

Managing Food Inflation in India

Deepika Goel¹

Abstract

Purpose : This paper aimed to analyze the trends in both wholesale price index food (WPIF) inflation and consumer price index food (CPIF) inflation in India and quantify the persistence and volatility in both measures of food inflation and their sub-components. The study used monthly data for the period 2012M4 to 2023M12.

Methodology : The study employed a univariate technique of quantifying persistence for the components of WPIF and CPIF inflation in India. Volatility of these components was also calculated using the simple measure of standard deviation.

Findings : The results suggested higher persistence in CPIF than in WPIF inflation. However, volatility remains the same in both of them. The disaggregated items of cereals, pulses, milk, and spices showed high persistence; whereas, pulses, fruits, vegetables, and certain manufactured products showed high volatility.

Practical Implications : The study identified the persistence-volatility pattern of components of food inflation in India. This pattern acted as a useful guide in formulating policies to control food inflation in the economy. Certain individual food items showed high volatility in overall food inflation, and short-term policies could effectively control their prices. However, items that exhibited high persistence in price changes require long-term policies to control their prices.

Originality : This paper discussed the persistence and volatility of the disaggregated components and uniquely compared trends in both CPIF and WPIF inflation together. Finally, the paper used the newly constructed consumer food price index for analysis as compared to the CPI-industrial worker (CPI-IW) used in some of the studies.

Keywords : consumer price index food inflation, wholesale price index food inflation, persistence, volatility, India

JEL Classification Codes : E31, C32, E52

Paper Submission Date : August 10, 2023 ; **Paper sent back for Revision :** February 1, 2024 ; **Paper Acceptance Date :** February 20, 2024

Inflation in food items affects the Indian economy significantly as food expenditure constitutes a large proportion of total household expenditure. Food inflation contributes to overall inflation, particularly through second-round effects on core inflation¹. High food inflation can lead to a decline in purchasing power and consumption levels of people experiencing poverty, who are disproportionately affected by an increase in food prices (Agarwal et al., 2019). The persistence of food inflation in India can be attributed to several factors, including robust real income growth, unpredictable weather conditions, rise in international food prices, and government interventions such as minimum support prices and trade policies. Food inflation has been a key driver of India's inflation dynamics, with food prices growing unevenly in the last decade and the increase in food prices surpassing the increase in non-food prices most of the time (Saxena & Bhadauriya, 2013). Food price inflation has also seen high volatility since mid-2009 in India, which is largely due to structural constraints. Food inflation also has global implications, as India's actions, such as export bans, can contribute to global food

¹ Anand et al. (2016).

¹ Associate Professor, Aryabhatta College, University of Delhi, Benito Juarez Road, New Delhi - 110 021.
(Email : deepika@aryabhattachcollege.ac.in) ; ORCID iD : <https://orcid.org/0000-0003-1823-2160>

DOI : <https://doi.org/10.17010/aijer/2024/v13i1/173411>

inflation and affect international food markets². The Indian Government's decisions regarding food inflation can also have political consequences, as food price increases and rigid agricultural policies can lead to social and political unrest. Food inflation may seriously affect overall inflation, leading to an adverse effect on the growth of the economy. Nevertheless, mild inflation may be able to sustain high growth (Maheshwari & Biyani, 2012).

The persistence of food inflation is a significant problem that requires attention. According to Dua and Goel (2021), persistence is defined as the rate at which a time series variable reaches equilibrium following a shock. If the continuity of the shock process is only temporary or a short-term occurrence, it is known as weak persistence. Nevertheless, the series has a permanent component if the process continues for a long time and the shock builds up. The shock has a dramatic and enduring effect on the series' historical trajectory. Government measures to control inflation would need to be short-term if the factors contributing to food inflation show limited persistence. If not, implementing targeted, long-term measures will be necessary to keep food inflation under control. In this context, a univariate technique is used in the research to quantify persistence in overall and disaggregated food inflation in India. The study also uses a straightforward standard deviation metric to calculate the volatility of the food inflation components. Monthly data on aggregate and disaggregate inflation for India is used in the analysis, spanning from 2012:4 to 2023:12. The issue estimates persistence and volatility for both consumer price index food (CPIF) and wholesale price index food (WPIF) measures of overall food inflation and their elements. The paper is organized as follows. First, different measures of food inflation are discussed. Then, trends in food inflation and its components are presented for the period under consideration. The next section elaborates on the data and methodology for the study. Finally, the results are presented, followed by the conclusion.

Measures of Food Inflation in India

Aggregate inflation in India is measured by the wholesale price index (WPI), which is available for the economy, segment-specific consumer price index (CPI), namely, CPI-IW, CPI-AL, CPI-RL, and CPI-UNME, and a national level CPI-combined (rural + urban), which was released in 2011 (Goel, 2018). Similarly, food inflation in India can be measured by the WPI food index, CPI-IW food index³, and CPI-combined food index. The Reserve Bank of India (RBI) now uses an all-India CPI-combined index as an inflation target for monetary policy. The focus of the paper is on CPI-combined food inflation to analyze its historical movements and compare them simultaneously with wholesale food inflation to observe divergences, if any, in wholesale and retail prices of food items.

The series for wholesale prices is compiled and released by the Office of the Economic Adviser, Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, Government of India, at regular intervals. The base year of WPI undergoes revision from time to time to maintain the sync of the series with changes in other macroeconomic variables. The latest revision took place in 2017, with the new base year as 2011–2012⁴. The new WPI series also provides data on the aggregate “Food index,” which is constructed by taking the weighted arithmetic mean of WPI for “Food Articles” categorized under Primary Article and “Food Products” coming under Manufacture Products.

The Central Statistics Office (CSO), Ministry of Statistics and Programme Implementation provides data on consumer price indices (CPI), which is based on the year 2012=100. Price indices are available for rural and urban areas separately and also combined for all Indian states and Union territories (Ministry of Statistics and Program

² See link <https://www.bbc.com/news/world-asia-india-66655642>

³ Since the CPI-IW index is not commonly used to track price movements, we look only at WPI and CPI combined series to analyze food inflation in India.

⁴ This paper is conducted on monthly data, and the period under consideration is April 2012 to December 2023. The new series, which had a base of 2011 – 2012 =100, was released in May 2017 and provides data from April 2012 onwards.

Implementation, Central Statistics Office, National Accounts Division, Government of India, 2015). CPI food index is also available for rural, urban, and combined areas.

By looking at the weights of the individual items in overall indices, one can say that food has the largest weight in the CPI combined index (45.86%). In contrast, food weighs only 24.38% of the overall WPI index (CPI manual on Consumer Price Index, CSO, National Accounts Division, Government of India). This shows that any change in the prices of food products in the economy would have a larger impact on the CPI index as compared to the WPI index. This implies that it is imperative to analyze the sub-groups within each category of overall food inflation to derive suitable inferences about the possible drivers of inflation in food items. The CPI and WPI food indices' general compositions are shown in Tables 1 and 2 below.

Table 1. Weights of Different Sub-groups Within the Consumer Food Price (CPIF) Index 2012 = 100

Sub-group	Rural	Urban	Combined
Cereals and Products	26.14	22.24	24.77
Meat and Fish	9.26	9.23	9.25
Egg	1.05	1.21	1.1
Milk and Products	16.34	17.98	16.92
Oils and Fats	8.9	9.49	9.11
Fruits	6.1	9.8	7.4
Vegetables	15.78	14.88	15.46
Pulses and Products	6.25	5.84	6.11
Sugar and Confectionary	3.61	3.28	3.49
Spices	6.57	6.05	6.39
Sub-groups of CFPI	100	100	100

Source : Manual on Consumer Price Index, Ministry of Statistics and Program Implementation, Central Statistics Office, National Accounts Division, Government of India (2015).

Table 2. Weights of Components of WPI Food (WPIF) Index (2011–2012 = 100)

WPI Food Index	Weights
WPI Food	24.38
Food Articles	15.26
a. Food grains (Cereals and Pulses)	3.46
b. Fruits and vegetables	3.48
c. Milk	4.44
d. Eggs, meat, and fish	2.40
e. Condiments and spices	0.53
f. Other food articles	0.95
Manufacture of Food Products	9.12
a. Processing and preserving of meat	0.13
b. Processing and preserving of fish, crustaceans, and molluscs and products thereof	0.20
c. Processing and preserving of fruit and vegetables	0.14
d. Manufacture of vegetable and animal oils and fats	2.64
e. Manufacture of dairy products	1.17

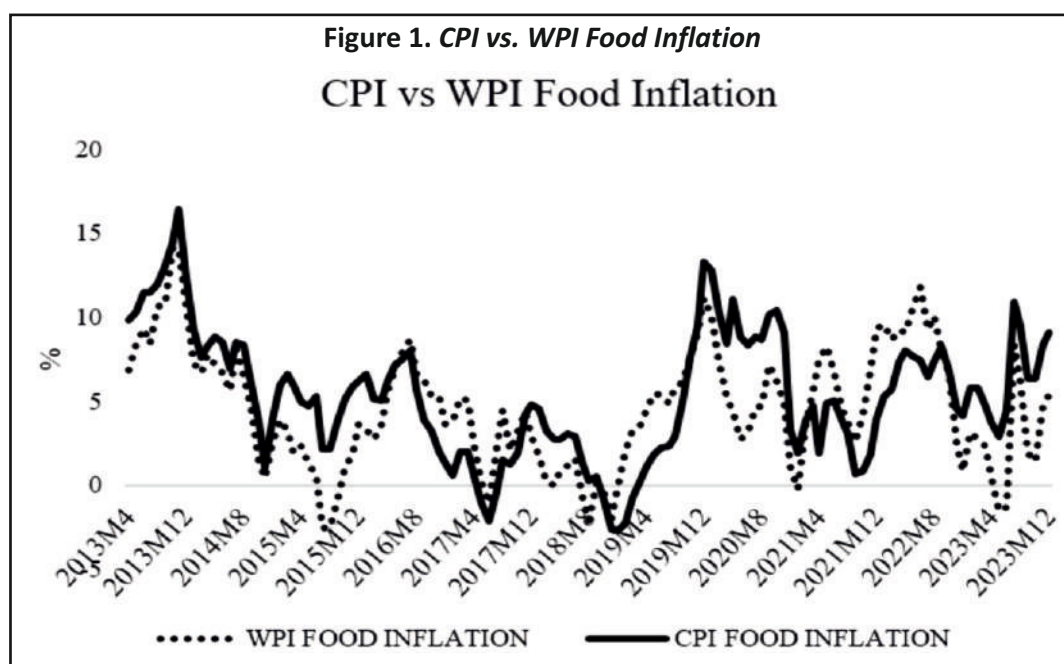
f. Manufacture of grain mill products	2.01
g. Manufacture of starches and starch products	0.10955
h. Manufacture of bakery products	0.21459
i. Manufacture of sugar, molasses, and honey	1.16275
j. Manufacture of cocoa, chocolate, and sugar confectionery	0.17501
k. Manufacture of macaroni, noodles, couscous, and similar farinaceous products	0.02640
l. Manufacture of tea and coffee products	0.37083
m. Manufacture of processed condiments and salt	0.16302
n. Manufacture of processed ready-to-eat food	0.02428
o. Manufacture of health supplements	0.22500
p. Manufacture of prepared animal feeds	0.35630

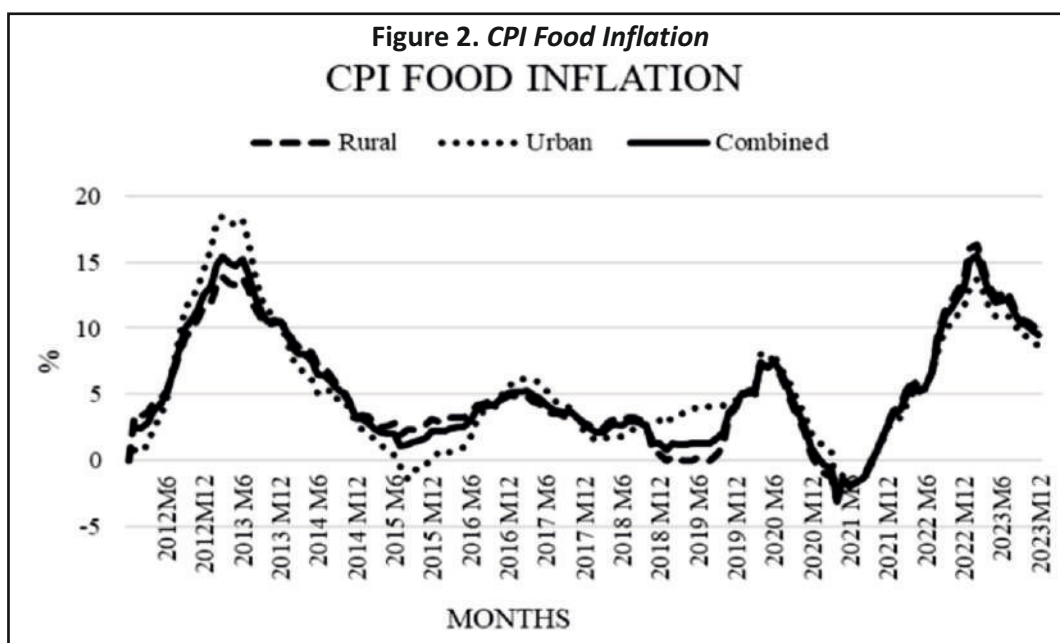
Source : Manual on Wholesale Price Index, OEA, Department of Industrial Policy and Promotion, GOI (2017).

Stylized Facts

This section presents the broad trends in both WPIF and CPIF inflation in India since 2011 (see Figure 1). Data for the CPI food index were made available by CSO starting in 2011. In April 2014, the Reserve Bank of India (RBI) decided to adopt the headline CPI (combined) inflation as a monetary policy anchor (Ministry of Finance, Government of India, n.d.). The central bank used WPI inflation as an anchor for monetary policy before 2014. According to Kothadia and Nayak's (2020) analysis, India's monthly WPI series is non-normal and integrated with order one.

Hence, we analyze the movements of wholesale price-based inflation before 2011–2012. Trends in consumer-based food inflation were analyzed using the CPI-IW series. During 2011–2012, a significant contribution to overall WPI inflation was made by primary articles, especially vegetables, eggs, meat, and fish, which reflected changes in the dietary patterns of the consumers (Office of the Economic Adviser, Department of Industrial Policy & Promotion, Ministry of Commerce and Industry, New Delhi, 2017).



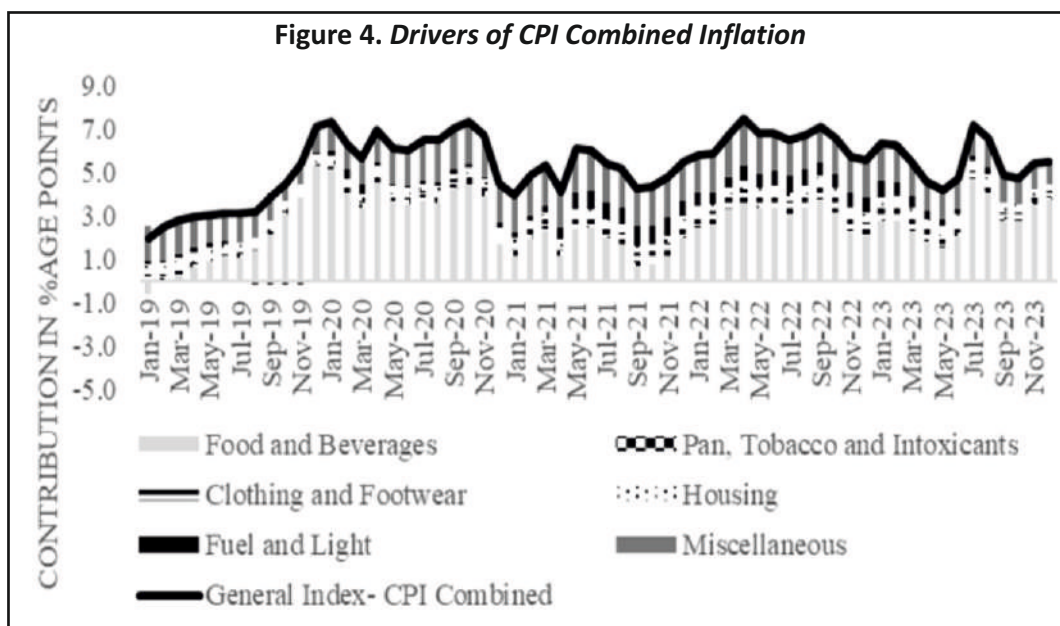
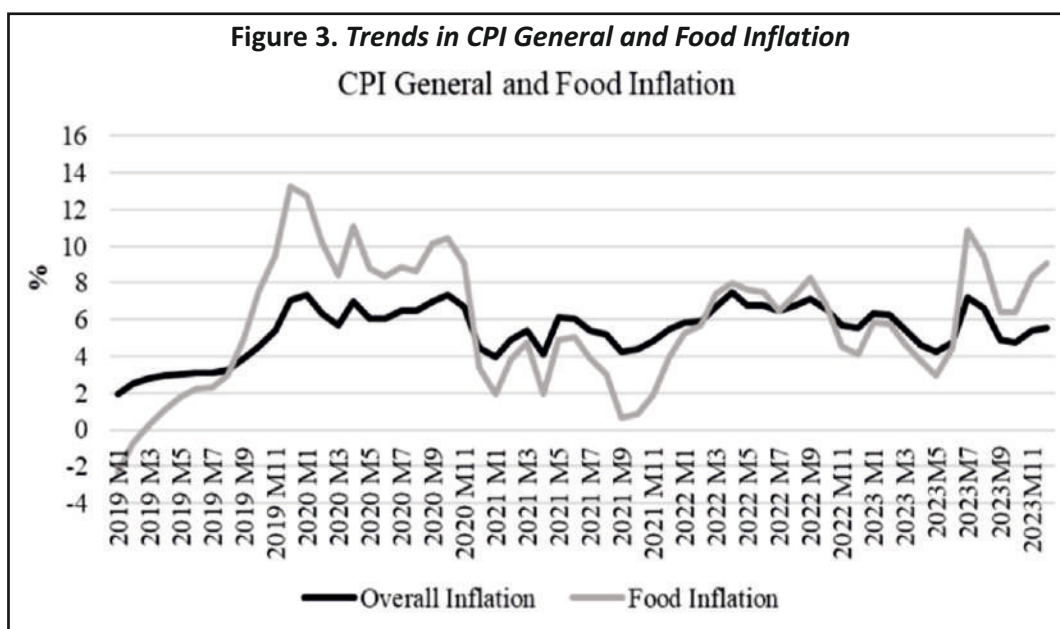


A robust harvest and reduced cereal inflation caused wholesale price food inflation to drop from 20.2% in February 2010 to 1.6% in January 2012. Due to a decline in food inflation, WPI and CPI inflation began to converge in 2011–2012. From 2011 to 2012, both manufactured food products and primary food articles based on WPI increased in value. Food inflation at the wholesale price exhibited an upward trend from 2012 to 2013, peaking at 10.39% cent in December of that year. Within primary food articles, protein inflation arising from milk and animal products moderated, and pulses registered a sharp decline. Cereals primarily contributed to inflation in food articles, registering 17.05% inflation in the third quarter of 2012–2013, in comparison to 2.35% in the same quarter of the last year. Maize, rice, and wheat were the primary causes of the rise in cereal inflation. Concurrently, increased prices were observed for fruits and vegetables, particularly for potatoes and onions. For the manufactured food goods (WPI sub-group), inflation decreased in comparison to 2011–2012. After being moderate between 2010–2012, grain mill products and sugar prices saw a significant increasing trend.

Food inflation reached double digits in early 2013–2014 due to severe weather changes, but it later reduced to an average of 6.22% for WPIF. In the same year, food inflation, as measured by the CPI-IW, also decreased to 9.22%. The increased weighting of food items in the consumer price indices was the main cause of the inflation gap between the WPI and CPI-IW (Goel, 2018). In January 2014, an expert committee formulated to strengthen the monetary policy framework recommended that the CPI-combined series should be used as the nominal anchor for a flexible inflation targeting (FIT) framework since it reflects the cost of living and affects inflationary expectations more than other anchors.

In April 2014, The RBI started using CPI-combined (henceforth referred to as CPI) as the nominal anchor for a flexible inflation-targeting framework. During the years 2011–2012, 2012–2013, and 2013–2014, approximately 50% of CPI inflation came from food. Factors affecting CPI food inflation were the same as those for WPI food inflation, namely, vegetables, cereals, and protein items. These items together contributed more than 80% to aggregate food inflation (see Figure 4).

The base effect and a seasonal drop in the price of fruits and vegetables were two factors contributing to the significant decrease in CPI food inflation that was observed in 2014–2015, especially near the end of the year. As seen in Figure 3, this allowed headline inflation to stay at reasonable levels. With the price of vegetables falling sharply and the prices of cereals, eggs, meat, and fish moderating, WPI food inflation also decreased to 4.8% between April and December 2014.



The production of onions, edible oils, tur and gram was not up to par during 2015–16, which put increasing pressure on the wholesale and retail prices of pulses. Nonetheless, throughout 2015–16, the price of cereals and other protein-based goods, including eggs, meat, fish, and milk, decreased. Since 2012, both WPI-food inflation and CPI-food inflation have been moving in tandem (see Figure 1). However, headline CPI and WPI remained divergent till 2015–2016, after which convergence was seen due to a decline in inflation across commodity groups, notably food. The production of vegetables, pulses, and cereals increased due to a favorable monsoon, which caused the CPIF to drop to 4.2% in 2016–2017. Throughout 2016 and 2017, there was a significant increase in sugar inflation due to rising global prices and decreased production. Food drove the CPI inflation rate in the first half of 2016–2017 (see Figure 4); in the second half, however, other groups—mainly services—drove the inflation rate.

The government's price monitoring and plentiful agricultural production in 2017–2018 helped to curb rising food inflation. The average food inflation rate for 2017–2018 dropped by 5.0% in December 2017. Reduced prices for seafood, meat, oils and fats, spices, and legumes made this decrease worse. According to the WPI, the average increase in food prices was 2.3% in 2017–2018 compared to 6.3% in 2016–2017. This resulted from a decline in the cost of food-related goods and products.

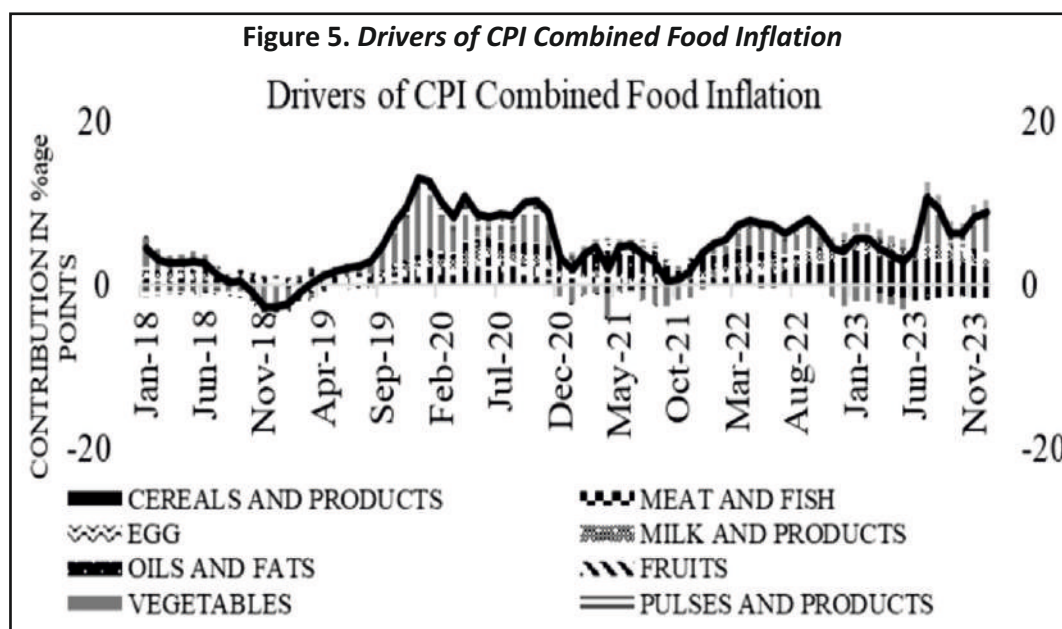
During the fiscal year 2018–2019, the average retail food inflation rate dropped to a low of 0.1%. The fall in prices was observed in the second half of 2018–2019 for fruits, vegetables, pulses and products, sugar and candy, and eggs. WPI food inflation too declined over 2018–2019 on account of a downward trend in the prices of pulses, vegetables, fruits, and sugar. Lower food inflation led to a decline in the average headline CPI inflation in 2018–2019. The CPI food inflation rate rose to 14.1% in 2019–2020, primarily due to increases in the cost of pulses and vegetables. Inflation of food also showed a regional trend in 2019–2020. Since July 2019, there has been a significant difference in the cost of cereals, eggs, fruits, and vegetables between rural and urban areas, which has resulted in significantly higher food inflation in urban areas (see Figure 2). Global economic activity was restrained, and certain nations experienced moderate inflation as a result of the COVID-19 epidemic and a steep decline in crude oil prices internationally. In 2020, the CPI food inflation difference between rural and urban areas decreased. Still, there was a persistent difference in other CPI components such as miscellaneous, apparel and footwear, and fuel and light.

The food and beverage group was the primary cause of CPI inflation in the years 2019–2020 and 2020–2021, contributing 53.7% in 2019–2020 and 59% in 2020–2021. As a result of the government's supply management approach, food prices have eased, causing average headline inflation to drop to 5.2% in 2021–2022 from 6.6% in the same period of 2020–2021 (Ministry of Finance, Government of India, 2022). CPIF inflation decreased to 2.9% from April to December 2021–2022, down from 9.1% during the same period the previous year, as a result of steady vegetable prices.

In 2022, the CPI showed fluctuations, with high inflation of 7.8%, static inflation until August 2022, and then a downward trend in inflation to reach 5.7% by December 2022. The war between Russia and Ukraine and crop damage due to unexpected heat in some parts of the economy led to rising inflation up to April 2022. The divergence between relatively high wholesale and lower retail inflation widened in May 2022 as both indices have differences in relative weights. In 2023, retail inflation was mainly driven by higher food inflation, which ranged between 4.2% and 8.6% between April and December 2022. Food inflation measured by the CPI grew from 3.8% in 2022 to 7.0% in 2023. The rise in food inflation was ascribed to spices, grains, vegetables, and milk. Since September 2022, cereal inflation has shown double-digit inflation. An increase in prices of edible oils in India during 2022 due to international price pressures of edible oils coming mainly from the Ukraine and Russia war eased somewhat in 2023. The first half of 2023–2024 saw a continued period of volatility in food inflation, with high prices recorded in July and August as a result of an unusual rise in the cost of certain food items such as fruits, vegetables, legumes, and spices. As per the latest release of the consumer price index for January 2024, the inflation rate was recorded at 5.1% in January 2024, with elevated food inflation at 8.3%.

In conclusion, from 2012–2013 to 2013–2014, the average CPI–food inflation was 11.8%; however, from that point on, it drastically decreased to 6.4% in 2014–2015. The percentage decreased even more to 4.9% in 2015–2016, 4.2% in 2016–2017, 1.8% in 2017–2018, and 0.6% in 2018–2019. Average food inflation elevated to 6.4% and 7.4% during 2019–2020 and 2020–2021, respectively. Inflation eased again to 3.7% in 2021–2022. Finally, a sharp rise was registered during 2022–2023 and 2023–2024⁵, when average food inflation increased to 6.4% and 7%, respectively. The major contributory factors in CPI food inflation were cereals, pulses, vegetables, and edible oils (see Figure 5). The same trend was also observed for WPI food inflation. Food inflation based on WPI averaged 6.9% in 2019–2020, falling to 3.9% in 2020–2021 and an increase to 6.8% in 2021–2022. Food

⁵ The latest CSO release provides CPI inflation estimates for January 2024.



inflation then registered a fall to 6.4% in 2022–2023. Hence, both CPI and WPI food inflation moved in tandem with each other.

Review of Literature

In the literature, the dynamics of food inflation in India have mostly been examined with regard to food purchased in bulk. Studies that take CPI food inflation into account in their research are hard to come by. The analysis of food inflation focuses on the factors that contribute to it and the degree to which food is a component of overall inflation.

An important argument arises in the literature that controlling inflation in the economy mandates an analysis of the components that it encompasses. However, food constitutes a small and declining proportion of gross domestic product, so it would be incorrect to think that it primarily affects headline inflation (Basu, 2011). Some of the prominent drivers of food inflation identified in the literature are cereals, eggs, milk, fish, sugar, edible oils, fruits and vegetables, pulses, and spices (Gopakumar & Pandit, 2017; Mishra & Roy, 2012; Nair & Eapen, 2012; Sekhar et al., 2018; Subbarao, 2009). The basic contention is that over time and with increasing incomes, people tend to shift their consumption from cereal-based items towards protein-based and vitamin-based items, which are also high in value (Bandara, 2013; Gulati & Saini, 2013; Subbarao, 2009).

Mishra and Roy (2012) and Nair and Eapen (2012) claimed that food inflation is volatile in developing nations and that there is a large pass-through effect on non-food inflation, which influences overall inflation. Additionally, the authors predict that food inflation will continue to rise in developing nations like India. It is also suggested that different commodities under the broad category of food inflation are affected by supply-side shocks in the domestic economy than global factors (Nair & Eapen, 2012). Food inflation has been impacted by various commodities in different years, according to a study on the subject conducted by Sekhar et al. (2018). While supply-side factors influence the price of edible oils and pulses, demand-side factors mostly influence the price of eggs, meat, fish, milk, and fruits and vegetables.

In a work on Indian inflation, Anand et al. (2016) indicated that India's inflation is highly persistent. Food is believed to have a higher share in the expenditure of households, and the role of food inflation in forming inflation expectations and wage settings leads to significant second-round effects. Bhattacharya and Gupta (2018)

analyzed the behavior and determinants of food inflation in India. The authors found an increase in the persistence of food inflation, resulting in a prolonged impact of a positive shock. Various components, like cereals, pulses, fruits, vegetables, meat, and fish, have contributed significantly to food inflation at different points in time.

The current study examines the persistence and volatility of different aspects of food inflation in India as measured by the CPI and WPI. This is done in light of the previous debate.

Data and Methodology

Data

The paper employs monthly data covering a period from April 2012 to December 2023 to check for the persistence and volatility of different components of WPI and CPI-combined food inflation in India. WPI inflation is defined as the year-on-year log difference of the WPI index with base 2011–2012=100. CPI inflation is defined as a year-on-year log difference of the CPI-C food index with base 2012=100. Data for CPI and WPI food inflation and its components is obtained from the Ministry of Statistics and Program Implementation's website, GOI (Ministry of Statistics and Program Implementation, Central Statistics Office, National Accounts Division, Government of India, 2015).

Methodology

The present study uses conventional univariate measures of persistence to study inflation persistence in various components of CPI and WPI food inflation in India. There have been various studies in the literature that estimate inflation persistence in India. The studies include Dua and Goel (2021), John (2015), Khundrakpam (2008), Maji and Das (2016), Malhotra (2022), and Patra et al. (2014), among others. Khundrakpam (2008) found that compared to international standards, inflation persistence in India is low. Patra et al. (2014), on the contrary, found that persistence has seen an upward shift in the post-crisis period compared to pre-crisis. John (2015) found that persistence, which had increased during 2004–2009, has started receding subsequently. He also finds that a decline in persistence coincides with a period of declining inflation. Maji and Das (2016) found that persistence in both headline and WPI-based core inflation, though declining, is high and averages around 0.4. Dua and Goel (2021) suggested that inflation persistence is high in the economy at both aggregate and disaggregate levels. Dholakia and Kadiyala (2018) used various conventional univariate measures to analyze inflation persistence in India.

As discussed by Dua and Goel (2021), the conventional univariate measures of persistence are the sum of autoregressive coefficients, the cumulative sum of the impulse responses, and the largest root of the autoregressive process. In their paper, Andrews and Chen (1994) discussed these measures of persistence and assumed that inflation follows a stationary autoregressive process of order p (AR(p)).

Persistence can be directly obtained from the following regression :

$$\pi_t = \alpha + \rho \pi_{t-1} + \sum_{j=1}^{k-1} \beta_j \Delta \pi_{t-j} \quad (1)$$

where, ρ is the measure of persistence.

According to Andrews and Chen (1994), persistence can be quantified by the best scalar measure, which is the sum of autoregressive coefficients as given in Equation 1. If ρ takes a value equal to or close to one, then the inflation process has a unit root or behaves like a random walk, which implies that it tends to deviate from its targeted value for a longer time. On the other hand, if ρ is lower than unity, a shock on inflation has only a

temporary effect on inflation and will soon revert to its trend level (Dua & Goel, 2021). The selection of lag lengths is done based on the Schwarz-Bayesian criterion (SBC) or Akaike information criterion (AIC).

Persistence is closely linked to the impulse response function (IRF) of the AR(p) process. Literature suggests that as the impulse response function is an infinite-length vector, it is not a useful measure of persistence (Marques, 2004).

According to Andrews and Chen (1994), cumulative impulse response (CIR) summarizes the information contained in the impulse response function (IRF) and, as such, is a good scalar measure of persistence. In a simple AR(p) process, the cumulative impulse response is given by $CIR = \frac{1}{(1-\rho)}$, where ρ is the sum of the autoregressive coefficients, as defined in Equation 1.

Since there is a monotonic relation between the CIR and ρ and hence, one can rely on the “sum of the autoregressive coefficients” as a measure of persistence (Marques, 2004, p.11). The greatest autoregressive root statistic as a persistence metric has been criticized by Andrews and Chen (1994) and Pivetta and Reis (2007) in their respective studies. Since the shape of this function relies on the other roots as well as the greatest one, the primary argument against this statistic is that it is an extremely poor summary measure of the IRF. Therefore, among the traditional measures of persistence, the sum of autoregressive coefficients might be utilized as a favored measure.

In their paper, Sekhar et al. (2018) measured volatility using the ratio method, which involves measuring the standard deviation of the growth rates of the price index - that is, the standard deviation of $\log(P/P_{t-1})$ where P_t is the price in period t and P_{t-1} is the price in period $t-1$. The underlying assumption is that the variance of the disturbance term is constant. We use the same approach to calculate volatility.

Analysis and Results

As was discussed in the preceding section, the lags of the inflation series serve as a measure of persistence for the sum of autoregressive coefficients. The univariate measures of persistence of WPI and CPI food inflation are presented in Tables 3(a) and 3(b), respectively. This contains OLS estimates of ρ , which are commonly used to gauge the persistence of inflation⁶.

Table 3 (a). Persistence Measure (Sum of Autoregressive Coefficients) (2013M4 : 2023M12) : Components of WPI Food Inflation

Variable (Y-O-Y Inflation)	WPI FOOD INFLATION				
	Lag Length	Break at	One Break (PC)	No Break (PC)	Volatility
WPI Food Inflation	3	2014M8	0.74*	0.83*	3.59
Food Articles	3	2013M11	0.74*	0.80*	4.67
Food Grains (Cereals+Pulses)	2	2016M7	0.90*	0.94*	5.66
Cereals	2	2021M7	0.91*	0.95*	5.25
Pulses	6	2016M7	0.88*	0.94*	17.17
Fruits and Vegetables	3	2016M7	0.69*	0.74*	15.50
Vegetables	3	2013M10	0.66*	0.74*	25.55
Fruits	3	2021M1	0.64*	0.76*	8.39
Milk	1	2015M1	0.88*	0.96*	2.76

⁶ Test for the lag length of the inflation series is done using either AIC or SBC criteria. A test for structural break is conducted using the Quandt-Andrews method to detect structural breaks in the series.

Eggs, Meat, and Fish	4	2018M11	0.73*	0.84*	4.08
Condiments and Spices	2	2021M11	0.93*	0.96*	10.74
Other Food Articles	3	2020M4	0.73*	0.83*	7.02
Manufacture of Food Products	2	2022M12	0.92*	0.95*	4.71
Processing and Preserving of Meat	1	2015M5	0.67*	0.86*	4.45
Processing and Preserving of Fish, Crustaceans, and Molluscs and Products Thereof	1	2016M2	0.67*	0.86*	7.81
Processing and Preserving of Fruit and Vegetables	1	2019M4	0.89*	0.94*	3.03
Manufacture of Vegetable and Animal Oils and Fats	2	2021M3	0.83*	0.96*	14.61
Manufacture of Dairy Products	4	2017M9	0.90*	0.93*	6.11
Manufacture of Grain Mill Products	2	2022M6	0.87*	0.94*	5.47
Manufacture of Starches and Starch Products	3	2021M12	0.88*	0.96*	11.44
Manufacture of Bakery Products	2	2021M10	0.87*	0.94*	3.34
Manufacture of Sugar, Molasses, and Honey	5	2017M9	0.85*	0.90*	11.14
Manufacture of Cocoa, Chocolate, and Sugar Confectionery	3	2017M4	0.52*	0.80*	2.61
Manufacture of Macaroni, Noodles, Couscous, and Similar Farinaceous Products	2	2017M5	0.70*	0.81*	8.08
Manufacture of Tea and Coffee Products	3	2020M4	0.63*	0.79*	7.66
Manufacture of Processed Condiments and Salt	1	2017M12	0.80*	0.93*	5.28
Manufacture of Ready-to-Eat Eat Food	2	2016M5	0.65*	0.83*	2.70
Manufacture of Health Supplements	2	2021M6	0.88*	0.93*	8.65
Manufacture of Prepared Animal Feeds	2	2021M1	0.89*	0.93*	8.22

Source : Authors' calculation, PC: Persistence coefficient.

Table 3 (b). Persistence Measure (Sum of Autoregressive Coefficients) (2013M4 : 2023M12) : Components of CPI Food Inflation

Variable (Y-O-Y Inflation)	CPI FOOD INFLATION				
	Lag Length	Break at	One Break (PC)	No Break (PC)	Volatility
CPI Food Inflation	3	2019M8	0.76*	0.91*	4.41
Cereals and Products	3	2022M6	0.88*	0.97*	4.05
Meat and Fish	2	2018M9	0.87*	0.92*	5.48
Egg	2	2019M8	0.78*	0.89*	3.26
Milk and Products	3	2021M4	0.92*	0.95*	9.38
Oils and Fats	2	2022M11	0.92*	0.98*	4.54

Fruits	2	2015M1	0.81*	0.89*	15.04
Vegetables	3	2023M9	0.78*	0.82*	13.33
Pulses and Products	1	2016M7	0.93*	0.99*	9.15
Sugar and Confectionary	3	2021M4	0.92*	0.94*	5.55
Spices	3	2022M5	0.94*	0.97*	3.93

Source : Authors' calculation, PC: Persistence coefficient, *denotes significance.

Table 3(a) shows that within WPI food inflation, the manufacturer of food products shows higher persistence than food articles, whereas volatility is roughly the same for both groups. Results indicate that high persistence is observed in some of the sub-components of food inflation with or without a structural break. This holds for both WPIF and CPIF inflation, as well as their components. Within food articles, cereals, pulses, milk, products, and spices show a high degree of persistence compared to other items. Pulses, vegetables, condiments, and spices also show very high volatility. Vegetable inflation is less persistent but more volatile, whereas cereal inflation is more persistent but less volatile. Within the broad category of manufactured food products, manufacturers of dairy products, grain and mill products, starches, sugar, molasses and honey, and bakery products exhibit high persistence. It is also observed that persistence is high in the manufacture of processed condiments, health supplements, and prepared animal feed. Volatility is relatively high for the manufacture of oils and animal fats, starch and starch products, sugar, molasses, and honey.

Table 3(b) indicates that WPI food inflation is less volatile than CPI food inflation, with the former exhibiting greater persistence. All products, with the exception of eggs and vegetables, exhibit significant persistence in the range of 0.90–0.99 within the CPI food inflation sub-groups. On the other hand, there is a lot of volatility in fruits, vegetables, milk and milk products, legumes, and products.

The above analysis shows that CPIF and WPIF inflation exhibit high persistence but similar volatility. However, within the components, pulses, cereals, milk, and spices, the manufacturing of dairy products exhibit high persistence. This implies that the main drivers of food inflation in India are these components that keep food inflation elevated. High volatility in food items may be a sign of seasonal variations or supply-side constraints like a shortfall in international supply, war, etc.

To address the problem of food inflation in India, the government has taken significant steps like imposing a ban on the export of certain crops, putting limits on stocks, relaxing the restrictions on imports of crops, etc. Apart from these short-term measures to contain food inflation, there is also a need to invest in medium to long-term measures such as decentralized cold storage facilities at production centers, judicious use of fertilizers, use of adequate and timely irrigation, use of new technology for post-harvest produce, transport infrastructure, etc. These measures would help in minimizing losses in the production of crops. Moreover, there is a need to devise mechanisms that would reduce wastage and develop consistent import patterns that would avoid problems of delay in supplies in the market.

Conclusion

The present study analyses the trends in wholesale and consumer price index food inflation and its sub-components in India. The paper also quantifies persistence and volatility for both measures of inflation and their components. The study is conducted using monthly data for both measures of food inflation for the period 2012M4 : 2023 M12. It has been observed that food inflation occupies an important position in explaining the drives of headline inflation in India. The weightage of food in retail inflation (CPI-C) is larger than wholesale inflation. Hence, during different periods, a divergence between WPI and CPI overall inflation is observed, which is primarily attributed to food inflation.

On the contrary, WPI food inflation and CPI food inflation have moved in tandem with each other. Since 2012, food inflation has shown signs of easing, with its major components like cereals, fruits, vegetables, and spices showing a downward spiral. However, during 2019–2020 and 2020–2021, some striking trends were observed in food inflation, such as the rise in prices of cereals, pulses, vegetables, and edible oils. Secondly, a divergence between rural and urban prices was also observed. Hence, estimates of persistence and volatility were found to decipher the behavior of the sub-components of overall inflation. Results reveal that CPIF inflation is more persistent than WPIF inflation. The sub-components of cereals, pulses, milk, and spices show high persistence, whereas pulses, vegetables, fruits, and certain manufactured food products show high volatility. Hence, the study concludes that government policies to control food inflation have to be long-term for items that show high persistence. In contrast, for volatile components, short-term policies may be put in place to obtain immediate results.

Author's Contribution

Deepika Goel is the sole author of this paper. She has contributed to the literature by quantifying persistence in Indian overall food inflation as well as its components. She also captured the trends in both WPI and the new CPI food index in India with the base year 2011–2012, highlighting the share of each component in the overall index.

Conflict of Interest

The author is affiliated with the University of Delhi as an Associate Professor, and the research conducted is purely for academic purposes. The author certifies that she has no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Funding Acknowledgment

The author received no financial support for the research, authorship, and/or for the publication of this article.

References

- Agarwal, A., Mishra, A., & Gupta, M. (2019). How does economic growth react to fiscal deficit and inflation? An ARDL analysis of China and India. *Arthshastra Indian Journal of Economics & Research*, 8(4), 7–20. <https://doi.org/10.17010/aijer/2019/v8i4/148068>
- Anand, R., Kumar, N., & Tulin, V. (2016). *Understanding India's food inflation: The role of demand and supply factors* (IMF Working Paper WP/16/2). International Monetary Fund. <https://doi.org/10.5089/9781513581347.001>
- Andrews, D. W., & Chen, H.-Y. (1994). Approximately median-unbiased estimation of autoregressive models. *Journal of Business & Economic Statistics*, 12(2), 187–204. <https://www.jstor.org/stable/1391483>
- Bandara, J. S. (2013). What is driving India's food inflation? A survey of recent evidence. *South Asia Economic Journal*, 14(1), 127–156. <https://doi.org/10.1177/1391561413477944>
- Basu, K. (2011). Understanding inflation and controlling it. *Economic & Political Weekly*, 46(41), 50–64. <https://www.epw.in/journal/2011/41/special-articles/understanding-inflation-and-controlling-it.html>

- Bhattacharya, R., & Gupta, A. S. (2018). Drivers and impact of food inflation in India. *Macroeconomics & Finance in Emerging Market Economies*, 11(2), 146–168. <https://doi.org/10.1080/17520843.2017.1351461>
- Dholakia, R. H., & Kadiyala, V. S. (2018). Changing dynamics of inflation in India. *Economic & Political Weekly*, 53(9), 65–73. <https://www.epw.in/journal/2018/9/special-articles/changing-dynamics-inflation-india.html>
- Dua, P., & Goel, D. (2021). Inflation persistence in India. *Journal of Quantitative Economics*, 19, 525–553. <https://doi.org/10.1007/s40953-021-00237-z>
- Goel, D. (2018). Measures of inflation in India. *Journal of Business Thought*, 9, 24–45. <https://doi.org/10.18311/jbt/2018/21171>
- Gopakumar, K. U., & Pandit, V. (2017). Food inflation in India: Protein products. *Indian Economic Review*, 52, 157–179. <https://doi.org/10.1007/s41775-017-0006-7>
- Gulati, A., & Saini, S. (2013). *Taming food inflation in India* (Discussion Paper No. 4). Commission for Agricultural Costs and Prices, Ministry of Agriculture, Government of India.
- John, J. (2015). Has inflation persistence in India changed over time? *The Singapore Economic Review*, 60(04), 1550095. <https://doi.org/10.1142/S0217590815500952>
- Khundrakpam, J. K. (2008). Have economic reforms affected exchange rate pass-through to prices in India? *Economic and Political Weekly*, 43(16), 71–79. <https://www.jstor.org/stable/40277642>
- Kothadia, K. D., & Nayak, D. N. (2020). Modeling inflation in India: A univariate approach. *Arthshastra Indian Journal of Economics & Research*, 9(2–3), 25–38. <https://doi.org/10.17010/aijer/2020/v9i2-3/155602>
- Maheshwari, N., & Biyani, R. (2012). Inflation and its effects on the Indian economy. *Indian Journal of Finance*, 6(4), 28–24. <https://www.indianjournaloffinance.co.in/index.php/IJF/article/view/72424>
- Maji, B., & Das, A. (2016). Forecasting inflation with mixed frequency data in India. *Calcutta Statistical Association Bulletin*, 68(1–2), 92–110. <https://doi.org/10.1177/0008068316668421>
- Malhotra, R. (2022). How South Asian economies managed their trade risks collaboratively? A study. *Arthshastra Indian Journal of Economics & Research*, 11(4), 26–44. <https://doi.org/10.17010/aijer/2022/v11i4/172741>
- Marques, C. R. (2004). *Inflation persistence: Facts or artefacts?* (No. 0371). <https://dx.doi.org/10.2139/ssrn.533131>
- Ministry of Finance, Government of India. (n.d.). *Economic Survey 2013–14, Ch 4*. <https://www.indiabudget.gov.in/budget2014-2015/es2013-14/echap-04.pdf>
- Ministry of Finance, Government of India. (2022). *Economic Survey 2021–22, Ch 5: Prices and inflation*. <https://www.indiabudget.gov.in/budget2022-23/economicsurvey/doc/eschapter/echap05.pdf>
- Ministry of Statistics and Program Implementation, Central Statistics Office, National Accounts Division, Government of India. (2015). *Consumer price index: Changes in revised series (Base Year 2012 = 100). Prices and cost of living unit*. https://cpi.mospi.gov.in/PDFile/CPI-Changes_in_the_Revised_Series.pdf

- Mishra, P., & Roy, D. (2012). Explaining inflation in India: The role of food prices. In, S. Shah, B. Bosworth, & A. Panagariya (eds.), *India Policy Forum* (Vol. 8, pp. 139–2012). National Council of Applied Economic Research. https://www.ncaer.org/wp-content/uploads/2022/09/1385633696IPF_2011_12_IPF-Vol_8-1.pdf#page=159
- Nair, S. R., & Eapen, L. M. (2012). Food price inflation in India (2008 to 2010): A commodity-wise analysis of the causal factors. *Economic and Political Weekly*, 47(20), 46–54. <https://www.jstor.org/stable/23214626>
- Office of the Economic Adviser, Department of Industrial Policy & Promotion, Ministry of Commerce and Industry, New Delhi. (2017). *Manual on wholesale price index (Base: 2011–12 = 100)*. https://eaindustry.nic.in/uploaded_files/WPI_Manual.pdf
- Patra, M. D., Khundrakpam, J. K., & George, A. T. (2014). Post-global crisis inflation dynamics in India: What has changed? In *India Policy Forum* (Vol. 10, Issue 1, pp. 117–203). National Council of Applied Economic Research. <https://www.ncaer.org/wp-content/uploads/2022/09/1432105116India-Policy-Forum-2013-14-Volume-10.pdf#page=142>
- Pivetta, F., & Reis, R. (2007). The persistence of inflation in the United States. *Journal of Economic Dynamics and Control*, 31(4), 1326–1358. <https://doi.org/10.1016/j.jedc.2006.05.001>
- Saxena, S. P., & Bhadauriya, S. (2013). Co-integration analysis of the determinants of inflation in India. *Arthshastra Indian Journal of Economics & Research*, 2(2), 4–12. <https://doi.org/10.17010/aijer/2013/v2i2/54507>
- Sekhar, C. S., Roy, D., & Bhatt, Y. (2018). Food inflation and volatility in India: Trends and determinants. *Indian Economic Review*, 53, 65–91. <https://doi.org/10.1007/s41775-018-0017-z>
- Subbarao, D. (2009). Inaugural address: Third annual statistics day conference. *Reserve Bank of India Bulletin*. https://www.rbi.org.in/scripts/BS_SpeechesView.aspx?Id=425

About the Author

Dr. Deepika Goel is currently teaching as an Associate Professor at the Department of Economics at Aryabhatta College, University of Delhi. She has 25 years of experience teaching undergraduate courses at the University of Delhi. She completed her B.A. (Hons.) in Economics from Hansraj College and has obtained her M.A., M.Phil., and Doctorate from the Department of Economics at the Delhi School of Economics. Her area of research involves macroeconometrics, time series, and forecasting. Her areas of teaching include econometrics, statistics, and macroeconomics. She has published papers in national and international journals and book chapters in her area of study.