficient form in short run. Kapil Jain & Paryul Jain (2013), Mohad & Mouhi (2013), Haritika Arora (2013), Sachin K & Kanlesha Sanningammanarara (2014) and Daniel Stefan & Sorin lulian (2014) proved that the

inefficient form of Indian capital market by using econometrics model like GARCH and other parametric tests. The volatility behaviour of Indian market was analysed by Ravi Kumar Gupta (2014) and the results did not show the evidence of random walk. But Ghada (2014) found that the daily returns do not confirm to a random walk during the period under examination in Damascus Securities Exchange. Achal Aswathi (2015) conducted a study to test the efficiency and random walk nature of Indian Stock Market. The auto-correlation results significantly differ which shows that the stock indices are biased random lime series and stock market is not weakly efficient in pricing securities.

STATEMENT OF THE PROBLEM

The evidence from past research shows that the efficiency in stock market explains the extent to which the stock prices reflects all available information in the market and therefore by relaying upon this information one can take decisions about buying or selling stock. In an efficient market, the share price over a long period of time do not show any types of patterns and there is no systematic correlation between one movement and subsequent ones. They all follows random walk and nobody knows exactly what will happen tomorrow. Financial economists often classify efficiency into three categories based on the level of information efficiency. Weak form suggests that one cannot beat the market by knowing past prices. Semi strong form efficiency suggests that one cannot consistently beat the market using publically available information, that is, cannot win knowing what everyone else knows- annual report. Strong form efficiency states that no information of any kind can be used to beat the market. But working on all the three forms is not possible because of unavailability of data.

Many research studies have been done on weak form market efficiency. From reviewing the past studies, it is identified that unit root, Serial correlation, Run test, Variance test ratio are the various tools used to test weak form efficiency. The studies conducted by the researchers are also contradicting to one another. Some studies prove that Indian stock market is weak form efficient where some other studies claim that Indian market is not weak form efficient. From the reviews, According to Fama (1997), Elory(2000), Mishra(2009), Gupta(2011), Rakesh Gupta(2011), Bharath(2012), Divyangi(2012), Kapil(2013), Mohad(2013), Sachin(2014) are in support of weak form efficiency in Indian market. But According to Srinivasan (2010), Khan (2011), Sharma(2011), Zabiulla(2012), Haritika(2013), Ravi Gupta(2014), Ghada(2014), Indian market is not weak form efficient. Studies provide different results because of the peculiarities of data and peculiarities of tool used. These variations and differences in results provide researchers opportunity to test the weak form efficiency of Indian Market for a long period and get the consistency of the result by dividing the study period in different sub- periods by applying the same statistical tools. This study makes an attempt to test the week form efficiency of Indian market by considering the data for a long period.

OBJECTIVES OF THE STUDY

The objectives of the study are listed below;

1. To understand the various forms of stock market efficiency.
2. To test whether the Indian Stock Market is weak form efficient or not

HYPOTHESIS

In order to determine whether the Indian stock market is weak form efficient or not, it can be verified by checking some characteristics of stock market. The stock market data falls in the category of time series. Time Series data generally follows some characteristics such as, stationarity, Independency and random movement of Prices, and specifically the stock prices follow a random walk movement. The characteristics of the Indian Stock market are verified by testing the following hypothesis.

H01: The Indian Stock market is not in Stationary form.

H02: Daily returns of Indian stock market do not exhibit significant serial correlation.

HO3: The Indian stock market follows a random sequence

DATA AND PERIOD OF THE STUDY

Indian capital market is always represented by the major two indices viz, NSE Nifty and BSE Sensex (BSE). The data for the study has been collected from the web sites of NSE and BSE. The data includes the daily closing vale of the stock indices from 1 January 1994 to 31 December 2015. Prices series are converted in return series to test the serial correlation of the Indian market returns.

TOOLS FOR THE ANALYSIS

This study is using parametric tests namely autocorrelation and variance test ratio, and one non parametric test called run test. This study is applying the unit root test to analyse the week form efficiency of Indian Capital Market.

VARIABLES OF THE STUDY

The two variables used in the study to test the efficiency of Indian stock market, are the daily closing value of major two indices in India such as NSE Nifty and BSE Sensex.

ANALYSIS & INTERPRETATION

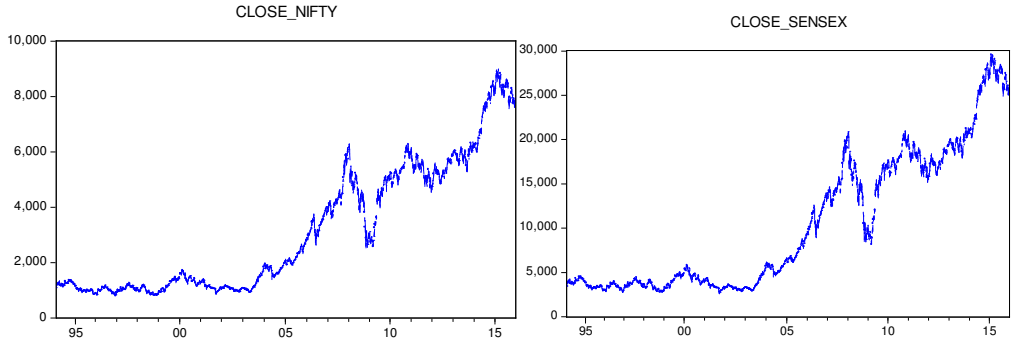
This session deals with the analysis and interpretation of data. The collected data are analyzed to have a deep understanding of the subject matter of the study. In order to analyze the data both statistical and mathematical tools are used. The behaviour of stock returns has been extensively debated over the years. Researchers have examined the efficient market hypothesis (EMH) and random walk characterization of returns. In an informationally efficient market, current prices quickly absorb information and hence such a mechanism does not provide scope for an investor to make abnormal returns (Fama 1970). In respect of empirical evidence, earlier studies have found evidence in favour and against of random walk hypothesis. In this context, an attempt is made to empirically check whether the Indian stock market follows random walk or not.

THE BASIC TRENDS AND PATTERNS OF STOCK MARKET MOVEMENTS

Line graphs are extensively used for the analysis of time series data (Robert, 1999). The basic trends and patterns of stock market movements can be explained in detail with the help of line graph. The trends of variables of the study can be identified from their below figure 1

The data for the study consist of BSE Sensex and NSE Nifty from 1 January 1994 to 31 December 2015. Before the establishment of NSE Nifty in 1994, BSE Sensex was the single stock index to represent the Indian market. After the implementation, Nifty has gained as an important stock market index. Now a day both the NSE Nifty and BSE Sensex are considered as appropriate indicators of Indian stock market.

FIGURE 1: LINE GRAPH OF NSE NIFTY AND BSE SENSEX FOR THE PERIOD OF STUDY



The Figure 1 shows the line graph of NSE Nifty and BSE Sensex for the whole period of study. The line graph of NSE Nifty and BSE Sensex almost moves in a similar pattern except certain trends and variations. The graph helps us to know the market reaction, the various crisis faced by the market and the level of ups and downs. From the line graph it can also identify shapes and patterns such as V shape, W shape, Double top, Cup and holder.

RANDOMNESS OF INDIAN STOCK MARKET

The random walk hypothesis is a financial theory stating that stock market prices evolve according to a random walk and thus cannot be predicted. It is consistent with the efficient-market hypothesis. In short, this is the idea that stocks take a random and unpredictable path (Rawal, 2014). The random walk can be measured with the help of various tests such as unit root, Run test, Autocorrelation and Variance test ratio.

DESCRIPTIVE STATISTICS

In order to get more clarification about the basic characteristics of variables, descriptive statistics can be used. Mean, Median, Standard Deviation, Skewness, Kurtosis and Jarque- Bera are measured and presented for the study period.

TABLE 1: DESCRIPTIVE STATICS FOR THE STUDY PERIOD

Statistic	NSE Nifty	BSE Sensex
Mean	3157.93	10532.59
Median	1977.73	6384.940
SD	2318.27	7743.552
Skewness	0.725	0.7007
Kurtosis	2.261	2.2001
JB	601.203	588.6917
Probability	0.000	0.0000
No of Obs.	5452	5426

The basic characteristics of a normal distribution are symmetric around their mean, median and mode of a distribution and it requires that skewness and kurtosis should be almost near to the standard values of 0 and 3 respectively. The Jarque Bera test also measures the normality of the data series.

Table No 1 contains the descriptive statistics of daily closing index value of NSE Nifty and BSE Sensex for the study period. It is clear from the figures listed in the table that the series is not normal for both the series. To apply various statistical models and tools, it requires normally distributed data series, for that the series is to be smoothened by converting them in to log form. The further tools are applied on the log data except the run test as it is a non-parametric test to be applied on the raw data.

DEPENDENCY BEHAVIOUR OF INDIAN STOCK MARKET

STATIONARITY OF DATA

A stationary time series is one whose statistical properties such as mean, variance and auto correlation are all constant over time (Babu, 2015). In other words, it is a quality in which the statistical parameters of the process do not change with time. In a stationarized series is relatively very easy to predict that is its statistical properties will be the same in the future as they have been in the past. Stationary is the important properties of time series data which shows the ability of the data series to explain the long and short term information. In time series econometrics, a time series that has a unit root is known as a random walk. A random walk is an example of a non-stationary time series (Shuba, 2010). As a preliminary test, it is necessary to test the stationarity of the variable by applying Augmented Dickey Fuller (ADF) and Philip Perron (PP) unit Root test. The below table 2 shows the stationarity test results of NSE Nifty for the periods of study

TABLE 2

ADF Test results of NSE Nifty						PP Test results of NSE Nifty				
Period	**Test statistic**	**Critical Values**			**Probability**	**Test statistic**	**Critical Values**			**Probability**
		1%	**5%**	**10%**			**1%**	**5%**	**10%**	
Whole Period	-2.765	-3.959	-3.410	-3.127	0.2105	-2.527	-3.959	-3.410	-3.127	0.3147

From the results, there is no possibility to reject the null hypothesis as the probability value is more than.05 and the test static values are less than the critical values, i.e. the daily closing values of NSE Nifty contains a unit root. The below tables 3 shows the stationarity test results of BSE Sensex for the study periods.

TABLE 3

Augmented Dickey Fuller (ADF) results of BSE Sensex					Philip Perron (PP) result of BSE Sensex				
Test statistic	Critical Values			Probability	Test statistic	Critical Values			Probability
	1%	**5%**	**10%**			**1%**	**5%**	**10%**	
-2.483	-3.965	-3.410	-3.127	0.3363	-2.314	-3.959	-3.410	-3.127	0.4254

The results state that BSE Sensex for the study period is non-stationary. The Indian stock market is non-stationary and contains a unit root. It's a general thing that the data which is nonstationary in level form will be stationary in first difference in this case it is essential to check the stationarity of data series in first difference and proved that the data is stationary in first difference.

TABLE 4

Unit root test in first difference of NSE						Unit root test in first difference of NSE	
ADF		PP		ADF		PP	
T Static	P value	T static	P value	T Static	P value	T static	P value
-16.753	.0000	-68.187	.0000	-16.949	.0000	-67.667	.0000

From the above results it is clear that NSE Nifty and BSE Sensex for the sub periods are non-stationary in level form and stationary in first difference, which implies that the series contains a unit root. Therefore, the market is inefficient at its weak form. The results are supported by the empirical evidence of Sharma (2011), Gupta (2013), Sachin (2014).

INDEPENDENCE OF INDIAN STOCK MARKET

Auto correlation test is the most commonly used tool to test weak form efficiency. The autocorrelation function (ACF) test is examined to identify the degree of autocorrelation in a time series data. It measures the relationship between the stock return at current period and its value in the previous period. Auto correlation techniques are used if price change in one-time period is not correlated with the price change in some other time period, then the price changes are considered to be serially independent. It means that the market is efficient.

One way to determine if there is autocorrelation in the time series is to plot the ACF with different number of lags and check if the correlation coefficient for each lag is significantly

different from 0. If time series has unit root, then the autocorrelation function slowly decrease starting from the value of one and the partial correlation function has only first value which differs from zero.

TABLE 5: AUTOCORRELATION RESULTS FOR THE STUDY PERIOD OF NSE NIFTY AND BSE SENSEX

Lags	NSE	BSE
1	0.999	0.999
2	0.999	0.999
3	0.998	0.998
4	0.998	0.998
5	0.997	0.997
6	0.997	0.997
7	0.996	0.996
8	0.996	0.996
9	0.995	0.995
10	0.995	0.995
11	0.994	0.994
12	0.994	0.994
13	0.993	0.993
14	0.993	0.993
15	0.992	0.992
16	0.992	0.992
17	0.991	0.991
18	0.991	0.991
19	0.990	0.990
20	0.990	0.989
21	0.989	0.989
22	0.988	0.988
23	0.988	0.988
24	0.987	0.987
25	0.987	0.987
26	0.986	0.986
27	0.986	0.986
28	0.985	0.985
29	0.985	0.985
30	0.984	0.984
31	0.984	0.984
32	0.983	0.983
33	0.983	0.983
34	0.982	0.982
35	0.982	0.982
36	0.981	0.981

The table no. 5 shows the auto correlation results of NSE Nifty and BSE Sensex for the whole study period. The test of autocorrelation is done using up to 36 lags depending upon akaike criterion. It's very interesting to note that the auto correlation results are same for both NSE and BSE. In the initial analysis it is found that both the NSE and BSE moves with similar trends and patterns, this finding is again supported by the auto correlation results. The results indicate a high degree of dependence on previous prices when the lag is low. For NSE Nifty and BSE Sensex the ACF value is ranging between 0.999 and 0.981. However, the market to be efficient in its weak form, the values of auto correlation should be around zero (Sachin,2014). That means the share prices do not follow the weak form efficiency or the market is inefficient in its weak form for the study period. The market conditions, related factors will affect the level of dependency. The test results are significant and it is supported by empirical evidences of sharma (2011), Jain (2013), Sachin(2014), Mohad(2013), Ghada(2014), Sunil(1996). The empirical results clearly explain that Indian share market movements may not follow a random walk and the market is inefficient at weak form.

THE RANDOMNESS OF PRICE CHANGES IN INDIAN STOCK MARKET

Run test is a nonparametric test for serial dependence in the stock Returns, which designed to examine whether or not an observed sequence is random. A run is the frequent occurrence of the same value of a variable. The run test converts the total number of runs into a Z statistic. For large samples the Z statistics gives the probability of difference between the actual and expected number of runs. The Z value is greater than or equal to +/- 1.96, reject the null hypothesis at 5% level of significance (Sharma and Kennedy, 1977). As can be seen from the above tables, the Z statistics of daily market return is greater than +/- 1.96 then it means that the observed number of runs is fewer than the expected number of runs with observed significance level.

The null hypothesis for the run test is the Indian stock market follows a random sequence.

The hypothesis is based on the belief that since the market is not normal we are expecting that the series may follow a random pattern. The below table 6 shows the result of run tests of NSE Nifty and BSE Sensex.

TABLE 6: RUN TEST RESULT OF NSE NIFTY AND BSE SENSEX FOR THE STUDY PERIOD

	NSE Nifty	BSE Sensex
Test Value[a]	1977.73	6384.94
Cases < Test Value	2726	2713
Cases >= Test Value	2726	2713
Total Cases	5452	5426
Number of Runs	10	12
Z	-73.601	-73.369
Asymp. Sig. (2-tailed)	.000	.000

Median

The above table shows the result of run test for the whole period of study of both NSE Nifty and BSE Sensex. For NSE Nifty, it is found that the Z value are more than +/- 1.96, therefore, null hypothesis for the run test is rejected at 5 percent level of significance for the period of NSE Nifty. When we take into consider the p value also it is 0.000 which is clearly too small than the alpha (.05) hence the null hypothesis is rejected. In case of BSE Sensex also the same results is revealed. Hence it can be concluded that both the series do not follow random walk over the time period of study and for this reason both the NSE and BSE are considered to be weak form inefficient. Sharma (2011), Mohad (2013), Sachin (2014), Kapil (2013) supported the results in their empirical conclusion. Therefore, in all the cases of both the NSE and BSE, the results states that the series of return is not following the assumption independent relationship of random walk model. Therefore, the study rejects the null hypothesis that the return series on the NSE Nifty and BSE Sensex follows random walk and by this evidence it is confirmed that Indian equity market is inefficient in its week form Market. The result is consistent with the literature of Sharma (2011), Mohad(2013), Sachin(2014), Kapil(2013).

TEST OF VARIANCE OF INDIAN STOCK MARKET RETURNS

The hypothesis of random walk can be tested under the asymptotic distribution of both homoscedasticity. Variance ratio estimators developed by Lo and MacKinlay (1988) can be applied to test the variance of Indian Stock market with the null hypothesis of VR (q) = 1, which means that the returns follow a random-walk process. If the value does not equal to one, then it means that the series is auto correlated.

TABLE 7: VARIANCE RATIO TEST RESULTS OF NSE NIFTY AND BSE SENSEX

	NSE	BSE
Var ratio	1.076	1.08
Z	3.405	3.837
P	0.0026	0.0005
Df	5451	5425

The variance ratio is more than one for both the NSE Nifty and BSE Sensex for the entire sub periods of study. Variance ratio is larger than unity, which indicates that the variances grow more than proportionally with time existing thus there is a positive autocorrelation of the daily closing prices. The Z statistic is also significant at 5% level of significance so the assumption of Indian stock markets follows random walk is not acceptable there is not random walk movement in the Indian stock market and the same situation is already revealed by Gupta (2014), Victor (2010), Ghada (2014), Daniel (2014).

CONCLUSION

This study discusses the empirical testing of market efficiency of Indian stock market based on the daily return of NSE Nifty and BSE Sensex form 1 January 1994 to 31 December 2015. To empirically test the weak form efficiency of Indian stock market four basic tools such as Unit root, Autocorrelation, Run test and Variance ratio have been applied in the study. From the descriptive statistics, it is clear that the Indian stock market daily closing price series does not follow a normal distribution. The log value of the variable is used for further analysis except for run tests. The unit root tests like ADF and PP tests are proved that the Indian stock market is non-stationary and contains a unit root. The auto correlation results are also revealed high degree of dependence on previous prices, which means that previous prices are related with current prices. The strong autocorrelation behaviour of the variable leads to non stationarity situation in data series, which means that the stock market movements are not in predictable manner. The run test results also proved that there is no randomness in Indian stock market. The actual runs are less than the expected runs. The variance ratio test results are also consistent with other results. It also shows that the Indian stock market does not follow a random walk model and contains a positive correlation. From the results, it is clear that the Indian stock market does not follow random walk and it is in inefficient in its weak form.

The efficiency of stock market explains the extent to which the stock prices reflects all available information in the market, and therefore by relying upon the information one can take decisions about buying and selling the stocks. Relevant investment strategies can also be adopted after deciding whether the market is efficient or not. On the basis of this empirical results proved by various tests, it can be concluded that the Indian stock market does not show efficiency in its weak form. The practical implication of inefficiency in stock markets is that, it may lead to the variation in the expected returns of the securities in the market. This is because the changes in the price of securities would be more than the expectation on arrival of some new information in the market. In other words, there is possibility of earning extra income in the Indian market because abnormal returns are possible only when the market is inefficient as the future prices can be predicted using the past information. Thus, observation and the use of the past behaviour of stock price movement may help investors in generating excess profits.

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