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Does Stock Returns Protect Investors Against Inflation in Nigeria?

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Abstract
Given that one of the major challenges facing investors in Nigeria is high inflation rate, this study investigates whether stock market returns protect investors against inflation. Monthly All-share Index and monthly consumer price index from January 1985 to March 2011 were analysed for evidence of cointegration using the Engle and Granger two steps cointegration model. Results of the cointegration analyses indicate that the stock returns and inflation are cointegrated. Similarly, results of the error correction model suggest that stock returns and inflation converge to long-run equilibrium but the speed of adjustment to equilibrium is slow. The results also suggest that inflation does not have significant short-term effects on stock returns. The study therefore concludes that the Nigerian stock market protects investors' wealth against inflation in the long-run but not in the short-run.
Key words: Stock Returns, Inflation Rate, Cointegration, Nigerian Stock Exchange.

1. Introduction

One of the major challenges facing investors in Nigeria is high inflation rate (Gunu and Idris, 2009). Inflation rate in Nigeria has been witnessing a rising trend. For instance, inflation rate in Nigeria rose from 5.7% in 1986 to 54.5% in 1988. By 2003, inflation rate is still as high as 23.9% (Babalola, 2007). On the average inflation rate in Nigeria has maintained a double digit. Inflation rate of this magnitude may have significant adverse effect on the investors, particularly in the context of fixed nominal interest rate. Interest rates on money market instruments have been low in relation to inflation rate. In 1988, the Deposit Money Bank (DMB) rate for Time deposit with maturity period of 12 months and above was 14.30%. By 2003, it fell to 11.88% (Central Bank of Nigeria, 2008). As at March 2011, inflation rate was still as high as 12.8 (National Bureau of Statistics, 2011), while deposit rate was a little above 4%. These clearly show that investors earn negative real returns from their deposits with DMBs in Nigeria, and as such, are not protected against inflation. On the other hand, the All Share Index (ASI), which is an indicator of the average price level on the Nigerian Stock Exchange (NSE), grew massively to 57990 points by December 2007 from 1113.4 points in January 1993. Though it fall to 23999 points by March 2011 owing to the global financial crises, NSE returns may have the potential for protecting Nigerian investors against double digit inflation rate.

The ability of financial assets returns to protect investors inflation is not a new a topic in both theoretical and empirical literature. The genesis of the debate goes back to Fisher (1930). According to the Fisher hypothesis, rational individuals focus on real return on investment, that is, after accounting for inflation. Generalizing the Fisher hypothesis to stock markets, the nominal stock returns needed to yield positive inflation adjusted return is the sum of the desired real return plus expected inflation. In stock markets where Fisher Hypothesis holds true, nominal stock prices should fully reflect expected inflation and the relationship between stock returns and inflation should be positive. As a result, investors are fully compensated for increases in the general price level through corresponding increases in nominal stock market returns and the real returns remain unaffected. In other words, the real value of the stock market is immune to inflation pressures.

Numerous studies have empirically investigated the ability of stock returns to hedge inflation in both developed and emerging stock markets. While some of the earlier studies find evidence of positive relation between stock returns and inflation (see for example, Firth, 1979; Gultekin, 1983), others found negative relation (see for example, Linter, 1975; Bodie, 1976). There are also studies that found evidence of partial hedge for stock returns against inflation (see, Anari and Kolari, 2001; Luintel and Pandyal; 2006). Evidence of stock returns providing hedge against inflation at some time periods and not in other periods also exist in literature (see for example, Spyrou, 2001). Studies conducted using Nigeria data have largely concluded that stock returns hedge inflation in the long-run (see, Nwokoma, 2005; Alagidede, 2009; Omotor, 2010).

This paper uses a more recent data, which include the period of global financial crises, to extend literature of the stock returns-inflation relation in Nigeria within the framework of cointegration introduced by Granger (1981). The Engle and Granger (2003) two steps cointegrating method was used to analyse data obtained from the Nigerian Stock Exchange (NSE) and the National Bureau of Statistics (NBS) not just for long-run but also for short-run relations between stock returns and inflation. The remainder of the paper is organised as follows. Section II embodies a brief review of the relevant literature. Section III provides methodology. Section IV presents empirical results and discussions, and section V concludes.

2. Brief Literature Review

The Literature on the relationship between stock returns and inflation is one of the longest in economic research. The traditional view that nominal rates of returns should move one-to-one with inflation is first attributed to Fisher (1930). According to this hypothesis, rational individuals are concerned with real return on investment. The real return on investment here implies rate of return that is earned after subtracting inflation rate. Hence, the nominal stock returns (R_t) needed to sustain investors' confidence in a stock market is the sum of the desired real return (D_t) plus expected inflation (I_t). The Fisher relation is represented symbolically as follows:

$$R_t = D_t + I_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

If relation of equation (1) holds between stock returns and inflation, stock returns would to co-vary positively with inflation rates, thereby making stock returns perfect hedge against inflation.

Numerous empirical studies document evidence to show that the Fisher's hypothesis holds true. Firth (1979) and Gultekin (1983) conclude that the relation between nominal stock returns and inflation in United Kingdom is positive. Loannidis et al. (2004) using data from 1985 to 2003, find evidence of positive relation between inflation rates and stock returns in Greece. Anari and Kolari (2001) and Luintel and Pandyal (2006) find evidence consistent with the fact that stock market provide a partial or complete hedge against rising inflation. Contrary to empirical evidence of positive relation between stock returns and inflation, evidence of an inverse relation has also been documented several classic papers including Linter (1975), Bodie (1976), Nelson (1976), Jaffe and Mandelker (1976), and Fama and Schwert (1977). More recently, Spyrou (2001) finds that the relationship between inflation and stock returns seems negative and significant, but that the relationship became insignificant after 1995, suggesting that the relation may change over time and may also depend on the period examined.

Various explanations of the inverse relation between stock returns and inflation have been offered. For example, Modigliani and Cohn (1979) maintain that stock market investors are subject to inflation illusion so that when inflation rises, they tend to discount expected earnings and dividends more heavily by using higher nominal interest rates. As a result, share prices are undervalued when inflation is high and may become overvalued when inflation falls. Feldstein (1980) argues that much of inflation's negative valuation effect could be explained by the interactions between inflation and tax laws, particularly those arising from historic cost depreciation and taxation of nominal capital gains. Fama (1981) propose the Proxy Hypothesis to explain the observed negative relation between inflation and stock returns. The hypothesis holds as follows, (i) a rise in inflation results in a decline in real economic activity; (ii) the stock market anticipates the decline in corporate earning associated with this slowdown. Hence, the regression of stock returns on inflation is spurious, that is inflation merely acts as a proxy for the true fundamentals – anticipated real economic activity. By extending this hypothesis, Geske and Roll (1983) support the basic idea that once one controls for the link between expected inflation and expected real activity, one is less likely to reject the traditional view that it is not expected inflation, or increases in expected inflation, per se, that cause lower real stock returns. Campbell and Vuolteenaho (2004) argue that inflation is highly correlated with stock market mispricing, and that investors fail to adjust their expectations for earnings growth during periods of rising inflation.

In spite of these plausible explanations for negative relation between stock returns and inflation found in literature, some studies have shown that the negative effect of inflation on stock returns tends to diminish at longer horizons (see foe example, Boudoukh and Richardson, 1993; Lothian and McCarthy, 2001). More recently, Akmal (2007) finds that stock returns hedges inflation in the long-run but not in short horizon and that the estimated relation between nominal stock return and inflation may even be negative in short horizon.

The relation between stock returns and inflation has also been studied in Nigeria. For instance, Omotor (2010) investigates this relation using monthly and quarterly data for the period 1985 to 2008 and finds that stock returns provide effective hedge against inflation in Nigeria in the long-run. Maku and Atanda (2009) examine the long-run and short-run effect of macroeconomic variables, including inflation, on the Nigerian capital market between 1984 and 2007. Their results reveal that macroeconomic variables exert significant long-run effect on stock market performance in Nigeria. In his PhD thesis, Bekithemba (2009) examined the relation between stock returns and inflation in Sub-Saharan countries. The study provides evidence to show, amongst others, that there is long-run positive relation between stock returns and inflation rate in Nigeria. Alagidede (2009) questions whether common stocks can act as a hedge against inflation in six African countries including: Egypt, Kenya, Morocco, Nigeria, Tunisia and South Africa. He finds evidence of positive relation between inflation and stock returns in Kenya, Nigeria and Tunisia. He concludes that stocks are good hedge against inflation over long horizons. In investigating the stability of stock market returns in three African stock markets, Nwokoma (2005) found evidence of a positive relationship between stock returns and inflation in Nigeria, but inconclusive results for Kenya and South Africa. Soyode (1993) tested the association between stock prices and exchange rate, inflation and interest rate. He finds that these macroeconomic variables are cointegrated with stock prices.

3. Methodology

3.1. Model Specification

The theme of Fisher relation is the notion that rational individuals focus on real return on investment, that is, after accounting for inflation. Therefore the expected nominal stock returns should be the sum of the desired real rate of return and inflation rate. Thus, if this relation holds in the case of the NSE, average stock returns should keep pace with the rate of inflation. To empirically verify this hypothesis in the case of Nigeria, we adopt a model of cointegrating regression following earlier studies (Firth, 1979; Lothain and McCarthy, 2001) as follows:

$$ASI_t = \alpha + \beta CPI_t + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where: ASI_t is the average stock returns in Nigeria in month t, CPI_t is the rate of inflation in month t, α and β are coefficients to be estimated and μ is the error term. Under the Fisher relation, β is *a priori* expected to have a unit value to ensure that investors are fully compensated for anticipated rates of inflation (Firth, 1979).

3.2. Data

The data for this study are the monthly All-Share Index (ASI) of the NSE and monthly Consumer price index (CPI) in Nigeria. While the ASI measures the average change in prices of all listed shares on the NSE, the CPI measures the average change over time in prices of goods and services consumed by people for day-to-day living in Nigeria. The monthly ASI was obtained from the NSE and the monthly CPI was obtained from the National Bureau of Statistics (NBS). The period under consideration for the variables ranges from January 1985 to April 2011, which yields 316 observations.

3.3. Estimation Techniques

We adopt the Engle-Granger two-step method to examine whether a cointegrating relation exists between stock returns and inflation in Nigeria, as well as the short-run effect of inflation on stock returns and the speed of error correction, if any, among the variables. The Engle-Granger method involves following steps.

The first step involves determining whether a set of data contain unit roots in the individual time series. Unit root tests are used to determine whether time series exhibit mean-reverting behaviour by showing their order of integration. If a pair of time series, such as ASI_t and CPI_t, are $I(1)$ variables, then cointegration techniques can be used to model their long-run relationship. The Augmented Dickey-Fuller (from fuller, 1976 and Dickey and Fuller, 1979) and Phillips-Perron (from Phillips, 1978, and Phillips and Perron, 1988) are used to examine the order of integration of ASI_t and CPI_t. The ADF test is estimated thus:

$$\Delta Y_t = \alpha_o + \beta t + \alpha_1 Y_{t-1} + \sum_{i=2}^{n} b_1 \Delta Y_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The null hypothesis is that Yt contains unit root, which implies that $\alpha_1 = 1$, against the alternative that the series does not contain unit root, which implies that $\alpha_1 < 1$. Dickey and Fuller (1981) provide cumulative distribution

function of the ADF statistic. If the computed absolute value of the coefficient of α_1 is less than the ADF critical tau values, reject the null hypothesis that $\alpha_1 = 1$, in which case Yt does not contain unit root. Otherwise accept the null hypothesis, in which case Yt contains unit root.

Phillips-Perron non-parametric test is used to confirm the result of the ADF test. One of the advantages of the PP test over ADF is that it is robust to general forms of heteroscedasticity in error term (ε_t). Another advantage is that the user does not have to specify a lag length for the test regression. The Phillips-Perron is estimated as follows:

$$Y_t = \alpha_o + \beta t + \alpha_1 Y_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The null hypothesis of the PP tests is that there is a unit root in Y_t series, against the alternative hypothesis of no unit root in Y_t. The decision rule of PP tests is the same with ADF.

Once the order of integration of the series (ASI and CPI) are confirmed I(I), we estimate the long-run relationships, i.e., run regression on equation (2) and save the regression residuals. In order for the ASI_t and CPI_t to be cointegrated, the estimated residual from the equation (2) should be stationary (i.e., $\mu_t \sim I(0)$).

The residual-based unit root test is used to examine whether the residuals from equation (2) are stationary. If they are stationary, then the series are cointegrated. If the residuals are not stationary, there is no cointegration. Rejecting the null hypothesis of a unit root, therefore, is evidence in favour of cointegration (Engle and Granger, 1987; Lee, 1993). Residual-based test is estimated as follows:

$$\Delta\mu_t = \alpha_1 \mu_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where, $\Delta\mu_t$ are the estimated first differenced residual, μ_{t-1} are the estimated lagged residuals, α_1 is the parameter of interest representing slope of the line, ε_t are errors obtained from the regression. Since the μ_t sequence is a residual from a regression equation, there is no need to include an intercept term (Nnachi, 2008: 95). If the NSE returns (ASI_t) and inflation in Nigeria (CPI_t) are cointegrated, ε_t should fail a unit root test.

The second step involves estimating an Error Correction Mechanism (ECM) by ordinary least square (OLS). ECM is based on the assumption that two or more time series exhibit an equilibrium relation that determines both short-run and long-run behaviour. It therefore models both short-run and long-run relations jointly. According to the Granger representation theorem, for any set of I(I) variables, error correction and cointegration are equal representations. In other words, if a number of variables, such as ASI_t and CPI_t, are cointegrated there will be ECM relating the variables. The ECM is estimated thus:

$$\Delta ASI_t = \alpha_o + \alpha_1 \Delta CPI_t + \alpha_2 \mu_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots (6)$$

Where, Δ denotes the first difference operator, α_1 is the inflation coefficient, α_2 is coefficient of the one period lagged value of the error term from the cointegrating regression in equation (2), and ε_t is a random error term. The α_1 measures the short-term effect of inflation on stock returns. The α_2, which is the error correction term, captures the rate at which stock return adjusts to the equilibrium state after a shock. The coefficient of α_2 should be negative in sign for the series to converge to long-run equilibrium. Negative and statistically significant α_2 coefficient is regarded as a convincing evidence and confirmation for the existence of cointegration found in the cointegrating regression (Engle and Granger, 1987). More so, the size of α_2 is an indication of the speed of adjustment towards equilibrium. Small coefficient of α_2, tending to -1, indicate that the speed of adjustment is fast; Larger values, tending to 0, indicate that adjustment is slow; and positive values would imply that the series diverge from the long-run equilibrium path.

4. Empirical Results and Discussions

4.1 Descriptive Statistics

Figure *1* and *2* present graphic relation between the stock index and inflation in Nigeria. The major feature of figure *1* is the upward drift in levels of the stock returns and inflation series. The upward drift of the series are clearly sign of non-stationarity as they exhibit positive trend and the series are not mean-reverting. On the contrary, the first differenced series in Figure *2* appear to have short memory, in which the series are briefly

interrupted and quickly returns to pre-shock levels. These indicate that the levels of the series are trending and appear non-stationary, whereas their logarithmic first differences are mean-reverting and appear stationary.

Table *1* shows descriptive statistics of the stock index and inflation in Nigeria. We observe, from this table, that annualized monthly mean return of the NSE over the sample period is 20.63%, whereas the annualized average monthly inflation rate is 18.60%. This suggests that the NSE mean return is greater than the average inflation rate over the sample period. The distributional characteristics of the two series appear to be inconsistent with the normality assumption. In a normally distributed series, the skewness is zero (0), Kurtosis is three (3), and Jarque-Bera is equal to zero (0). Positive or negative skewness and J-B indicate evidence against the normality assumption. Also, Kurtosis greater than or less than *3*, suggest deviation from normality. From table *1*, Skewness is -0.6483 and 1.0866 for stock returns and prices respectively. These show that while the stock returns are skewed to right, the inflation rates are skewed to left, indicating evidence of asymmetric distributions. Kurtosis is 8.8873 and 6.9334 for stock returns and inflation respectively, indicating evidence of leptokurtic distribution. Jarque-Bera is 1058.7433 and 692.9487. The overall results from table *1* indicate evidence against normal distribution in the series at 1% significance level.

4.2 Testing for Unit roots

Table *2* presents results of unit root tests performed on logarithmic levels of stock returns and inflation as well as their first differences. It can be observed from the ADF and PP tests results that both stock returns and inflation contain unit root at conventional significance levels (i.e., $ASI_t \sim I(1)$ and $CPI_t \sim I(1)$). At first differences, however, the results show that the series do not contain unit root (i.e., $ASI_t \sim I(0)$ and $CPI_t \sim I(0)$). These results indicate that the series require first differencing to achieve stationarity; they are $I(1)$ variables. Hence, we can conduct cointegration tests on the variables.

4.3 Testing the Long-run Relationship

In this section, the results of the relation expressed by equation (2) are presented. Table *3* shows the estimated results of the Engle-Granger cointegration test and Table *4* shows the results of the residual-based test.

It is clear from the results that we cannot reject cointegration (i.e. long-run relation) between stock returns and inflation as measured by the CPI. From the residual-based unit root test performed on the residuals and presented in table *4*, it can be seen that the test statistic (-6.204) is less than the 5% critical tau (τ) value (-2.871). Since the computed τ value is less than the conventional critical tau values, we reject the null hypothesis of no cointegration in favour of the alternative. This result, therefore, indicates evidence of long-term relation between stock returns and inflation in Nigeria.

Similarly, the estimated inflation coefficient is positive (0.027) and statistical significant at 5% level of significance. This result satisfies our *a priori* expectation of positive, though not unit, slope coefficient. It also suggests that the real rate of return on the NSE is invariant to the rate of inflation in Nigeria. Any shock to the stock returns or inflation rate will briefly interrupt this equilibrium relationship existing between the two variables, but they will return to the pre-shock levels. The speed of this pre-shock adjustment will however depend on error correction mechanism.

4.4 Estimating the Error Correction Mechanism (ECM)

This section presents the results of the ECM. The model of the ECM is of the form of equation *6* and the estimates of the short-run and long-run movements, as well as the error correction term, which proxies speed of adjustment, are provided in table *5*. It can be observed that short-run changes in inflation have a positive but statistically insignificant impact on short-run changes on stock returns. This suggests that stock returns do not protect investors against inflation in the short-term in Nigeria. Similar result has also been documented in literature (see for example, Akmal, 2007).

Table 5 also shows useful long-run information. The equilibrium adjustment coefficient (-0.0238) enters with a correct sign (negative). This suggests that stock returns and inflation series converge to long-run equilibrium; deviations from this equilibrium relationship as a result of shocks will be corrected over time.

It can also be observed that α_2 tends to zero, indicating that the speed of adjustment to equilibrium is slow. It follows that about 2.39% of the deviation from equilibrium path is corrected per month. The ECM results

therefore confirm the long-run relation between stock returns and inflation observed from the residuals of equation *2* but do not appear to show such relation in the short-run.

This lack of significant positive relationship between stock returns and inflation in the short-run contradicts the notion of numerous speculative investors who invest in the NSE for short-term profit. In 2007 for instance, the NSE yielded 74.8% annual return and 12.09% return between January and February 2008, out-performing other major stock exchanges in the world. These high returns attracted so many investors who entered the market to reap benefits of the short-term high returns. Not so long after the market yielded these high returns, the market witnessed a crash which resulted in a massive fall in the index. From March 2008 to December 2009, the NSE lost over 70% percent of its value. This heavy loss in value of the market resulted in not only mass exit from the market but also loss of confidence in the market.

Despite the huge loss in the value of investments, results of this study suggest that the NSE has protected investors' wealth against inflation over the sample period. For instance, the annualized average stock returns (20.63%), despite the huge loss in NSE returns resulting from recent global economic crunch, is greater than the average inflation (18.60%), despite the high inflation rate In Nigeria. Thus indicating that, on average, an investment in the NSE portfolio would be protected against inflation on the long-run. But this protection is not guaranteed for short-run investors. Results of this study therefore reaffirm ability of the stock market, as a long-term investment avenue, to protect investors against inflation in the long-run in Nigeria.

5. Conclusions

This paper analyses the relation between stock returns and inflation in Nigeria using the Engle-Granger two steps cointegration method. The economic motivation is to assess whether investment in equity market protects investors against inflation in both short-run and long-run in Nigeria. The descriptive statistic shows that the NSE average return is greater than the average inflation rate for the sample period. The analyses of residuals from our cointegrating regression indicate evidence of cointegration between stock returns and inflation. Similarly, estimates from the error correction model provide evidence to show that stock returns and inflation series converge to a long run cointegrating equilibrium but at a very slow rate. The ECM results also show that short-run changes in inflation have a positive but statistically insignificant impact on short-run changes in stock returns, suggesting that stock returns do not protect investors against inflation in the short-run. We therefore conclude that stock returns protect investors' wealth against inflation, in the long-run but not in short-run, in Nigeria.

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Appendices

Figure 1: Log-Level All-share Index and Consumer Price Index

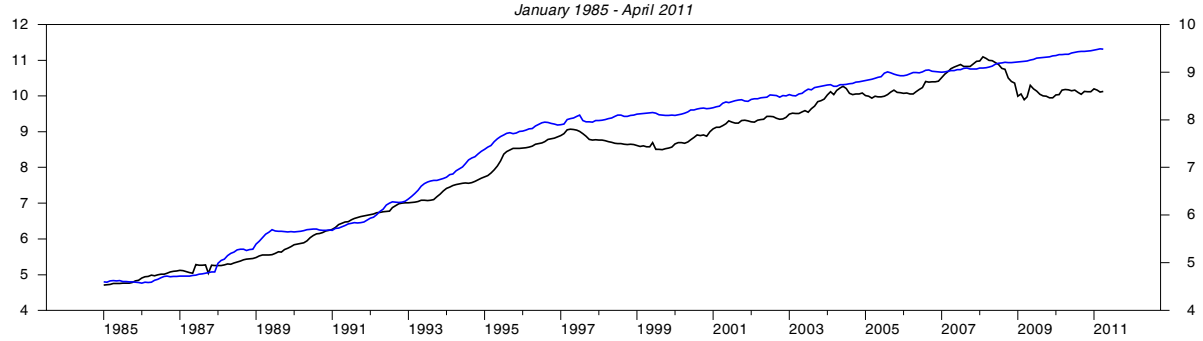

Figure 2: First Differenced All-Share Index and Consumer Price Index

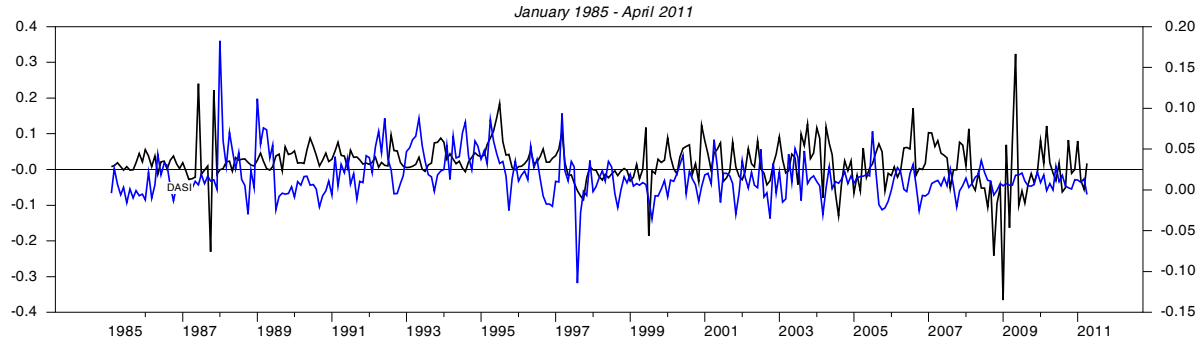

Table 1: Descriptive Statistics of ASI and CPI

Variable	Description		Variable	Description	
(ASI_t)	Observations	316	**(CPI_t)**	Observations	316
	Mean	0.0171		Mean	0.0155
	Variance	0.0037		Variance	0.0007
	Std. Dev.	0.0610		Std. Dev.	0.0264
	Skewness	-0.6483 (0.0000)		Skewness	1.0866 (0.0000)
	Kurtosis	8.8873 (0.0000)		Kurtosis	6.9334 (0.0000)
	Jarque-Bera	1058.74 (0.0000)		Jarque-Bera	692.94 (0.0000)

Note: coefficients in bracket indicate marginal significance level.

Table 2: Unit Root Tests Results

Variables	Critical Value 10%	Critical Value 5%	Critical Value 1%	Computed value	Unit Root Test
ASI	-3.13573 {-3.13563}	-3.4257 {-3.4255}	-3.99106 {-3.99071}	-0.31476 {-0.19803}	ADF PP
CPI	-3.13568 { -3.13563}	-3.42564 { -3.42556}	-3.99088 { -3.99071}	-0.55676 { -0.26188}	ADF PP
Variables	**Critical Value 10%**	**Critical Value 5%**	**Critical Value 1%**	**Computed value**	
ΔASI	-3.13575 { -3.1357 }	-3.42577 { -3.4256 }	-3.99115 { -3.9908 }	-6.08189** { 15.5151**}	ADF PP
ΔCPI	-3.13568 { -3.1357}	-3.42564 { -3.4256}	-3.99088 { -3.9908}	-8.19127** { 11.9744**}	ADF PP

Note: Lag length on ADF chosen using Akaike Criterion. ** indicates significant at 1% level of significance.

Table 3: Estimation Results of Long-run Relationships ($ASI_t = \alpha + \beta CPI_t + \mu_t$)

Variable	Coefficient	Std Error	T-Stat	Significance	D-W
Constant (α)	0.02184	0.01898	1.15053	0.25081	2.059
CPI (β)	0.02737*	0.01371	1.99668	0.04673	

Note: D-W is Durbin-Watson statistic. * indicates significant at 5% level of significance.

Table 4: Residual-based Unit Root Test ($\Delta\mu_t = \alpha_1\mu_{t-1} + \varepsilon_t$)

Variables	Critical Value 10%	Critical Value 5%	Critical Value 1%	Test Statistic
Residuals (μ_t)	-2.57179	-2.87102	-3.45316	-6.20395**

Note: ** indicates significant at 1% level of significance.

Table 5: Error Correction Mechanism ($\Delta ASI_t = \alpha_o + \alpha_1\Delta CPI_t + \alpha_2\mu_{t-1} + \varepsilon_t$)

Variable	Coefficient	Std Error	T-Stat	Significance
α_o	0.010799832	0.004194261	2.57491	0.01049178
α_1	0.144035965	0.141329658	1.01915	0.30892955
α_2	-0.023852819	0.011449839	-2.08324	0.03805069

R^2 = 0.1196 **D-W = 2.0641**

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