

Study on Causality between Inflation and Selected Macro Economic Variables in India

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Abstract: *This study attempts to investigate the relationship between inflation and various macro-economic variables. Granger Causality Test was used to test the causality between inflation and various selected macro economic variables i.e. Gross Domestic Product, Government debt, and Money supply. For this purpose the data were collected from various government reports. Unit root test (ADF) and Granger causality test were used to investigate the stationary and causal relationship respectively. The tests revealed that there is one way (unidirectional) causality can be seen between Inflation and GDP. No causality has been found between inflation and two other selected variables i.e. government debt and money supply.*

Key Words: *Macro Economic Variables, Inflation, Granger Causality, Gross Domestic Product, Government Debt, Money Supply* JEL Classification: E31, E51, B22, H5

1. INTRODUCTION:

The inflation rate is an important economic indicator for policymakers. It's accurate prediction is required for better macroeconomic decision making. Inflation leads to fall in the purchasing power by increasing the general level of prices for goods and services (Sharma Bhagwati, 2014). In general sense inflation is opposite of price stability but in economics, price stability is not used in a rigid sense. A modest increase in the price level i.e. 2 to 3 percent per annum is desirable for the economic development (Kalsie & Srivastav, 2017). In the last five years, the economy has witnessed a gradual move from a period of high and variable inflation to more stable and low level of inflation (The Economic Times, July 4, 2019). According to Economic Survey 2019, headline Consumer Price Inflation for April 2019 was 2.9% which was 4.6% in April 2018. The rise in the general price level is one of the most persistent problems in India. Inflation not only hurts the poor and fixed income groups, but also influences the rich and foreigners.

2. REVIEW OF LITERATURE

Mamo Tsegaye Fikirte (2012) examined the link and causality between inflation and economic growth with the help of panel data of 13 Sub Saharan Africa countries' from 1969 to 2009. Economic growth as a dependant variable and inflation, investment, population, initial GDP as independent variables have been chosen to investigate the relationship. An indirect relationship was revealed between economic growth and inflation. The study used Granger Causality test and it has been found that inflation causes economic growth for all countries in the sample, while economic growth causes inflation for two countries. Cioran Zina (2014), the research aimed at the study of dynamics between inflation rate, interest rate of monetary policy and unemployment rate, both at the national and European backdrop. A direct relation between inflation rate and interest rate, and an inverse relation with unemployment rate was revealed; thus making inflation rates a conducive or competent instrument for central bank to discipline or manipulate. Kalsie & Srivastav (2017) highlighted various reasons of inflation and its effect on selected macroeconomic variables like Balance of Payment, Investment, and poverty and currency depreciation by analyzing the data from 1950 to 2013. Further, impact of reserve rates, exchange rates and petrol prices have been analyzed with the help of natural logarithm of Consumer Price Inflation and it has been recommended that in order to keep the economy stable, it is necessary to have better management of monetary as well as fiscal policy. Mira Andani & Myslym Osmani (2017) investigated the relationship between growth and inflation, inflation and budget deficit, and deficit and growth empirically, with the use of time series regression, Autoregressive Distributive Lag (ARDL), Threshold and Switching Regression Model. It has been found that there is indirect or negative relationship between inflation and growth whereas a positive or direct relationship has been found between inflation and fiscal deficit. The study also found there is no relationship between fiscal deficit and growth in Albania. Sacala Cristina Daniela (2015) investigated the impact of GDP Growth Rate on inflation in Romanian Economy. The data selected for the study was for the period of 2000 to 2013. By applying simple direct regression, it has been found that GDP growth rate has a positive impact on Inflation.

3. RESEARCH METHODOLOGY:

This study is mainly based on secondary data and was collected from various published sources. The Data sources used in this research are Government of India (GOI), Ministry of Commerce, Ministry of Finance, Economic survey etc. In order to find out the causality between inflation and selected macroeconomic variables like GDP growth rate, Government debt, and money supply in the context of India, the study used annual data set. The variables considered in this study are Consumer Price Index (CPI) for inflation, GDP growth rate, government debt as in % of GDP, and growth rate of broad money as money supply. The study covers the period from 1980 to 2018. Unit root test (Augmented Dickey Fuller Test) and Granger causality test were used to investigate the stationary and causal relationship between the selected macro economic variables.

3.1. Following are the objectives of this paper:

- To study the causality between Inflation and selected macro economic variables in India
- To study the trends and behaviour of selected Macro economic variables i.e. Inflation, Gross Domestic Product Growth Rate, Government debt, and Money supply

4. RESULTS AND DISCUSSION:

In order to examine the broad trends and behavior of the variables, time series plots are drawn for all the selected variables. Figure 1 shows the movement of inflation, GDP growth rate and money supply and government debt. It can be seen in the Figure 1 that there are extreme fluctuations in inflation. In 1991, the inflation was marked at 13.88%, which was very high. The reason behind this inflationary pressure on the economy was 37% rupee depreciation with respect to dollar. From 1995-96 onwards, there has been a continuous slowdown in the inflation. Since 1950s, the average inflation for the period 1996-97 to 2000-2001 was at the lowest.

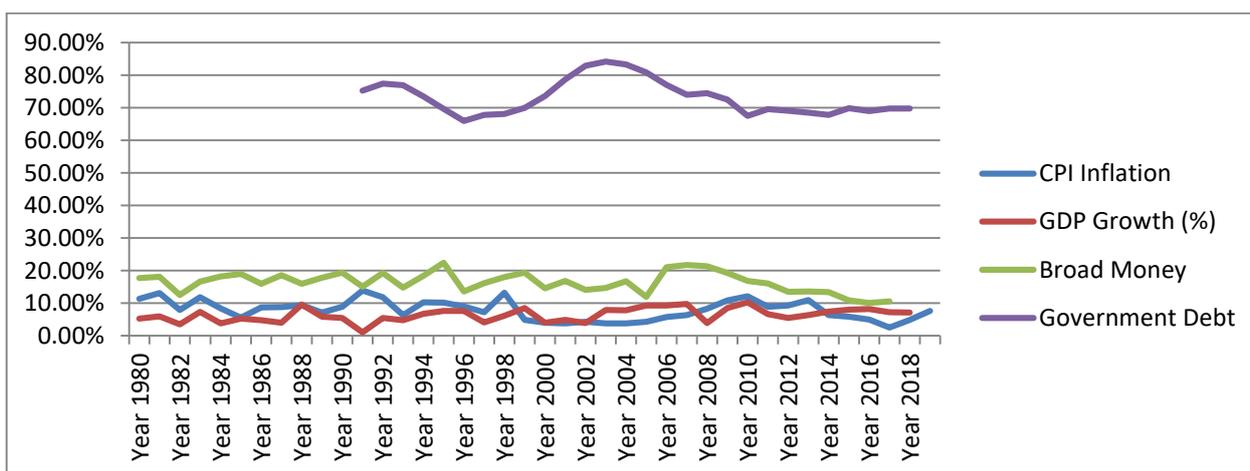


Figure 1: Time series plot of CPI Inflation, GDP growth rate, and Money Supply (Broad Money), Government Debt

From 2010, high inflation was noticed due to unseasonal rains post monsoon and increasing global commodity prices. Further, it can be summarized that there is a close association between Inflation and GDP. The growth rate of GDP in India increased from 5.30 % in the 1980 to 9.60% in 1988 which is coexisted with decrease in the rate of inflation by 7.20% in 1988 from 11.30% in 1980. In period for 1988 -1991 and 1994-1998 low GDP growth rate was coexisted with high inflation rate in the Indian economy. Further, in the period of 2003-2007 the scenario was different. In the aforesaid period high GDP growth rate was coexisted with low inflation rate. In other words it can be said that stable inflation rates coexisted with recovery of Indian economy. But suddenly in 2008 GDP drastically gone down and inflation drastically increased. This was the period of recession in the whole world. Again from 2014 onwards the same scenario is noticed i.e. when inflation increased with the low rate and it was low as compared to GDP.

4.1. Unit Root Test:

To check whether data is stationary or not, the unit root tests, namely Augmented Dickey-Fuller (ADF) test has been employed. The unit root tests, also known as Augmented Dickey-Fuller (ADF) is used to check the stationary nature of the time series data. The non-stationary nature of the time series data, may lead to false results and ambiguous conclusions. Dickey Fuller has developed test by augmenting the three equations by directing the serial correlation by adding lagged first difference to the auto regressive equation. The presence of unit root of the data series are tested through this test. Every random shock carries away the process from its earlier level not to return back again unless another random shock push it towards its previous level. Therefore, it behaves like AR (1) process with $\rho = 1$. Dickey Fuller test is designed to examine if $\rho = 1$

Let
$$y_t = \rho y_{t-1} + \varepsilon_t$$

$$y_t - y_{t-1} = \rho y_{t-1} - y_{t-1} + \varepsilon_t$$

$$\Delta y_t = (1 - \rho)y_{t-1} + \varepsilon_t$$

$$\Delta y_t = \delta y_{t-1} + \varepsilon_t$$

In ADF test, the hypothesis is to test if $\delta = 0$. The test procedure is same as t test but standard critical values of the t test are not valid. The modified critical values tabulated in MacKinnon(1991) are used for ADF test. To get white noise the lagged terms of ΔY_t are also included in the regression. The following regression equations were formed.

$$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \sum_{i=1}^m \alpha_i \Delta y_{t-i} + \varepsilon_t$$

Where
$$\Delta y_{t-1} = (y_{t-1} - y_{t-2}), \Delta y_{t-2} = (y_{t-2} - y_{t-3})$$
 etc.

The number of lagged difference terms to include is often determined empirically, the idea being to include enough terms so that the error term is serially uncorrelated, hence we can obtain an unbiased estimate of δ , the coefficient of lagged y_{t-1} depending on which terms.

The null and alternative hypothesis are formulated as follows

H_0 =Series has unit root: i.e. Non stationarity

H_1 = Series does not have unit root: i.e. Stationarity

Table 1: Unit Root Test

Variables	Level		1 st Difference	
	t statistics	P value	t statistics	P value
LGDP	-4.782(-2.994)	0.000	-3.491(-2.997)	0.002
LGDEBT	-1.220(-2.994)	0.234	-2.443(-2.997)	0.02
LMS	-2.603(-2.994)	0.015	-1.525(-2.997)	0.010
LCPI	-3.001(-2.994)	0.006	-6.716(-2.997)	0.000

Augmented Dickey Fuller (ADF) tests are used to test the stationary /non stationary behaviour of the variables.

Table no. 1 shows the results of the unit root statistics for all the selected macro economic variables. It is found that in all the selected variables are having unit. The result also indicates that in case of all the variables, the first difference series becomes stationary.

4.2. Granger Causality Test

After checking for stationarity, Granger Causality test was used to test the causality. A statistical approach proposed by Clive W Granger (1969) to infer cause and effect relationship between two (or more time series) is known as Granger causality. It use F test to study find the right direction of variable. Granger Causality is based on the simple logic that effect cannot precede cause. Granger causality identifies preference and information content but does not by itself indicate causality in the more common use of the term. It is a necessary condition for causality, but not a sufficient condition. The test is similar to an F test of the joint significance of the other variable(s) in a regression that includes lags of the dependent variable.

4.3. Procedure of Traditional Granger Non-Causality Test:

In its original form it is based on following bi- variate regression model (there are some other procedures used for causality testing such as Sim’s Causality test, Hasiao Causality Test etc.)

$$y_t = \alpha_0 + \sum_{i=1}^I \alpha_i y_{t-i} + \sum_{j=1}^I \beta_j x_{t-j} + \varepsilon_t$$

$$x_t = \omega + \sum_{i=1}^I \gamma_i x_{t-i} + \sum_{j=1}^I \theta_j y_{t-j} + \varepsilon_t$$

If all the coefficients of x in first regression equation of y , i.e. b_i for $i=1, \dots, l$ are significant that the null hypothesis that x does not cause y . However, the significance of the coefficient cannot be evaluated based on usual t -statistic. For this purpose the following procedure of testing the nested models is used.

Estimate the model without including lagged values of variable x . Suppose the R^2 from this estimate is R_1^2 .

Now estimate the model including lagged values of variable x . Suppose the R^2 from this estimate is R_2^2 .

F-ratio for improvement in the model is worked out as follows:

$$F = \frac{(R_2^2 - R_1^2)/k^*}{(1 - R_2^2)/(n - k)}$$

Where k^* are the number of lag orders l of variable x , k is the total number of the parameters estimated and n is the number of observations. The null hypothesis of non-causality is rejected if F statistic is greater than its critical value at k^* and $(n-k)$ degree of freedom. Similarly from the second equation above, we can test the null hypothesis that 'y does not cause x'. If only one of the two variables causes the second variable but the second variable does not cause the first variable, it is called one-way causality. If both the variables cause each other it is called the feedback causality.

Table 2: Granger Causality Test Results:

Variables	Hypothesis	F statistic	Probability	Results (Decision)	Direction
GDP	GDP growth rate does not granger cause Inflation	3.5068	0.0485	Rejected	Unidirectional
	Inflation does not granger cause GDP growth rate	2.233	0.1320	Accepted	
Government Debt	Government Debt does not granger cause Inflation	0.24124	0.7879	Accepted	No Causality
	Inflation does not granger cause Government Debt	0.7425	0.4886	Accepted	
Money Supply	Money Supply does not granger cause Inflation	2.5009	0.1061	Accepted	No Causality
	Inflation does not granger cause Money Supply	1.2354	0.3110	Accepted	

From the results of the Granger Causality test in Table No. 2, it shows that the hypothesis that GDP growth rate does not cause inflation is rejected and inflation does not granger because GDP growth rate is accepted. It means that there is a unidirectional causality between inflation and GDP growth rate under 5% significance level. It indicates the fact in the long run the GDP growth rate result an increase in inflation in India. This shows that inflation is due to increase in aggregate demand as per the macroeconomic Keynesian theory of income multiplier. This can be considered as a positive factor or element for the economy. Taking the long run relationship between government debt and inflation, there is no causality between the two. Also there is no causality between inflation and money supply.

5. CONCLUSION:

Inflation is one of the most critical issues in developing countries like India. Various researches have been performed in several time periods on this issue. This research attempts to analyze the causal relationship between inflation and different macroeconomic variables by employing time series data in India for a period of twenty three eight from 1980 to 2018. The results of the Augmented Dickey Fuller test illustrate that inflation; GDP and Govt. Debt are stationary at level, while money supply is stationary at first difference. In order to investigate the causal relation between inflation and the selected variables, granger causality test is employed and the results from the test revealed that there is one way (unidirectional) causality can be seen between Inflation and GDP. No causality has been found between inflation and two other selected variables i.e. govt debt and money supply. From the policy implication point of view, the finding that shows the unidirectional causal relationship between inflation and GDP (GDP causes inflation) suggest that inflation can be seen as the good sign of economic growth. The only thing to focus is to maintain price stability. In other words, it is observed that in order to foster high economic growth, it is necessary to maintain price stability. The Reserve bank of India will need to maintain monetary policy consistent with low inflation and high economic growth.

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