# The Food Price Channel: Effects of Monetary Policy on the Poor in India

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**Abstract**

Poverty and hunger have been largely ignored in the practice and conduct of monetary policy. This paper studies the impact of monetary policy on the distribution of food consumption in India, particularly focusing on the subsistence food consumption of poor households and inequality. Using household survey data from 1996:Q1 to 2013:Q4, I estimate the dynamic effects of monetary policy shocks on relative food prices and the distribution of food consumption in rural and urban India from a dynamic common factor model (Bernanke, Boivin, and Eliasz, 2005 and Stock and Watson, 2011), and identify monetary policy shocks using the sign restriction approach of Uhlig (2005). Factor-Augmented Vector Auto Regression (FAVAR) results show that an expansionary monetary policy shock increases the *relative* food prices, reduces the subsistence food consumption of poor households, and raises inequality across households in food consumption. This paper provides evidence of the impact of a *"food price channel"* of monetary policy on poor households in India. To the best of my knowledge, this is the first study to empirically analyze the impact of monetary policy on poor households in India. This study may hold important policy implications for Indian policymakers as well as those in similar low-income countries.

**Keywords**: Monetary Policy, Food Prices, Food Subsistence, Poverty, Inequality, Development
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# 1. Introduction

Poverty and hunger are a primary concern of developing countries, where they can have significant implications for long-term economic growth.[1] Food intake below the biological minimum leads to undernutrition, malnutrition, and mortality, which represent a direct loss to the human capital and productivity, thereby reducing the pace and durability of economic growth (Dreze and Sen, 1989; Horton, 1999; Behrman et al., 2004; Deaton and Dreze, 2009; Dreze and Sen, 2013). Indirect losses from child undernutrition are caused by poor cognitive function, grade repetitions, and lower school attainment. Dasgupta (1997) shows that a poverty trap can operate with undernourished people finding it hard to get employment because they are unproductive, and remaining unproductive because they are unemployed. Many other studies have examined how physical productivity of labour and, thereby, employment and wages are related to food intake (Dasgupta, 1995; Haddard and Bouis, 1991; Sahn and Alderman, 1988; Behrman and Deolalikar, 1988; Dasgupta and Ray, 1986; Stiglitz, 1976). In total, the economic cost of hunger is estimated to range from 2 to 3 percent of Gross Domestic Product (GDP) in low income countries, to as much as 16 percent of GDP in most affected countries.[2]

Despite its importance, poverty and hunger have been largely ignored in the practice and conduct of monetary policy. Most papers in applied monetary economics are concerned with aggregate macroeconomic data, and ignore the possible consequences of monetary policy interventions on poor households. The aim of this paper is to fill the gap by estimating the effects of monetary policy shocks on poor households in India - a developing country ranked

[1] FAO defines "hunger" as chronic undernourishment and food intake less than 2100 Kcal, over a period of one year. FAO estimated that about 795 million people, 11% of the world's population suffered from chronic undernourishment in 2014-2016. Almost all the hungry people, 780 million, live in developing countries.

[2] Productivity losses as a result of undernutrition have been conservatively estimated in low income countries to be at least 2-3 percent of GDP annually (Horton, 1999; Behrman et al., 2004). However in Africa, these losses are very high. The economic costs of undernutrition have been estimated to be 16.5% of GDP in Ethiopia and 10.3% of GDP in Malawi. See The Cost of Hunger in Africa and The Cost of Hunger in Malawi.

as one of the fastest growing large economies in the world but paradoxically also ranked as one of the poorest countries in the world, measured by *'gross national income per capita'*, that makes it an interesting case for such a study. In particular, I estimate the dynamic effects of policy shocks on the distribution of food consumption and compare effects across this distribution, to understand its implications for poverty and inequality in the country.

This study is important, because of the indispensable role played by food in the survival of poor households, who form a significant proportion of the population in low-income countries. In India, nearly 25% of the population or close to 300 million people live below the national poverty line. The bottom quartile (poor households), on average, spends 65% of their income on food and yet, remain substantially food deprived. The per capita per day intake of calories for poor households is 1,500 Kcal in rural India and 1,577 Kcal in urban India, which is significantly below the biological minimum intake of 2,400 Kcal in rural areas and 2,100 Kcal in urban areas. Hunger accounts for 24% of under-five deaths and 30% of neo-natal deaths. Despite years of robust economic growth, poverty and hunger continue to remain India's compelling challenge.[3]

Using household survey data from 1996:Q1 to 2013:Q4, I estimate the dynamic effects of monetary policy shocks on relative food prices and the distribution of food consumption in rural and urban India from a dynamic common factor model (Bernanke, Boivin, and Eliasz, 2005 and Stock and Watson, 2011), and identify monetary policy shocks using the sign restriction approach of Uhlig (2005). I report two principal findings from this empirical study. First, monetary policy shocks have statistically significant effects on food consumption of poor households in India: an expansionary monetary policy shock increases the *relative* prices

[3]India has been ranked 97 among 118 developing countries in the 2016 Global Hunger Index. The GHI, adopted and developed by the International Food Policy Research Institute (IFPRI) in 2006, is a multidimensional statistical tool used to describe the state of a country's hunger situation. The GHI combines 4 component indicators: 1) the proportion of the undernourished as a percentage of the population; 2) the proportion of children under the age of five suffering from wasting; 3) the proportion of children under the age of five suffering from stunting; 4) the mortality rate of children under the age of five.

of food, and reduces the subsistence food consumption of poor households. Monetary policy shocks seem to play a non-trivial role in accounting for fluctuations in food consumption of poor households. For example, forecast error variance decompositions suggest that the contribution of monetary policy shocks to fluctuations in food consumption of poor households is of the same order of magnitude (*nearly 20%*), as the contribution of these shocks to any other macroeconomic variable like GDP or inflation. Second, there is considerable heterogeneity in the food consumption responses faced by households across different expenditure classes to monetary policy shocks. The lower the expenditure class of the household, the higher is its sensitivity to fluctuations in relative food prices and hence to monetary policy shocks. An expansionary monetary policy shock raises the observed inequality across households in food consumption.

This paper documents the evidence of the impact of a *"food price channel"* of monetary policy on poor households in India. The underlying mechanism is that, inorder to stimulate the economy when the central bank employs an expansionary monetary policy, food prices being relatively more flexible, adjust quicker than the overall price level in the economy. Therefore an expansionary monetary policy shock generates an increase in the *relative* prices of food. At short horizons, over which wages are fixed, an increase in *relative* prices of food adversely affects poor households particularly because of three features that stand out among the Indian poor - first, they are net buyers of food; second, they have limited ability to substitute food when relative food prices rise, due to a high share of food expenditure in their total budget and subsistence caloric intake; and finally, they are financially constrained (unbanked population) because of which they are unable to borrow and insure against idiosyncratic risks.[4] Due to the presence of these features, poor households are highly sensitive to fluctuations in relative food prices. An expansionary monetary policy shock that increases *relative* food prices, triggers a negative income effect for poor households, thus reducing their

[4]see section 2 for details.

subsistence food consumption and ultimately hurting them unintendedly. Taken together, results of this paper imply that, while expansionary monetary policy is a potent tool to stimulate the economy, it may come with an unwanted side effect: a decline in food consumption of poor households and an increase in food consumption inequality. To the extent, that Planning Commission of India uses alternative poverty measures based on food such as the hunger criterion, food-share criterion, and calorie cut-off as criterion, results of this paper imply that an expansionary monetary policy increases poverty and inequality in India.

In prior literature, various channels explaining the impact of monetary policy on poverty and inequality focused mostly on advanced countries. Because monetary policy is transmitted through different direct and indirect channels, and because households in developing countries significantly differ from those in advanced countries in many respects (with regard income, wealth, employment status, financial inclusion, institutions, patterns of consumption expenditure etc.), channels through which monetary policy affects households in advanced countries may not be relevant to developing countries. For example, on average, the share of food in total household expenditure is 40-50% in developing countries as compared to 10-15% in advanced countries (Figure 1); on average more than half of the population in developing countries lack access to the formal financial system, by contrast in advanced countries, nearly all households have such access (Figure 2). Due to differences in degrees of development across countries, monetary policy channels do not affect households in all countries in the same way.[5] The main contribution and novelty of this paper is finding evidence of the impact of a *"food price channel"* of monetary policy on poor households in a developing country, India. This channel is particularly relevant to developing countries, due to certain features of poor households in these countries, notably being, high share of food expenditure in total consumption expenditure and low financial inclusion. This study may hold important policy implications for Indian policymakers as well as those in similar

[5]The distributional effects of monetary policy on the rich versus the poor is specific to the institutions, characteristics and histories of each economy (Easterly and Fischer, 2000).

developing countries.

## 2. Stylized Facts

In this section, I present some stylized facts that explain the dominant role played by changes in relative food prices in India.

Nearly 25% of the Indian population or close to 300 million people, live below the national poverty line of Rs 33 (50 cents) per person per day in urban areas and Rs 27 (42 cents) per person per day in rural areas. The bottom quartile (poor households) in rural and urban India are net purchasers of food (Figure 3), and spends 60-65% of their income on food (Figure 4).[6] Despite a very high share of expenditure on food, the bottom quartile is substantially food deprived. The per capita per day intake of calories for poor households is 1,500 Kcal in rural India and 1,577 Kcal in urban India, which is significantly below the biological minimum intake of 2,400 Kcal in rural areas and 2,100 Kcal in urban areas. The Public Distribution System in India is endeavoured to providing subsidized cereals and sugar to poor households but this does not seem to improve their nutrition status because, first, food grains distributed by the Public Distribution System (PDS) forms a small part of the food consumption of poor households (Figure 5), and second, these households still have to rely on the market for consumption of other essential food commodities such as lentils, milk, fruits and animal proteins that provide important micro nutrients to the human body. The primary observation from the aforementioned points is that, poor households in India have limited ability to substitute food when relative food prices increase, due to a high share of food expenditure in their total budget and subsistence food intake.

Further, the bottom quartile in India comprises the poor daily wage workers who are em-

[6]The bottom 37% of the rural population comprises the landless labourers (less than .002 hectare of land) and labourers with very little land (less than .01 hectare of land); they are net purchasers of food (refer to Figure 3).

ployed in the informal sector, where wages are not indexed to inflation and workers don't have much bargaining power vis-a-vis their employers (Gulati et al., 2013; Rajan, 2016). This proportion of the population has been largely excluded from benefits of India's economic growth. For example, whereas real GDP of the economy grew at an annual rate of 6% in the past 20 years, real consumption expenditure of the bottom quartile recorded a negative growth rate of .36% over the same period (Table 1).[7]

The financial inclusion in India is very low, more than half of the population lack access to the formal financial and banking system (Figure 2). Lack of access to the financial market makes the demand of credit-constrained poor households insensitive to fluctuations in interest rate. The credit-constrained poor households cannot borrow and therefore cannot insure against idiosyncratic risks (Anand and Prasad, 2012).

The main summary from the above discussion is that, poor households in India are net buyers of food, have limited ability to substitute food due to a high share of food expenditure and subsistence food intake, and are financially constrained; all these features make poor households highly sensitive to fluctuations in relative food prices and hold potential implications for their response to changes in monetary policy.

# 3. Literature Review

My study is closely linked to three strands of literature, which I summarize below.

[7]Despite robust economic growth in India, mean real wages rose at a slow rate of only 1.03% in rural India and 2.6% in urban India. Sen et al. (2013) argue that the reason why economic growth in India has led to so little increase in wages is owing to 'jobless growth'. India's rapid economic growth during the last twenty years has been driven mainly by the 'service sector' which is heavily skill intensive (such as software development, financial services and other specialized work) rather than more traditional labor intensive sectors. While this has helped, the educated class to earn higher wages, the bulk of the labor force has been left in agriculture and other informal sectors (which employs more than 90 percent of the labor force) where wages remained very low.

(3.1) *Impact of Monetary Policy on Relative Food Prices*

Richard Cantillon, in "An Essay on the Nature of Trade in General" published in 1755 was the first to point out the idea that price level changes are caused by increases in the quantity of money, which in turn depends on the way new money is injected into the economy and actually where it affects prices first. Bordo (1980), Chambers and Just (1981), Frankel (1986), Orden (1986), and Cho et al. (1993) have given empirical and theoretical explanations for the tendency of agricultural (food) prices to be more flexible relative to the general price level in the economy.[8] The authors show that prices of agricultural goods respond more quickly to changes in monetary policy than do prices of other goods. Orden and Fackler (1989) and Dorfman and Lastrapes (1996) show that an increase in money supply raises agricultural prices relative to the general price level for more than a year, providing evidence of real short-run and long-run effects of monetary changes on agricultural prices. Further, Lastrapes (2006) and Balke and Wynne (2007) show that monetary disturbances have substantial relative price effects, resulting in an increase in dispersion of the cross-section distribution of prices.

The literature provides evidence of monetary non-neutrality. Commodity prices do not respond uniformly to monetary policy shocks and food prices being highly flexible and volatile, fluctuate more relative to the general price level in the economy.

(3.2) *Impact of Relative Food Prices on Poverty and Inequality in Low Income Countries*

The most important distributional consequence of a rise in relative food prices on poor is through a reduction in real income. Mellor (1978), Ravallion (1998), Rao (1998), and Pons (2011), among many others, show that an increase in relative food prices increases poverty and inequality in India, through adverse distributional effects on the real income of poor

[8]Bordo (1980) argues that agricultural commodities exhibit lower transaction cost than manufactured goods, therefore agriculture prices are characterized by short term contracts and respond more quickly to monetary changes than the prices of other goods.

households. Research studies done on Latin American countries - Guatemala, Nicaragua, Honduras, and Peru show that an increase in relative food prices represents a negative shock for poor households due to their disproportionately high share of food expenditure (Robles and Torero, 2010).

The next important distributional consequence of a rise in relative food prices is through its differential effects on net buyers and net sellers of food. Higher relative food prices hurt all households who are net purchasers of food (Dev and Ranade, 1998; Kapila and Krishna, 2009). Dev and Ranade (1998) investigate the distributional consequence of a rise in relative food prices in India, through its effects on net buyers vs. net sellers of food. The authors find that by a very conservative estimate, the entire urban population and at least 50 per cent of the total rural population is adversely affected by an increase in relative prices of food. Research studies done on Zimbabwe and Sub-Saharan Africa show that there are clear links between higher relative food prices, lower caloric intake, poverty, and increase in child malnutrition (Wodon et al. 2010; Alderman, Hoddinott, and Kinsey, 2006).

Given these previous literatures, a conclusion is reached: higher relative food prices disproportionately hurt the poor households in low income countries particularly because of two features that stand out among them - they are net buyers of food and they spend a substantial proportion of their income on food.

(3.3) *Impact of Monetary Policy on Poverty and Inequality*

In the literature, various channels explaining the impact of monetary policy shocks on poverty and inequality, focused mostly on advanced countries.[9] Coibion et al. (2012) summarize five channels whereby monetary policy can impact inequality (i) income composition channel -

[9]Yannick and Ekobena (2014) studies the distributional effect of monetary policy shocks on absolute poverty in US and Africa. Very recently Villarreal (2014) studied the distributional effects of monetary policy shocks on inequality in Mexico.

the tendency of capital income to rise more relative to wage income (ii) financial segmentation channel - the ability of some financial market agents to benefit more from policy shocks than others (Williamson, 2009; Ledoit, 2009). (iii) portfolio channel - wealthy households who tend to be the largest holders of securities will gain more from asset market booms created by expansionary monetary policy (Erosa and Ventura, 2002; Albanesi, 2007; Saiki and Frost, 2014) (iv) savings redistribution channel - an unexpected decrease in interest rates will hurt savers and benefit borrowers (Doepke and Schneider, 2006; Coibion et al., 2012) and (v) earnings heterogeneity channel - the tendency of lower incomes to be more sensitive to the business cycle (Carpenter and Rodgers, 2004; Heathcote et al., 2010; Coibion et al., 2012).

Because monetary policy is transmitted through different direct and indirect channels, and because households in developing countries significantly differ from those in advanced countries in many respects (with regard income, wealth, employment status, financial inclusion, institutions, patterns of consumption expenditure etc.), monetary policy does not affect all households in the same way. Yannick and Ekobena (2014) finds that whereas an increase in interest rate increases poverty in United States through the savings redistribution channel, an increase in interest rate does not affect poverty in Central Africa because of low financial development. Monetary policy channels differ across economies with different degrees of development. The main contribution of this paper is finding evidence of the impact of a *"food price channel"* of monetary policy on poor households in a developing economy, India.

# 4. Data

The data sample I use for this study is quarterly and ranges from 1996:Q1 to 2013:Q4. I measure aggregate output as real GDP (seasonally adjusted), the price level as the Consumer Price Index, the nominal interest rate as the Prime Lending Rate and the stock of nominal

money as M3. The above data on macro-variables are taken from *Handbook of Statistics on Indian Economy*, Reserve Bank of India. The average annual growth rates of real GDP, real money supply and CPI over the study period have been presented in Table 1. India witnessed a robust real GDP growth of 6.2% per year over the study period.

(4.1) *Food Consumption*

I use the average real per capita food consumption expenditure (real PFCE) of households as a measure of food consumption in this study. The household consumer expenditure surveys, published by India's National Sample Survey Organization, report the distribution of average nominal monthly per capita food consumption expenditure for different expenditure classes across rural and urban India.[10] I carefully choose four expenditure classes for my empirical analysis (explained below), keeping in mind my focus on poverty and inequality. I compute quarterly averages of nominal monthly per capita food consumption expenditure of households, taken from consumer expenditure surveys, and deflate them by the wholesale price index (WPI) of food, to obtain their quarterly averages of real per capita food consumption expenditure (real PFCE).

The objective of this study is to investigate the distributional effects of monetary policy on food consumption expenditures of households and understand its implications for poverty and inequality. I therefore select the following four expenditure classes and estimate their food consumption responses to monetary policy shocks:[11]

[10]Household consumer expenditure surveys have been conducted for the following years - 1994, 1999-2007, 2009 and 2011. For the missing years, during which the survey was not done I geometrically interpolate the data points assuming constant growth and for the years 2012 and 2013, I extrapolate the numbers using data points of 2009 and 2011. Each household consumer expenditure survey is cross-sectional, representative at the national level and based on a stratified multi-stage sampling design. Participating households are randomly selected and report demographic data and household characteristics, and total consumption expenditure (food and non-food). The data on nominal food consumption expenditure is reported on the basis of a 30 day recall period.

[11]Inorder to fully disentangle the distributional consequences of monetary policy, it would be intuitive to see the effects of policy shocks on the entire distribution, however I am constrained from doing so, owing to data challenges.

**Poor Households**: Households who just meet the national poverty line requirements in India are located in 20-30% of expenditure distribution.[12] In this study, I select two classes of poor households in rural and urban India, based on the extent to which they fall below the poverty line, or more generally based on their intensity of poverty:[13]

1. Poor households who lie in a threshold around the poverty line (least poor) i.e. households located in the 20-30% of expenditure distribution.

2. Poor households who lie furthest below the poverty line (most poor) i.e. households located in the bottom 10% of expenditure distribution.

Selecting the two classes of poor households based on their intensity of poverty is indispensable to understanding the sensitivity of the poor households to monetary policy shocks. The average annual growth rates of real PFCE of poor households are provided in Table 2. I observe that, the calorie consumption and real per capita food consumption expenditure of poor households have been consistently declining since the past 20 years.[14]

**Median Households**: Next, I take the median class of households into my empirical analysis. The median class is located above the poverty line in the expenditure distribution, and hence are classified as non-poor households.

**Rich Households**: Finally, I select the richest class of households i.e. households who are located in the 90-100 % of expenditure distribution.[15] Following Coibion at al. (2012)

[12]The Planning Commission of India quantifies, in terms of money, an ideal poverty line basket which includes a food component and a non-food component (Planning Commission of India, 2014).

[13]The poverty gap concept established by World Bank estimates the intensity of poverty by considering how far, on average, the poor are from the poverty line. Larger the distance from the poverty line, larger is the poverty gap and higher is the intensity of poverty (Poverty Manual, Chapter 4, World Bank).

[14]Deaton and Dreze (2009) and my calculations note that the per capita consumption of calories has been falling in India in the past 20 years. Deaton and Dreze (2009) argue that this trend could be attributed to a combination of falling incomes, rising food prices, and rising agricultural unemployment.

[15]Taking the richest and the poorest expenditure class into my analysis is required to construct an inequality measure in this study.

who uses the difference between the 90th percentile and the 10th percentile of the log levels in income and consumption distribution, I use the difference between the 90th percentile and the 10th percentile of the log levels in food consumption distribution as a measure of food consumption inequality. Figure 6, shows movements in food consumption inequality in rural and urban India, over the study period. I observe that, inequality in food consumption has gone up in the past 20 years both in rural and urban India.

(4.2) *Food Price*

The household consumer expenditure surveys aggregate 208 food items into 11 independent food types.[16] The surveys also provide data on households' food expenditure shares at the disaggregate level on the different food types. Figure 7, shows the allocation of a poor households' budget on the eleven different food types - cereal, lentils, vegetables, fruits, milk products, animal proteins, spices, sugar, salt, edible oils and beverages. In both rural and urban India, poor households spend maximum (upto 35 %) on cereals, followed by vegetables (17 %). I measure prices of food as the quarterly averages of their monthly wholesale price indices (WPI), taken from the Ministry of Statistics and Programme Implementation, Central Statistical Organization. Table 3, presents the summary statistics of nominal food prices. Vegetables are the most volatile and have recorded the highest growth rate over the study period, followed by Animal Proteins.

(4.3) *Monetary Policy*

The Reserve Bank of India (RBI) is India's central banking institution, which controls the monetary policy of the Indian Rupee. The objectives of monetary policy is to maintain a judicious balance between full employment output and price stability. The monetary policy framework and the associated operating procedure of monetary policy in India have evolved over time. Till mid- 1990's India followed a monetary targeting framework, however struc-

[16]The aggregation of 208 food items into 11 independent food types or food bundles, is based on the underlying principle that the food types have very low degree of substitution between them.

tural reforms and financial liberalisation in the late 1990s led to a shift in the monetary policy towards market-determined interest rates and exchange rate. The Reserve Bank adopted a 'multiple indicators approach' in April 1998 as a part of which, information content from a host of quantity variables such as money, credit, output, trade, capital flows and fiscal position as well as from rate variables such as rates of return in different markets, inflation rate and exchange rate was analyzed for drawing monetary policy perspectives. The multiple indicators approach suffered from the weakness of lack of a clearly defined nominal anchor for monetary policy (Mohanty, 2010). In the backdrop of the same, The Reserve Bank introduced a full-fledged liquidity adjustment facility (LAF) in 2004, which was later reinforced in 2011, with the overnight call money rate (also known as the central bank rate) being explicitly recognised as the operating target of monetary policy and the repo rate, as the only one independently varying policy rate to influence the operating target (Mohanty, 2011).[17]

One difficulty in measuring the impact of monetary policy shocks rises when operating procedures change overtime. Because monetary policy framework and the corresponding operating procedure in India underwent periodic modifications and shifts based on experience and development of financial markets, I use the overnight prime lending rate as an indicator of monetary policy change in India (Figure 8).[18]

# 5. Empirical Framework

(5.1) *Empirical Model and Identification*

My aim is to investigate the dynamic effects of monetary policy shocks on the distribution

[17]Repo Rate is the (fixed) interest rate at which the Reserve Bank provides short-term (overnight) liquidity to banks against the collateral of government and other approved securities under the liquidity adjustment facility (LAF).

[18]The prime lending rate is the average rate of interest charged by major banks on loans to its credit worthy borrowers. Significant unidirectional causality has been found from policy interest rate to various measures of liquidity, providing evidence of a high intensity of monetary policy transmission in India (Mohanty, 2013).

of food consumption in India and understand its implications for poverty and inequality. I estimate the dynamic responses of relative food prices and the distribution of food consumption in rural and urban India to monetary policy shocks using a factor-augmented vector autoregression model (Bernanke, Boivin, and Eliasz, 2005 and Stock and Watson, 2011), and identify monetary policy shocks using the sign restriction approach of Uhlig (2005). The factor-augmented vector autoregression model (FAVAR) is very useful here, because it summarizes information from a large sample of disaggregated food prices into one estimated food price index or one latent factor and studies its dynamic effects in response to monetary policy shocks.[19] The dynamic factor model is particularly well-suited for this study because it provides a parsimonious means for incorporating (many different) individual food prices into the analysis without eating up degrees of freedom and also allows for heterogeneity in the responses across relative prices of the different food types to monetary policy shocks.

Let $X_t$ be a $n$- dimensional vector stochastic process for a set of nominal Wholesale Price Indices of food and a set of of "informational" variables, and $F_t$ be an $q$-dimensional vector of latent common factors. The informational variables are primarily used in estimation to help extract the common latent factors. Given a time series realization for $X_t$ and the observable subset of $F_t$, I estimate the following dynamic factor model (FAVAR) of Bernanke, Boivin, and Eliasz (2005, equations (1) and (2)) and Stock and Watson (2011), and others:

$$X_t = \Phi_x X_{t-1} + \Lambda F_t + \upsilon_{xt} \tag{1}$$

$$\begin{bmatrix} Y_t \end{bmatrix} = \begin{bmatrix} Z_t \\ F_t \end{bmatrix} = B(L) \begin{bmatrix} Z_t \\ F_t \end{bmatrix} + \begin{bmatrix} \epsilon_t \end{bmatrix} \tag{2}$$

[19] Dynamic factor models are commonly used in macro-time series analysis to summarize information from a large time series data set into an estimated index, or factor and study its dynamic effects in response to aggregate shocks.

where, $Y_t$ follows the following linear dynamic process

$$Y_t = B_1 Y_{t-1} + ....B_p Y_{t-p} + \epsilon_t \tag{3}$$

$Y_t$ is a $m \times 1$ vector of data at date $t = 1, ..., T$, $B_i$ are coefficient matrices of size $m \times m$ and $\epsilon_t$ is the one-step ahead prediction error with variance-covariance matrix $\Sigma$.

The system in Eq. (3) is the reduced form, from a dynamic structural model. My interest lies not in the reduced form shocks but, in identifying how the variables in $Y_t$ respond to structural shocks. The prediction error $\epsilon_t$ can be decomposed into economically meaningful innovations or fundamental innovations. There are $m$ fundamental innovations which are mutually independent and normalized to be of variance 1: they can therefore be written as a vector $u_t$ of size $m \times 1$ with $E\left[u_t {u_t}'\right] = I_m$. What is needed is to find a matrix $D_y$ such that $\epsilon_t = D_y u_t$.

The structural counterpart to Eq. (3) in moving average form is:

$$Y_t = \left(I - B_y L\right)^{-1} D_y u_t \tag{4}$$

$$Y_t = (D_0 + D_1 L + D_2 L^2 + .....) u_t \tag{5}$$

The only restriction on $D_y$ thus far emerges from the covariance structure:

$$\Sigma = E\left(\epsilon_t \epsilon_t^{'}\right) = D_y E\left(u_t u_t^{'}\right) D_y^{'} = D_y D_y^{'} \tag{6}$$

There are $\frac{m(m-1)}{2}$ degrees of freedom in specifying $D_y$, and hence further restrictions are needed to achieve identification. In this paper, I am solely interested in identifying the innovation corresponding to the monetary policy shock.[20] This amounts to identifying a single

[20] I do not identify the other $m - 1$ fundamental innovations.

column of matrix $D_y$ in Eq. (6).

I identify monetary policy shocks using the "pure sign-restriction" approach of Faust (1998) and Uhlig (2005).[21] In particular, I identify an expansionary monetary policy shock as one that does not lead to a decrease in real GDP, CPI and money supply, or an increase in the interest rates over a selected horizon. The "pure sign-restriction" approach produces results that are reasonable by conventional wisdom (Uhlig, 2005) and economically plausible i.e. a monetary expansion reduces interest rate, and raises the price and real output over the selected horizon. My primary reason for adopting the "pure sign-restriction" approach in this paper is that, this identification strategy eliminates any price puzzle by construction.

However, even though the "pure sign-restriction" approach has many advantages over alternative just-identifying schemes, it does not completely lack for criticism. Fry and Pagan (2011) note that the "pure sign-restriction" approach successfully identifies only the structure but not the model. There is a multiple models problem because there are many set of impulse vectors that satisfy the sign restrictions, and will yield the same VAR and give the same fit to the data. One solution to overcome the model identification problem suggested by Fry and Pagan (2011) is to use quantitative information about the magnitude of the impulse responses in order to reduce the set of models. The "penalty function" method by Uhlig (2005) solves the model identification problem, by minimizing a given criterion function on the space of all impulse vectors, which penalizes any sign restriction violation. While pure sign restriction approach provides a range of impulse vectors consistent with sign restrictions, the penalty function approach uniquely identifies the model and selects the best of all impulse vectors that goes as far as possible in imposing certain sign restrictions. Given a choice

[21] Faust (1998) uses sign restrictions to identify monetary policy shocks, imposing them only at the time of impact, however Canova and De Nicol (2002, 2003) identify monetary shocks using sign restrictions on impulse response correlations. More recently, Dedola and Neri (2007) have used sign restrictions to identify technology shocks and Mountford (2005), Peersman (2005), Benati and Mumtaz (2007), Dungey and Fry (2009) and Fry and Pagan (2007) have addressed the issues pertaining to identification of multiple shocks using sign restrictions. .

among many candidate monetary impulse vectors the "penalty function" approach picks the one which generates a more decisive response of the variables (Uhlig 2005, p. 414). I use the "penalty function" approach of Uhlig (2005, Appendix B.1, pp. 413-417) as a solution to the model identification problem and as a robustness check for my main empirical method.

(5.2) *Model Specification and Estimation*

Following Bernanke, Boivion, and Eliasz (2005), I use a two-step estimation method, in which the latent factor is first estimated by principal components prior to estimation of the factor-augmented vector autoregression model (FAVAR).

(5.2.1) *Model Specification*

**Step I**: $X_t$ in Eq. (1) includes nominal Wholesale Price Indices of 11 independent food types - cereal, lentils, vegetables, fruits, milk products, animal proteins, spices, sugar, salt, edible oils and beverages that constitute the food basket of poor households. I estimate $F_t$ as the first principal component of $X_t$: $\hat{F}_t = \left(\frac{1}{n}\right) \hat{\Lambda}' X_t$, where $\hat{\Lambda}$ contains the eigenvectors of $X_t$, normalized so that $\left(\frac{1}{n}\right) \Lambda'\Lambda = I$. Thus $\hat{F}_t$ is the estimated common latent factor, which deflated by CPI, serves as a measure of the aggregate relative food price index in my VAR model. By including $\hat{F}_t$ in the VAR, I am augmenting the standard VAR model with an estimated latent factor; this makes the standard VAR a factor-augmented VAR.

**Step II**: With the common latent factor in hand from Step I, the next strategy depends on how I specify the macro subsystem ($Z_t$) in Eq. (2). My aim is to estimate the dynamic responses of the distribution of food consumption to monetary policy shocks in rural and urban India respectively. Keeping in mind my objective, I include the following five macro-variables in the macro sub-system ($Z_t$): real GDP, consumer price index (CPI), interest rate, nominal money supply, and the average real per capita food consumption expenditure of the respective income group.

The FAVAR ($Y_t$) given by Eq. (3) is my baseline model. ($Y_t$) includes the above five observable macro variables contained in ($Z_t$), and one latent factor extracted from the set of nominal food prices contained in ($X_t$). I estimate the baseline model separately *(independently)* for each of the four expenditure classes in rural and urban India respectively. I examine the presence of unit roots, non stationarity and non-invertibility of Eq. (3) and find no cointegrating vectors in my models. I have fitted a VAR with 4 lags in levels of the logs of the series, except for using the interest rate directly.[22] I add a constant and a time trend to Eq. (3). The horizon over which I impose the sign restrictions to identify monetary policy shocks is $k = 2$ quarters, including the initial period of the shock. These restrictions are imposed only on the real output, consumer price index, and money supply. I use a Bayesian method to estimate the posterior densities of the parameters of interest, conditional on observing the sample data, for the baseline model as well as alternatives to check for robustness of the model specification. None of the results in section 6 are sensitive to increasing the common lag in the VAR to five lags, and to assuming the sign-restriction horizon as three quarters. My results discussed in section 6, for the baseline model are robust to changes in model specification.

(5.2.2) *Estimation*

I estimate the posterior density using the "pure-sign restriction" approach of Uhlig (2005, Appendix B, pp 409-412) as generalized by Rubio-Ramirez, Waggoner, and Zha (2010). Note in particular that $B$ and $\Sigma$ are directly identified from estimation of the parameters in Eq. (3) using OLS. I assume a Gaussian likelihood function and a standard diffuse (Jefferey's) prior on the reduced form parameters $B$ and $\Sigma$, which implies that the joint posterior density

[22] I estimate my VAR using levels of the log of variables, rather than first differences, therefore the restrictions are indeed imposed on the impulse responses and not on the cumulative impulse responses.

of the parameters is of the Normal-Wishart form (Uhlig 2005, pp. 409-410):[23]

$$\Sigma^{-1} \sim W\left[\left(T\hat{\Sigma^{-1}}\right), T\right] \tag{7}$$

$$(B|\Sigma) \sim N\left[\hat{B}, \Sigma \times \hat{\Omega}\right] \tag{8}$$

where $T$ is the time series sample , $\hat{B}$ and $\hat{\Sigma}$ are the OLS estimates of the dynamic factor model with observable factors, and $\hat{\Omega} = \frac{1}{T}\sum_{t=1}^{T} Y_{t-1}{Y_{t-1}}'$. The algorithm entails the following steps:

1. Estimate $\hat{B}$ and $\hat{\Sigma}$ from Eq. (3) by OLS. OLS is efficient given the restrictions of the model.

2. Draw $\bar{B}$ and $\bar{\Sigma}$ from the posterior distribution given by Eq. (7) and (8) and conditional on the OLS estimates from step 1.

3. Using the values from this draw, impose the sign restrictions to identify structural shocks using the following algorithm of Rubio-Ramirez, Waggoner, and Zha (2010, section 6.4, pp. 688)

   (a) Draw a $m \times m$ matrix $M$, element by element, from a standard normal density, and use its "Q-R" factorization to set $M = QR$, where $Q$ is an orthogonal matrix ($QQ' = I$) and R is normalized to have positive diagonal elements.

   (b) Set $D_y = \tilde{D}Q$ which from Eq. (5) implies values for $\bar{D}_k$ for $k = 1, ...., K$, where $\tilde{D}$ denotes the lower-triangular Cholesky factor of $\Sigma$.

   (c) If the $\bar{D}_k$ estimates *do not satisfy* the sign restrictions for monetary policy shocks over the chosen horizon $K$, return to substep 3(a), draw a new value of Q, and continue until the draw of Q yields responses that satisfy the sign-restrictions.

   (d) If the $\bar{D}_k$ estimates *satisfy* the sign restrictions, compute and save the corresponding impulse response coefficients relating to the variables in $Y_t$ and $X_t$ to these

[23] see Uhlig(1994) for a detailed discussion on the properties of Normal-Wishart distribution

shocks. Then return to step 2 and draw a new set of reduced form parameters.

4. Iterate on steps 2 through 3(d) until 20,000 draws from the posterior distribution of the dynamic responses of all the variables to monetary policy shocks (that satisfy the conditions of step 3(d)) are produced.

I report the median and the 16% and the 84% quantiles from this empirical posterior density in the results section.

I use the "penalty function" approach of Uhlig (2005, Appendix B.1, pp. 413-417) as a robustness check for my main empirical method. Consistent with Uhlig (2005), I also find that the results from "penalty function" approach are a sharpening of the results from "pure sign-restrictions" approach, due to additionally desirable properties imposed on the the magnitude of the impulse responses. In sum, my results discussed below using the"pure sign-restrictions" approach are robust to changes in the empirical specification.

# 6. Empirical Results

In this section, I discuss the responses of relative food prices and the distribution of food consumption in rural and urban India to an expansionary monetary policy shock. As noted above, I have estimated models separately for the four expenditure classes in rural and urban India respectively. The magnitude of the monetary policy shock is nearly the same in all models. The impulse responses are presented in Figures 9-17. The food consumption responses of poor households who are located in a threshold around the poverty line (20-30% of expenditure distribution) in rural and urban India are given by Figures 9-10 respectively. The impulse responses of relative food prices at the disaggregate level is given by Figure 11. The food consumption responses of poor households who are located in the bottom decile (0-10% of expenditure distribution) in rural and urban India are given by Figures 12-13 respectively. The food consumption responses of median households in rural and urban India

are given by Figures 14-15 respectively. The responses of food consumption inequality in rural and urban India are given by Figures 16-17 respectively.

## (6.1) The Food Price Channel of Monetary Policy: Results and Discussion

### (6.1.1) *Dynamic Responses to Monetary Policy Shocks*

The estimated response functions for the interest rate series, relative food price series and the real per capita food consumption expenditure (real PFCE) series are the main focus of this research. An expansionary monetary policy shock causes the interest rate to fall by 30 basis points on impact (Figure 9). The interest rate gradually rises and turns positive after 5 quarters for perhaps one of the following two reasons. First, this may reflect that monetary policy shocks really arise as errors of assessment of the economic situation by the central bank. The central bank may typically try to keep the steering wheel steady: should they accidentally make an error and shock the economy, they will try to reverse course soon afterwards. Second, this may reflect a reversal from a liquidity effect to a Fisherian effect. Given an expansionary monetary policy shock that causes interest rates to fall by 30 basis points, the nominal money supply rises by .50% on impact, and then rises permanently by .80% over the next nine quarters. Output rises fairly monotonically for five quarters, following the shock and then makes a gentle descent back to its original value. The peak elasticity is approximately .70, meaning that an expansionary monetary policy shock which results in a decline in interest rate by 30 basis points increases real output by .70% at a five-quarter horizon. The consumer price index responds positively to the monetary policy shock, reaching a peak impact of .75 at the two-quarter horizon, and then gradually begins a slow asymptote towards its original value (Figure 9).

In response to an expansionary monetary policy shock, the aggregate relative food price index rises by 1% on impact and further by 1.50% in the first quarter and continues to

remain high for three quarters, before which it slowly starts falling (Figure 9). Results of this paper find that food prices are more sensitive and persistent to monetary policy shocks *relative* to the general price level in the economy, which matches the results found in several earlier studies using agricultural prices instead of food prices. This is because, as noted in the literature above, food sector features perfect competition and flexible prices.

Further, the responses of relative food prices across the eleven different food types is not uniform (Figure 11) i.e. monetary policy shocks have *distortionary* effects on relative food prices which again, also matches the results found in several earlier studies. The relative prices of cereals, lentils, vegetables, animal proteins, spices and salt rise by greater than 1.50%, whereas that of fruits, milk, sugar, oils and beverages rise by less than 1.50%. This asymmetry in the responses of relative food prices, can have potential implications for poor households. "When relative food prices rise, not only are poor households penalized more than rich households but the impact also depends on the commodity whose price has increased" (Pons, 2011). In India, cereals form the largest component of poor people's diet. For poor households, a relatively larger increase in price of cereals, which constitutes 35 % of their food expenditure, is likely to hurt them more (due to a larger income effect) than an equivalent increase in price of salt, which constitutes only .4 % of their food expenditure.[24] Results of this paper find that, relative prices of food that form kitchen-staples of the poor in India (eg. cereals, lentils and vegetables that form 50% of the poor people's budget) are more sensitive to monetary policy shocks.[25]

Given an expansionary monetary policy shock, that increases the relative food price index by 1.50%, the real per capita food consumption expenditure (real PFCE) of households who are located in a threshold around the poverty line (20-30 % of expenditure distribution) falls by 2.30% in rural India and 2.05% in urban India in the first quarter, and continues to

[24] see Figure 7.

[25] The matrix of factor loading is provided in Table 4.

remain low around the same range for three quarters before which it slowly starts rising, but whereas the real PFCE of the rural households remains in a negative range over the entire sample period (9 quarters), the real PFCE of the urban households marginally enters the positive range in the beginning of the sixth quarter (Figures 9-10). The Real PFCE of households who are in the bottom 10% of expenditure distribution falls by 3.25% in rural India and 3.11% in urban India in the first quarter, then slowly starts rising and becomes positive at the beginning of the fourth quarter (Figures 12-13). An important observation here is that, poor households who are located in the bottom decile (most poor) are more sensitive but less persistent to monetary policy shocks than those who are located in a threshold around the poverty line (least poor). This is because, the more poor a household is, the higher is its share of food expenditure, and therefore the higher is its sensitivity to fluctuations in relative food prices and monetary policy shocks.[26]

In response to an expansionary monetary policy shock, the real PFCE of median households does not change on impact, however with a lag it starts falling slowly, reaching a lower bound of 1.4% in rural India and 1.2% in urban India at the three quarter horizon, before which it begins a fairly monotonic rise. The food consumption response of the median group continues to remain in the negative region for the first four quarters, then reverses course and turns positive in the fifth quarter (Figures 14-15). Interestingly, I find that the median households are less affected by fluctuations in relative food prices and consequently by monetary policy shocks, than the poorer groups. This is because first, median households allocate roughly 45% of their budget to food expenditures as against poor households who allocate $65-70\%$ and second, median households lie significantly above biological minimum caloric intake levels, so that a marginal fall in their food consumption does not affect their food security.

[26]Ernst Engel had argued that with given tastes or preferences, the proportion of income spent on food diminishes as income increases.

Thus, I observe considerable heterogeneity in the food consumption responses faced by households across different expenditure classes, to monetary policy shocks. Comparing the food consumption responses of median households (non-poor households), poor households who are in a threshold around the poverty line (least poor) and poor households who are in the bottom decile (most poor), a clear conclusion can be drawn : the lower the expenditure class of the household, the higher is the sensitivity to monetary policy shocks of the household.

The heterogeneity becomes even more prominent, when I observe the responses of food consumption inequality to monetary policy shocks in rural and urban India. Using the difference between the 90th percentile and the 10th percentile of the log levels in food consumption distribution as a measure of food consumption inequality, I find that monetary policy shocks have statistically significant effects on food consumption inequality (Figures 16-17). In response to an expansionary monetary policy shock, the food consumption inequality rises by 3.20% in rural India and 2.86% in urban India on impact, then steadily falls and comes back to the original level in the third quarter.

Below, I discuss the potential causal channel for my empirical findings.

(6.1.2) *Discussion*

This paper documents that monetary policy shocks have statistically significant effects on food consumption of poor households: an expansionary monetary policy shock increases *relative* food prices and reduces the subsistence food consumption of poor households. Empirical findings of this paper provide evidence of the impact of a *"food price channel"* of monetary policy on poor households in India. The underlying mechanism is that, inorder to stimulate the economy when the central bank exercises an expansionary monetary policy, food prices being relatively more flexible, adjust quicker than the overall price level in the economy. Thus an expansionary monetary policy shock generates an increase in the *relative* prices of

food, and this adversely affects poor households.

Further there are differential impacts of monetary policy shocks on different expenditure classes. An expansionary monetary policy shock alters the distribution of food consumption, penalizing poor households more relative to the non-poor (median and rich households). The primary reason for the observed heterogeneity in food consumption responses across different expenditure classes emerges from the differences in characteristics of the poor vis-a-vis the non-poor in India.[27] On one hand, the poor households are net purchasers of food and have limited ability to substitute food owing to a high share of food expenditure in their total budget and subsistence caloric intake, which makes them highly sensitive to fluctuations in relative food prices induced by monetary policy changes. On the other hand, these households are informally employed and financially constrained, which makes their earnings and savings insensitive to monetary policy changes. The credit-constrained poor households cannot borrow and hence cannot insure against idiosyncratic risks. Under such conditions, an expansionary monetary policy shock that increases *relative* food prices, sets off a negative income effect for poor households, and reduces their subsistence food consumption. Thus, it ultimately ends up hurting poor households unintendedly.

However, the same cannot be concluded for median and rich households in India. Median and rich households exhibit features that can weaken the effects of the *"food price channel"* of monetary policy. Median and rich households hold higher ability to substitute food due to a relatively lower share of food expenditure in their budget and higher caloric intake. Furthermore median and rich households, being financially included, hold higher ability to borrow and benefit from a decline in interest rate following an expansionary monetary policy shock. Financial inclusion allows this fraction of the households to smoothen consumption behaviour and also insure themselves against idiosyncratic shocks.

[27] see section 2.

Similar to some earlier studies (Carpenter and Rodgers, 2004; Heathcote et al., 2010; Coibion et al., 2012), where the employment channel of monetary policy explains the tendency of employment of lower incomes to be more sensitive to the business cycle and monetary policy shocks, in this study, the food price channel of monetary policy explains the tendency of food consumption of lower incomes to be more sensitive to monetary policy shocks.

The main conclusion from the above discussion is that, due to the presence of heterogenous agents, a fraction of whom (poor households) have limited ability to substitute food and no access to the formal financial system, an expansionary monetary policy shock, via the *"food price channel"*, increases the observed inequality across households in food consumption. In sum, results of this paper imply that, while expansionary monetary policy is a potent tool to stimulate the economy, it may come with an unwanted side effect: decline in food consumption of poor households and increase in food consumption inequality. To the extent, that Planning Commission of India uses alternative poverty measures based on food such as the hunger criterion, food-share criterion, and calorie cut-off as criterion, results of this paper imply that an expansionary monetary policy increases poverty and inequality in India (discussed in section 7).

(6.2) *How much variation do monetary policy shocks explain?*

According to the median estimates shown in the middle lines of Figures 18-19, monetary policy shocks account for upto 15 % of the variation in real GDP and interest rate, and upto 20% of the variations in CPI at all horizons. Monetary policy shocks account for 15-20 % of the variation in relative food price index and real per capita food consumption expenditure of poor households at all horizons. Monetary policy shocks appear to have played a non-trivial role in accounting for fluctuations in food consumption of poor households in rural and urban India over the study period. The forecast error variance decompositions show

that the contribution of monetary policy shocks to fluctuations in food consumption of poor households is of the same order of magnitude as the contribution of these shocks to other macroeconomic variables like GDP and inflation.

**Figures 9-19**

# 7. Implications for Poverty

Poverty is a multi-dimensional phenomenon and deprivation of food is one, most crucial component.[28] Using poverty measures based on food cut-off is standard in India and other low income countries.[29] The Planning Commission of India uses alternative poverty measures based on food such as the hunger criterion, food-share criterion and calorie cut-off as criterion (Planning Commission 1993, 2014). In other low income countries like Bangladesh, Tanzania, Cambodia, Rwanda and other African countries, food is used to define the lower poverty line.

Standard in low income countries, this paper adopts a food based poverty measure. The "Poverty Gap Index" measures the depth of poverty by considering how far, on average, the poor are from the poverty line (Poverty Manual, Chapter 4, World Bank).[30] Larger the

[28]The idea of multi-dimensional poverty is that poverty manifests itself in multiple deprivations, such as lack of food, poor health, lack of education, absence of sanitation facilities, and various kinds of material deprivations. A person is counted as 'multi-dimensionally poor if he or she experiences at least a certain proportion (say one third) of these deprivations. (Sen et al., 2013)

[29]Ernst Engel had argued that with given tastes or preferences, the proportion of income spent on food diminishes as income increases. Poor living is characterised by a large proportion of the total consumer expenditure taken up by items such as food which are absolutely essential for sheer physical survival. The proportion of expenditure on food, the author argued, can therefore be used as a general measure of welfare. Anand and Harris (1994) do a theoretical and empirical welfare analysis using Sri Lankan data, and find that of the four possible indicators of living standard (namely income per capita, total expenditure per capita, food expenditure per capita and the share of food in total expenditure), food expenditures per capita gives the best guidance to the households' living standard.

[30]The poverty gap as a poverty measure is an improvement over the poverty headcount because the latter simply counts the number of people below a poverty line and considers them equally poor whereas the former measures the extent to which individuals fall below the poverty line and indicates how poor the poor are. In other words poverty headcount gives a measure of the incidence of poverty but poverty gap gives a measure

distance from the poverty line, larger is the poverty gap index and higher is the intensity of poverty.

The "Poverty Gap Index" is given by Eq. (9) below.

$$PGI = \frac{1}{N}\sum_{i=1}^{N}\left[\frac{z - x_i}{z}\right][I(x_i \leq z)] \tag{9}$$

The specifications of the variables in Eq. (9) are enumerated as follows:

1. $PGI$ is the Poverty Gap Index.

2. $x_i$ is the food intake, or more generally the caloric intake of poor households.

3. $z$ is the food component of the poverty line basket determined by policy makers *(the food poverty line)* and exogenous to monetary policy shocks.

4. $I(.)$ is an indicator function that is 1, if it's argument is true and 0, otherwise. Poor households are located below the poverty line i.e. their food consumption is lower than the food component of the poverty line basket, therefore $(x_i \leq z)$ and $I(.) = 1$.

5. Evidently a decline in $x_i$, the food consumption of poor households, is tantamount to an equivalent rise in the poverty gap index (refer to Eq. 9).

Relying on a food based poverty measure, this paper documents that an expansionary monetary policy shock, via the *"food price channel"*, reduces the food consumption of poor households, and increases the intensity of poverty in India.

of the depth of poverty (Poverty Manual, Chapter 4, World Bank).

# 8. Conclusion

*"The analysts cheer every cut in interest rates because markets are assumed to have a Pavlovian positive response to them. Even the poor are inured to their fate of seeing real incomes erode, and are only aggrieved when the price of some food staple sky-rockets."*
*Rajan, 2016*

Overall, results of this paper provide evidence of the impact of a *"food price channel"* of monetary policy on poor households in India. The mechanism is straightforward: inorder to stimulate the economy when the central bank employs an expansionary monetary policy, food prices being relatively more flexible, adjust quicker than the overall price level in the economy. Thus an expansionary monetary policy shock generates an increase in the *relative* prices of food. Poor households in India are net buyers of food, have limited ability to substitute food due to a high share of food expenditure in their total budget and subsistence food intake, and are financially constrained (unbanked and unable to insure against idiosyncratic risks), which makes them very sensitive to fluctuations in relative food prices. An expansionary monetary policy shock that increases *relative* food prices, generates a negative income effect for poor households, thus reducing their subsistence food consumption and ultimately hurting them unintendedly. Monetary policy shocks account for a significant proportion of fluctuations in food consumption of poor households (*nearly 20%*), which indicate that these shocks are important.

Interestingly, median and rich households are relatively less affected by the *"food price channel"* of monetary policy. This is because median and rich households exhibit features, for instance a relatively low share of food expenditure in their total budget, high caloric intake, and high degree of financial inclusion (allowing them to borrow and fully insure against idiosyncratic risks), that makes them less sensitive to fluctuations in relative food prices and

consequently to the *"food price channel"* of monetary policy.

Due to the presence of heterogenous agents, a fraction of whom (poor households) have limited ability to substitute food in the wake of increasing relative food prices and no access to the formal financial system, an expansionary monetary policy shock, via the *"food price channel"*, increases the observed inequality across households in food consumption.

In conclusion, results of this paper imply that, while expansionary monetary policy is a potent tool to stimulate the economy, it may come with an unwanted side effect: decline in food consumption of poor households and increase in food consumption inequality. To the extent, that Planning Commission of India relies on food based poverty measures such as the hunger criterion, food-share criterion, and calorie cut-off as criterion, results of this paper imply that an expansionary monetary policy increases poverty and inequality in India.

In addition to the relevance for India, this study also points to potential implications of following expansionary monetary policy in other developing countries, where relative food prices play a dominant role. This paper identifies empirical regularities regarding the impact of monetary policy on poor households in India, which could eventually serve as reference in the development of models for monetary policy analysis and formulation in other low-income countries. It is possible that the *"food price channel"* will be more dominant in African economies, where poor households spend an even larger portion of their income on food (75%). This international comparison is an avenue for further research.

# Tables and Figures

**Figure 1: Cross Country Comparison: Share of Food Expenditure in Consumption Expenditure (in percent)**

| *Emerging Markets* | | *Advanced Economies* | |
|---|---|---|---|
| Indonesia | 53.0 | Japan | 14.7 |
| Vietnam | 49.8 | Germany | 11.5 |
| India | 48.8 | Australia | 10.8 |
| China | 36.7 | Canada | 9.3 |
| Russia | 33.2 | United Kingdom | 8.8 |
| Malaysia | 28.0 | USA | 5.7 |
| **Average** | **41.6** | **Average** | **10.1** |

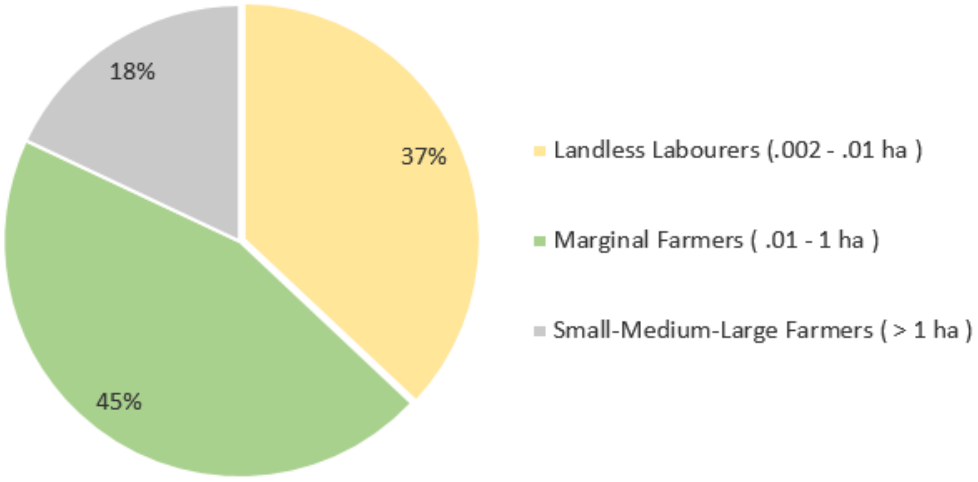
Source: Anand and Prasad, 2012

**Figure 2: Cross Country Comparison: Financial Inclusion (in percent)**

| *Selected EMs* | *Percent with access* | *Selected EMs* | *Percent with access* |
|---|---|---|---|
| Argentina | 33 | Nigeria | 30 |
| Brazil | 56 | Philippines | 27 |
| Chile | 42 | Poland | 70 |
| China | 64 | Russia | 48 |
| India | 35 | South Africa | 54 |
| Indonesia | 20 | Thailand | 73 |
| Kenya | 42 | Turkey | 58 |
| Malaysia | 66 | | |
| **Median (29 Emerging Markets): 42** | | **Median (27 Advanced Economies): 96** | |

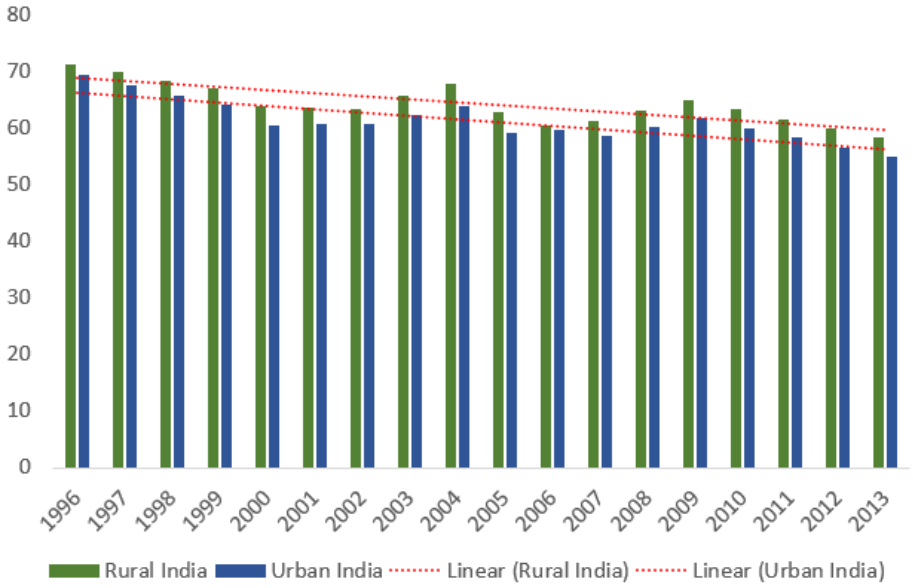
Source: Anand and Prasad, 2012

**Figure 3: Break up of the Population into Net Buyers vs. Net Sellers of Food, Rural India**




Source: Key Indicators of Land and Livestock Holdings in India, NSSO, India.[31]

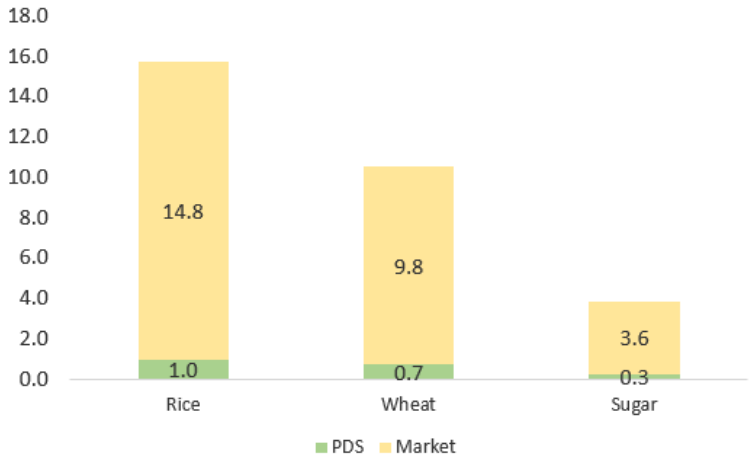
**Figure 4: Share of Food Expenditure in Consumption Expenditure, Bottom Quartile, India, 1996-2013 (in percent)**




Source: Household Consumer Expenditure Survey Reports, NSSO, India.

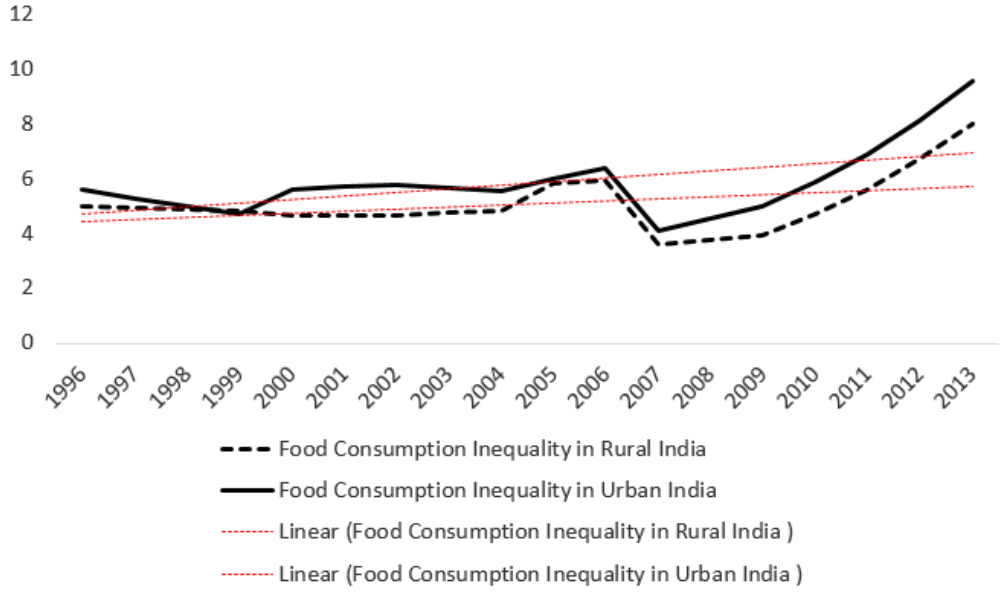
[31] About 45% of rural households are marginal farmers in India and net purchasers of food; this is because the value of the food they produce is less than the value of food they consume. (Dev and Ranade, 1998; Kapila and Krishna, 2009). The bottom 37% of the rural population comprises of landless labourers (less than .002 hectare of land) and labourers with very little land (less than .01 hectare of land); they are net purchasers of food.

**Figure 5: Public Distribution System (PDS)**
**Share of Food Expenditure on Market vs. Fair Price Shops, Bottom Quartile, India (in percent)**



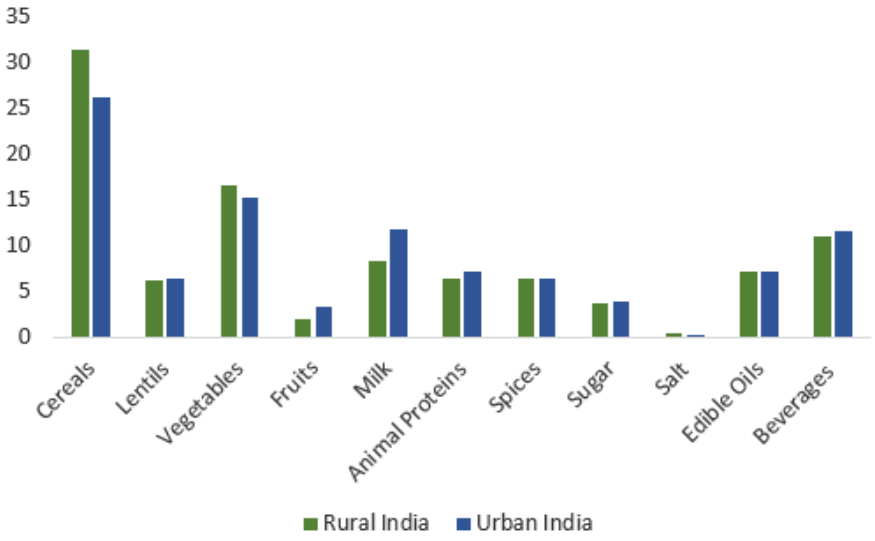

Source: Household Consumer Expenditure Survey Report, NSSO, India.

**Figure 6: Food Consumption Inequality, India (Kuznets Ratio)**



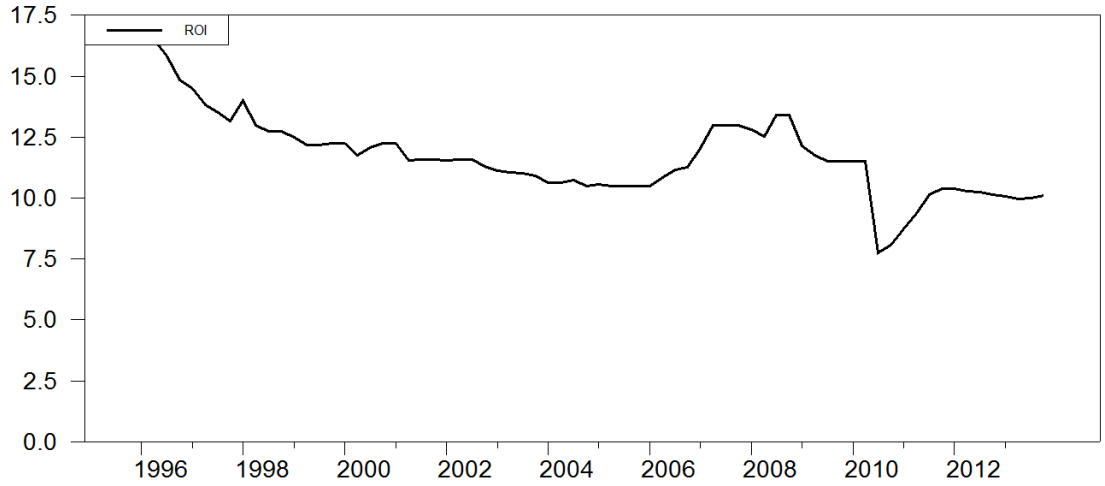

Source: Household Consumer Expenditure Survey Reports, NSSO, India.

**Figure 7: Share of Food Expenditure on Food Types, Bottom Quartile, India (in percent)**



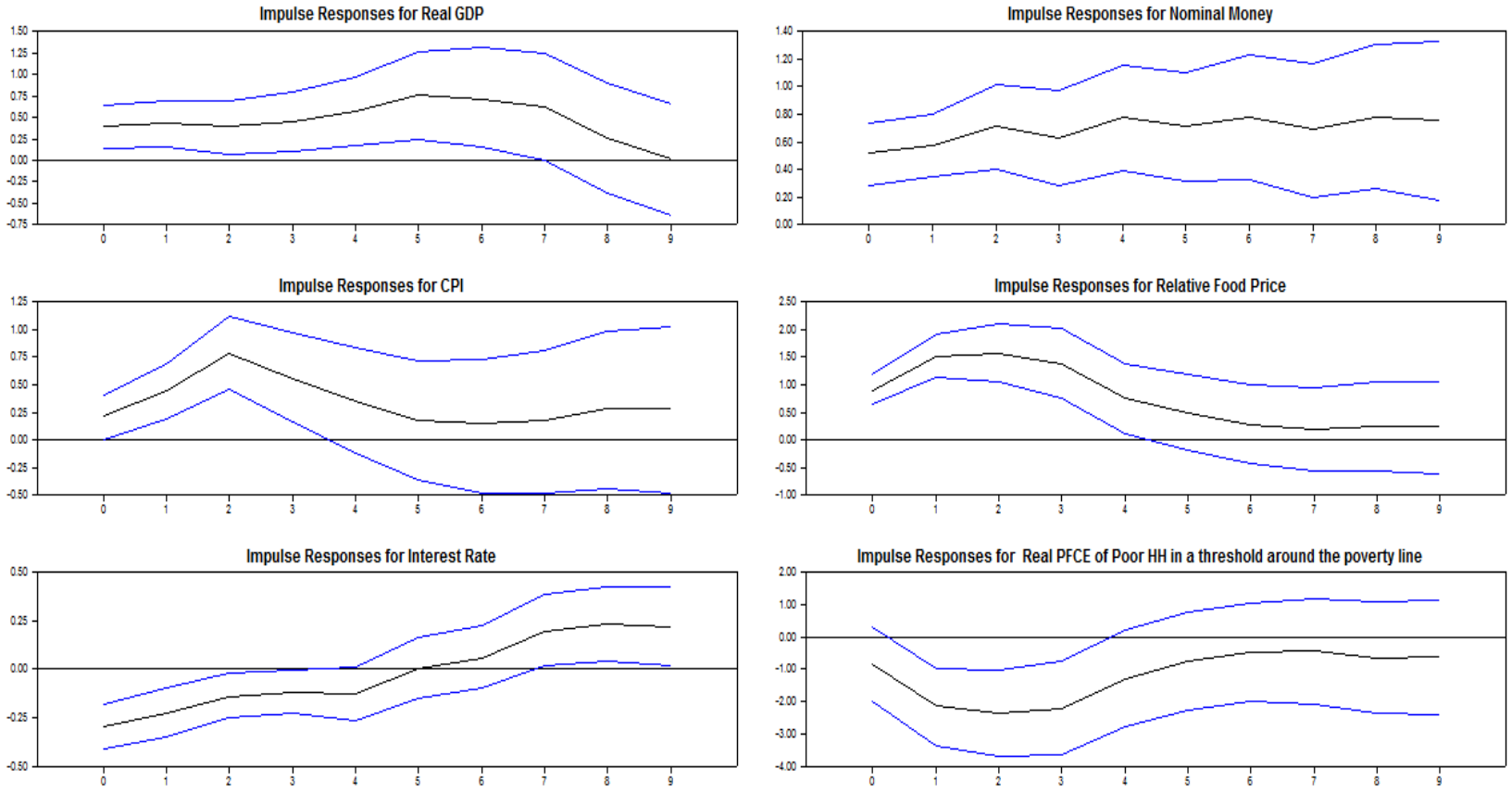

Source: Household Consumer Expenditure Survey Reports, NSSO, India.

**Figure 8: Prime Lending Rate, India (in percent)**



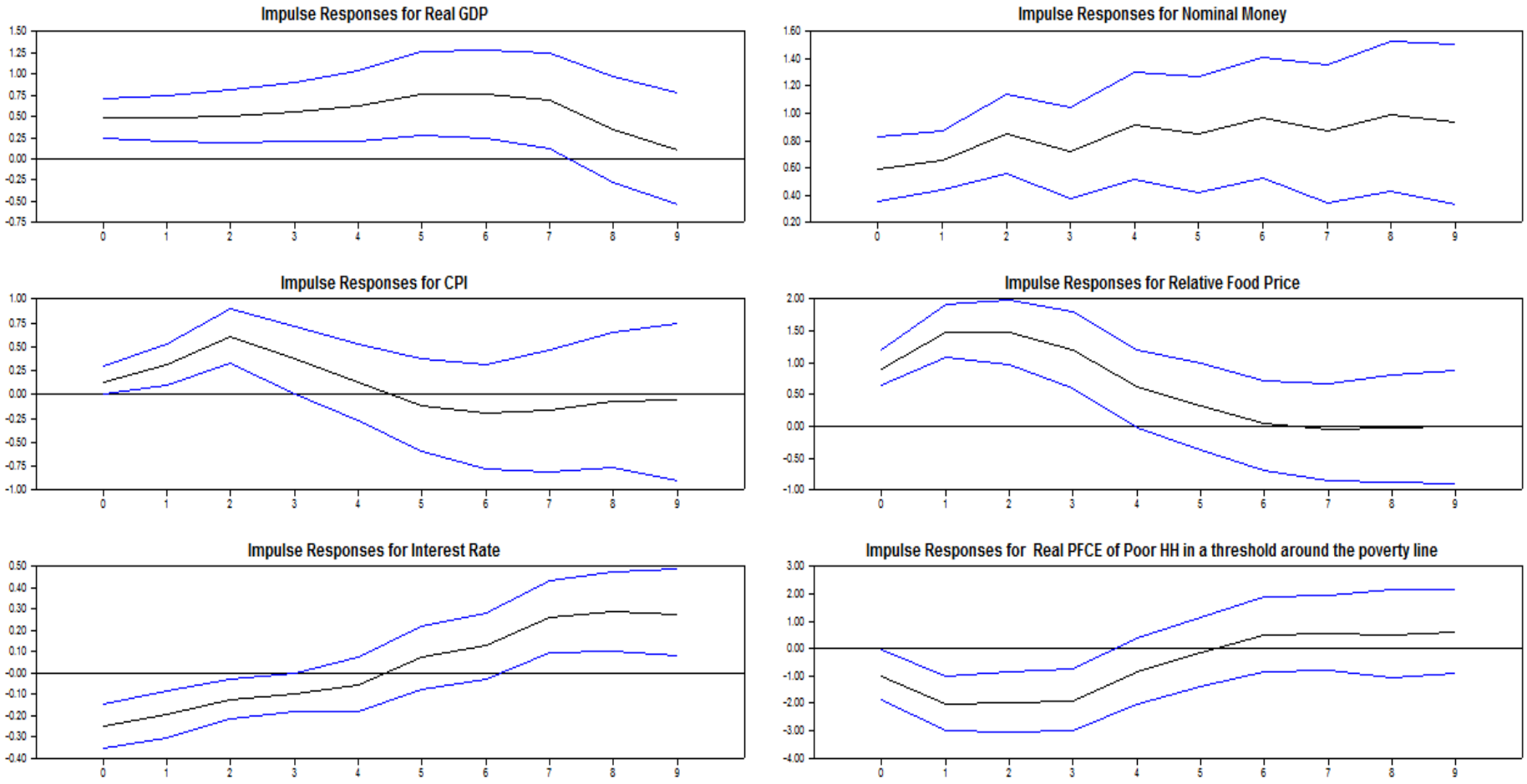

Source: Handbook of Statistics on Indian Economy, Reserve Bank of India.

**Figure 9: Food Consumption Response of Poor Households in a Threshold around the Poverty Line (20-30% of Expenditure Distribution), Rural India**[32]



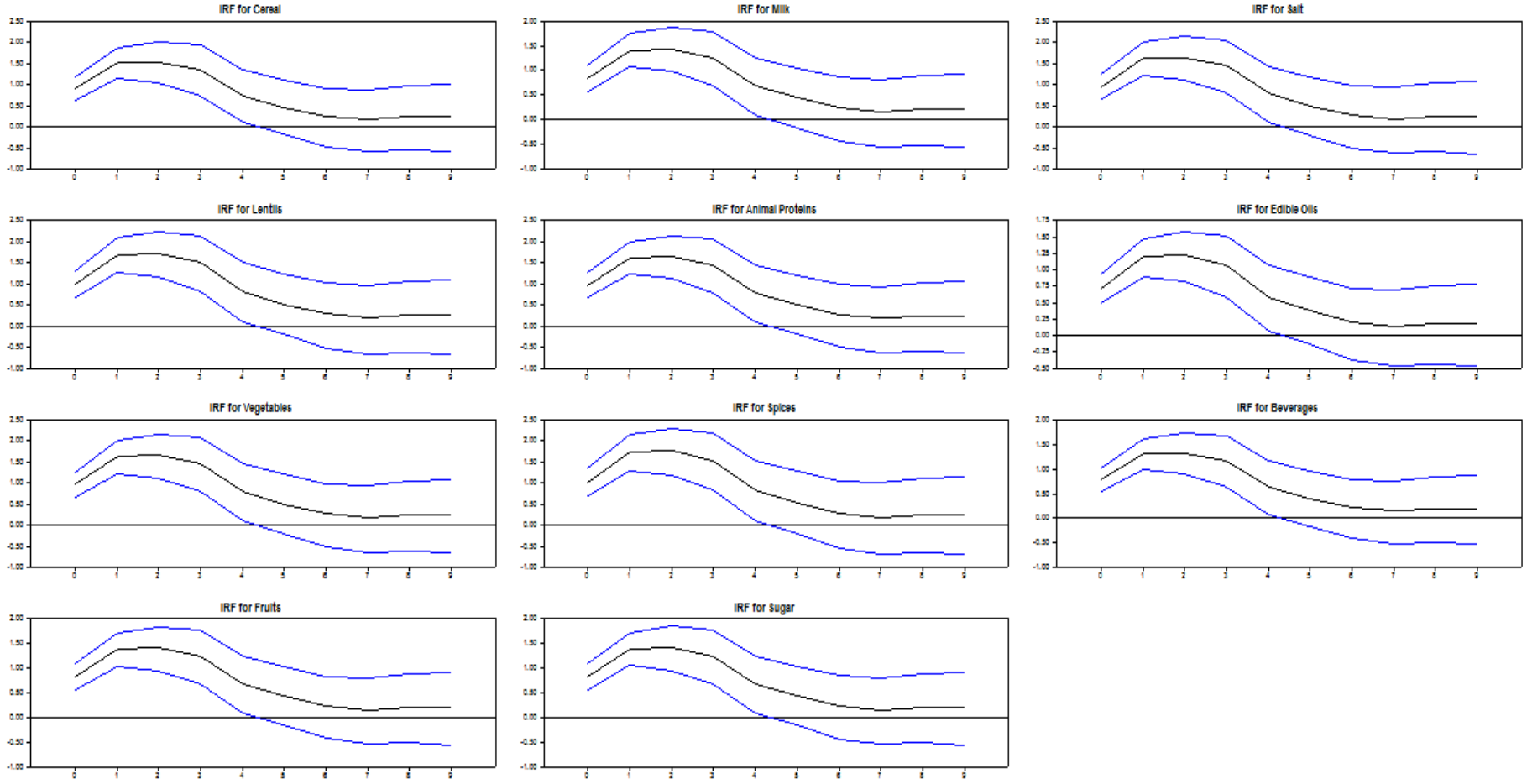

[32]Impulse responses to an expansionary monetary policy shock in rural India one standard deviation in size, using pure sign restriction approach using $K = 2$ (2 years). That is the responses of the CPI, the real GDP and nominal money supply has been restricted not to be negative and the interest rate not to be positive for quarters k, k=0,1,2 after the shock.

**Figure 10: Food Consumption Response of Poor Households in a Threshold around the Poverty Line (20-30% of Expenditure Distribution), Urban India**[33]



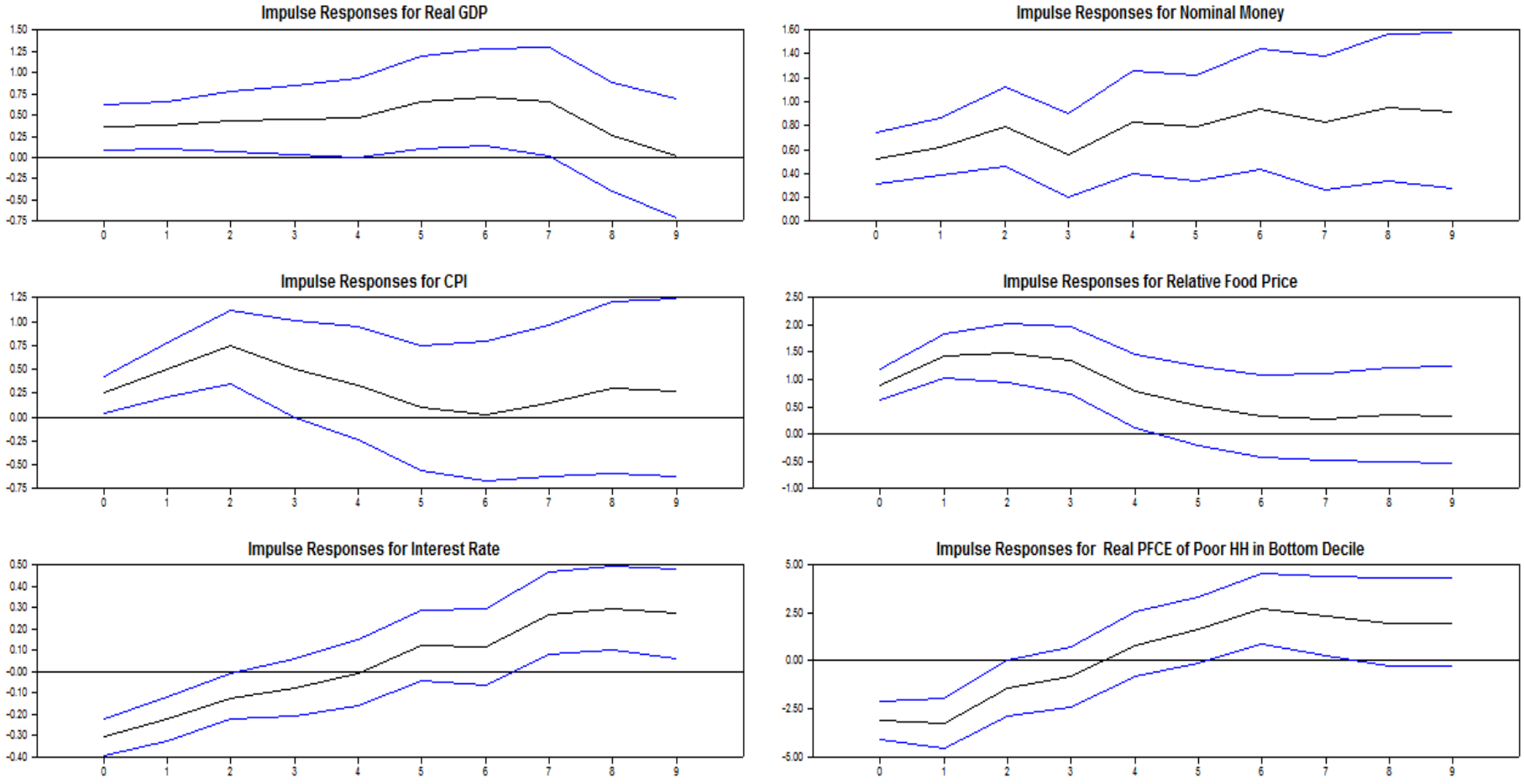

[33]Impulse responses to an expansionary monetary policy shock in urban India one standard deviation in size, using pure sign restriction approach using $K = 2$ (2 years). That is the responses of the CPI, the real GDP and nominal money supply has been restricted not to be negative and the interest rate not to be positive for quarters k, k=0,1,2 after the shock.

## Figure 11: Impulse Responses of Relative Prices of Different Food Types to Monetary Policy Shock[34]



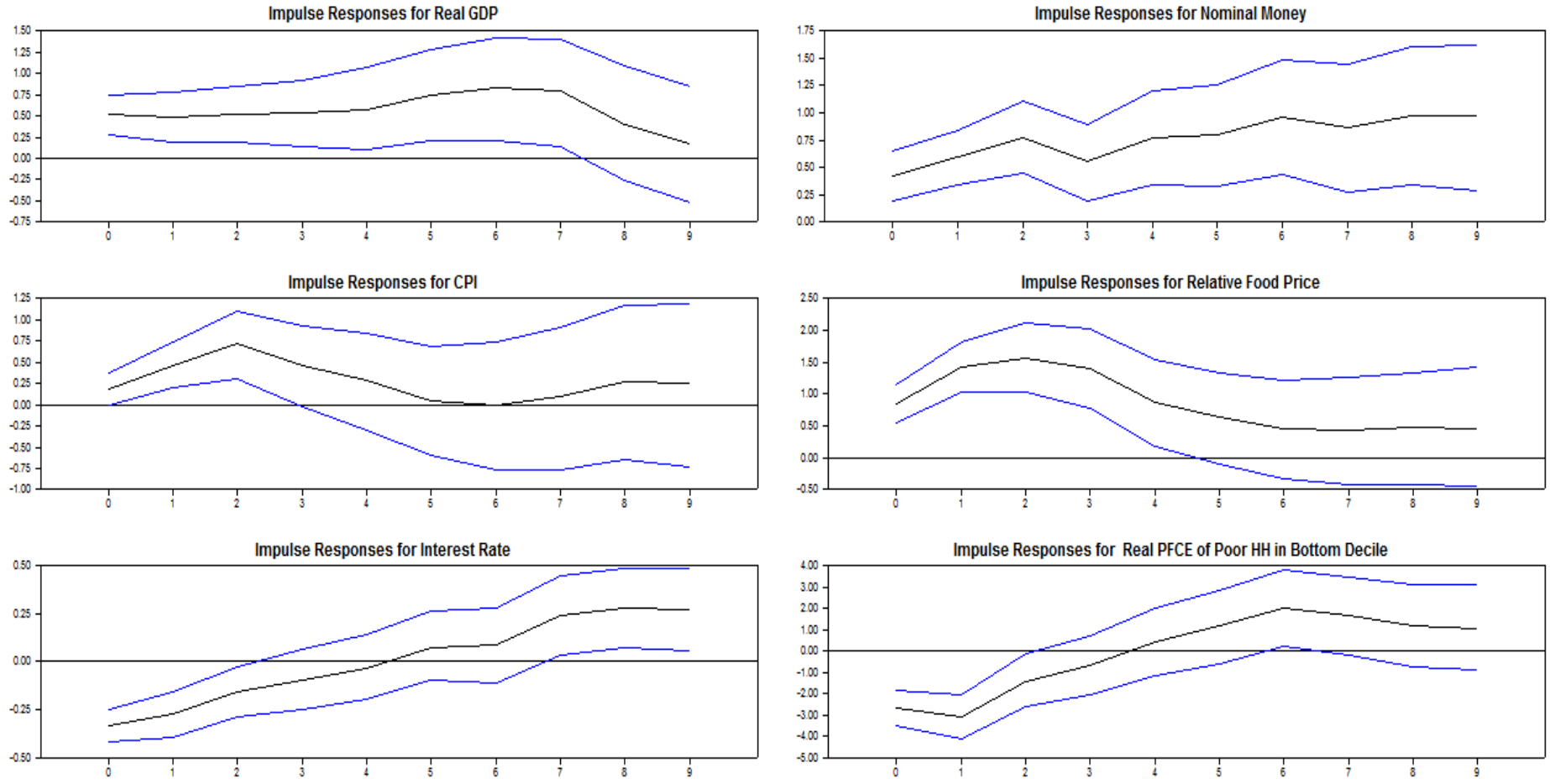

[34]Impulse responses to an expansionary monetary policy shock in India one standard deviation in size, using pure sign restriction approach using $K = 2$ (2 years). That is the responses of the CPI, the real GDP and nominal money supply has been restricted not to be negative and the interest rate not to be positive for quarters k, k=0,1,2 after the shock.

## Figure 12: Food Consumption Response of Poor Households in Bottom Decile (0-10% of Expenditure Distribution), Rural India[35]



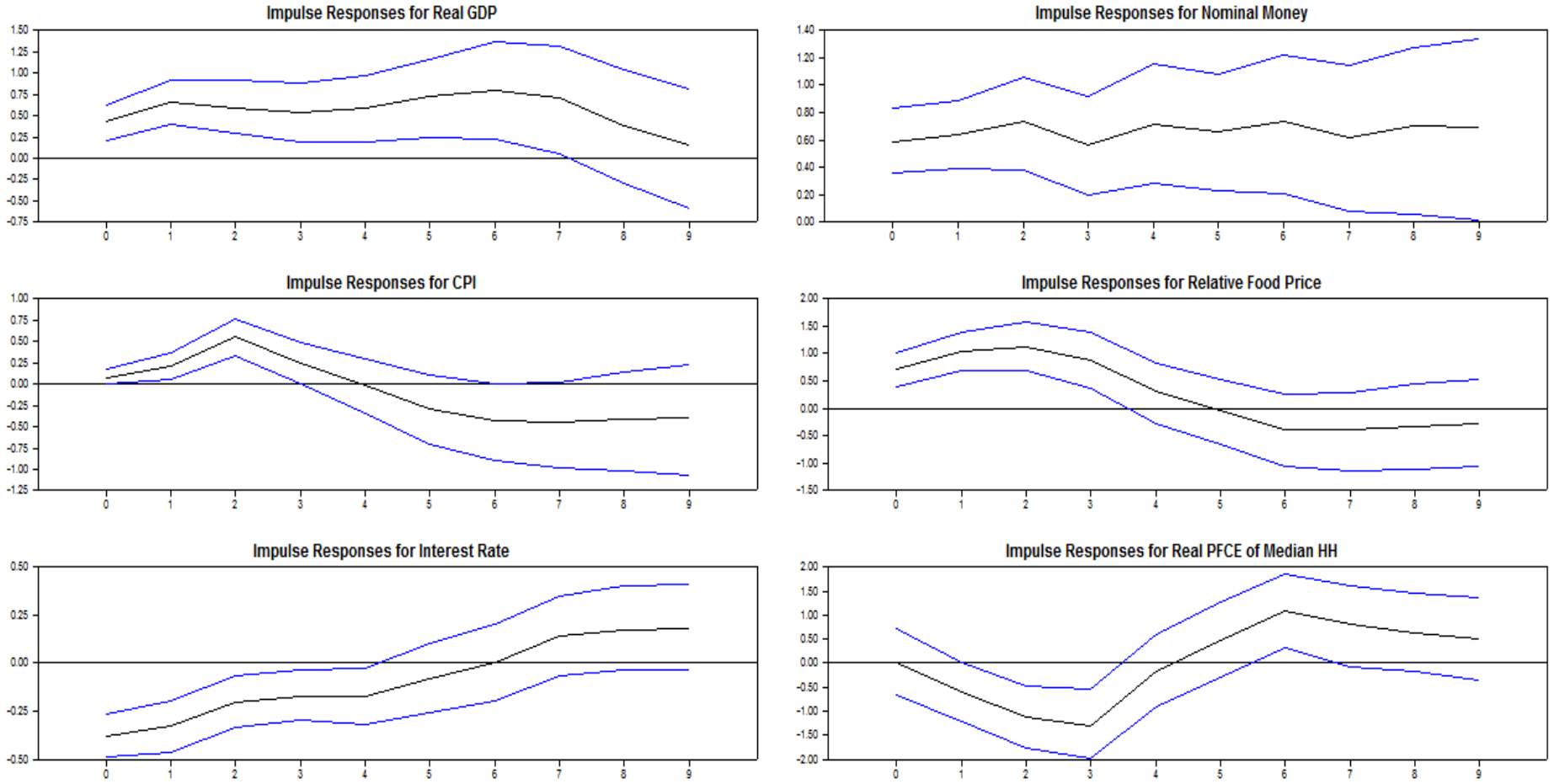

[35]Impulse responses to an expansionary monetary policy shock in rural India one standard deviation in size, using pure sign restriction approach using $K = 2$ (2 years). That is the responses of the CPI, the real GDP and nominal money supply has been restricted not to be negative and the interest rate not to be positive for quarters k, k=0,1,2 after the shock.

## Figure 13: Food Consumption Response of Poor Households in Bottom Decile (0-10% of Expenditure Distribution), Urban India[36]



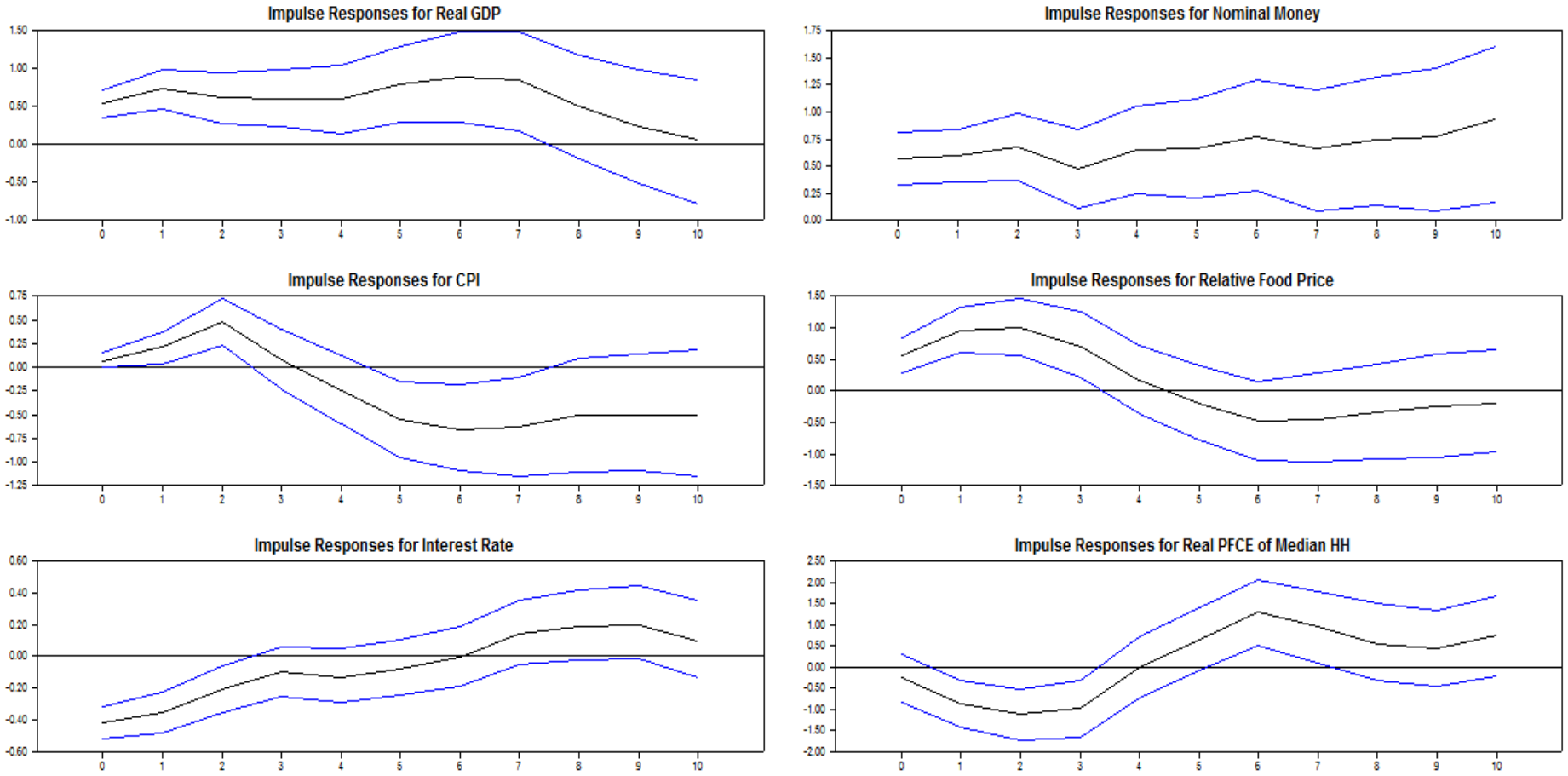

[36]Impulse responses to an expansionary monetary policy shock in urban India one standard deviation in size, using pure sign restriction approach using $K = 2$ (2 years). That is the responses of the CPI, the real GDP and nominal money supply has been restricted not to be negative and the interest rate not to be positive for quarters k, k=0,1,2 after the shock.

## Figure 14: Food Consumption Response of Median Households, Rural India[37]



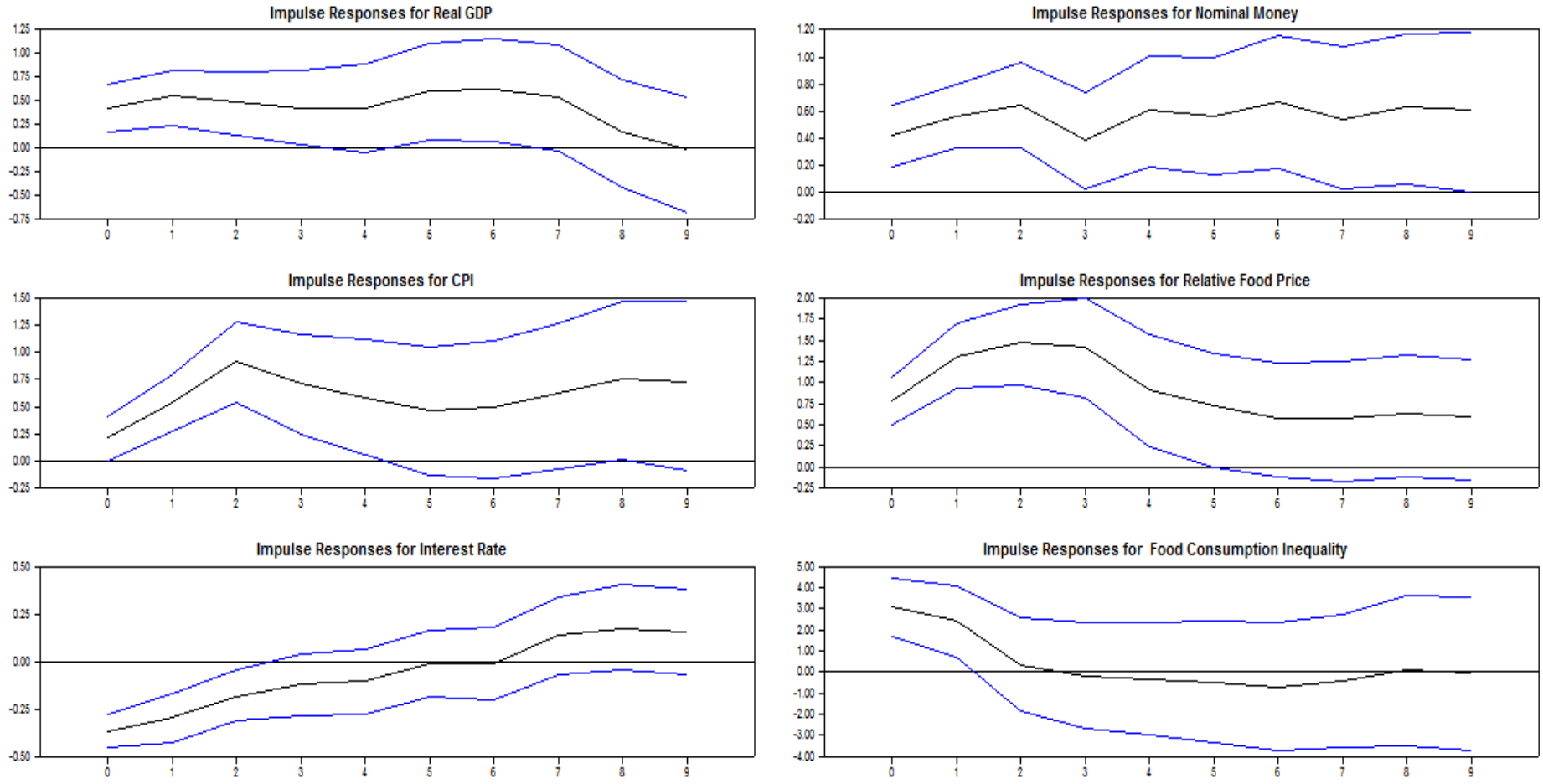

[37]Impulse responses to an expansionary monetary policy shock in rural India one standard deviation in size, using pure sign restriction approach using $K = 2$ (2 years). That is the responses of the CPI, the real GDP and nominal money supply has been restricted not to be negative and the interest rate not to be positive for quarters k, k=0,1,2 after the shock.

## Figure 15: Food Consumption Response of Median Households, Urban India[38]



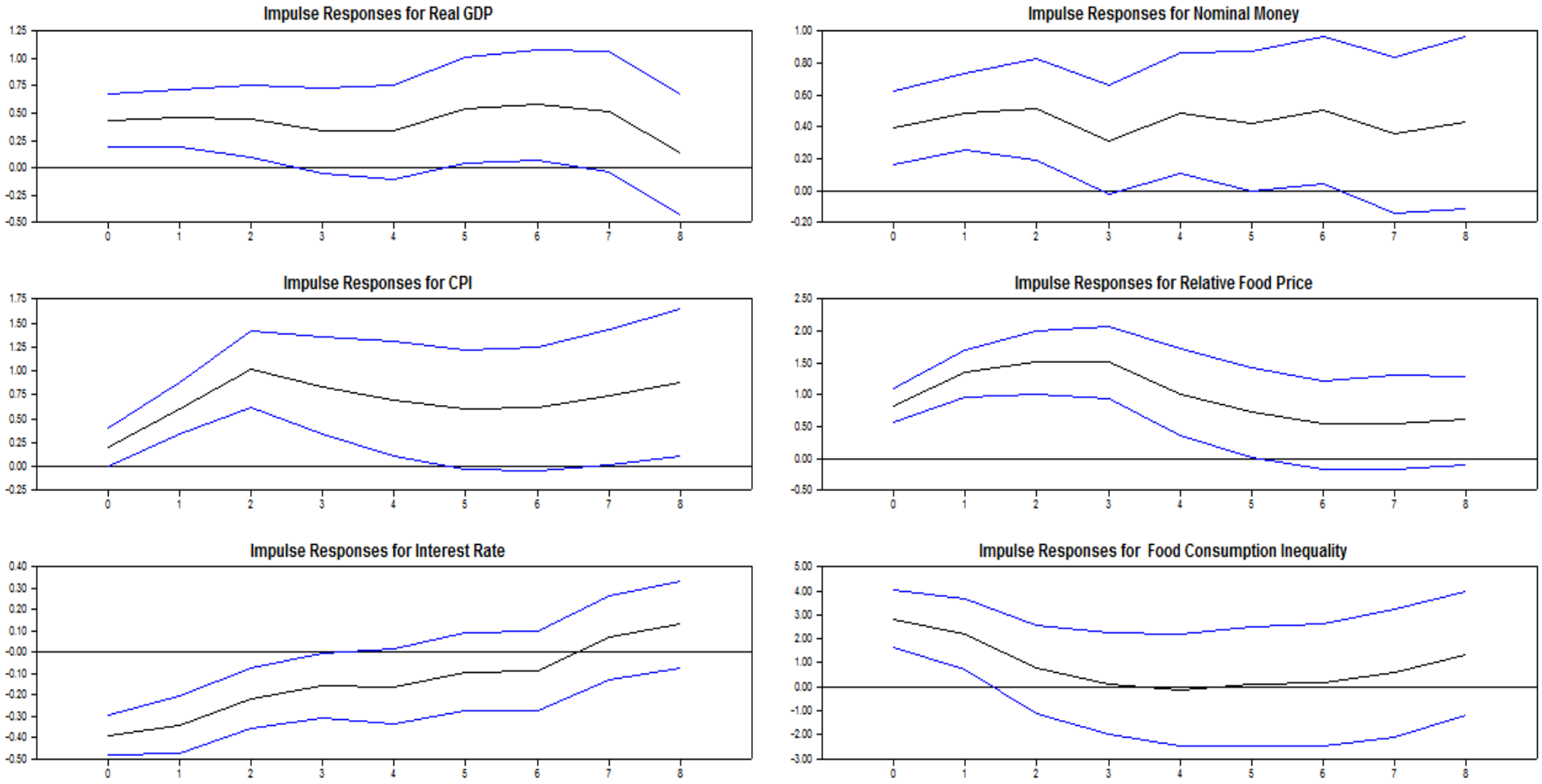

[38]Impulse responses to an expansionary monetary policy shock in urban India one standard deviation in size, using pure sign restriction approach using $K = 2$ (2 years). That is the responses of the CPI, the real GDP and nominal money supply has been restricted not to be negative and the interest rate not to be positive for quarters k, k=0,1,2 after the shock.

## Figure 16: Impulse Response of Food Consumption Inequality, Rural India[39]



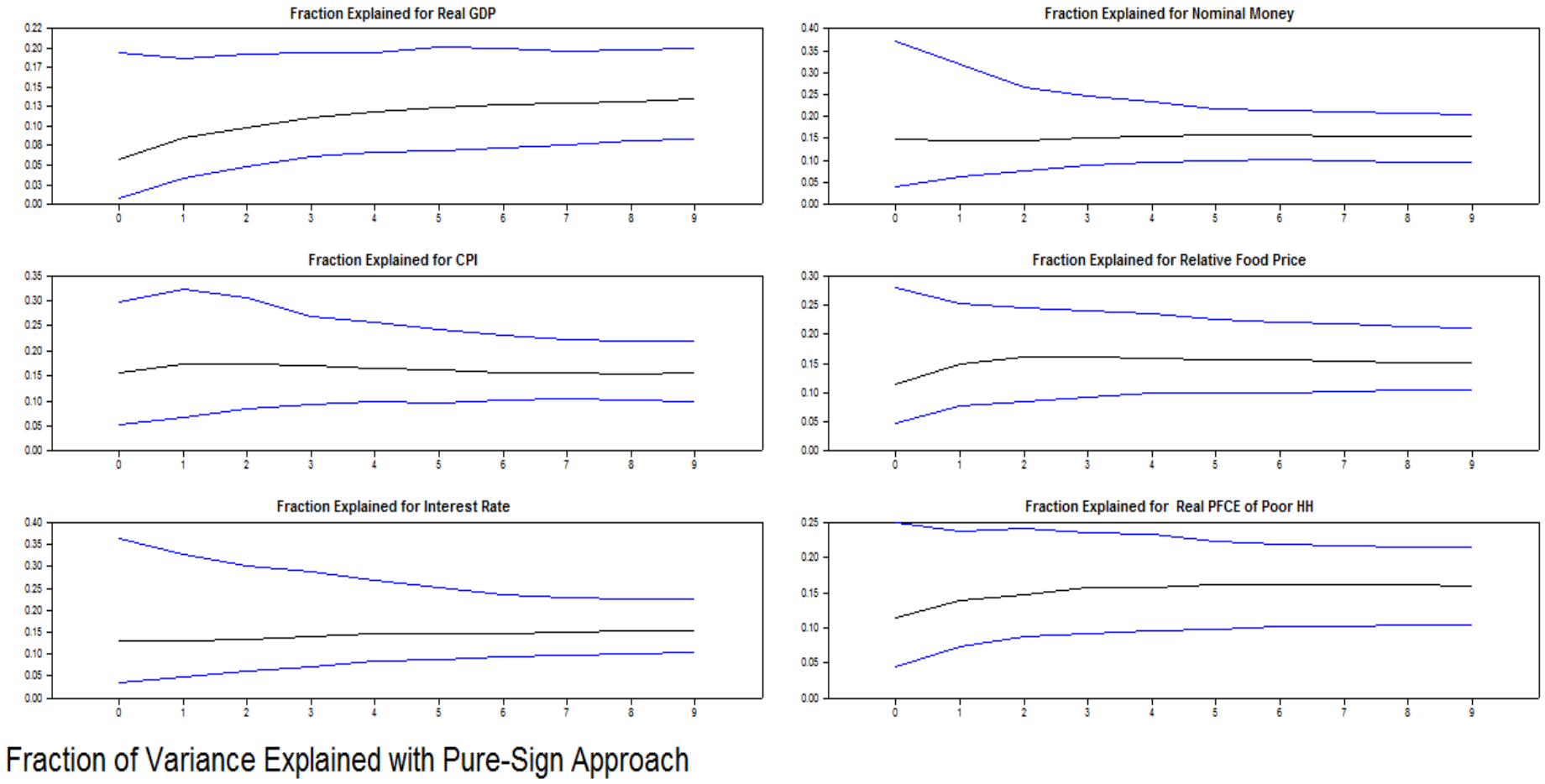

[39]Impulse responses to an expansionary monetary policy shock in rural India one standard deviation in size, using pure sign restriction approach using $K = 2$ (2 years). That is the responses of the CPI, the real GDP and nominal money supply has been restricted not to be negative and the interest rate not to be positive for quarters k, k=0,1,2 after the shock.

## Figure 17: Impulse Response of Food Consumption Inequality, Urban India[40]



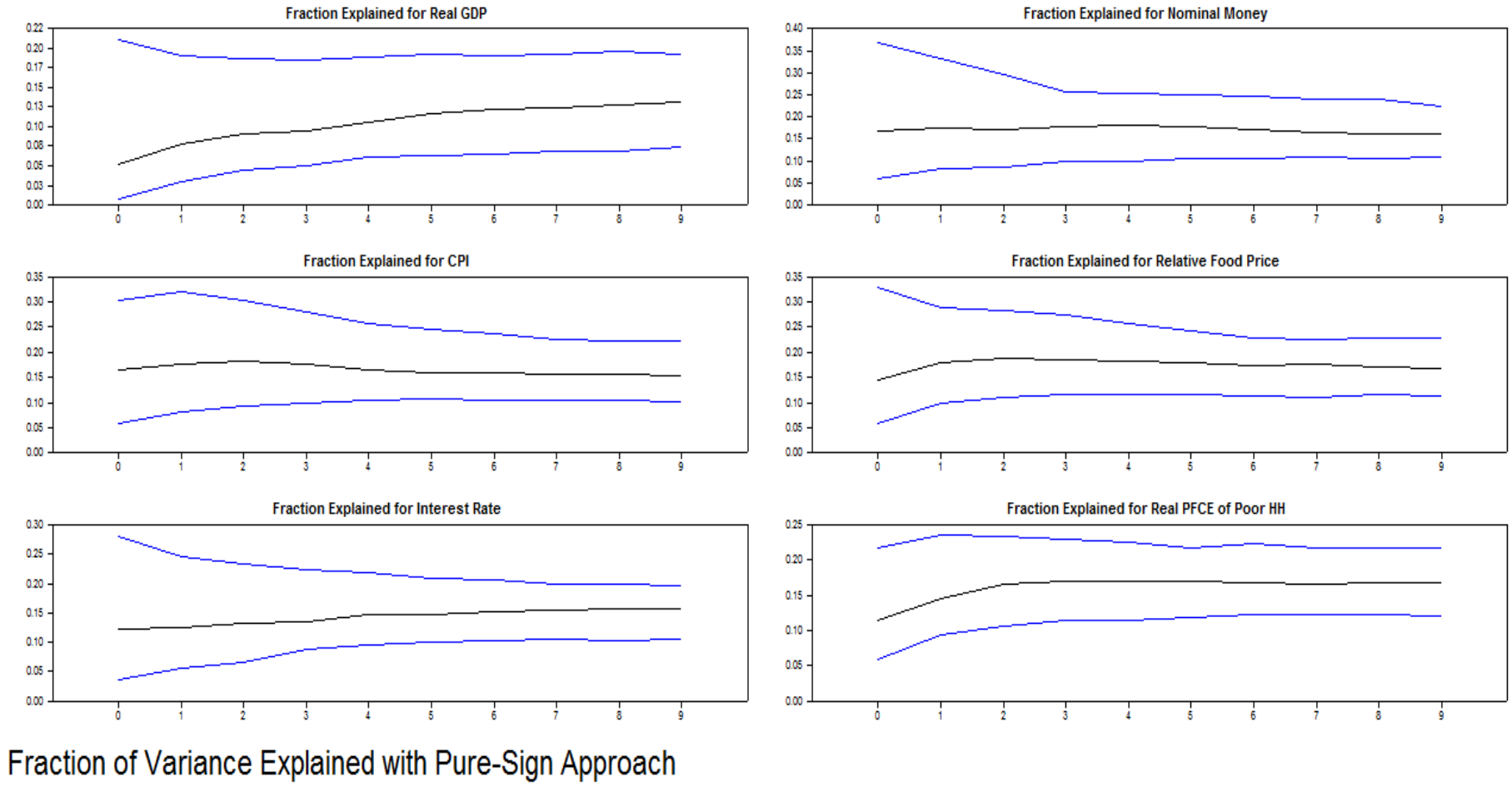

[40]Impulse responses to an expansionary monetary policy shock in urban India one standard deviation in size, using pure sign restriction approach using $K = 2$ (2 years). That is the responses of the CPI, the real GDP and nominal money supply has been restricted not to be negative and the interest rate not to be positive for quarters k, k=0,1,2 after the shock.

**Figure 18: Fraction of the forecast error variance explained by monetary policy shock, Rural India**[41]




[41]These plots show the fraction of the variance of the k - step ahead forecast revision explained by a monetary policy shock, using pure sign restriction approach with $K = 2$ (2 years). The three lines are 16 % quantile, the median and the 16 % quantile of the posterior distribution.

**Figure 19: Fraction of the forecast error variance explained by monetary policy shock, Urban India**[42]




[42]These plots show the fraction of the variance of the k - step ahead forecast revision explained by a monetary policy shock, using pure sign restriction approach with $K = 2$ (2 years). The three lines are 16 % quantile, the median and the 16 % quantile of the posterior distribution.

**Table 1: Average Annual Growth Rate, India, 1996-2013 (in percent)**

| Variable | Average Annual Growth Rate (%) |
|---|---|
| Real GDP | 6.2 |
| Real money supply | 8.6 |
| CPI | 7 |
| Real Consumption Expenditure, Bottom Quartile | -.36 |

Source: Handbook of Statistics on Indian Economy, Reserve Bank of India; Household Consumer Expenditure Survey Reports, NSSO, India.

**Table 2: Average Annual Growth Rate of Real Per Capita Food Consumption Expenditure, Poor Households, 1996-2013 (in percent)**

| Poor Households | Caloric Intake (%) | Real PFCE (%) |
|---|---|---|
| Poor HH in a threshold around the poverty line (20-30% of expenditure distribution) | -1.0 | -0.65 |
| Poor HH in the bottom decile (0-10% of expenditure distribution) | -0.43 | -0.55 |

Source: Household Consumer Expenditure Survey Reports, NSSO, India; Nutritional Intake Survey Reports, NSSO, India.

**Table 3: Summary Statistics of Food Prices, 1996-2013**

| Food Type | Minimum Value | Maximum Value | Mean | Std. Deviation | Growth Rate |
|---|---|---|---|---|---|
| Cereals | 69 | 230 | 123 | 41 | 6.91 |
| Lentils | 78 | 255 | 136 | 51 | 6.21 |
| Vegetables | 55 | 374 | 130 | 59 | 10.91 |
| Fruits | 55 | 212 | 113 | 42 | 7.67 |
| Milk | 65 | 202 | 115 | 40 | 6.51 |
| Animal Proteins | 66 | 281 | 129 | 55 | 8.41 |
| Spices | 86 | 266 | 140 | 54 | 6.19 |
| Sugar | 73 | 194 | 116 | 35 | 5.25 |
| Salt | 92 | 195 | 139 | 32 | 1.05 |
| Edible Oils | 64 | 150 | 101 | 25 | 4.13 |
| Beverages | 64 | 170 | 109 | 27 | 5.61 |

Source: Wholesale Price Indices, Ministry of Statistics and Programme Implementation, Central Statistical Organization, India.

**Table 4: Matrix of Factor Loading**

| Food Type | Variance Share |
|---|---|
| Cereals | 1.05 |
| Lentils | 1.12 |
| Vegetables | 1.08 |
| Fruits | 0.92 |
| Milk | 0.94 |
| Animal Proteins | 1.07 |
| Spices | 1.10 |
| Sugar | 0.93 |
| Salt | 1.07 |
| Edible Oils | 0.79 |
| Beverages | 0.86 |

Source: Authors' Calculation.

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