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A Statistical Analysis of the Stochastic Drift between Sensex & Nifty- an in-Depth Study

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Abstract:
Predicting stock market behaviour has been quite an extensive research domain for many years for now. It makes the work simpler and easy to derive the pattern of a market movement if both are stochastically drifted in a similar direction. S&P BSE Sensex has been in existence since late 1970s, and developed as an Index in the early 1980s. In 1986, it developed the BSE [1]SENSEX index, giving the BSE a means to measure overall performance of the exchange. In 2000, the BSE used this index to open its derivatives market, trading S&P BSE SENSEX futures contracts.CNX Nifty or NSE 50 was incorporated in 1992 as a tax-paying company and was recognized as a stock exchange in 1993 under the Securities Contracts (Regulation) Act, 1956.[1]CNX NSEplatform offers trading, clearing and settlement services in equity, equity derivatives, and debt and currency derivatives segments. It is the first exchange in India to introduce the electronic trading facility. Conventional wisdom depicts that FII & DII move the markets, however, research shows a different picture, similarly, this study is to reveal whether the common wisdom of Sensex and Nifty moving along in similar directions is correct or not. This study is also to identify the driver and driven Index patterns through waveform analysis. If the Indexes are closely cointegrated then the arbitrage opportunity will drastically come down increasing the efficiency in both the capital markets.

Keywords: *Granger causality, stochastic drift, CNX Nifty, S&P BSE Sensex, cross correlation function, ACF & PACF*

1. Research Methodology

This study tries to find a link between the patterns of the two largest Indian indices. Granger Causality has been used to identify the link and establish the connection. The study period is from 29th October 2013 to 18th August 2014, BSE 30 & NSE 50 have so many stocks in common so the stochastic drift of the Indices should have ideally been similar. 54% of the CNX Nifty stocks are common in S&P BSE Sensex; in fact Sensex has only 3 uncommon stocks while comparing with Nifty. Where such a high commonality has been spotted there the movement pattern tend to be similar too. Stochastic Drift indicates change in the average value of any random process. As both the movement of the indices is random in nature, so, it could be derived that they could be measured by this unique statistical measurement too. Now since both are falling into the same basket of stochastic drift, the most apt test for the linkage establishment will be the method of "Granger Causality", where one signal is determining the other. So, the signal that determines has the clue of determination of the second signal in its past behavioural pattern. Thus a valid relationship could be established. In this case, both type of Granger Causality test have been performed, that means Sensex influencing Nifty behaviour and Nifty influencing Sensex behaviour, within the fixed frame of time. Cross correlation function is used to check and identify the similarity of patterns in between the two waveforms visually representing the two indices.

Also, it has been found that most of the times both follow the same directional pattern too. Now the research question lies in the fact, that whether they follow the same stochastic drift and are they cointegrated. If they are found to be cointegrated, then arbitrage opportunities within will automatically come down. This in turn will make the markets increasingly efficient. But if they are found non-cointegrated despite having majority stocks in common, then the significant arbitrage opportunity will make both the indices a weak form of efficiency.

2. Literature Review

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3. Study

Box-Cox transformation parameter (X series)	
1	
Degree (d) of non-seasonal differencing (X series)	
0	
Degree (D) of seasonal differencing (X series)	
0	
Seasonal Period	
1	
Box-Cox transformation parameter (Y series)	
1	
Degree (d) of non-seasonal differencing (Y series)	
0	
Degree (D) of seasonal differencing (Y series)	
0	
Number of non-seasonal time lags in test	
1	
Chart options	
Width:	600
Height:	400
Label y-axis:	y
Label x-axis:	x

Table 1

Granger Causality Test: Y = f(X)				
Model	Res.DF	Diff. DF	F	p-value
Complete model	193			
Reduced model	194	-1	0.834881863583547	0.362004723810136

Granger Causality Test: X = f(Y)				
Model	Res.DF	Diff. DF	F	p-value
Complete model	193			
Reduced model	194	-1	37.9121270901734	4.20646801106115e-09

Table 2

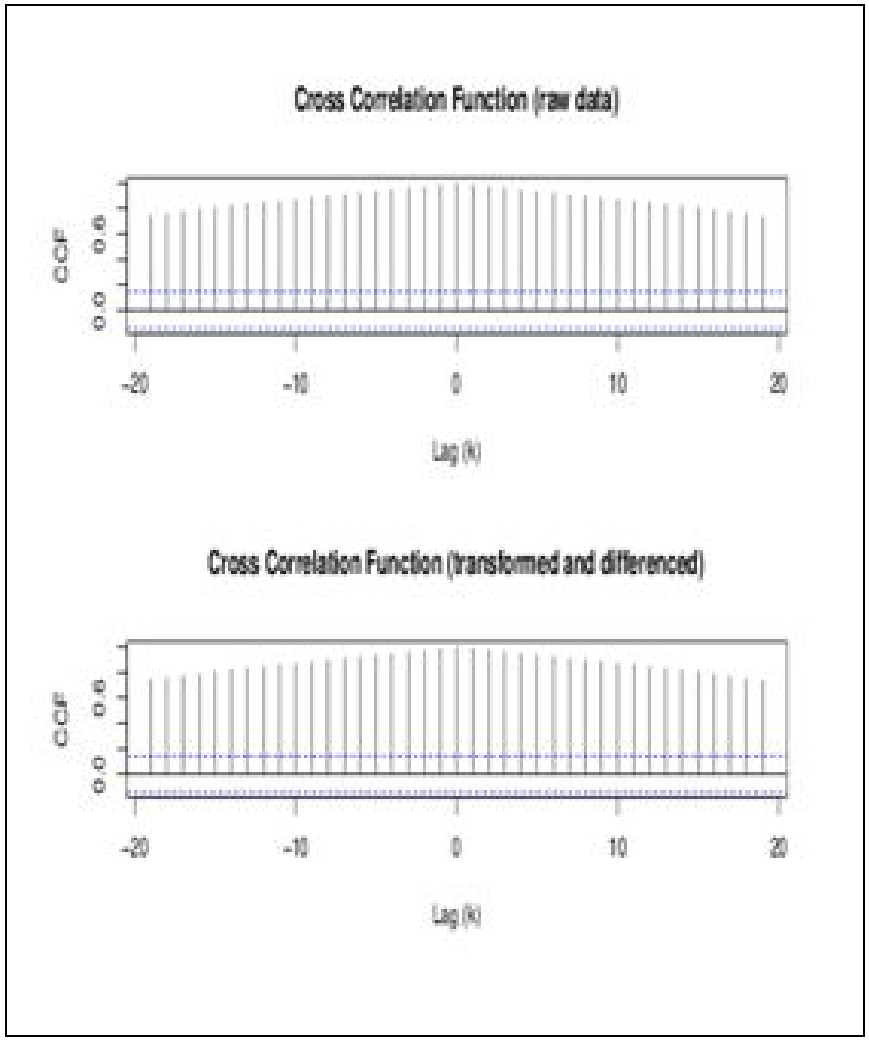

Figure 1

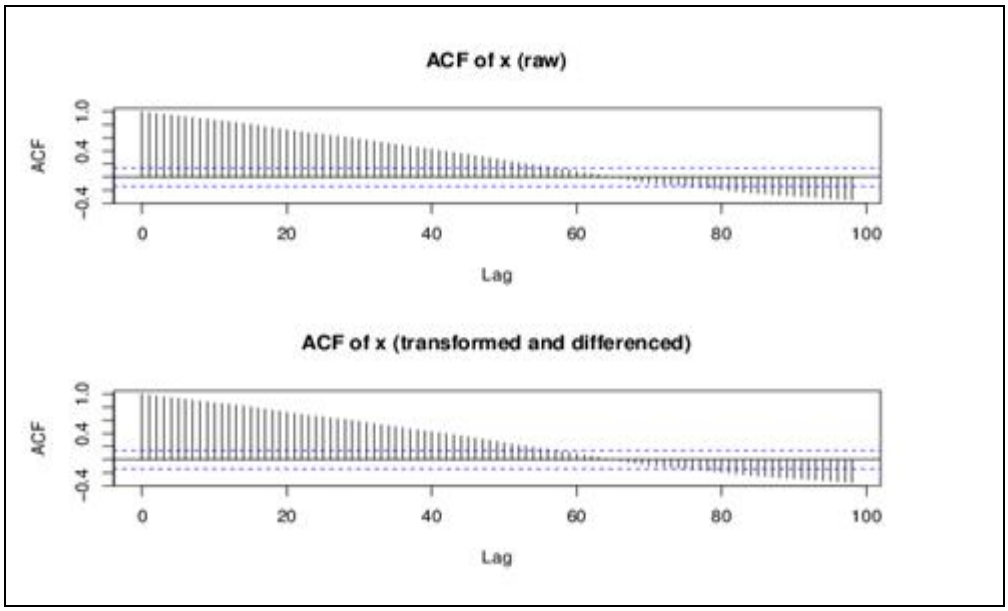

Figure 2

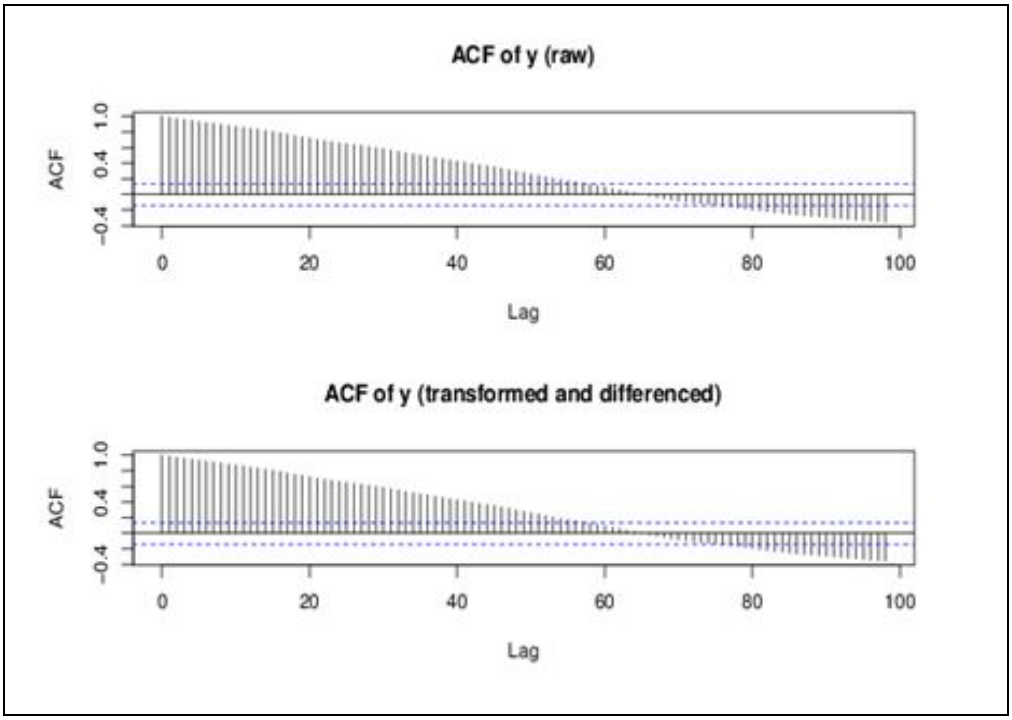

Figure 3

4. Interpretation & Conclusion

ACF & PACF interpretation shows that both raw data as well as processed (transformed and differentiated) data has values significant even after 6 lags, so the series is non-stationary. Cross correlation function clearly indicates that the two wave forms are not in same or similar order, in fact sides are tapered.

Granger Causality can be applied in three different methods. In a simple method there are two variables with their lags. In a multivariate Granger Causality more than two variables are used, as it is believed that two or more independent variables are causing the effect. It can also be tested in a VAR framework, where the multivariate model can be extended to test of simultaneity of all included variables. In this case the researcher has accepted the first method. The cardinal reason for acceptance of the first method has been rested on the logic of being more than 54% commonality in Nifty from Sensex and 90% commonality in Sensex from Nifty. Granger Causality regression shows that P Value of the first case that is Sensex is independent and NIFTY depends on Sensex comes around 36% with error level range of 5%. So, as the data is far above the error limit, we have to conclude that Granger Causality Test proves that Sensex & NIFTY do not have a common stochastic drift.

The second part of the test in which Sensex depends upon NIFTY, so NIFTY is X and Sensex is Y, the results are shocking. NIFTY cannot alter the stochastic drift of Sensex as the P Value is 420%.

So in one case the value, that came out is 415% out of the error limit and the other is 31% out of the error limit. So, we can hereby conclude that though they do not have similar or same stochastic drift, at least within the same study period, NIFTY still accepts certain clues from Sensex, but the reverse is not true at all. This gives birth to the age old debate, that why Indian stock indices are weak form of efficiency. So, stocks despite being the same behave differently when in different indexes. This opens up a new angle of thought that investor buying behaviour is dependent on stocks but not alone on the contrary, on the index too.

Thus Indexes do not follow each other (waveforms do not match each other and cross correlation function depict the same).

Arbitrage opportunities will exist and traders will take the advantages. For investors, it will be increasingly difficult to study the pattern in order to safeguard their wealth.

5. Limitations

This study captures a relatively shorter time frame of 11 months. However this same study could be repeated with arelatively longer time frame. Sensex could be put in comparison with S&P BSE 100. Again all different type of Granger Causality could be taken into consideration. Two or more Indices could be considered too. Partitioning around medoids (PAM), algorithm is another effective method of clustering, which could be used.

6. Teaching Notes

This study depicts and reaffirms the state of Indian stock markets, as weak form of efficiency. Where despite being more than 54%participation in one of the premier index, the influencing is not being found. Tracking of these two premier Indices have to be done separately.

7. Key Take Away

The cardinal point is no cross correlation and no similar stochastic drift between S&P BSE Sensex & CNX Nifty, within the said study period under consideration.

Arbitrage opportunities being present clearly will help the day traders instead of the long term investors. Also, pattern tracking of CNX Nifty could be dealt in a different way.

8. Further Scopes of Research

Johansen's cointegration test could be performed under the same research window. Artificial Neural Network & Fuzzy Neural Network could be used in the same study too, for a different perspective. The cardinal question remains whether investors are focusing on indexes first and then stocks or not.

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