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## **FRACTAL AND ENTROPY ANALYSIS OF NIGERIAN ALL SHARE INDEX (ASI) AND GROSS DOMESTIC PRODUCT (GDP)**

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### **ABSTRACT**

Nigeria is one of the fastest growing economy in the world. This study aims to investigate the dynamics of two important economic indices in Nigeria – All Share Index (ASI) and Gross Domestic Product (GDP) using the Hurst and Entropy measures. Data used in this study were obtained from the Central Bank of Nigeria for the period 1981 – 2012. Results obtained indicates that the indices (GDP and ASI) show persistence and high disorder. Despite high disorder (randomness), the two indices show tendencies to grow in the future.

**Keywords:** GDP All Share Index CBN Hurst Exponent Entropy

### **1. INTRODUCTION**

Nigeria is the largest economy in Africa with a population of over 140 million [1]. The country gained independence from British Colonial Masters in 1960. The economy was before 1980s mainly agrarian in nature. With the discovery of crude oil, the agricultural sector witnessed a major decline in output.

Two commonly used indicators of economic growth are the strength of the capital market and Gross Domestic Product. The capital market, according to [2], is a collection of financial institutions set up for the granting of medium and long term funds for development. A growing capital market is an indication of a developing private sector, high earning and saving power of the citizens and access to long term funding. The Nigeria Stock Exchange, Lagos was established in 1961 with branches in major cities in the country. It is the main-operator of capital market operations in the country. The other indicator of economic growth is the Gross Domestic Product (GDP). The GDP is the money value of goods and services produced in an economy during a period of time irrespective of the nationality of the people who produced the goods and services. It is calculated without making deductions for depreciation [2].

There exist many indices for examining nonlinearity in time series. The Hurst exponent can be used to determine whether a time series is random or not. The exponent shows persistence, anti-persistence and randomness in a time series. If the exponent,  $H$  is between 0 and 0.5, it implies an increasing trend will like be followed by a decreasing trend while values of  $H$  between 0.5 and 1 indicates persistence (increasing trend will be followed by increasing trend – long memory). Entropy is the degree of disorderliness in a time series [3,4].

Financial and market data have been investigated by several authors for nonlinear properties. It has been shown that that there is no direct linkage between the All Share Index and Exchange rate [5]. A mutual fund in Nigeria has been shown to exhibit chaotic features [6]. The Czeck GDP has been found to have a Hurst Exponent of 0.96. The Hurst Exponent from twelve (12) different countries was investigated by Mitra [7] and found to be within 0.46 – 0.54. A value of 0.63 was obtained as Hurst Exponent for exchange rates of Brazilian Exchange rates [8].

This study aims to investigate fractal structures and disorder analysis in financial indices (All Share Index and GDP) using Hurst Exponent and Entropy methods.

## 2. METHODS

The All Share Index and GDP data used in this study were obtained from the Central Bank of Nigeria [1]. Monthly values of ASI and quarterly values of GDP from 1981 – 2012 were retrieved from the site. To examine the underlying dynamics of the data, trends were removed by first order differencing i.e.

$$y_i = x_{i+1} - x_i \quad (1)$$

The original ASI and detrended ASI are shown in Figure 1 while the GDP data (original and detrended) are shown in Figure 2.

The Hurst Exponent was computed using the Rescaled Range Analysis method while the Shannon Entropy was also computed.

## 3. RESULTS AND DISCUSSION

The graph of All Share Index and its differenced values from 1981 – 2012 is shown in Figure 1 while the GDP and its differenced values are shown in Figure 2. Computed values of Entropy and Hurst Exponent for the GDP and ASI are presented in Table 1.

From the results obtained, the ASI shows long term memory which implies that the current increasing trend will be sustained. This was observed for both the original and differenced data. Similar results was obtained for the GDP time series.

The computed entropy values for original and differenced time series are also shown in Table 1. There is high disorderliness in all time series investigated. Values obtained for both original and difference time series in the case of ASI and GDP are very similar.

## 4. CONCLUSION

This study has investigated fractal structures and entropy analysis of two economic indices. From the results obtained, the GDP and ASI data set was found to exhibit persistence (long term memory). This implies that current increasing trend will be sustained over the foreseeable future. The two data set also show high randomness in data set. It is suggested that chaotic nature of the data set be further investigated to study the internal dynamics of the data using Lyapunov Exponent, surrogate data test, correlation dimension and other tests. This result shows that the Nigerian economy has potential for growth and a good destination for investors.

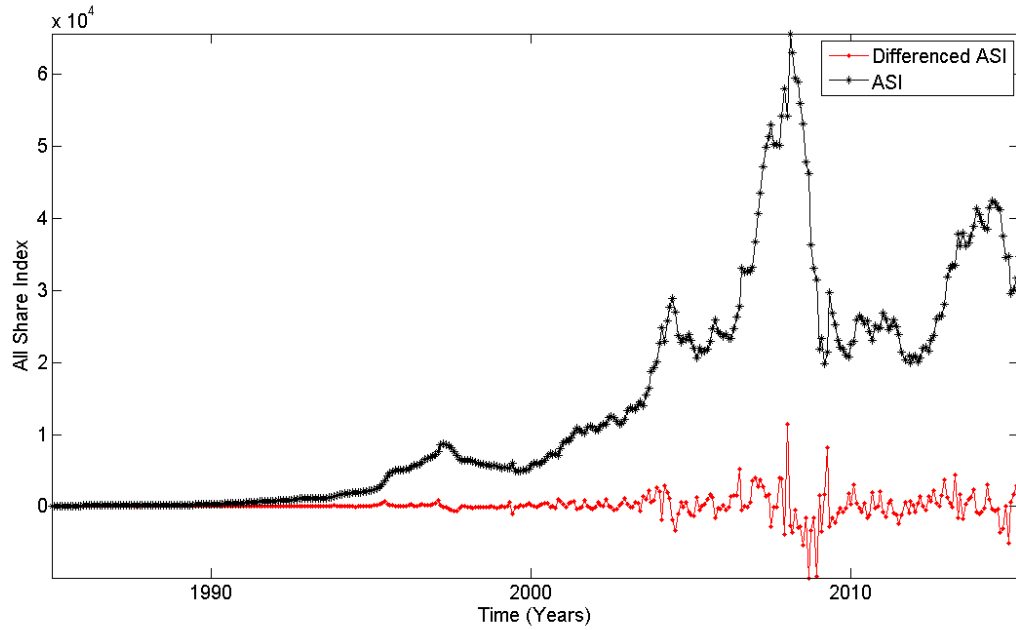


Fig. 1. All Share Index of the Nigerian Stock Exchange

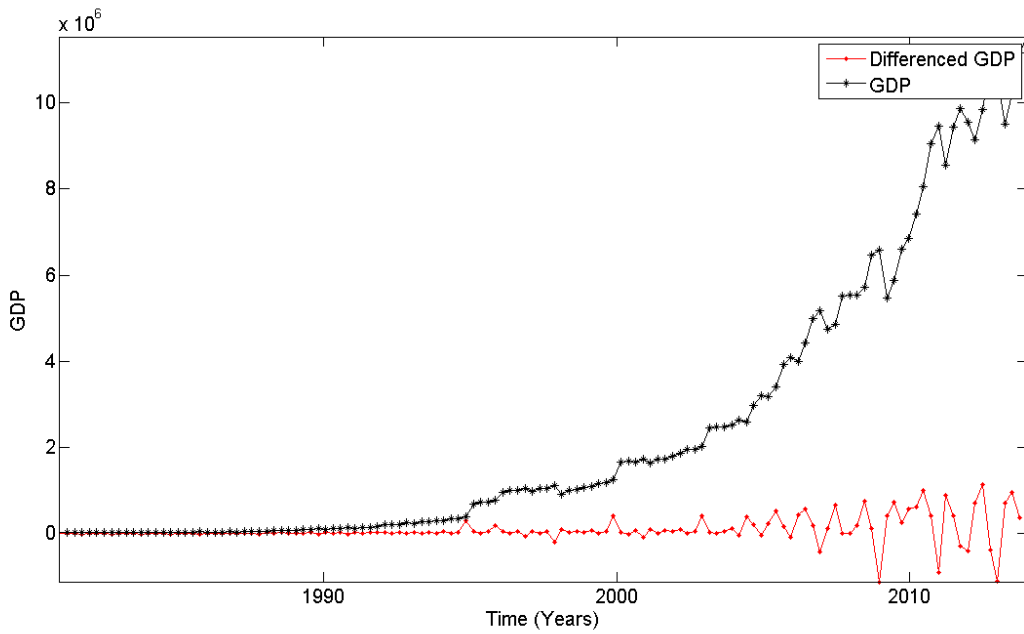


Fig. 2. Quarterly values of Gross Domestic Product of Nigeria

Table 1. Hurst and Entropy values for All Share Index and GDP of Nigeria

Index	Hurst Exponent	Entropy
All Share Index	0.9946	8.497
Detrended ASI	0.6723	8.445
GDP	1.0000	7.044
Detrended GDP	0.7640	7.0334

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