

Quest of dynamic linkages between monetary factors and food inflation in India

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Abstract. *This study attempts to investigate the dynamic linkages between the monetary factor and food inflation from an Indian macroeconomic perspective, based on time series data from 1991 to 2022. The outcome of the present investigation reveals that a narrow and broad money supply have a significant impact on food inflation. Furthermore, the result of causality analysis in current research reveals that a narrow money supply does not cause food prices to rise in the short run. However, the broad money does. Finally, the relevant outcome reveals that both narrow and broad money supplies jointly cause food inflation in India. In terms of policy implications, current research emphasises the role of monetary factors in controlling food inflation in the context of India.*

Keywords: food inflation, inflation, narrow money supply, broad money supply, India.

JEL Classification: E00, E02, E31, E51, E62.

1. Introduction

India is one of the fastest-growing economies in the world, registering an annual GDP growth rate of 8.7% in the fiscal year 2021-2022. It is the seventh-largest economy and the second-most populous country in the world (World Bank, 2022).

The country is not just endowed with a stock of natural resources; it is also characterised by a strong demographic dividend. The average age group of the working population is 15 years to 64 years, which is set to be a source of labour force for accelerating economic growth. The country is emerging in the global outlook as a destination for investment and is ambitious to be a \$5 trillion economy.

According to the United Nations report (2022), about 415 million poor people fell from 2005-2006 to 2019-2021. This can act as a stimulus for achieving the target of reducing half of the proportion of the population living in poverty by 2030, set under sustainable development goals. However, the socio-economic characteristics indicate that the Indian economy is still not free from poverty and inequality. Despite the fact that India is progressing on many fronts, the country is still suffering from vulnerability, which may have been further affected negatively due to the COVID-19 pandemic and rising food prices.

The worrisome fact is that 4.2% of the population lives in severe poverty, and 18.7% of people are vulnerable to poverty. The question is: how are people able to manage the minimum needs in an environment of rising food inflation? Apart from the initiatives for social security measures taken by the government through fiscal policies, The Reserve Bank of India controls and manages the money supply for macroeconomic stability. The objective of money supply management is to control the increasing inflation and provide a congenial environment for investment and saving channelization for capital formation without affecting the growth momentum. It is expected that the money supply will push money into the hands of people and influence the supply and demand of output in the economy. Nevertheless, inflation affects the purchasing power of people, and it even leads to vulnerability due to the inability to purchase the minimum needed. Retail inflation measured by the Consumer Price Index (CPI) registered a low in October 2022, which was 7.41%, and 7% in August 2022.

At the same time, the provisional data for the Whole Price Index also registered 8.39%, down from 10.7%. Before 10 years i.e. during October 2012 the CPI inflation was down 2.98% and WPI was up to 0.94%. Though RBI is able to maintain retail inflation as per its projection of 6.7% in the year 2022-2023 and the real GDP of 7% but its aims to achieve a target of medium term CPI inflation of 4% supporting the growth of the economy⁽¹⁾ (Forbes, 2022). Therefore, when the country is growing, the other area of concern is inflation in general and food inflation in particular due to its direct impact on peoples purchasing power. The intervening factor is the money supply which plays an important role in the context of economic growth as well.

In light of the above backdrop, the present paper is an attempt to examine the empirical data and observe whether the money supply is having a significant impact on food inflation or not. The rest of the paper is organised as follows: Section 2 reviews the literature; Section 3 presents the data and explains the methodology. Section 4 demonstrates the result analysis. Finally, Section 5 concludes.

2. Literature review

There is a stock of literature examining the casual relationship among different macro-economic variables. Notable researchers have carried out studies to observe how money supply and inflation casually influence economic growth. However, most of the studies have adopted economic growth as the dependent variable in analysing how economic growth and other variables are responsible for the inflationary situation, particularly with reference to the data of the recent past.

Notable studies like Mishra (2010) examined the causal relationship between money supply inflation and output growth in India. The study is based on the data for the period 1950-1951 to 2008-2009. Applying the co-integration technique of time series econometric modelling, the study found that there is bidirectional causality between money supply and output produced, and unidirectional causality exists from inflation to money supply and output produced. However, there is bidirectional causality between money supply and inflation level and unidirectional causality between output produced and inflation level. The study concludes that money is not neutral and that inflation is a short-run monetary phenomenon.

Another important study is by Rami (2010), which examined the causality between money, price, and output in India for the period of 1951-2005. The study applied the Granger casualty test and found money does not play a casual role in changing income, and price is partially supportive of the Keynesian approach. Further, the study supports the monetarist view that money (narrow money) plays an active role, which leads to changes in income in India.

Tiwari (2010) did the casualty analysis to investigate the relationship between food price and money supply in static and dynamic conditions. This study took the data set for the period 1974-2006 and applied the Augmented Dickey-Fuller test (ADF) and Phillips-Perron (PP) test, Engle-Granger causality analysis, diagnostic checks analysis, and co-integration test, and observed that narrow money supply causes food inflation in India, while broad money does not. The study also found food inflation increased the money supply.

Babatunde and Shuaibu (2011) tested the long-run relationship between money supply, capital stock, inflation, and economic growth using data for the period 1975-2008 in the context of Nigeria. They applied error correction mechanisms in the bounds testing approach to co-integration within an autoregressive distributed lag framework. According to their findings, there is a positive and significant relationship between money supply and capital stock, while a negative relationship exists between inflation and growth. Similarly,

Sola and Peter (2013) conducted a causal analysis between money supply and inflation in Nigeria. For the period of 1970 to 2008. This study applied the vector auto-regressive (VAR) model. They tested the stationary properties, applied the Granger causality test, and concluded that there is unidirectional causality from money to inflation and also from interest rate to inflation rate.

Durevall et al. (2013) worked on inflation dynamics and food prices in Ethiopia. They estimated a model of inflation for the period 2000-2009 by using data up to 2012. They used error correction models (ECMs) for the Consumer Price Index (CPI) and three major components such as cereals, food, and non-food prices. The study found that agricultural supply shocks affect food inflation in the short run, which causes large deviations from long-run price trends. Money supply growth affects non-food price inflation in the short run. Further, they suggest that world food prices and domestic agricultural production should be considered in the analysis of inflation.

A study conducted by QraIhsan and Anjum (2013) used regression analysis to find the relationship between money supply and inflation in the case of Pakistan. They considered the data set for the period 2000-2011 on the inflation rate, interest rate, and CPI. According to their study, there is a positive impact of money supply on the rate of inflation, and the interest rate and CPI have a significant relationship with GDP, but the study did not find any significant relation between inflation and GDP.

Mbongo et al. (2014) did the study on money supply and inflation in the context of Tanzania. Using a vector auto-regression model and an error correction model, we found that the impact of money supply and exchange rate on inflation is significant. This impact exists in the short run as well as the long run.

Yu (2014) conducted a study in the context of monetary easing policy and long-run food prices, considering China as the case study. This empirical study, based on data for the period 2003-2012, examines the impact of money supply on seven major food products. Excess money supply series data was used rather than nominal money supply so as to test the impact of monetary policy on food prices.

Applying the Dicky-Fuller (ADF) test and the KPSS test for testing the stationary and co-integration tests for causality, the study found that the price of rice is stable. The price of wheat flour registers a slight increase, and the price of other food products like soybean oil, poultry meat, pork, and mutton registers a decline in response to the expansion in the money supply.

Slahor et al. (2015) did a correlation analysis for money supply, i.e., M3, and the price level in the case of Europe. They compared the situation before the financial crisis and after the financial crisis. They applied the Pearson product-moment correlation coefficient as a degree of dependence between the monetary aggregate (M3) and the harmonised index of consumer prices in Europe. In their analysis, they found that there is a highly positive correlation between money supply and price level.

Obi et al. (2015) investigated the relationship between money supply and price level in ECOWAS member states for the period 1980-2012. For their analysis, they adopted Granger causality with the vector error correction model method and the Johansen co-integration test model. The result shows that there is causality from money supply to price level.

Goyal (2015), in her work "Understanding the High Inflation Trend in India", has adopted panel regression and time series techniques. The structural vector auto regression (VAR) used to estimate the aggregate demand and supply shocks, Granger causality, co-integration, and vector error correction models were used to observe the causality. The study analysed the data for a period of 1990 to 2012 and concluded that structural features are consistent with an elastic aggregate. Supply-side bottlenecks and governance failures are also responsible for changes in the price level.

Additionally, Sasmal (2015) worked on 'Food price inflation in India: The growing economy with sluggish agriculture' using time series annual data with the objective of observing the factors that increase food prices. It says there was moderate food inflation up to 1990, and after that, the consumer price index increased, but after 2005, it remained high. The study found that India's growth is experiencing a high rate of food price inflation. The growth has been very uneven across sectors, with agriculture remaining very sluggish. The time series econometric results establish no long-run relationship between money supply and agricultural prices. The increase in public expenditure and the unfavourable foreign exchange rate are having casual effects on prices, though the result is not robust.

Additionally, Holtemöller and Mallick (2016), in their work on "Global food prices and monetary policy in an emerging market economy: The case of India", have explored how poor countries are affected by price movements in the global commodity markets. The study is based on the 1996 Q2 to 2013 Q2 period. They applied the standard SVAR model to observe how global food prices influence aggregate prices and food prices in India. The empirical results conclude that variation in inflation is due to cost-push shocks. The study concludes that inflationary supply shocks, i.e., cost-push, oil price, domestic food price, and global food price shocks, are significant contributors to inflation. In addition to this, the study also observed that the response to supply shocks by applying a higher rate of interest tends to slow growth.

Many empirical studies have found a link between monetary factors and food prices worldwide (Kargbo, 2005; Mishra, 2020; Mbongo et al., 2014; Mishra et al., 2021; Mishra, 2020a; Mishra, 2022).

On the other hand, Bhattacharya and Gupta (2017) did a study to examine the drivers and impact of food inflation in the context of India. The study has used data from 1998-2014 to study the impact of different factors on food inflation in a SVAR framework. The study concludes that food inflation is due to various factors. Nevertheless, agricultural wage inflation is a common driver of food commodity inflation and aggregate food inflation in India. Similarly, fuel inflation also impacts food inflation, but moderately. They conclude that there is limited influence of fuel and international prices, except for tradeable.

A notable study relating to monetary policy and food inflation was conducted by Iddrishu and Alagidede (2019) in the context of South Africa. The study applied a quantile regression analysis. They used the data for the period January 2002 to November 2018. The study concludes that monetary policy positively influences food prices, and it is significant for all the quantiles. Therefore, rises in food prices are destabilised by monetary policy, even though there is a restrictive response. Transportation costs affect food prices significantly only at the median or 50th quantile. However, it is worthy to note here that the exchange rate and world food prices are two important driving factors for food prices, as per this study.

Further, whether monetary policy stabilises food inflation or not is investigated by Bhattacharya and Jain (2019), considering both advanced and emerging economies. This study examined the dates for the period 2006 Q1 to 2016 Q2. The study found that unexpected monetary tightening has a positive and significant effect on food inflation in both advanced and emerging economies. The researcher suggested that tightening monetary policy may turn out to be destabilising for food inflation and the overall inflationary situation.

From the above review of literature, it is clear that food inflation is a major concern. The existing stock of literature has touched upon many dynamics of it, but there is no sufficient study available to investigate whether the intervention of monetary policy in terms of money supply influences food influence or not. In addition to this, though studies have been conducted in the context of India, most of these studies are either based on a group of countries studies or under the framework of other variables. Since every country is different in terms of its socio-economic background, the influence of monetary policy may not be similar from one country to another. India is growing and has experienced the effects of different phases of socio-economic and political incidents that have occurred at the national and international level in the recent past. Therefore, it is domineering to examine the case of India, considering recent data, to understand the influence of money supply on food inflation. The present study fills this gap in the existing literature. Further, the findings and conclusion of this work would be helpful for necessary and effective policy interventions in the future. Which will also be helpful for other countries with similar socio-economic characteristics.

3. Data and methodology

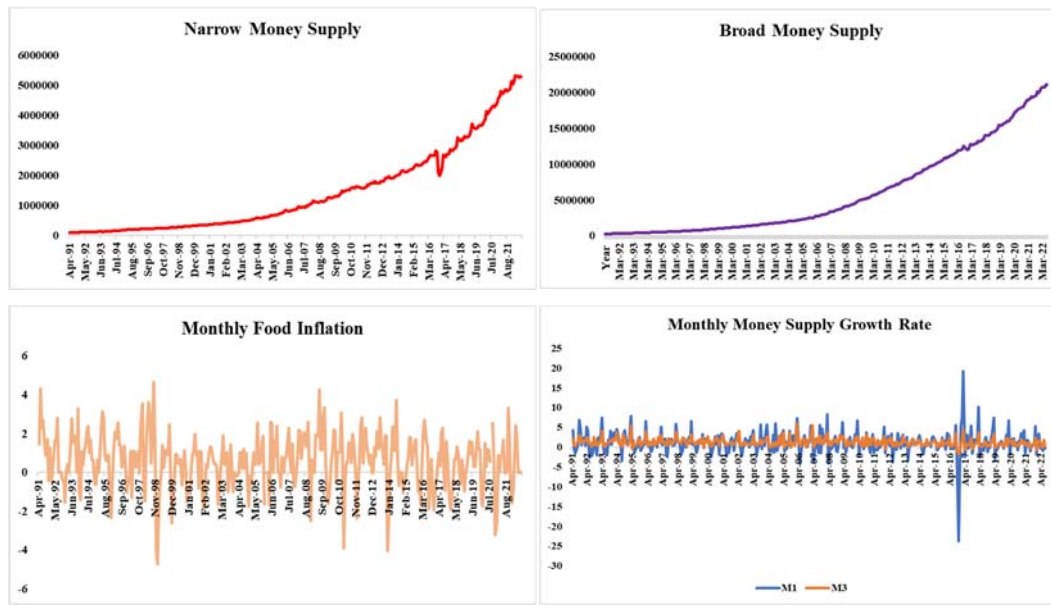
3.1. Data

The fundamental aim of the current pragmatic research is to reveal the impact of money supply on food prices in India. It also strived to investigate the possible causal impact of monetary factor on food inflation in the Indian outlook. To accomplish the above pertinent objective, current research accumulates data from various sources, including the Reserve Bank of India (RBI), Ministry of Statistics and Programme Implementation (MOSPI).

All the associated data included the monthly time series data point for 30 years from April 1991 to August 2022 (Figure 1). The information for money supply was collected from the Reserve Bank of India (RBI) database (<https://dbie.rbi.org.in/DBIE/dbie.rbi?site=home>).

While data regarding food inflation has been collected from the (MOSPI) and RBI website Jointly.

Figure 1. Monthly broad, narrow money supply and food inflation from 1991 to 2022



Source: Reserve Bank of India data base.

Table 1. Unit root test of the narrow, broad money supply growth rate and food inflation

Variables	ADF Test			Phillips-Perron Test		
	Trend	Trend and Intercept	None	Trend	Trend and Intercept	None
Narrow Money Supply growth	-5.95**	-5.65**	-6.35**	-46.24**	-45.29**	-49.27**
Broad Money Supply growth	-3.55*	-3.24*	-3.66*	-19.36**	-19.56**	-20.52**
Food Inflation	-4.30**	-4.76**	-4.29**	-11.52**	11.03**	10.99**

Note: ** is significant at 1% and * is at 5%.

Source: Author’s calculation.

The outcome of the Augmented Dickey-Fuller and Phillips-Perron unit root test reveals that all the above variables, such as broad money supply growth, narrow money supply growth, and food inflation, are stationary at either the 1% or 5% level of significance. As it is evident from the above outcome that all our concerned variables are stationary at level, in these circumstances, revealing the short-run and long-run nexus among the variables such as retail food inflation, broad money supply, and narrow money supply can be done by employing the vector autoregressive model (VAR) propounded by Pasran et al. (1996).

3.2. Methodology

The main goal of current research is to investigate the impact of narrow and broad money supply on food inflation in India. Additionally, it endeavors to reveal the cause and effect relationship among the variables. As we have already perceived that all our concerned variables are stationary at level, which directly justify the implication of VAR econometric

analysis for investigation of log run impact of monetary variables on food inflation. Additionally, current analysis tries to reveal the short run causal effect among the variables, and for that current paper rely on granger causality test. The causality test efficiently works when our variables are stationary at level, which is applicable in present scenario.

Vector auto-regressive model

$$food_t = \beta + \sum_{i=1}^n \beta_{1,i} food_{t-i} + \sum_{i=1}^n \beta_{2,i} M1_{t-i} + \sum_{i=1}^n \beta_{3,i} M3_{t-i} + u_t$$

From above VAR model, we can see that the food inflation $food_t$ depend upon the its own past lag as well as previous value of narrow money supply $M1$ and broad money supply $M3$. In the current model β is constant term while on the other hand, $\beta_i, \beta_j, \beta_k$ are the coefficients of the model, which actually represent the impact of lag independent variables on the current food inflation. Additionally, the u_t is epsilon term of the model, which is assumed to be identically independently normally distributed (IIND). For estimation of coefficient of the model OLS can be exerted, which provides the coefficient that fulfill the property of Gauss-Markov theorem.

Granger causality analysis

$$food_t = \beta + \sum_{j=1}^n \beta_{11,j} food_{t-j} + \sum_{j=1}^n \beta_{12,j} M1_{t-j} + \sum_{j=1}^n \beta_{13,j} M3_{t-j} + e_{1t}$$

$$M1_t = \beta + \sum_{j=1}^n \beta_{21,j} food_{t-j} + \sum_{j=1}^n \beta_{22,j} M1_{t-j} + \sum_{j=1}^n \beta_{23,j} M3_{t-j} + e_{2t}$$

$$M3_t = \beta + \sum_{j=1}^n \beta_{31,j} food_{t-j} + \sum_{j=1}^n \beta_{32,j} M1_{t-j} + \sum_{j=1}^n \beta_{33,j} M3_{t-j} + e_{3t}$$

where n is the maximum number of lagged observations included in the model, the matrix β contains the coefficients of the model (i.e., the contributions of each lagged observation to the predicted values of $food_t$ and e_t is the error term of the model. If the variance of e_{1t} is reduced by the inclusion of the $M1$ (or $M2$) terms in the first equation, then it is said that $M1$ and $M2$ Granger-(G)-causes food inflation. In other words, $M1$ and $M3$ granger causes food inflation, if the coefficients in $\beta_{12,j}$ and $\beta_{13,j}$ are jointly or individually significantly different from zero. This can be tested by performing an F-test of the null hypothesis that $\beta_{12,j} = 0, \beta_{13,j} = 0$ or $\beta_{12,j} = \beta_{13,j} = 0$. Similarly, the same mechanism works for the second and third equation.

4. Result analysis

Table 2. Result of vector autoregressive model

Variables	Coefficient	t statistics	p value
$food_{t-1}$	0.50***	9.80	0.00
$food_{t-2}$	-0.20***	-3.47	0.00
$M1_{t-1}$	0.053*	1.68	0.10
$M3_{t-1}$	0.17**	2.08	0.02
$M3_{t-3}$	0.25***	2.93	0.00
Constant	-0.165	-1.069	0.58

Note: *** is significant at 1%, ** is at 5% and * is at 10%. While coefficient without * is not significant

Source: Author's calculation.

The outcome of the vector autoregressive model reveals the long-run relationship between money supply and food inflation in India. It can be seen from the result (Table 2) that the

coefficient of the lag value of food inflation significantly impacts the food inflation of the current period, as these coefficients are significant at the 1% level of significance. The outcome reveals that the previous food inflation had a positive impact on current food prices. It can be concluded that a 1% rise in food inflation in the previous month leads to a 0.5% surge in current food prices in India. Additionally, our result shows that past two-month food inflation has had a negative impact on current food prices, as the coefficient is negative. Based on the outcome, it can be surmised that a 1% rise in the last two months' food inflation leads to a decline in current food prices of 0.2 percent. Our result also reveals that, in the long run, narrow and broad money supply have a significant impact on food inflation. The above result shows that a one percent increase in the narrow money supply leads to a surge in food prices by 0.05 percent, as the coefficient is significant at the 10 percent level of significance. Additionally, the outcome clearly manifests that, in the long run, broad money supply has a significant impact on food inflation in India. Based on the result, we can infer that a one percent increase in broad money supply will instigate food inflation by 0.17 and 0.25 percent, respectively. The above outcome is consistent with the results of many researchers. For example, Mishra et al. 2019 and Wong et al. 2019 conclude the impact of money supply on food inflation in India and Malaysia, respectively.

Table 3. Result of short run Granger Causality analysis

Null Hypothesis	Chi Square	p value	Conclusion
Narrow money does not cause food inflation	5.216	0.150	Narrow Money supply Doesn't Cause Food Inflation
Narrow money does not cause food inflation	13.39***	0.00	Broad Money supply Cause Food Inflation
Narrow and Broad money jointly does not cause food inflation	23.91***	0.00	Narrow and Broad Money supply Jointly Cause Food Inflation

Note: *** is significant at 1%, ** is at 5% and * is at 10%. While coefficient without * is not significant.

Source: Author's calculation.

The above Table 3 demonstrates the outcome causality analysis, which has been accomplished based on Granger causality analysis. The outcome reveals that there is no short-run causality running from narrow money supply to food inflation in India. This is evident from the result, as the chi squared statistics are not significant at the 5 percent level of significance; hence, we cannot reject the null hypothesis of no causality. Contrary to that, the result reveals that there is short-run causality running from broad money supply, as the test statistics are significant at the 5 percent level of significance. Hence, based on the above outcome, we can surmise that a broad money supply causes food inflation in India. Finally, the above also manifests that in the short run, narrow money and broad money supply cause food inflation in India, as the test statistics are significant at the 1 percent level of significance.

5. Conclusion and policy implications

Investigations pertaining to food inflation are gaining momentum globally. However, pragmatic investigation of the monetary factor in food inflation is not only limited to the literature in India, where food dominates the consumption basket and poverty levels are widespread, but remains unscrutinized. The current empirical examination strives to reveal

the dynamic nexus between food inflation and money supply in India by using monthly data from April 1991 to August 2022. The relevant conclusion of the current investigation can be summarised below.

The outcome of the vector autoregressive model reveals the long-run relationship between money supply and food inflation in India. It is observed that a 1% increase in the narrow money supply causes a 0.05% rise in food prices, as the coefficient is significant at the 10% level of significance. Furthermore, the results clearly manifest that broad money supply has a considerable influence on food inflation in the long run, which is evident by the findings that a one percent rise in broad money supply causes food inflation of 0.17 and 0.25 percent, respectively. The aforementioned conclusion is consistent with the findings of many other notable researchers, like Mishra et al. 2019 and Wong et al. 2019, who similarly concluded about the influence of money supply on food inflation in India and Malaysia, respectively. Nonetheless, the outcome of the causality analysis conducted in this work concludes that there is no short-run causality originating from narrow money supply to food inflation, but there is short-run causation originating from broad money supply to food inflation. However, in the short run, both the narrow and broad money supply jointly contribute to food inflation in India. Therefore, on the basis of the findings, it can be concluded that both narrow and broad money supplies have a significant impact on food inflation in the long run.

The money supply plays a significant role in controlling food inflation. A suitable monetary policy is necessary to control the money supply as it influences food prices. Tightening the money supply can be adopted to regulate the upward swing of food inflation. The broad money supply can be the regulating factor to control food prices, but in the long run, both narrow and broad money supplies should be adopted.

The present study is limited to an Indian perspective. The scope of the research can be widened to examine the casual role of other variables like fluctuations in international food prices and economic uncertainty, supply-side factors like food production, the seasonal fluctuation of demand and supply in the domestic market, etc. Still, the findings of the study will be helpful in developing suitable policy interventions for other countries.

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