

A study on stationarity of global stock market indices

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ABSTRACT

*Studying the behavior of stock prices has always been a subject of interest to researchers. Stock markets are always taken as a prominent indicator of the performance of the economy of a country and the industry. Financial markets form the backbone of the country's economy, and stock markets being an integral part of the financial markets play a crucial role in determining the economic status of a nation. With the globalization of the capital markets, stock markets worldwide are integrated and the performance of one has a bearing on the other due to movement of capital from one market to the other. During the current scenario, when stock markets of the world are facing major volatility the researcher aims to study the behavior of major stock indices of the world. The major idea of the research is to find out how the stock market indices have reacted to the changes that have happened in the markets. The stock markets are said to be efficient when prices fully reflect all available information. Hence, the current paper tries to study the stock indices of the various markets by studying the stationarity of the stock index returns. **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.** The Dicky Fully test of stationarity is applied to the stock index returns of select global indices and tested for stationarity. The results of the paper will throw light on the general behavior of the stock indices and help us gauge the efficiency of the global stock markets.*

Introduction

Studying the behavior of stock prices has always been a subject of interest to researchers. Stock markets are always taken as a prominent indicator of the performance of the economy of a country and the industry. Financial markets form the backbone of the country's economy, and stock markets being an integral part of the financial markets play a crucial role in determining the economic status of a nation. With the globalization of the capital markets, stock markets worldwide are integrated and the performance of one has a bearing on the other due to movement of capital from one market to the other. Indian stock markets have witnessed sweeping changes in the last decade in terms of infrastructure, volume of trade and number of participants. There has been significant growth in the Debt markets too. The Indian equity markets have been one of the dynamic markets of the world which indicates strong fundamentals and a growing economy. During the current scenario, when stock markets of the world are facing major volatility the researcher aims to study the behavior of major stock indices of the world. The major idea of the research is to find out how the stock market indices have reacted to the changes that have happened in the markets. The stock markets are said to be efficient when prices fully reflect all available information. Hence, the current paper tries to study the stock indices of the various markets by studying the stationarity of the stock index returns.

With the Indian stock market strongly outperforming those in other parts of the world over the past five years, we are often in the belief that Indian market is unaffected by global changes. But an analysis of stock market trends over the past ten years suggests that it might not be true. The relationship between the Indian stock market and its global counterparts has strengthened significantly in recent years. It may be increasingly important, even for long-term investors to factor global market events into their investment decisions. Various studies conducted between the global markets and the Indian market show a strong link between the global and domestic markets.

The performance of the Capital market gives a picture of the financial health of a country. In general, the markets, which are stable and able to withstand the forces of demand and supply, are deemed to be efficient. Technically, a market is said to be efficient when the prices of shares in the market are able to fully assimilate all information, and the prices equal the risk-adjusted rates of return for all participants. In the real world, it is difficult to find an efficient market. However, markets can be efficient if the costs of imperfections are trivial. With globalization, it becomes a question of concern to find out how efficient is our markets when compared with other financial markets. Even though a perfectly efficient market is far beyond reality, the measure of efficiency can serve as a useful benchmark to assess the financial markets.

A large number of researches are undertaken to study the behavior of capital market in India and other parts of the world. Many studies are conducted to test the efficiency of the Indian Capital Markets. **Rao and Mukherjee (1971)** conducted the first study to examine the validity of the Random Walk Hypothesis for the Indian Aluminum Company in India. The study was carried out for a period of 16 years (1955-1970) and the results confirmed the validity of the Random Walk Hypothesis. **Sharma J L, Robert E Kennedy (1977)** studied the behavior of share price returns of the Indian Capital Market and compared this behavior with that of stock markets in the US and England. **Philippe Jorion and William Goetzmann** in their study on global capital markets studied the indices of 39 markets during 1926 to 1996 and found that the returns obtained by US markets were high when compared to other markets. With the globalization of capital markets and integration of financial markets, studies on the behavior of various stock markets will throw a light on the current status of the stock markets around the globe. Hence the current study proposes to study the behavior of global stock market indices by testing the stationarity of the stock index returns.

Objectives of the study

The objective of the study is to test the stationarity of the share index returns of the leading global stock indices.

Data

The nature of data collected for this study is secondary. Secondary Data refers to the information gathered from the Sources that

already exists. The various sources from which the data are obtained for this Study are as follows:

- Financial Databases from various portals have been used in collecting the Index Quotes of the various global equity markets.

The population consists of all the different stock markets across the whole world. The samples selected for this study are the major stock markets across the continents. The sampling unit consists of some of the key equity markets like DOW JONES, NASDAQ, NYSE, S&P 500, NIKKEI225, BOVESPA, FTSE, FCHI, AUSTAORD, HANG SENG, Merval, SSE-Shanghai Composite, and BSE-SENSEX.

Period of study

The analysis and the interpretation performed in this study are for a period of 9 years starting from January 1st 2000-December 31st 2008.

Methodology

The test of Stationarity is carried as a preliminary test using the **Dicky Fuller Unit Root test**. The purpose is to test the stationarity of the share indices using the Dicky Fuller Unit root test. A time series can be said to be stationary if its mean and variance are constant over time and the value of covariance between two time periods depends only on the distance or lag between the two time periods and not on the actual time at which the covariance is computed.

Dicky fuller test

The stationarity of a time series can be tested by the Dickey Fuller unit root test.

Consider the following model:

$$Y_t = \rho Y_{t-1} + u_t \quad (1)$$

Where u_t is the stochastic error term that follows the assumptions, like zero mean, constant variance σ^2 , and is non auto correlated. This error term is called as white noise error term. Equation 1 is a AR(1) first order regression term, where we regress the value of Y at time t on its value at time (t-1). If the coefficient of Y_{t-1} is equal to 1, we can say there is a unit root, or the time series is non-stationary.

Rewriting the regression equation,

$$Y_t = \rho Y_{t-1} + u_t \quad (2)$$

When we find $\rho = 1$, we can say that the stochastic variable Y_t has a unit root. **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.**

An alternative way to express the above equation is as follows:

$$\Delta Y_t = (\rho - 1) Y_{t-1} + u_t \quad (3)$$

$$= \delta Y_{t-1} + u_t \quad (3a)$$

$\delta = (\rho - 1)$ and where Δ is the first difference operator.

$$\Delta Y_{t-1} = (Y_t - Y_{t-1}) \quad (3b)$$

To test the time series for stationarity we formulate the Null Hypothesis, that $\delta=0$.

That is,

$$\Delta Y_t = (Y_t - Y_{t-1}) = u_t \quad (4)$$

The above equations say that the first differences of a random walk time series are stationary time series because by assumption u_t is purely random.

To find out whether a time series is non stationary, run the regression equation (2), and find out if ρ is statistically equal to 1, or alternatively estimate equation (3), and find out if $\delta = 0$ on the basis of t statistic. The computed t values do not follow the Student t distribution even in large samples.

Under the null hypothesis that $\rho = 1$, the computed t statistic is known as τ statistic, whose critical values have been tabulated by Dickey and Fuller on the basis of Monte Carlo simulations₂. After estimating the regression equation, divide the estimated t statistic with the standard error to compute the Dickey Fuller τ statistic and refer to the Dickey Fuller tables to see if the null hypothesis $\rho = 1$ is rejected. If the computed absolute values $|\tau|$ exceeds the DF absolute critical values, then we do not reject the hypothesis that the given time series is stationary. On the other hand if it is less than the critical value, the time series is non stationary.

Null Hypothesis : The stock index series is non stationary

Alternate Hypothesis : The stock index series is stationary.

Analysis and Interpretation

The Dicky Fuller Unit Root was applied to the various leading stock indices and tested for stationarity. The results of the Unit root tests of the various indices are put in a consolidated table format and interpreted.

The Dicky Fuller Unit Root test is applied to the 13

indices and results are tabulated. The results show that out of the 13 indices except the NASDAQ-AMERICA all other global stock indices showed the presence of Unit root. Thus the Null Hypothesis that the share index series are non-stationary cannot be rejected. Hence it can be concluded that majority of share index values are non-stationary and are moving at random.

Table showing the Results of Dicky Fuller Unit Root Test

SL.NO	INDEX	T STATISTIC	DF STAT	RESULT
1	DOW JONES	-1.05362	-2.57	Non Stationary
2	NASDAQ	-2.666	-2.57	Stationary
3	NYSE-COMPOSITE	-1.2440	-2.57	Non Stationary
4	S&P 500	-1.6829	-2.57	Non Stationary
5	AUSTA-ORD	-1.0863	-2.57	Non Stationary
6	BOVESPA	-0.9331	-2.57	Non Stationary
7	FCHI	-1.2331	-2.57	Non Stationary
8	FTSI	-1.7692	-2.57	Non Stationary
9	HSI-HANGSENG	-1.2665	-2.57	Non Stationary
10	MERVAL	-1.1081	-2.57	Non Stationary
11	NIKKEI 225	-1.6295	-2.57	Non Stationary
12	SSE – Shangai	-1.0451	-2.57	Non Stationary
13	BSE	-0.93212	-2.57	Non Stationary

Conclusion

The main objective of this paper is to study the Stationarity of the leading stock indices of various countries. For this purpose the stock index prices of select stock indices is obtained from their respective websites for the period January 1, 2009 to December 31, 2009. The data are arranged and the Dicky Fuller Unit root test is administered to check for the presence of unit root to confirm the stationarity of the stock index series. The results of the tests confirmed that out of the 13 indices chosen, 12 stock indices showed the presence of Unit root and showed Non-Stationarity. The NASDAQ index of America alone is found to be stationarity. Hence from this study we can conclude that, the general behavior of stock indices of various stock markets are found to be non-stationary and hence confirming the random or independent movement of stock prices. The BSE SENSEX-India also showed non-stationarity of time series and found to move in an independent fashion. This shows that in general the stock markets of various countries are showing signs of efficient behavior.

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