

The linkage between inflation and economic growth : Evidence from India

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Abstract

Even though the country's economic numbers showed improvement, a re-calculation revealed a substantial decrease in growth. As a result, the economy of a country is struggling, which is a grave worry. A drop in revenues, a reduction in economic activity and job losses are all the outcomes of such a decline. In addition to economic development, inflation is a critical component of the economy.

Purpose of the Study: While some studies found that economic expansion does not directly affect inflation, foreign investment and other economic issues, further research

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discovered the opposite. This research explored the effect of inflation on economic growth and determined a positive link between inflation and economic development in India. The study uses quarterly time-series data to analyze the impact of inflation on economic growth from the first quarter of the 2011-2012 financial year to the first two quarters of the 2020-2021 financial year.

Methodology: To complete this study, the time-series data was used during the time span 2011-2021. Several econometric methods are employed to research this kind of connection, including the Augmented Dickey-Fuller (ADF) unit root test, ARDL, Johansen co-integration and Granger-causality test.

Finding: A positive connection in the context of inflation and economic growth was found in the research. The study indicates a very strong, obvious inverse relationship between the two.

Subject Classification: 91.

Keywords: Indian economy, Economic slowdown, Gross domestic product, Inflation, Consumer price index, Economic growth, ARDL.

1. Introduction

Economic growth is “a real rise in an economy’s Gross Domestic Product (GDP).” GDP is defined as “the market value of all final goods and services generated in an economy within a specific fiscal year.” Inflation is defined as an increase in the total level of prices in an economy. The Indian economy has been slowing in recent years, with a drop in growth rate, despite a change in measuring technique that has improved the statistics compared to the preceding series. A country’s economic growth is deteriorating, which is a cause for concern. It signals fewer revenues and decreased economic activity and as a result, lower employment exists. Another important component of an economy is inflation.

The link between inflation and growth remains contentious in both theory and actual data. Since its inception in Latin America in the 1950s, the topic has sparked a long-running dispute between structuralists and monetarists. Inflation, according to structuralists, is necessary for economic growth, but inflation, according to monetarists, is harmful to economic advancement. This debate has two components:

- (a) the nature of the connection, if one exists and
- (b) the direction of causation.

Macroeconomics research has focused on the impact of inflation on output, growth and productivity. Inflation is examined through theoretical

models in the money and growth literature, especially its influence on the steady-state equilibrium of capital per capita and production (Orphanides, 1990). There are three different situations in which inflation impacts output and growth: None, positive and negative.

In a nutshell, the following sums up the uncertain connection between inflation and economic growth: The full spectrum of occurrences has occurred historically: inflation without development and inflation and action without inflation and inflation. Sidrauski (1967) was the first to discover that genuine money balances (M/P) appear under an optimum control framework that is genuinely neutral or superneutral. According to Tobin (1965), money may be substituted for capital and his study showed that inflation boosts growth. This is called the Tobin effect. The anti-Tobin effect, a phenomenon where inflation harms growth, is mainly related to cash-in-advance models (Stockman, 1981), which see money as a complement to capital.

However, the findings are inconclusive. There are several research concerning India. Also, this research yielded mixed outcomes. Some people don't believe in a relationship, while others claim that the relationship turns negative when inflation reaches a certain threshold. Analysis of current data from the Indian economy appears to be missing in the context of the economy.

This study is being conducted to discover the relationship between inflation and economic growth in India during the previous decade. In addition, the study will examine the link, if any, relation between inflation and economic growth in India today.

2. Literature Review

Macroeconomics has looked into the effect of inflation on output, growth and productivity and inflation's effect has been a primary focus. The money and growth literature considers inflation's effect on the steady-state equilibrium of growth by focusing on inflation's effects on the theoretical model, per capita GDP and production. Although the macroeconomic study has always been a significant focus to understand the relationship between inflation and real growth, one of the studies presumes that price stability and economic growth are either mutually exclusive or can be traded off in the long or short term (Kun-Shan, 2001). For example, new endogenous growth theories hypothesised that inflation had a detrimental effect because it inhibits productivity and effectiveness.

While ignoring periods of discrete severe inflationary crisis, Bruno and Easterly (1998) found no indication of a trade-off between growth and inflation. However, the data showed a substantial decline in economic growth when inflation levels passed the 40% mark. Huang & Huang (2004)[9] claim that investigators could not detect meaningfully a stylized quick rebound of output that can be blamed for inflation's relationship with growth. Even after accounting for inflation, the general statistical link is moot.

A multivariate Vector Autoregressive (VAR) framework was used by Liang and Teng (2006)[3] to come to the conclusion that financial development is a required condition of economic growth in China for the period 1952–2001. Myung Hoon Yi (2008)[4] suggested that there is a unidirectional causality in the world. Further the study extended from financial development to economic growth, which lends credence to the notion. While it is true that financial development control leads to economic growth, the opposite is not true in this case. Korea was studied using the super exogeneity methodology for the period 1971–2002 and the results were found that the supply side theory is the most likely explanation. Colombage (2009)[5]. Vector error is being utilised to analyse the financial markets in several countries, including Japan, Switzerland, the United Kingdom and the United States. The model of correction (VECM) with the use of ARDL limits, Uddin et al. (2014)[6] was able to support the finance-led growth hypothesis.

Endogeneity was addressed by Habibullah and Eng (2006)[7] at the same time, but they overlooked the problem of causality. Uncertainty in the bias GMM panel estimators have been employed in the literature due to these researches and publications in the field of finance and economic development from 1982 to 1995, Levine (1998)[8] applied GMM to 44 industrialised and developing countries around the globe, in which it was found that the legal environment is favorable for the exogenous component of banking development—the component defined by the International Monetary Fund when it comes to economic growth.

Arellano and Bover (1995)[9] created a system estimator for a panel data set of 74 observations, which they tested on their data. Data was collected from 1960 to 1995 and averaged over 5 to 7 years intervals, resulting in a total of 115 countries. The researcher concluded that the external component of intermediary financial development exerts a significant influence.

The influence on economic growth is significant and positive. Beck and Levine's (2004)[10] findings corroborate the findings of this study.

In this study, they used the GMM estimator for a panel data set of 40 countries over the period 1976–1990 and discovered that both stock market development and bank development are mutually significant and, as a result, contribute to the growth of the economy

According to Rioja and Valev (2004)¹¹, the growth effect of the financial system varies depending on the degree of deregulation in terms of financial development. Over the course of the 1960s and 1970s, an analysis of a panel data set comprising 74 countries was carried out.

Objectives of the Study

1. To determine the link between GDP and CPI.
2. To determine if GDP's lag or the lag of inflation(CPI) can explain GDP.
3. To determine whether there is a long-term link between GDP and inflation (CPI).

3. Research Design and Methods

3.1 Data

The research looks at the whole Indian economy at the macroeconomic level. Information from the Reserve Bank of India's real-time statistics on Indian economic conditions may be found on their website. In addition, we have reviewed quarterly statistics. Measures of economic growth and inflation have been found using the percentage change in GDP and CPI, respectively. The CPI data serves as a stand-in for inflation, while GDP is used to proxy economic growth.

3.2 Research Methodology

To do the analysis, time-series data of Gross Domestic Product (GDP) and Consumer Price Index(CPI) is used. The data set consist of quarterly data a from 2011 to 2021. The data was collected from the website of Reserve Bank of India (RBI)

The study is conducted to observe the relationship between the selected variables. To determine whether given data are steady, researchers used the unit root test. it's too random to rely on figure diagnosis to assess variation. There are various methods to examine data stationarity, such as Augmented Dicky Fuller test, Philip Perron test and KPSS test. This research will utilise the Augmented Dickey-Fuller test (ADF) to overcome

the problem of correlated error terms. The research employs a unit root method, allowing for the inclusion of intercept and temporal trend to assess if the data series has a unit root.

The study implements the autoregressive distributed lag (ARDL) model to establish the variables' long-term and short-term relationships. ARDL model establishes a relationship between both stationary as well as non-stationary data. In this study, the linear combination of variables that are stationary at different levels is examined. Thus, before estimating the ARDL model, the stationarity of the variables is tested in advance. According to Pesaran (1997) , Pesaran and Shin (1998), ARDL model can be written as:

$$\alpha(L, p)y_t = \alpha_0 + \sum_{i=1}^k \beta_i(L, q_i)x_{i,t} + \varepsilon_t$$

Where,

α_0 = constant

y_t = dependent variable,

L- lag operator

ε_t = disturbance term

$i = 1, 2, 3, \dots, K$

$x_{i,t}$ = vector of regressors

The model for the study is:

$$\ln \text{GDP} = \alpha_0 + \gamma \ln \text{GDP}_t + \delta \text{CPI}_t + \varepsilon_t$$

GDP = Gross Domestic Product

CPI = Consumer Price Index

The structural lags were founded by means of minimum Akaike's Information Criteria (AIC)

4. Data Analysis and Interpretation

4.1 Descriptive Statistics

It is very important to keep a track on macroeconomic indicators as these indicators can effects the industries. Gross Domestic Product (GDP) is considered the primary indicator of the financial health of any economy. Inflation is another key indicator which the effects the company's and asset performance. Inflation is measured with the help of consumer price

Table 1
Descriptive Statistics

	GDP	CPI
Mean	0.012295	0.009817
Median	0.021613	0.014685
Standard Deviation	0.077698	0.030849
Kurtosis	10.522680	18.609530
Skewness	-2.230703	-3.952112
Maximum	0.208830	0.039467
Minimum	-0.346572	-0.154020
Total number of observations	37	37

Source: Author's calculation

index (CPI). Thus, GDP can be effected by a change in the consumer price index. The descriptive statistics of our data is discussed in Table 1.

Table 1 shows that the mean value of GDP and CPI is positive which indicates that the value increases with the passage of time. Standard deviation is an indicator of variance of variables under study. Result shows that there is not much variation in GDP and CPI. Skewness of GDP as well as CPI is negative which means that the average growth over decades is smaller than typical-year (median or mode) growth. Kurtosis of GDP and CPI is positive, indicating the distribution has flatter tail than the normal distribution.

4.2 Normality Test

To test the normality of the data Jarque-Bera test is used for the study. Following hypothesis are formed for the study:

H_0 : Data is distributed normally

H_1 : Data is not distributed normally

Table 2
Jarque Bera Test

	Rgdp	Rcpi
X-Squared	147.91	710.6
df	2	2
p-value	<2.2e-16	<2.2e-16

Source: Author's own calculations

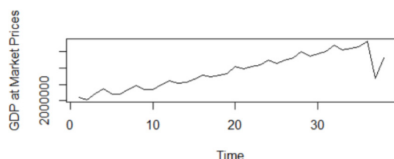


Figure 1
GDP at Market Price

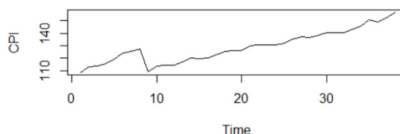


Figure 2
Consumer Price Index

From Table 2 it can be observed that value of p in GDP and CPI is less than 5 percent level of significance which says that alternative hypothesis is accepted. Hence, the variables are not normally distributed.

4.3 Stationarity Test

To find the co-integration between the dependent variable and independent variables, Engle and Granger (1987) discussed that the variables should be integrated at the same order but Johansen and Juselius (1990) discussed that to find the co-integration between variables, there is no need to pre-test the stationarity of variables. Variables can be of different orders (i.e. dependent variable can be of series I (0) and independent variables can be of series I (1). Hence, where the variables are of different orders ARDL technique is used. A series is considered to be stationary when mean and variance does not change with the change in time.

The quarterly data of GDP and CPI of India was collected from the year 2011-12 till 2021-21. There was total of 37 observations under study. The actual data is shown in Figure 1 and Figure 2. It is done to see whether the data is stationary or not.

Figure 1 and Figure 2 shows that the data is not stationary. Therefore, the data of GDP and CPI is first converted into stationary by the following formula:

$$RGDP = \ln(P_t/P_{t-1})$$

Where:

Ln = natural log

RGDP = return on GDP

P_t = price on the current date

P_{t-1} = price on the previous date

Consumer Price Index is also converted into return data by using the same formula.

4.3.1 Augmented Dicky-Fuller Test

The Augmented Dicky-fuller test is applied to test the stationarity of the data. Following hypotheses are framed:

H_0 : Data is non-stationary.

H_1 : Data is stationary.

The calculations are shown in Table 3

Table 3 is divided into three parts. First part shows the result of original data. Second part shows the result of returns data which is calculated after taking natural log of the data. The third part shows the result of the data at first difference. The result of original data shows that the data is non stationary as the p value is more than 5 percent level of significance. The result of the data after doing log transformation shows that the p value of CPI is less than 5 percent level of significance but the value of GDP is more than 5 percent level of significance. Hence, it shows that the data of CPI has become stationary but the data of GDP is still non stationary. So, the logarithmic data of GDP is converted into first difference. The result at first difference shows that the p value is less than 5 percent level of significance, so data has now become stationary.

Table 3
Augmented Dickey-Fuller Test

		GDP	CPI
Original Data	Dicky-Fuller	0.63252	-1.806
	Lag order	3	3
	p-value	0.99	0.6491
After log transformation	Dicky-Fuller	-0.85133	-3.5604
	Lag order	3	3
	p-value	0.9469	0.04966
At first difference	Dicky-Fuller	-6.0244	-
	Lag order	3	-
	p-value	0.01	-

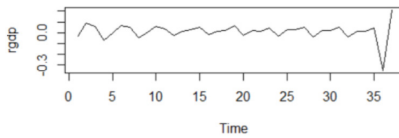


Figure 3
Stationarity of GDP

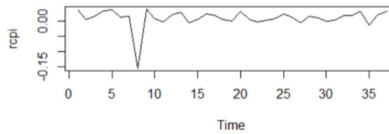


Figure 4
Stationarity of CPI

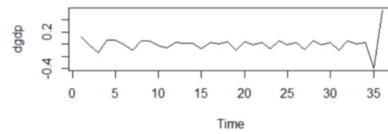


Figure 5
Stationarity of GDP at first difference

The stationarity of the data is also shown in Figure 3, Figure 4 and Figure 5.

4.4 ARDL Model

ARDL term means autoregressive-distributed lag. It means that the dependent variable can be explained by its own lagged values or can be explained by the successive lag values of the explanatory variables. In our model GDP is a dependent variable and Consumer Price Index(CPI) is the explanatory(independent) variables. With the help of ARDL model, study is trying to explain whether GDP is dependent on its own lag or on the successive lag values of CPI.

Before applying ARDL model, it is important to verify the lag values of dependent variable and independent variable. Lag values of all the variables can be checked with the help of Akaike Information Criterion (AIC) or Schwarz Information Criterion (SIC). The appropriate lag length of dependent variable i.e. GDP is found to be 7 and lag length of explanatory variables i.e. Consumer Price Index (CPI) is found to be 1. So, with the help of these lag length the ARDL model is created in Table 4.

Table 4
Result of ARDL model

Variable	Coefficient	Standard error	t value	p-value
CPI.t	-5.208e+03	1.127e+04	-0.462	0.64859
CPI.1	1.855e+03	9.654e+03	0.192	0.84944
GDP.1	2.411e-01	2.230e-01	1.081	0.29184
GDP.2	2.284e-01	1.223e+00	0.187	0.85367
GDP.3	1.945e+00	1.210e+00	1.608	0.12286
GDP.4	1.465e+00	4.025e-01	3.639	0.00154 **
GDP.5	-1.175e+00	5.231e-01	-2.246	0.03561 *
GDP.6	1.779e-01	1.271e+00	0.140	0.89006
GDP.7	-2.029e+00	1.234e+00	-1.643	0.11522
Constant	5.540e+05	7.461e+05	0.742	0.46603

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

R-squared: 0.8965, Adjusted R-squared: 0.8521

F-statistic: 20.2 on 9 and 21 DF, p-value: 2.027e-08

The equation of ARDL model is as follows:

$$GDP = C + \beta_1 GDP_{t-1} + \beta_2 GDP_{t-2} + \beta_3 GDP_{t-3} + \beta_4 GDP_{t-4} + \beta_5 GDP_{t-5} + \beta_6 GDP_{t-6} + \alpha_0 CPI_t + \alpha_1 CPI_{t-1} + \alpha_2 CPI_{t-2} + \varepsilon_t$$

$$GDP = 5.540e+05 - 0.2411GDP_{t-1} + 0.2284 GDP_{t-2} + 1.945GDP_{t-3} + 1.465GDP_{t-4} - 1.175GDP_{t-5} + 0.1779 GDP_{t-6} - 2.029GDP_{t-7} - 5208CPI_t + 1855CPI_{t-1} + \varepsilon_t$$

From the Table 4 it can be observed that all the lag values of CPI are more than five percent level of significance. Hence, lag values of all the explanatory variables does not have any effect on returns of GDP. Only lag value of previous year of GDP is significant, which means that the returns of GDP has a highly significant effect of its own previous value at 1 percent level of significance.

4.5 ARDL Bound Test

ARDL Bound test is done to find out the long run relationship between the dependent variable and explanatory variable. The hypothesis formulated are as follows:

H_0 : Co-integration does not exists between GDP returns and CPI

H_1 : Co-integration exists between GDP returns and CPI

Table 5
ARDL Bound Test (Pesaran, Shin And Smith (2001) Co integration Test)

Test Statistic	Value	Significant Level	I(0)	I(1)
F- statistic	3.4868791272833	10%	4.23	5
K	3	5%	5.26	6.16
		1%	7.62	8.82

To find out the co-integration between the selected variables Pesaran *et. al.* (2001) test is applied in the study. The results of the test are shown in Table 5.

In Table 5, it can be observed that the value of f-statistics is 3.486 which is less than 5.26 i.e. value of I(0) at 5 percent level of significance. Therefore, we accept null hypothesis. In our study, we can say that there is no long term relationship between returns of GDP and CPI.

4.6 Diagnostic Test

4.6.1 Checking stability

To check the stability of the ARDL model CUSUM and CUSUMSQ test are applied. The output of the CUSUM test is shown in the graphical form. The results of the CUSUM test is depicted in the Figure 7.

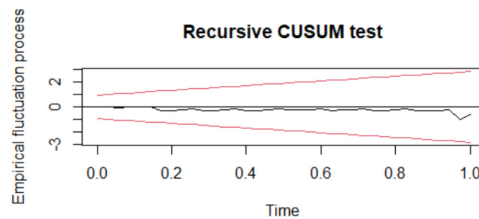


Figure 7

In the Figure 7 it can be observed that the CUSUM test line lies within the critical band of five percent level of significance over time. Therefore, the graphical representation confirms that ARDL model is stable in our case.

5. Conclusion

The present study, tried to present one of the dynamic model known as Auto Regressive Distributed Lag (ARDL) to find out the short run and long run relationship between returns of GDP which is taken as dependent

variables and CPI as independent variable from the year 2011-12 till 2020-21. There was the mixed stationary at level and at first differencing among the variables. ARDL model was created with the help of lag value of 7 for GDP and lag value of 1 for explanatory variables. The model showed that lag values of explanatory variables does not affect the dependent variable. Rather, GDP is affected by its own lag values of previous year. Secondly, ARDL Bound test also proved that there is no long term relationship between GDP and CPI. With the help of CUSUM test it is also confirmed that ARDL model is stable in our case. The result of the study is similar with the literature of the previous study done on the similar concept in other countries. Obradović, Šapić, Furtula, & Lojanica (2017). Taiba, eddine Karaachira, & Bouguesri (2021) results the negative relationship between inflation and GDP. Mohaddes, & Raissi (2014) shows that there is a negative long-run relationship between inflation and economic growth.

Future Scope of the study

The study is confined to only two variables, Economic Growth and Inflation and hence the breadth of the relationship opportunity being examined is constrained. The study could be strengthened further by examining the relationship opportunity between export volume, debt, natural resource yield, net foreign aid received, life expectancy, investment rate and foreign direct investment inflow using the Vector Autoregressive model, Granger Causality model and Auto regressive distributive lag model. Study will now give a large and relevant topic for future research.

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