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Causality between Inflation and Economic Growth in India: A Granger Causality Approach

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Abstract: ***This paper examines the relationship between gross domestic product (GDP) and inflation (WPI) in India during the period 1951- 2012. Vector Error Correction Method and co-integration techniques are used for analyzing the relationship between gross domestic product (GDP) and inflation (WPI) in this study. The Johansen co-integration test indicates gross domestic product (GDP) and inflation (WPI) are co-integrated, and that a long-run equilibrium exists between them. The Vector Error Correction test reveals that there is unidirectional causality running from inflation (WPI) to gross domestic product (GDP) in the long run. It means inflation (WPI) lead to gross domestic product (GDP) but gross domestic product (GDP) does not lead to inflation (WPI).***

Keywords: Economic Growth, Inflation, Causality, Co-Integration. VECM
JEL Classifications: C3, C4, E31, O4,

I. INTRODUCTION

Economic growth with price stability had remained one of the main objectives of economic planning in India. The relationship between inflation and growth remains a controversial one in both theory and empirical findings. One group of economists including Keynes is of the opinion that inflation is a factor which helps economic growth. It is argued that inflation tends to redistribute income and wealth. Keynes favours mild inflation on the ground that it tends to stimulate business optimism through rising prices, resulting in high profit expectation which stimulates further investments, employment, output and income. Another group of economists including Milton Friedman is of the view that inflation does not stimulate economic development. Inflation creates more burdens on the cost of living, and makes the life of common man more miserable. It is also known that inflation leads to uncertainty about the future profitability of investment projects especially, which have long gestation period. The increased price variability may lead to an increase in cost of production and less profitability. Inflation imposes negative externalities on the economy, when it gets in the way with an economy's efficiency. Besides this, inflation may lead to uncertainty about the future profitability of different investment projects. It may also reduce the country's international competitiveness. When there is an increase in the cost structure and price level, the international competitiveness of the country also may be adversely affected. The export prices of that country also may become relatively more expensive than the prices of the competitors, and thus, adversely affect the balance of payments.

So one group of economists support the hypothesis that inflation led to economic growth and second group of economist support the hypothesis that inflation does not lead to economic growth, Therefore, this study tries to find out the relationship between inflation and economic growth in India using Vector Error Correction Method.

II. REVIEW OF LITERATURE

Girija and Anis (2001) use cointegration and error correction models to empirically test the long run and short run dynamics of the inflation-economic growth relationship for the four South Asian Countries viz., Bangladesh, India, Pakistan and Srilanka. Using the Annual Data, this study finds that there is long run positive relationship between growth and inflation. Further, the sensitivity of inflation to changes in growth rates is larger than that of growth to changes in inflation rates of all the selected countries. These findings have significant implications. This study concludes that inflation is helpful to growth, but faster economic growth feeds back into inflation. Thus, these countries are on a knife-edge. The challenge for these selected South Asian countries to find a growth rate which is consistent with a stable inflation rate, rather than beat inflation first to take them to a corridor of faster economic growth.

L Krishna Veni and Pradeep Kumar Choudhury (2007) examined the relationship between inflation and growth of the Indian economy during 1981-2004. The results of the causality test prove that the variables, viz., growth and inflation are independent of each other in India. The results of the cointegration test confirm the fact that the two variables—inflation and growth—are not cointegrated. Therefore, it is evident that there is no long run relationship between these two variables in India.

Medhavin Bhalchandra Dave and Gaurang Dattubhai Rami (2008) in their paper entitled "A study of causality between money supply and price level in india (monthly data): 1953 to 2005" examined the relationship between money supply and price level using monthly data on two alternative measures of Money supply viz. Narrow Money (M1) and Broad Money (M3) and a measure of Price Level viz. the Whole Sale Price Index (WPI) for the Indian economy from June 1953 to December 2005. The results show that there is unidirectional causality running from WPI to M3 and M1. It means WPI Granger causes M1 and M3, However, M1 and M3 not Granger causes WPI.

Gaurang Rami (2010) "Causality Between Money, Prices and Output in India (1951-2005): A Granger Causality Approach" in his paper investigated relationship between money, price and output. using pairwise Granger causality test on annual data of the Indian economy covering a period from 1951 to 2005. Lag length is selected using standard criteria – LR, FPE, AIC, SC and HQ through VAR estimation. The results revealed that the Keynesian views that money does not play an active role in changing income and price is partially supported. However, the monetarist view that money (Narrow Money) plays an active role and leads to change in income in India.

Ashutosh Sharma, Abodh Kumar and Prof. Neeraj Hatekar (2010) investigated causality relation between money and output and money and prices by making use of monthly data covering the period of 1993:1 to 2009:9. The results show that causal and reverse causal relations between money and output and money and prices vary across frequencies. The causality running from money to output remains a short-run phenomenon. The relationship between money and output remained unidirectional for this sample period, with causality running from money supply to output. This study also found a unidirectional causality between money and prices, with causality running from money supply to prices. The unique contribution of the study lies in decomposing the causality on the basis of time horizons and demonstrating that short run causality from money supply to output, long run causality from money supply to prices, as well as lack of long run causality from money supply to output.

Prasanna V salian and Gopakumar. K (2011) in their paper "Inflation and Economic Growth in India –An Empirical Analysis" investigated the cointegration and error correction models have used to empirically examine long-run and short-run dynamics of the inflation-economic growth relationship in India using annual data 1972-73 to 2007-08. The interesting results found in this exercise was that the, inflation and economic growth are negatively related. Second, the sensitivity of inflation to changes in growth rates is larger than that of growth to changes in inflation rates.

Ashwani (2014) in her paper entitled "Determinants of Inflation in India: A Co-Integration Approach" investigated relationship between inflation and macroeconomic variable using annual time series data from 1981 to 2011. Co-integration method is used to identify the long-run relationship followed by error correction model for short-run relationship among the inflation and other macro-economic indicators. The result found that there is presence of long-run relationship between inflation, money supply, private and social spending and exchange rate in India. Money supply, exchange rate and private final consumption expenditure contribute the inflation significantly.

Some scholars, mainly those in favour of Keynesian perspectives tend to believe that inflation is not harmful to economic growth, other scholars particularly those in favour of monetarist views, argue that inflation is harmful to economic growth. Some findings say that there is significant relationship between inflation and economic growth and some findings say that there is not significant relationship between inflation and economic growth. This study investigated the relationship between inflation and economic growth in India.

III. OBJECTIVES OF THE STUDY

Specifically the study aimed at achieving the following objectives:

1. To examine a long run co integration relationship between Inflation and Economic Growth in India.
2. To examine a long run causality between Inflation and Economic Growth in India.
3. To examine a short run causality between Inflation and Economic Growth in India.
4.

IV. RESEARCH DESIGN

In this study, annual data is used from 1951 to 2012. All the data were collected from HAND BOOK OF INDIA (RBI) 2012-13. Variables used in this study and the definitions are Inflation (log of Wholesale Price Index) and GDP (log of Gross Domestic Product) The data is analyzed to determine the causality between Inflation and Economic Growth. Before analyzing the causal relationship between Inflation and Economic Growth, data has been transformed in to natural logarithms, and then possible existence of unit roots in the data is examined. The stationarity of each series is investigated by employing Augmented Dickey-Fuller unit root test. The number of lagged differences included is determined by the Schwarz Information Criterion and Akaike Information criteria. Further proceed with the VAR lag order selection criteria to choose the best lag length for the VAR time series model to examine the Granger Causality test for all the series is performed. Johansen co-integration test is also applied to test for co-integration. The basic empirical investigation has two purposes. The first one is to examine the long-run relationship between Inflation and Economic Growth while the second is to examine the short-run dynamic causal relationship between Inflation and Economic Growth. The basic testing procedure requires three steps. The first step is to test whether the variables contain a unit root to confirm the stationarity of each variable. This is done by using the Augmented Dickey–Fuller tests (ADF). In the second step we test for the existence of a long-run cointegrating relationship between the variables. This is done by the use of the Johansen co-integration test. Finally, the last step, if all variables are integrated of same order and co-integrated then short run and long run causality test can be computed using the vector error correction model (VECM) method suggested by Engle and Granger (1987).

V. EMPIRICAL RESULTS

5.1 Result of Stationarity Test:

One of the most important attributes of a time series variable is its order of integration. Hence, we first perform unit root tests in levels and first differences in order to determine the order of integration of the series. To test the order of integration, we employ the conventional

Augmented Dickey-Fuller (ADF) test.

Table-1
Result of Unit Root Test Using Augmented Dickey Fuller Test

Variable	At Level		At First Difference		Conclusion
	ADF	Prob.	ADF	Prob.	
Wholesale Price Index (WPI)	3.9332	1.0000	-5.6794	0.0000	I (1)
Gross Domestic Product (GDP)	6.1989	1.0000	-4.3354	0.0000	I (1)

It is evident from the above table that the calculated ADF statistics for level variables are less than the critical values in both cases, suggesting that the variables are not level stationary. Table 1 also shows that the ADF statistics for both the variables imply first-difference stationary.

5.2 Result of Lag Order Selection Criteria for WPI and GDP

For getting optimal lag Length for co integration analysis, we have used five criteria namely, LR test statistic, Final prediction error, Akaike information criterion, Schwarz information criterion and Hannan-Quinn information criterion. All the criteria have suggested a leg length of 1 as a optimal leg length.

Table 2
VAR Lag Order Selection Criteria for WPI and GDP

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-259.1670	NA	32.72072	9.163755	9.235441	9.191615
1	32.82307	553.2444*	0.001338*	-0.941160*	-0.726102*	-0.857581*
2	36.14268	6.056841	0.001371	-0.917287	-0.558857	-0.777989
3	37.68804	2.711152	0.001497	-0.831159	-0.329357	-0.636142
4	39.93140	3.778287	0.001596	-0.769523	-0.124349	-0.518786
5	43.69227	6.070177	0.001617	-0.761132	0.027414	-0.454676

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic
HQ: Hannan-Quinn information criterion
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion

5.3 Result of Co-Integration Test Based on Johnson Juselius Method:

Once we have the results of unit roots, the next step is to determine whether there exists co-integration, using the same order of integrated variables. To test for co-integration, the Johansen and Juselius (1990) procedure was used, which leads to two test statistics, trace test and maximum eigenvalue test, for cointegration.

Table-3
Result Of the Co-integration Test based on Johnson Juselius method

Johansen Test for Co-integration (Trace Test)				
Hypothesized No. of CE(s)	**Trace Statistic**	**0.05 Critical Value**	**Prob.**	**Conclusion**
None r = 0	17.92680	15.49471	0.0211	One Co integrating Relationship
At most 1 r > 0	1.611857	3.841466	0.2042	
Johansen Test for Co-integration (Maximum Eigen value Test)				
Hypothesized No. of CE(s)	Max-Eigen Statistic	0.05 Critical Value	Prob.	Conclusion
None r = 0	16.31494	14.26460	0.0234	One Co integrating Relationship
At most 1 r + 1	1.611857	3.841466	0.2042	
Source: Estimated by researcher				

Table3 express the results of the co-integration test. There are two test statistics for co-integration, the Trace test and Maximum Eigen value test. The Trace-Statistic value is shown to be greater than the critical values at both 1% and 5% levels. Therefore, we reject the null hypothesis of no co-integrated equation among the variables. Thus, we conclude that there is at most one co-integrated equation among the variables. The results of Maximum Eigen value test statistics also express same here. Finally, we can say that there is a long run relationship between Inflation and Economic Growth.

5.4 Result of Granger Causality Test Based on VECM:

5.4.1 Long run Causality Test Based on VECM:

The long run causality test based on VECM result presented in Table 4 revealed the long run causal relationship among gross domestic product (GDP) and inflation (WPI). The result showed that the error correction term for co-integrating equation with gross domestic product (GDP) as a dependent variable is significant and negative at one percent, implying that there strong long run relationship running from inflation (WPI) to gross domestic product (GDP). However, the error correction term for co-integrating equation with inflation (WPI) as a dependent variable is not negative and not significant. It means that there is no long run causal relationship running from economic growth (GDP) to inflation (WPI). Therefore, we conclude that there is uni-directional causality running from inflation (WPI) to economic growth (GDP) in long run.

Table 4
Long run Causality Test Based on VECM: WPI and GDP

Null Hypothesis	ECM_{t-1}	T-Statistic	P-Value	Result
Causality from GDP to WPI	0.0108	0.3753	0.7088	Uni directional Causality
Causality from WPI to GDP	**-0.0324**	**-2.9376**	**0.0048**	
Source: Estimated by researcher				

5.4.2 Short run Causality Test Based on VECM/ Block Exogeneity Wald Tests

The short run causality test based on VECM/ Block Exogeneity Wald test result presented in Table 5 revealed the short run causal relationship among gross domestic product (GDP) and inflation (WPI). The result showed that there no short run causality between gross domestic product (GDP) inflation (WPI).

Table 5
Short run Causality Test Based on VECM/ Block Exogeneity Wald Tests: WPI and GDP

Null Hypothesis	Chi-statistics	P-Value	Result
Causality from GDP to WPI	0.1114	0.7385	No Causality
Causality from WPI to GDP	0.1249	0.7237	

5.4.3 Comparison of Long Run and Short Run Causality Test

Table 6 expresses the comparison of long run and short run causal relationship between gross domestic product (GDP) and inflation (WPI). The result shows that GDP does not lead to WPI in long run as well as in short run. However, the WPI lead to GDP in long run but short run it does not lead to GDP.

Table 6
Comparison of Long run and Short run Causality Test: WPI and GDP

Null Hypothesis	Long run Causality	Short run Causality
Causality from GDP to WPI	No	No
Causality from WPI to GDP	Yes	No

VI. CONCLUSION

In this paper, we have examined the relationship between gross domestic product (GDP) and inflation (WPI) in India using time series data from 1951 to 2012. This study uses the ADF unit root test, Johansen co-integration and Vector Error Correction techniques to investigate the long run and short run causality between gross domestic product (GDP) and inflation (WPI) in India. From the above study, it can be concluded that the Augmendented Dickey Fuller unit root tests show that gross domestic product (GDP) and inflation (WPI) series become stationary when first difference are considered. The empirical result reveals a long run co-integrating relationship between gross domestic product (GDP) and inflation (WPI) in India. We found that in short run gross domestic product (GDP) does not lead to inflation (WPI) and inflation (WPI) does not lead to gross domestic product (GDP). We also found evidence of unidirectional causality running from inflation (WPI) to gross domestic product (GDP) in long run. It means in long run Inflation is not harmful for Economic Growth. So we accept Keynesian hypothesis and reject the Milton Friedman hypothesis for India.

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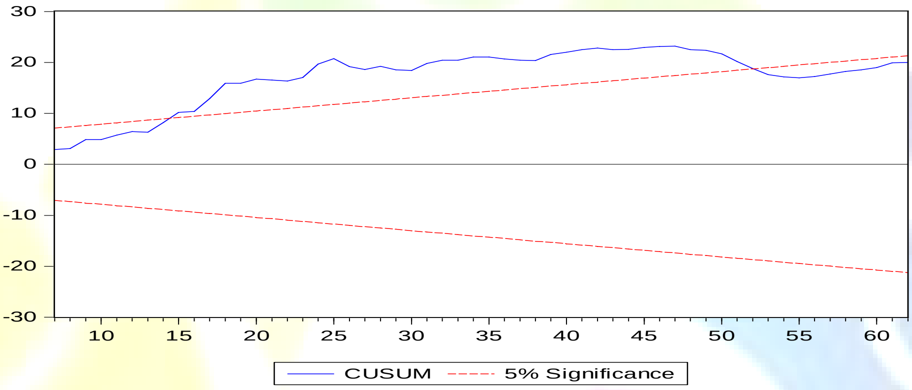
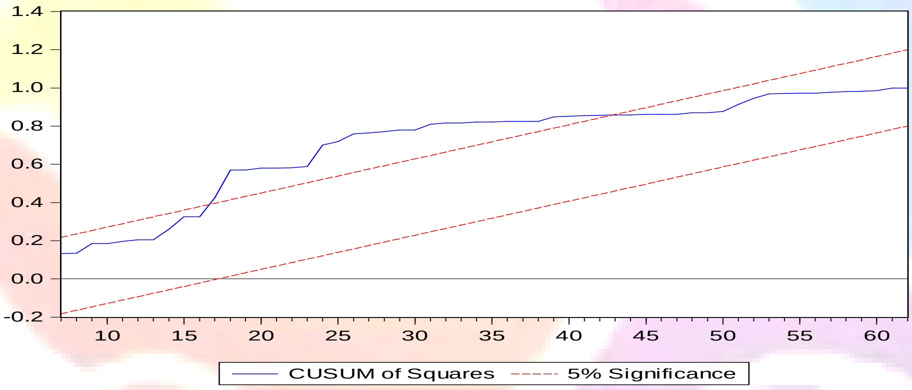
APPENDIX

VECM Diagnostic Tests for GDP and WPI

VECM Diagnostic Tests for GDP and WPI						
MODEL	**1. GDP = f (WPI)**			**2. WPI = f (GDP)**		
Test	**Statistic**	**P-Value**	**VECM**	**Statistic**	**P-Value**	**VECM**
Breusch-Godfrey Serial Correlation LM Test:	2.7129	0.1052	✓	0.2144	0.6451	✓
Heteroskedasticity Test: ARCH	0.5851	0.4475	✓	8.4835	0.0051	×
Jarque-Bera NormalityTests:	3.9636	0.1378	✓	6.6357	0.0362	×
Ho : No serial correlation, Ho : No heteroscedasticity, Ho: There is normal distribution						
Source: Estimated by researcher						

CUSUM AND CUSUM SQUARE TEST FOR GDP AND WPI





The straight line represents the critical bound at 5% significance level. Figures show CUSUM and CUSUMQ Test: Plot of cumulative sum of square of recursive residual