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Inflation and Stock Market in India: An Analysis

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Abstract

This paper checked whether inflation matter for stock markets or not. In this paper the nature of relationship and the causality between inflation rates and stock market is checked for the period ranging from April 2005 to March 2015 for Indian market. Augmented Dickey-Fuller Unit Root test is applied and it is found BSE 100 series and Wholesale price Index series are non-stationary at level and at first difference these series are stationary. And then by applying Granger-Causality test, it is found that there is no causal relationship between inflation rates and stock market in Indian context. They do not lead or lag each other. Again, by applying Johansen co-integration test it is seen that inflation rates and stock market do not move together in the long run and there is co-integration between them. The findings of this paper might help policy makers and investors to take better decisions.

Keywords: *Inflation Rate, Stock Market, Granger Causality, Johansen Co-integration.*

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INTRODUCTION

Stock market is one of the mostimportant barometers to assess the health of an economy. Any country's industrial & commercial growth is analysed through its stock returns. Both investors and companies need stock market as investors need it for their portfolio returns and companies need it to raise funds. Stock market is mainly the place where companies get listed to issue the shares and raise the fund and investors get marketability as well as liquidity.

The stock market works with the sentiments of participants, which depend on macroeconomic and other factors, which makes it a very sensitive segment of the economy. New Economic reforms in 1991 have added to the sensitivity by increasing determinants

of the stock market movement manifold. Among the various important determinants, one whose relationship with the stock market is of great concern is inflation rate as it is directly related to economic growth.

The theoretical relationships between stock returns and inflation have been denominated by two schools of thoughts. The first is based on the generalization of Fisher's hypothesis or Fisher effect proposed by Irvin Fisher in 1930. It states that expected rate of return on an asset should comprise of real return plus a compensation for expected rate of inflation. In the context of stock market, to provide hedge against inflation then stock returns should rise along with inflation.

However, some studies like Fama and Schwert (1977); Chen et al. (1986) found statistical evidence that rejected Fisher's hypothesis and established a negative relationship between stock returns and inflation. So, here emerges a second school of thought which is based on Fama's Proxy Hypothesis. Fama (1981) proposed that there is a negative relationship between stock market returns and inflation. He argued that this negative relationship is due to the positive causal link between real output and stock returns and a negative causal link between real output and inflation. As rise in inflation leads to an increase in discount rate in stock valuation model which leads to lower stock prices and lower stock returns. Also inflation increases the consumption expenditure which leads to a fall in investments as more resources will be consumed in consumption expenditure.

The purpose of this study is to investigate the short run causal relationship between inflation and stock returns and also to examine the long run co-integration for India for a comprehensive period of 10 years from April 2005 to March 2015 using Unit root test, ADF test, granger causality, and Johansen co-integration test.

This research paper would be of particular relevance to various stakeholders such as regulators and policy makers, investors, academicians and researchers. As regulators would be able to frame inflation policies which improve stock returns and minimize volatility. Investors can use this study to plan their investment strategies after considering the impact of future expected inflation on stock returns.

REVIEW OF LITERATURE

Various research paper have been studied and few prominent studies are discussed below:

Joshi (2015) studied the causal relationship between stock prices and macroeconomic variables like inflation, exchange rate, foreign institutional investments, gold prices, etc from 2008-09 to 2013-14 using causality tests, VAR technique and Unit Root tests. It was found that stock market does not granger cause Foreign Institutional investors, Gold, M3, inflation while stock market does granger cause Crude Oil, Exchange Rates and Index of Industrial Production

Al-Majali and Al-Assaf (2014) investigated whether Amman Stock Exchange, Jordan is affected by macroeconomic variables or not. They took quarterly data from 1992 to 2014 and used Johansen Cointegration test and Vector Error Correction Model, Impulse Response Function (IRF) and Variance Decomposition (VD) techniques. Their empirical results showed that there is a long run equilibrium relationship among stock market index and the main macroeconomic variables in Jordan.

Tripathi and Kumar (2014) examined long term relationship between inflation and stock returns in BRICS markets using panel data for the period from March 2000 to September 2013. They found negative relationship between stock index and inflation rate for Russia and a significantly positive relationship for India & China. Their results also showed there is no long term co-integrating relationship between stock index values and inflation rates using Pedroni panel co integration test.

Hosseini, et al (2011) checked the relationship between stock market and four macroeconomics variables, i.e., crude oil price,

money supply, industrial production and inflation rate in China and India for the period 1999-2009. Their result depicts long and short run linkages between macroeconomic variable and stock market index in each of these two countries.

Geetha, et al (2011) examined the relationship between stock market, expected inflation rate, unexpected inflation rate, exchange rate, interest rate and GDP for Malaysia, US and China. They found long run co-integration between these variables in all three countries but there is no short run relationship between stock market, expected inflation, exchange rate, unexpected inflation, interest rate and GDP for Malaysia and US and only short run relationship between expected inflation rates with China's stock market.

Wongbangpo and Sharma (2002) found a two-way Granger causality existed between inflation and stock prices in five ASEAN countries namely Indonesia, Malaysia, Philippines, Singapore and Thailand.

Bhattarai and Joshi (2009) analysed Nepal stock market for inflation and found that in short run there is a unidirectional causal relationship from inflation to stock index while a reverse causality from stock index to inflation existed in long run.

Shanmugan and Misra (2008) tested Indian stock market for inflation using monthly data on real stock return, inflation and real activity from 1980-2004. They concluded that Indian stock market shows future real activity and the negative stock returns-inflation relation emerges from the unexpected component of the inflation but this negative relation vanishes when they controlled for the inflation-real activity relation.

Hsing (2011) studied the effect of selected macroeconomic variables on stock market index in South Africa. It was concluded that South Africa's stock market index is negatively influenced by the domestic inflation rate.

Naka, et al (1998), analysed long-term equilibrium relationships between stock market and macroeconomic variables in India. They used different macroeconomic variables like industrial production index, consumer price index, M1, etc.. They used Vector Error Correction Model and VAR techniques and found these variables are co-integrated and long run equilibrium exists among these variables. Their results also showed that industrial production is the largest positive determinant of Indian stock prices whereas, inflation is the largest negative determinant.

Fama and Schwert (1977) established that equity stock returns were negatively related to both expected and unexpected inflation and hence were not a good hedge against inflation. Similarly **Asprem (1989)** reported a negative relationship between stock prices and inflation for some European countries. Also, **Geske and Roll (1983)** in their study of the US stock market, found stock prices to be negatively related to inflation.

Bhattacharya and Mukherjee (2002) documented a bi-directional causality between inflation and BSE SENSEX using monthly data for the period 1992-93 to 2000-01. Similarly, **Singh (2010)** reported that inflation was significantly correlated and had a unidirectional causality with stock index in Indian market for the period 1995-2009.

Kumar (2011) found that Indian stock index NSE Nifty did not Granger Cause inflation and inflation also did not Granger Cause Nifty for 2006-2010. **Dasgupta (2012)** analysed Indian stock market for inflation and concluded that no short-run causal relationships between BSE SENSEX and inflation exits for the period 2007-2012.

Naik and Padhi (2012) found that short-term inflation is negatively and significantly related to Indian stock market index for the period from 1994 to 2011. **Tripathi and kumar (2015)** showed that Granger causality results in unidirectional causality from stock return to changes in inflation in Russia, India and South Africa and bidirectional causality in China for study period 2000-2013.

OBJECTIVES

On the basis of above studies following research objectives have been laid down:

1. To check the causal relationship between inflation and stock market.
2. To check the long run co-integration between inflation and stock market.

On the basis of above objctives, following hypothesis have been constructed:

Ho_1: There is no Granger Causal Retationship between inflation and stock market.

Ho_2: There is no long run co-integration between inflation and stock market.

DATA AND METHODOLOGY

DATA

The period of this paper is taken for 10 years ranging from April 2005 to March 2015. This period is chosen to analyse the relationship between stock market and inflation rate considering 2004-05 as base year for inflation. BSE 100 is used as a proxy for stock price index in India because it is a broad-based index and it has also been accepted widely as market proxy among investment researcher as well as practitioners in the country. This index is based on 100 actively traded equity shares. Wholesale Price Index (WPI) is used as a proxy for inflation rates. WPI is an index that measures and tracks the changes in price of goods in the stages before the retail level. WPI report monthly to show the average price changes of goods sold in bulk. So, this paper analyses monthly data. The total number of observations, which is equal to 120, is believed to constitute a large data set for time series analysis. The WPI isobtained from Database on Indian Economy maintained by Reserve Bank of India. BSE 100 data is obtained from the www.bseindia.com.

METHODOLOGY

To check the Stationarity for Time Series data, Augmented Dickey-Fuller (ADF) Unit Root Test has been used and to check short run causal relationship between the 2 variables, Granger-Causality test has been applied. Further, to test for long run co-integration, Johansen test has been used. Lastly, E-views software is used to analyse these test. A brief description of all these tests has been provided below.

Augmented Dickey Fuller (ADF) Test

Given an observed time series Y_1, Y_2, ……,Yn, Augmented Dickey and Fuller test finds the presence of a unit root-without drift or trend with the help of three differential-form autoregressive equations as shown euations (1), (2) and (3) below:

$$\Delta Y_t = \gamma Y_{t-1} + \sum_{j=1}^{p} \left(\delta_j \Delta Y_{t-j}\right) + e_t \quad (1)$$

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + \sum \left(\delta_j \Delta Y_{t-j}\right) + e_t \quad (2)$$

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{j=1}^{p} \left(\delta_j \Delta Y_{t-1}\right) + e_t \quad (3)$$

where

- α is a constant intercept also known as drift,
- β is known as the coefficient for a time trend,
- γ is the coefficient which represents focus of testing,
- p denotes the autoregressive process of lag order for first-differences,
- e_t depicts residual term.

The difference between the three equations concerns the presence of the deterministic elements α (a drift term) and β_t (a linear time trend).

The focus of testing is whether the coefficient γ equals to zero, what means that the original Y_1, Y_2,..., Y_n process has a unit root; hence, the null hypothesis of $\gamma = 0$ (random walk process) is tested against the alternative hypothesis $\gamma < 0$ of stationarity.

To accept or reject the null hypothesis, Dickey-Fuller statistic is calculated and compared with the relevant critical values and if test statistic is more than critical value then the null hypothesis is accepted. This test critical value depends on the size of sample.

Granger Causality Test

To test the causal relationship between Indian stock market and interest rates, Granger-Causality test is being used. This test uses time series data to check the statistical hypothesis. Clive Granger argued "that causality in economics could be reflected by measuring the ability of predicting the future values of a time series using past values of another time series. A time series X is said to Granger-cause Y if it can be shown, usually through a series of t-tests and F-tests on lagged values of X (and with lagged values of Y also included), that those X values provide statistically significant information about future values of Y.

The test is based on the following regressions:

$$Y_t = \beta_0 + \sum_{k=1}^{M} \beta_k Y_{t-k} + \sum_{l=1}^{N} \alpha_t X_{t-l} + u_t$$

$$X_t = \gamma_0 + \sum_{k=1}^{M} \gamma_k X_{t-k} + \sum_{l=1}^{N} \delta_l Y_{t-l} + \nu_t$$

where Y_t and X_t are the variables to be tested, and U_t and V_t are mutually uncorrelated white noise errors, and t denotes the time period and 'k' and 'l' are the number of lags. The null hypothesis is $\alpha_1 = \Delta_1 = 0$ for all i's versus the alternative hypothesis that $\alpha_l \neq 0$ and d_t¹ 0 for at least some i's. If the coefficient α_i's are statistically significant but d_1's are not, then X causes Y. In the reverse case, Y causes X. But if both a_t and d_t are significant, then causality runs both ways."

Johansen co-integration Test

To analyse the relationship between Indian Stock market and interest rates in long run Johansen Co-integration test is used by using time series data. Johansen test named after Søren Johansen, "It is a procedure for testing co-integration of several time series. This test permits more than one cointegrating relationship so is more generally applicable than the Engle–Granger test. The Johansen multivariate co-integration approach is based on error correction representation of the p order Vector Autoregressive model with Gaussian error:

$$\Delta X_t = \phi + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-1} + \Pi X_{t-p} + \varepsilon_t$$

Where Δ is the most first difference operator, $r_i = -(1 - A_1 \ldots - A_i)$ is coefficient matrix representing short-run dynamics, and Π defined by $\Pi = -(1 - A_1 \ldots - A_i)$ is n´n matrix, where 1 is an identity matrix, whose rank determines the number of cointegrating vectors. If rank (Π) = r, then X_t has r cointegrating relation or n – r common stochastic trends. The extent of long-run relationship is determined by the number of cointegrating vectors. Here, there are three possible cases that may arise: If n – r = 0 (r = n) (full rank), X_t is stationary [1 (0)] and there are no stochastic trends. Cointegration is said not to be defined in such cases. Rank (Π) = 0 indicating no stationary long-run relationships among the elements of X_t. Reduced rank (i.e. rank (Π) <n) implying presence of at least one common stochastic trend, and error correction representation of X_t such that $\Pi = \alpha\beta$, where α and β are nxr matrices. The rows of β matrix give the cointegrating vectors and the columns of matrix a are adjustment factors. Two different likelihood ratio tests were developed by Johansen for testing the number of co-integration vectors (r): the trace test given by:

$$\lambda_{\text{trace}}(r) = -T \sum_{i=r+1}^{g} \ln(1 - \lambda_i)$$

And Maximum eigenvalue test statistics given by:

$$\lambda_{ax}(r, r+1) = T \ln(1 - \lambda)_{i+1}$$

The null hypothesis of the trace statistics tests is no co-integration H_0: r = 0 against the alternative of more than 0 co-integration vector H_1: r > 0 whereas the maximum Eigenvalue statistics test the null hypothesis of r cointegrating vectors against the alternative of *r* + 1 cointegrating vectors."

EMPIRICAL ANALYSIS

Firstly, the data was arranged in a systematic way starting from April 2005 to March 2015. After this, stationarity of both BSE 100 series and WPI have been checked by using Augmented Dickey-Fuller test statistic of Unit Root test. At Level, BSE 100 series P-value is 0.8688 which is more than significance level 0.05, which means null hypothesis, is accepted and series is non-stationary as shown in Table 1. Similarly WPI series P-value is 0.8172 which is greater than significance level 0.05, so null hypothesis is accepted and series is non-stationary at level as shown in Table 2.

Table 1: BSE 100 Series ADF Test at Level

	t-Statistic	P-value	
Augmented Dickey-Fuller test statistic		-0.584410	0.8688
Test critical values:	1% level	-3.486064	
	5% level	-2.885863	
	10% level	-2.579818	

Table 2: WPI Series ADF Test at Level

	t-Statistic	P-value	
Augmented Dickey-Fuller test statistic		-0.792885	0.8172
Test critical values:	1% level	-3.486551	
	5% level	-2.886074	
	10% level	-2.579931	

After this, ADF unit root test has been applied at 1st difference. BSE 100 series is stationary at 1st difference as P-value is 0.0001 which is lower than significance level of 0.05 as shown in Table 3. Similarly, WPI series is stationary at 1st difference as P-value is 0.0001 which is lower than significance level of 0.05 as shown in Table 4.

Table 3: BSE 100 Series ADF test at First Difference

	t-Statistic	P-value	
Augmented Dickey-Fuller test statistic		-10.76016	0.0001
Test critical values:	1% level	-3.485586	
	5% level	-2.885654	
	10% level	-2.579708	

Table 4: WPI Series ADF test at First Difference

	t-Statistic	P-value	
Augmented Dickey-Fuller test statistic		-6.367671	0.0001
Test critical values:	1% level	-3.486551	
	5% level	-2.886074	
	10% level	-2.579931	

To apply the Granger Causality statistics, lag length need to be checked and for this Vector Auto Regression technique is used. Optimal lag length came was 1 using AIC Criteria. This is depicted in Table 5.

Table 5: VAR Lag Order Selection CRITERIA

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-974.563	NA	150238.1	17.59573	17.64455	17.61553
1	-959.019	30.24803	122027.3*	17.38773*	17.53419*	17.44714*
2	-958.099	1.756722	129003.5	17.44323	17.68733	17.54225
3	-957.029	2.004447	136026.7	17.49603	17.83777	17.63466
4	-950.719	11.59690*	130530.5	17.4544	17.89379	17.63265
5	-945.499	9.406342	127766.8	17.43241	17.96944	17.65027
6	-943.907	2.810409	133547.3	17.47581	18.11047	17.73327
7	-943.013	1.546005	141399.7	17.53177	18.26408	17.82885
8	-939.235	6.399911	142182.3	17.53576	18.36571	17.87245

* indicates lag order selected by the criterion

LR denotes sequential modified

LR test statistic (each test at 5% level)

FPE denotes Final prediction error

AIC denotes Akaike information criterion

SC denotes Schwarz information criterion

HQ denotes Hannan-Quinn information criterion

After this, Granger- causality test have been checked, and it is found that there is no causality between wholesale price index and stock market. Neither WPI causes stock market returns nor Stock market causes WPI as P-values are 0.4363 and 0.6712 respectively which are greater than significance level 0.05, hence null hypothesis is accepted and it depicts there is no granger-causality between these 2 variables as shown in Table 6.

Table 6: Granger-Causality Test

Null Hypothesis:	Obs	F-Statistic	P-value
D(CMR) does not Granger Cause D(BSE)	118	0.61035	0.4363
D(BSE) does not Granger Cause D(CMR)		0.18114	0.6712

Lastly, long-run co-integration is being tested between these 2 variables using the Johansen Co-integration test, and there also no long-term co-integration exists between these 2 variables as P-value came out to be 0.7040 which is greater than significance level 0.05 and hence null hypothesis is accepted as shown in Table 7.

Table 7: Johansen Co-integration Test

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	P-value
None *	0.048297	5.927965	15.49471	0.7040
At most 1 *	0.002043	0.235202	3.841466	0.6277

CONCLUSION

In this paper, it is checked whether inflation matters for stock markets or not by studying the nature of relationship and the causality between inflation and stock market for the period ranging from April 2005 to March 2015 for Indian market. This period is considered to check the relationship between these two variables after base year revision in the year 2004-2005. BSE 100 index is used as a proxy for stock market and wholesale price indexis used as a proxy for inflation rate. The monthly data has been collected from www.bseindia.com and Database on Indian Economy maintained by Reserve Bank of India. Granger causality is used to check the short term causal relationship and Johansen co-integration tests is used to check the long run co-integration, and to check the stationarity. Augmented Dickey-Fuller Unit Root test is applied.

It is found BSE 100 series and WPI series are non-stationary at level and at first difference these series are stationary. And then by applying Granger-Causality test, it is found that there is no causal relationship between inflation and stock market in Indian context. They do not lead or lag each other. Again, by applying Johansen co-integration test it is found that inflation rates and stock market do not move together in the long run and there is no co-integration between them.

The findings in this paper are particular to a study period, methodology and variables. The findings may differ if any of this change. But, the findings of this paper, might help policy makers while framing monetary policy by considering its effects on stock prices. Further study can be done covering wider period of study and also considering more variables.

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