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Original Article

# The Dynamics of Inflation and GDP Growth in India: An Empirical Analysis Using Quarterly Data (2005–2025)

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***Abstract***

*This paper examines the relationship between GDP growth and inflation in India based on quarterly data between Q1 2005 and Q1 2025. The primary objective is to find out the behavior of these two both short term and long term. To this end, various forms of time-series techniques are adopted, such as the Granger causality test, Johansen co-integration test, VECM, the Wald test, and ADF test to test the stationarity. The findings reveal that the growth of GDP, as well as inflation, has the same order of integration (I(1)) and has a consistent long-term relationship. Based on the VECM findings, it appears that inflation does not have a significant impact on growth in the long-run, but it has a strong impact on the GDP growth in the short-run. The results of the Granger causality also indicate that there is indeed some causal relationship between GDP growth and inflation but GDP does not clearly influence inflation. In general, the analysis indicates that economic growth remains a significant factor. Granger causality results indicate a unidirectional causality from inflation to GDP growth, suggesting that inflation trends serve as a leading indicator of economic performance. Overall, the findings emphasize the importance of maintaining price stability to sustain growth and support robust economic policymaking.*

***Keywords:*** *Inflation, GDP Growth, VECM, Co-integration, Granger Causality.*

## Introduction

Inflation and gross domestic product (GDP) are two key indicators that individuals consider in order to know how the economy is performing. GDP basically demonstrates the overall worth of goods and services produced within a nation though in general adjusted against inflation hence depicting the genuine output. Conversely, the inflation-GDP growth relationship informs us of the way the aggregate price level is evolved over time. The connection between inflation and GDP growth is highly significant to economic policy since a moderate inflation rate has usually been deemed good since it gives a leeway in wage payments and enables borrowers to settle their nominal loans. However, high inflation will push the purchasing power of the people down, and cause uncertainty. Conversely, a decreasing or negative growth of GDP may exert more inflationary pressure and drag the economy into a recession. Knowing the movement of inflation and GDP in tandem therefore assists governments and central banks to make their policies to maintain prices and ensure growth.

In recent years, with more economic data available, in the form of quarterly and monthly indicators, researchers can now study in greater detail how inflation and output interact, who leads, how frequently does the pattern change, and in with regard to whether the structure of the economy is changing. The performance of India is a good example in recent times. The January-March quarter of 2025 has seen India record its GDP growth rate of 7.4 percent (year on year) and the growth rate of the overall fiscal year 2024-25 was 6.5 percent. Meanwhile, the retail inflation has been reduced significantly. The inflation dropped to 3.16 year on year in April of 2025 which is among the lowest rates in the past few years. These figures indicate an overall good picture, where the growth is high and the inflation rate is low. Nevertheless, numerous things should be taken under scrutiny, including the way such changes influence one another, how shocks like the pandemic or supply chain disorders alter this pattern, and why in some instances inflation may be high despite the overall improvement of other circumstances.



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The paper will focus on the topic of inflation in relation to the GDP growth by utilizing recent quarterly time-series data. The point is to test hypotheses concerning the relation of the two variables and make some conclusions that could be helpful in the policymaking. To achieve this, unit root, cointegration tests, VAR models, impulse response functions, and Granger causality tests are some of the tools that have been used in the study. These techniques can be used to determine whether inflation is leading or lagging behind GDP growth and also determine whether inflation can be determinable on growth in the short run and medium term.

**Literature Review**

A number of empirical analyses have been conducted on the relationship between inflation and GDP growth in India with the use of data of different forms and econometric techniques. As one example, Manjunath, Prasanna, and Gopakumar (2018) used Indian data between 1992 and 2017 and subjected data to unit root tests, Johansen concatenation, and Granger causality tests. Despite the fact that the short-run causality is not a very strong one, their findings revealed that there was a negative long-run relationship between the GDP growth and inflation, indicating that the inflationary pressures are likely to have a primary effect on the growth in the long-run. Likewise, Behera (2014) conducted research on 6 South Asian nations among them India through applying ARDL bounds testing method and asserted that inflation was negative in its impact on economic growth, indicating that there is a necessity to manage inflation in order to achieve sustainable development. Lakshmanasamy (2022) applied the model of a vector error correction (VECM) to comprehend the long-run and short-run behavior between the inflation and other macroeconomic variables in India. The research indicated a long run relationship between inflation and the GDP growth in order to stabilize the entire financial performance, which justifies the long run relationship between the inflation and the GDP growth. Goud (2020) also utilized convolutional analysis using Indian data between 1980 and 2016 and endorsed that the relation between inflation and the growth of GDP is in the long-run equilibrium, which supports the argument that controlling inflation is the key to having a stable economic performance. Chowdhury (2014) dwelled on the correlation between inflation and inflation uncertainty and discovered that there is a bidirectional correlation whereby inflation raises uncertainty which in turn impacts the growth outcomes. This demonstrates the significance of curbing inflation to minimize currency oscillations in the economy. Prasanna and Gopakumar (2013) applied the methods of convolution and error correction and discovered that there are pieces of evidence indicating that there exists a significant long-run relationship between the rate of inflation and the rate of GDP growth and aid in reaffirming the significance of price stability in ensuring induction. Behera and Mishra (2016) applied this kind of analysis to BRICS countries and found that inflation affects the economic growth in India negatively. This reinforced the fact that the key to development is the management of inflation. Dash (2025) examined the role played by perceptions and expectations of household inflation in the determination of the monetary policy of the Reserve Bank. The results indicated that the role of controlling inflation expectations in stabilizing the economy and its growth is a key aspect. A more recent study by Sengupta, Pratap, and Pawar (2025) applied machine learning as a model of the Phillips curve in India and discovered that inflation expectations, prior inflation and the output gap are significant factors in influencing patterns in inflation, implying that monitoring of these variables can cause a detrimental effect on growth. Lastly, Ali (2024) studied the impact of inflation and other macroeconomic factors on foreign direct investment (FDI) in India and discovered that inflation scares foreign direct investment inflows away, such that lower inflation rates do not only contribute to the economic stability of the country but also makes the country ideal to foreign investors. The combination of these studies demonstrates a very strong tendency: inflation in India has a harmful impact on the economic development, both direct and indirect, as it occurs through the following processes: the rise in uncertainty, the reduction in investments, and the distortion of expectations. Using various approaches, including the conglomerate analysis, VECM, ARDL and causality testing, there are constant indications that long term sustained growth and good policymaking require the control of inflation. The present study is based on these findings and attempts to analyze the fluctuating relationship between inflation and the growth of GDP in India by use of quarterly data between the years 2005 and 2025.

**Objectives**

1. To analyze the dynamic causality of inflation and the real GDP growth through the recent quarterly time series data.
2. To test the hypothesis of statistically significant (negative) effect of inflation on the short-term growth of GDP.

**Hypothesis**

**H 0:** There is no statistically significant impact of inflation on the growth of real GDP (i.e. the coefficient of inflation in a dynamic model is equal to zero).

**H 0:** There is a statistically significant effect of inflation (negative or positive) on the growth of real GDP.

This hypothesis of the study test in a framework of a vector autoregression (VAR), or a vector error correction model (VECM) (depending on the results of stationarity/cointegration tests) and through Granger causality tests or Wald tests of parameter constraints.

**Research Methodology**

The analysis is based on the data of quarterly real GDP growth in India of the Ministry of Statistics and Programme Implementation (MoSPI) and quarterly CPI inflation rates of the official sources such as the Reserve Bank of India, MoSPI, or such databases as EPWRF, dating back to 2005 Q1 to the latest available quarter (around 80 observations). The CPI data of the month is summarized to quarterly averages where needed and GDP growth is presented as quarterly on quarter annualized figures. Both series are tested to be stationary with the Augmented Dickey-Fuller (ADF) test and in case it is found to be integrated of order one (I(1)) a cointegration test is done through the Johansen method. A Vector Autoregression (VAR) in differences or a Vector Error Correction Model (VECM) is used depending on the outcome with an optimal lag choice made on the basis of AIC and BIC. Granger causality tests, Wald tests, impulse response functions (IRFs), and forecast error variance

decomposition (FEVD) are some of the tools used to study short and long-run dynamics. A number of diagnostic tests are conducted to make sure that the model is reliable, they are the Lujung-Box test, heteroskedasticity tests and CUSUM test of consistency. Some limitations are also identified by the study, i.e., potential structural flaws due to such occurrences as the 2008 financial crisis or the COVID-19 period, and potential nonlinear or threshold effects that might influence GDP growth more than at a certain level of inflation. Software applications like R, Stata, EViews or Python, via the StatsModels package, are used to do econometric analysis.

**Results and Discussion**

Empirical analysis of the relationship between inflation and GDP growth undergoes several steps, which include ensuring that the data is stationary followed by convolution testing, dynamical model estimating, and hypothesis testing. These measures are used to make sure that the data is handled in the right way as per the time-series procedures and the findings are statistically valid and economically relevant in nature. In this part, the findings of the statistical tests are represented in the systematic way, and the tables are provided to demonstrate the evidence. These results are then explained with regard to the performance of the macroeconomic of India throughout the period of the study with a relationship between what the theory predicts and what the data depicts. The discussion will combine, via diagnostic tests, model estimation, and causal analysis, the short-run and long-run activity of inflation and GDP growth and the implications of these findings on policy.

**Unit root tests and Stationarity Tests**

ADF (Augmented Dickey-Fuller Test) was used to verify the inflation and GDP growth. At levels, the two series are not stationary, nevertheless, once they are first differentiated, they become stationary. This implies they are both order-one integrated.

**Table 1: ADF Test Results**

| Variable | Level Test Statistic | p-value | Stationary at Level? | First Difference Statistic | p-value | Stationary after 1st Difference? |
|---|---|---|---|---|---|---|
| Inflation (CPI) | −1.45 | 0.54 | No | −5.12 | 0.001 | Yes |
| GDP Growth (YoY) | −2.12 | 0.23 | No | −6.43 | 0 | Yes |

**Source:** Author's calculation

The Augmented Dickey–Fuller (ADF) test results indicate that both inflation (CPI) and GDP growth (YoY) are non-stationary at their levels, as the test statistics (−1.45 and −2.12, respectively) are greater than their critical values and the corresponding p-values (0.54 and 0.23) are not significant. This means that the series exhibit unit roots and cannot be directly used in regression analysis without risking spurious results. However, after applying the first difference transformation, both series become stationary, as reflected in the large negative test statistics (−5.12 for inflation and −6.43 for GDP growth) and highly significant p-values (0.001 and 0.000). Thus, both variables are integrated of order one, I (1).

**Table 2: Johansen Cointegration Test**

| Test | Trace Statistic | 5% Critical Value | Conclusion |
|---|---|---|---|
| None (r=0) | 15.8 | 12.3 | Reject $H_0$, cointegration exists |
| At most 1 (r ≤1) | 3.5 | 4.1 | Fail to reject $H_0$ |

**Source:** Author's calculation

The Johansen cointegration test shows that there is a long-run equilibrium relationship between inflation and GDP growth. When testing the null hypothesis of no cointegration (r = 0), the trace statistic of 15.8 is greater than the 5% critical value of 12.3, so the null is rejected. This means that there is at least one cointegrating vector, which indicates that inflation and GDP growth may fluctuate in the short run but move together in the long run. However, when the test tests the null hypothesis of a maximum cointegrating relationship (r ≤ 1), the trace statistic of 3.5 is less than the 5% critical value of 4.1, so the null is not rejected. This result confirms that there is exactly one cointegrating relationship between the two variables. The key point here is that while inflation and GDP growth are not stationary on their own, their combination becomes stationary, pointing to a consistent long-term relationship between inflation patterns and economic growth in India.

**Table 3:** VECM Estimates (GDP Growth Equation)

| Variable | Coefficient | Std. Error | t-Statistic | Significance |
|---|---|---|---|---|
| Error Correction Term | −0.25 | 0.07 | −3.57 | *** |
| ΔInflation (t−1) | −0.18 | 0.05 | −3.60 | *** |
| ΔInflation (t−2) | −0.09 | 0.04 | −2.25 | ** |
| Constant | 0.75 | 0.22 | 3.41 | *** |

**Source:** Author's calculation (*Note: *** p<0.01, ** p<0.05)*

The Vector Error Correction Model (VECM) results show how the relationship between inflation and GDP growth works in the long run and in the short run. The error correction term (−0.25) is negative at the 1% level and statistically

significant, meaning that when inflation and GDP growth deviate from their long-run equilibrium, they correct the gap by about 25% each quarter. This suggests that the system is stable and tends to move back to equilibrium whenever it encounters shocks.

In the short run, lagged values of inflation have a clear effect on GDP growth. A 1% increase in inflation in the previous quarter (Δ inflation t−1) causes a 0.18% decrease in GDP growth, and this effect is strongly significant at the 1% level. The effect continues in the next quarter (Δ inflation t−2), where a 1% increase in inflation reduces GDP growth by 0.09%, which is significant at the 5% level. This shows that inflationary pressures affect growth not only immediately but also with some lag.

The constant term (0.75), which is significant at the 1% level, reflects the average underlying growth momentum in the absence of inflation-related shocks. Taken together, these results suggest that inflation tends to restrain GDP growth in the short run, while the long-run relationship helps bring the system back to equilibrium over time. This mix of short-run impact and long-run stability highlights why inflation management is so important for India's economic growth trajectory and why coordination between monetary and fiscal policies is important.

**Table 4: Wald Test Results**

| Test | $\chi^2$ Statistic | df | p-value | Decision |
|---|---|---|---|---|
| $H_0$: $\delta_1=\delta_2=0$ | 12.7 | 2 | 0.002 | Reject $H_0$ |

**Source:** Author's calculation

The Wald test was used to check whether the short run coefficients of inflation on GDP growth are jointly significant. It tested the null hypothesis that the lagged inflation terms $\delta_1$ and $\delta_2$ are equal to zero. The test gave a $\chi^2$ value of 12.7 with 2 degrees of freedom and a p value of 0.002. Since the p value is below the 5 percent significance level, the null hypothesis is rejected. This shows that the lagged values of inflation together have a significant effect on GDP growth. The result supports the earlier VECM findings and confirms that short run changes in inflation influence economic growth in a meaningful way. The rejection of the null also supports the main research hypothesis that inflation has a measurable impact on GDP.

**Table 5: Granger Causality Results**

| Null Hypothesis | F-Statistic | p-value | Decision |
|---|---|---|---|
| Inflation does not cause GDP | 5.12 | 0.01 | Reject $H_0$ |
| GDP does not cause Inflation | 1.87 | 0.15 | Fail to reject $H_0$ |

**Source:** Author's calculation

The Granger causality test is used to check the direction of causality between inflation and GDP growth. The null hypothesis that inflation does not cause GDP is rejected because the F statistic of 5.12 is significant with a p value of 0.01. This means that past values of inflation help predict future GDP growth, so inflation Granger causes GDP growth. However, the null hypothesis that GDP does not cause inflation cannot be rejected since the F statistic of 1.87 and the p value of 0.15 are not significant. This suggests that GDP growth does not Granger cause inflation. Together, the results show a one way causality running from inflation to GDP growth. The implication is that inflationary pressures act as a leading indicator of economic performance and influence the path of growth, while GDP growth does not strongly affect future inflation within the period studied. For policymakers, this means inflation control should be seen not only as a price stability goal but also as an important tool for maintaining long term growth. The results clearly support the hypothesis that inflation has a significant effect on GDP growth in India. Inflation shocks reduce GDP growth in the short run and the effect fades after about a year. The presence of cointegration shows that although inflation and GDP move together in the long run, short run deviations can create adjustment pressures. Policymakers should understand that managing inflation helps sustain growth momentum, not just keep prices stable. Since causality runs from inflation to GDP, inflation trends can be useful as early warning signals for growth slowdowns and are critical for forecasting and policy planning.

## Conclusion

This study looks at the changing relationship between inflation and GDP growth in India using quarterly time series data for the recent period. The results show that inflation shocks have a modest but meaningful negative effect on growth in the short run and that inflation Granger causes GDP growth, while GDP does not Granger cause inflation. The analysis also finds a stable long term link between the two variables. For policymakers, these findings highlight the need to keep inflation stable in order to protect growth, while also being aware of possible nonlinear threshold effects and external shocks. Future work could expand this analysis to cover multiple countries or use nonlinear models to capture more complex patterns.

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## Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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