Food Inflation and Volatility in India

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Abstract

Almost half of the total consumption expenditure in rural India is spent on food. Food inflation has been a persistent policy concern in India also because of its effect on headline inflation and growth. Results of our study show that commodities with higher weight in the consumption basket such as rice, eggs, meat, fish, milk, and vegetables have also shown larger increase in prices, which is a cause for concern. Price volatility is found to be a lot higher for perishable commodities such as fruits and vegetables. Econometric analysis of the determinants indicates that both supply and demand factors are important, although their relative importance varies across commodities. Addressing supply bottlenecks, mainly increasing production, judicious price and stocking policy and improving processing infrastructure for fruits and vegetables appear important for addressing food inflation.

Keywords: Inflation, Food prices, Food inflation, price volatility, India

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India is home to one-third of the world's poorest population, numbering about 1.2 billion people, who are living below 1.25 USD per capita per day (World Bank 2013)[1]. India's success in addressing food inflation, therefore, has important implications for global food security. According to the latest estimates, the share of food in consumption expenditure in rural India is about 49% and about 69% of Indian population lives in rural areas (*Census 2011*, Registrar General of India). Majority of the rural population, including the small and marginal farmers, are net buyers of food. About half of the labour force in the country is engaged in agriculture and the average size of the agricultural landholdings is very small (about 1.15 hectares). These factors, combined with a very slow growth in the per capita incomes of the rural and urban poor, make containing food inflation an extremely important issue for Indian policymakers.

Food inflation is also important on macroeconomic considerations. India is one of the fastest growing economies in the world today. Sustaining this growth is important in the context of the recent slowdown in the global economic growth. The nexus between relative prices and overall inflation or, the disproportionate effect of prices of few commodities or commodity groups, such as food, on overall price level is extremely important. Welfare, particularly of the poorer sections is impacted by food inflation. Cross-country evidence shows that food inflation is not only more

[1] According to World Bank (2013), India has 33 percent of the world's poorest 1.2 billion people (below 1.25 USD per capita per day), even though the country's poverty rate is half as high as it was three decades ago

volatile but is also higher, more persistent and is strongly propagated, as compared to non-food inflation (Walsh, 2011). Given the larger percentages of poor population in many developing countries and a larger share of expenditure on food among the poor, these findings have serious implications. If transmission of food price shocks into non-food prices is strong, as is the case in many low income countries, the impact of food inflation on headline inflation can be substantial (Bhatt and Kishor, 2015).

In India, food inflation has been continually high over the last several years, particularly after the drought in 2009[2]. Initially, this was attributed to drought & its carryover effects and also inappropriate trade policy (Chand 2010, Nair and Eapen 2012, Nair 2013). However, the problem persisted even after improvement in the food production, tightening of grain exports and liberalizing imports. This is a cause for concern to the policymakers.

A systematic analysis of food inflation in India and its determinants is therefore imperative. The present study is a step in this direction. Most of the previous studies on this subject were based on one or two episodes of inflation. More importantly, years of low inflation were not factored into these analyses to check the robustness of the conclusions drawn. The present study attempts to fill this gap by carrying out the analysis over a longer time horizon and also at disaggregate commodity level, to identify the main contributors to food inflation and the underlying determinants.

[2] There has been a slowdown in food inflation since August 2014, which is mainly due to the higher base effect and slowdown in food & fuel prices globally (Mandal et al. 2012). However, understanding the long-term trends is still important for informed policymaking. The food inflation has started inching up again since April 2015

The study is organized as follows. After a brief background and introduction to the problem, a detailed review of literature is undertaken in section 2. Section 3 contains a description of the methodology followed. Results of the analysis are presented in section 4. Section 5 presents a summary of the study, brief conclusions and important policy implications.

2. Review of Literature

Inflation-growth nexus and threshold inflation received a fair share of attention in the literature. Fisher (1993) in an important article, using cross-section and panel regressions, showed that growth is negatively associated with inflation – mainly through reduction in investment and productivity. Although there is broad consensus on the adverse effects of inflation on growth, there is not enough agreement on the threshold above which inflation starts affecting growth adversely. Bruno and Easterly (1995) argue that growth is adversely affected only in years of very high inflation – above 40% – and the recovery is strong and fast once inflation falls. Khan and Senhadji (2001) estimate the threshold inflation to be 1-3 per cent for industrial countries and 11-12 per cent for developing countries. There appears to be a greater agreement about the negative effects of inflation on the poor though (Easterly and Fischer 2001).

Another important issue is the link between relative prices and overall inflation. Ball and Mankiw (1995) show that large shocks to few commodities can have disproportionate effect on overall price level, mainly because of the adjustment costs of firms. Aggregate inflation depends on the distribution of relative price changes and inflation rises when the distribution is skewed to the right. In such cases, measures of supply shocks, such as relative prices of food and energy, work better than the traditional measures of core inflation (Bhatt and Kishor, 2015). Fisher (1981) in his earlier work reached somewhat similar conclusions, which refute the classical

monetarist notion that inflation is the result of changes in money supply whereas relative price changes occur because of real factors, and therefore do not affect overall inflation.

A more recent work on relative food inflation is by Walsh (2011). Using CPI data for 91 countries[3], the study argues that in lower income countries, food inflation is not only more volatile but is also, on an average, higher than non-food inflation. The study shows that food inflation is more persistent than non-food inflation and that food price shocks are strongly propagated to non-food inflation in many countries. Given the larger percentages of poor population in many developing countries and a larger share of food in total expenditure of the poor in general, these findings have serious implications.

In India too, food inflation received considerable attention of researchers. Mishra and Roy (2011) show that food inflation in India is concentrated in few commodity groups such as milk, fruits & vegetables, eggs-fish-meat and cereals. They mainly attribute this inflation to production shocks compounded by excessive government intervention in the food markets. Chand (2010) argues that most of the food inflation is due to production shocks. He recommends augmenting buffer stocks, improving storage facilities and dovetailing trade policy with production scenario in the country. Gopakumar and Pandit (2014) built a structural simultaneous equation model for cereals by incorporating procurement. Using this model, they show that demand side management is relatively more important. Nair and Eapen (2012) argue that production shortfalls and cost of production played the major role in the inflation episode between January 2008 and July 2010. They argue that the demand side factors played little role. However, this assessment

[3] For India, WPI data are used as this is the only national price index with a monthly frequency available. We have also used WPI data in the present study

changes somewhat in a later study by the same author. Nair (2013), analyzing the inflation episode between December 2009 and August 2013, argues that increases in demand side pressures – mainly for pulses, milk, edible oils, eggs-meat-fish – and increases in the cost of production are the major factors behind food inflation. Bhattacharya and Sengupta (2015) conclude that both demand and supply factors have contributed to recent surge in food inflation in India and show that rise in cost of production and procurement prices are the main drivers of inflation in cereals. Eapen and Nair (2015) argue that despite the slowdown in the agricultural sector, food prices were relatively low during the post-economic reforms period (1992–2013), compared to the earlier periods. Stable agricultural growth, higher buffer food stocks, greater coverage of the public distribution system, and better responses to food price fluctuations due to import/trade liberalisation and a more comfortable foreign exchange reserves position are identified as the factors responsible this.

The results of the abovementioned studies are interesting. These studies show that the trends as well as the underlying causal factors of food inflation can undergo quick changes. For example, production shocks, not-so-comfortable stock levels and exports in the preceding years were cited as factors responsible for rice price increases between 2007-08 to 2009-10. However, India imposed export bans in 2008, which continued until 2011. Also India's production was impressive and stocks rose way above the buffer norms in these years, except in 2009 when the production suffered due to a severe drought. Despite these favourable factors, rice prices continued to be high. Similar is the case with some of the other commodities too. A change in the trend of perceived causal factors did not always result in the expected outcomes as regards inflation.

It is clear from the foregoing review that food inflation is more complex with several factors at work simultaneously such as supply, demand, external factors, policy etc. Most of the previous studies, although rich in detail and insights, have drawn inferences mainly based on one or two episodes of inflation. More importantly, years of low inflation were not factored into these analyses to check the robustness of the conclusions drawn. The present study makes an attempt to fill some of these gaps. We propose to carry out the analysis over a longer time horizon at disaggregate commodity level to identify the patterns and determinants of food inflation.

3. Objectives, Methodology and Database

The specific objectives of the study are the following

i. Assessing the trends in food inflation and patterns in volatility of food prices in India
ii. identifying the drivers of food prices
iii. to make short to medium term projection of food prices

3.1 Methodology

Trends in food inflation haven been presented through tabular and graphical analysis. Following this, a detailed decomposition analysis has been undertaken to identify the major commodities contributing to food inflation. This is followed by an analysis of the volatility patterns in ARCH / GARCH framework and also using the ratio method. Finally, the effect of plausible causal factors on food prices is assessed using panel regressions using crop-fixed effects. The detailed methodology is outlined below.

3.1.1 Decomposition of Food Inflation into Contribution by Different Commodities

The following scheme has been used to identify the major contributors to food inflation. We have used the monthly data on WPI (2004-05 prices) from 2005 to 2015 for this exercise.

$$\text{Let } I_t^F = \frac{\sum_j I_{jt}^F w_{jo}^F}{\sum_j w_{jo}^F} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where I_t^F denotes wholesale price index of food in time t, I_{jt}^F is the wholesale price index of the food commodity j in time t and w_{jo}^F is the expenditure share of the food commodity j in total food expenditure in the base period o.

Taking first differences of (1) and dividing by I_{t-12}^F, we get food inflation as

$$\frac{\Delta I_t^F}{I_{t-12}^F} = \frac{\sum_j \Delta I_{jt}^F w_{jo}^F}{\sum_j w_{jo}^F I_{t-12}^F} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Now multiplying and dividing the right hand side expression by $I_{j(t-12)}^F$ and rearranging the terms yields the following equation (3), which represents the contribution of individual commodities to overall food inflation. In this manner the overall food inflation $\frac{\Delta I_t^F}{I_{(t-12)}^F}$ can be decomposed into contribution of each commodity j.

$$\frac{\Delta I_t^F}{I_{(t-12)}^F} = \sum_j \frac{w_{jo}^F}{(\sum_j w_{jo}^F)} \cdot \frac{\Delta I_{jt}^F}{I_{j(t-12)}^F} \cdot \frac{I_{j(t-12)}^F}{I_{(t-12)}^F} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The first term on the right denotes the relative weight of the commodity j in the overall food basket, the second term denotes the inflation of the commodity and the third term denotes the price index of the commodity relative to the overall food price index during the same month in the previous year (12 months before), which is the *Base Effect*.

3.1.2 Volatility

Volatility has been measured by using the 'ratio' method and conditional variance methods such as ARCH/GARCH, and Threshold Arch models. See the Annexure at the end for details of these models. Ratio method involves measuring the standard deviation of the growth rates i.e. standard deviation of log (P_t / P_{t-1}), where P_t is 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.

3.1.3 Categorization of commodities

After the inflation and volatility computations are made the commodities are categorized in the following way. For each year the median values of inflation are computed. A commodity is then categorized as 'high inflation commodity' or 'low inflation commodity' in each year, depending on whether the inflation of the commodity is greater or lower than the median inflation for the year. The overall categorization of the commodity is made depending on whether the commodity falls in the 'high' or 'low' category for five or more years during the period of analysis i.e. 2008 to 2015. Similar procedure is followed for categorizing on the basis of weight of the commodity and volatility (calculated by ratio method).

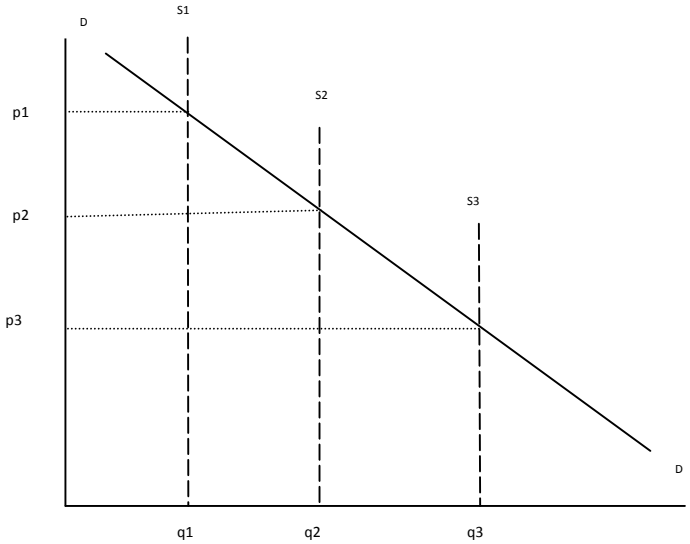
3.1.4 Drivers of Food Inflation

The nature of agricultural production process is such that stability in prices requires that either the demand or the supply function be elastic (Johnson 1975, Sekhar 2003). Generally for any given geographic region, there are relatively fewer shifts in the demand function in the short run. Thus, market price is generally influenced by the supply function.

There are two supply relations in agriculture. One is the conventional short-run supply function, where there is a time lag between the production decision and the actual production. Production decisions are made based on current or most recent prices, alongwith other relevant factors. Because of this lag, actual production becomes a function of past prices. Since production cannot be totally adjusted to price changes in a single period, a partial adjustment model, where current production is a function of lagged production alongwith expected price and other supply shifters, is more popular in literature (Nerlove, 1958),

The second and a more important supply relation, which is very short term in nature, comes into play once production is realized (Tomek and Robinson, 1972). Once produced, the quantity cannot be varied until the next production cycle (which is normally a season). This makes the supply completely inelastic for a short period of time. With a stable demand schedule, current price then becomes a function of current supply (production), as illustrated below.

Figure 1: A very short-run supply and price scenario



s1, s2 and s3 denote supply schedules at t1, t2 and t3, with gradually increasing supply i.e. q3>q2>q1. Because of the inelastic supply schedule, the corresponding equilibrium prices bear the relation p1>p2>p3. There are also other additional factors such as administered prices,

production costs (due to rigidities in factor markets or/and regulation of wage rates), exports / imports, income changes etc that influence equilibrium price.

The simplest model can be written as follows

$Q_t^s = \alpha_0 + \alpha_1 Q_{t-1}^s + \alpha_2 p_{t-1} + \alpha_3 SV_t^s + \varepsilon_t^s$ .....(1)
$p_t = \beta_0 - \beta_1 Q_t^d + \beta_2 y_t + \beta_3 SV_t^d + \varepsilon_t^d$ .....(2)
$Q_t^d = Q_t^s$ at equilibrium .....(3)
From 1, 2 and 3 we get
$p_t = \beta_0 - \beta_1(\alpha_0 + \alpha_1 Q_{t-1}^s + \alpha_2 p_{t-1} + \alpha_3 SV_t^s) + \beta_2 y_{t-1} + \beta_3 SV_t^d$ .....(4)
where Q_t^s, Q_t^d are quantity supplied and quantity demeanded respectively at t;
p_t and y_t are the price and income respectively;
SV_t^s, SV_t^d are the other shiter variables of supply and demand schedules respectively
α, β are parameters to be estimated and $\varepsilon_t^s, \varepsilon_t^d$ are the error terms

From (4) it is clear that the price, because of the very short-run supply relation discussed above, is a function of supply in the current and previous periods, price in the previous period and other shifters of supply and demand. The following model can thus be formulated to identify the plausible determinants of food price.

$$WPI_{it} = f(c, a_i, prod_{it}, prod_{it}(-1), MSP_{it}, M_{it}, X_{it}, WR_{it}, MPCE_{it}(-1)) \text{ .....(5)}$$

where WPI_{it} is the wholesale price index (2004-05 = 100) of commodity i in time t; a_i denotes the crop fixed effects and $prod_{it}, MSP_{it}, M_{it}, X_{it}, WR_{it}, MPCE_{it}$ denote production, minimum support price[4], imports, exports, wage rate and average monthly per capita expenditure on commodity i respectively.

The model is estimated in panel regression framework with crop-fixed effects

3.2 Database

[4] Minimum support price (MSP) is announced before every cop season to provide a price assurance to the farmer. The government is statutorily bound to purchase at this price whatever quantity becomes available

Data Sources: There are mainly two data sources on food price indices in India – 1) wholesale price index (WPI) which is available at the commodity level from 2005 (at 2004-05 prices) from the Office of the Economic Adviser, Ministry of Commerce & Industry, GoI 2) consumer price index or the CPI (Rural/Urban/combined) which is available at the commodity level from 2011 and the annual inflation rates from January 2012 from the Central Statistics Office (CSO), Ministry of Statistics and Programme Implementation. We have used WPI because of its availability over longer time period. Data for cost of production of crops and wage rate for the crops for major producing states is collected from the various issues of *Cost of Cultivation of Principal Crops in India*, *DES, Ministry of Agriculture.* C2 cost and wage rate (in Indian Rupees) are used. The state-level cost and wage data thus collected for each crop are aggregated using simple averages to derive the cost and wage data at the national level. Data on production, minimum support prices (MSP) and stocks is collected from the *Agricultural Statistics at a Glance* and the online database of the *Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India*. Data for trade of cereals and others (import and export) is collected from the *Agricultural Statistics at a Glance, DGCIS database of Ministry of Commerce & Industry* and *FAOSTAT database of the Food and Agricultural Organization (FAO)*. The production and trade data for fruit and vegetable crops is collected from the *Indian Horticulture Database, National Horticulture Board, MoA, GoI*. Yearly data on real per capita expenditure on commodity (in Rs.) is collected from various rounds of NSSO reports. The world price data is collected from *Pink sheets data, World Bank* for the reported crops. The period of analysis is from January 2001 to July 2015.

4. Results

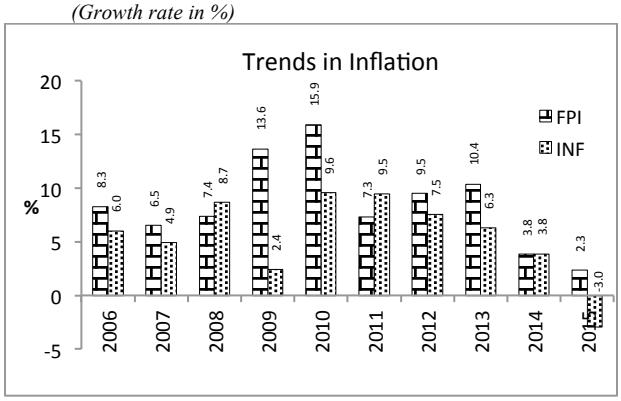
4.1 Inflation Decomposition

Food inflation (FPI) has exceeded 6% in all the years except 2014 and 2015 (Figure 2). Food

inflation has been higher than overall inflation in eight out of the last ten years and has been continuously high since the drought year 2009, despite cooling down in the last two years. No single commodity / group showed uniformly high inflation in all these years and different commodities showed high inflation in different years. This is perhaps indicative of the absence of any major structural problem with any one single commodity / group. Therefore, there is a need to assess systematically the specific contribution of individual commodities to food inflation.

Figure 2: Trends in Inflation

(Growth rate in %)



Source: Office of the Economic Adviser, Ministry of Commerce & Industry, Government of India (GoI) and Agricultural Statistics at a Glance

Contribution of a commodity to food inflation (during a month) depends not only on the y-o-y inflation of the commodity but also weight of the commodity (in the consumption basket) and price level of the commodity in the corresponding month of the previous year. Therefore, contribution of each commodity is further decomposed into base effect, weight and inflation using the methodology for decomposition outlined in section 3.1.1. The commodities are then categorized based on this classification (see section 3.1.3). The contribution of major sub-groups is presented in Figure 3 and that of major commodities is presented in Figure 4.

From Figure 4 it can be seen that the major contributors to food inflation are milk (22%), eggs-meat-fish or EMF (20%), rice (11%), sugar (9%), wheat (5%), banana (3%), tomato, brinjal and

cabbage– 1 to 2% each. These commodities together accounted for about 76% of the overall food inflation during the period. Further decomposition of the contribution into individual components i.e. base effect, weight and inflation is presented in Table 1 to Table 4. Five out of the nine commodities i.e. milk, eggs-meat-fish, rice, banana and cabbage are falling in the "High Base – High Weight – High Inflation" (HBHWHI) category. Thus, for these five commodities all the three effects are stronger. This is a reason for concern. For the remaining four commodities, only one or two effects are strong. The worrying feature is that majority of the commodities is falling in the HBHWHI category, which means that the commodities that have *larger weight* in the consumption basket are also showing a *higher level* of prices and *faster increase* in these prices.

Figure 3

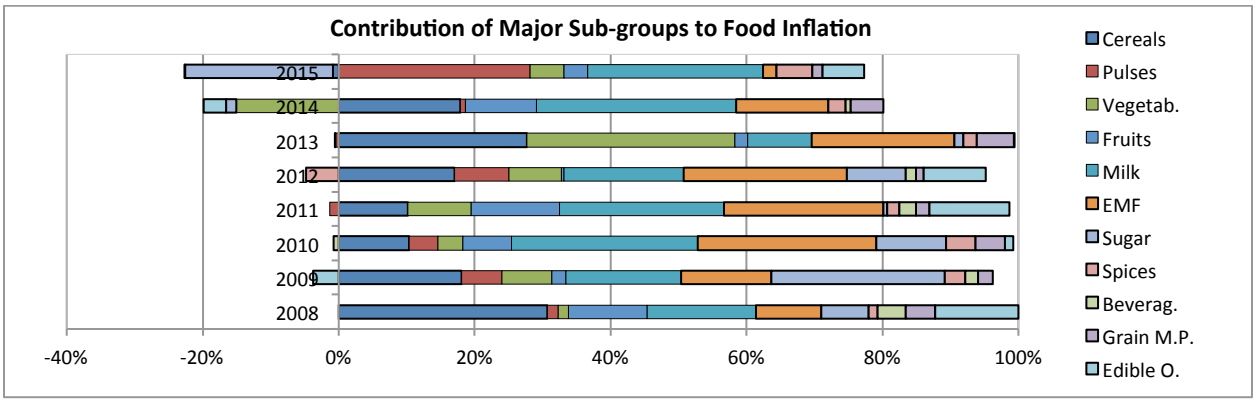


Figure 4: Average contribution of major commodities to food inflation (2008 to 2015)