WP-2019-002

Modeling Heterogeneity and Rationality of Inflation Expectations across Indian Households

Ashima Goyal and Prashant Parab

Indira Gandhi Institute of Development Research, Mumbai
February 2019

Modeling Heterogeneity and Rationality of Inflation Expectations across Indian Households

Ashima Goyal and Prashant Parab

Email(corresponding author): ashima@igidr.ac.in

Abstract

We analyze the inflation expectation formation of Indian Households using Inflation Expectations Survey of Households dataset, and draw out its implications for the effectiveness and use of the expectations channel of monetary policy transmission. Using quantitative responses we discover that households' expectations are adaptive and backward looking. They are not efficient. Food inflation has a significant short run impact but the effect of core inflation increases over the long run. There is considerable heterogeneity across households with females, daily workers, young and retired persons having higher inflation expectations than their counterparts. Unlike advanced economies, retired persons have higher expectations perhaps due to the accumulated information about higher inflation in the past, inadequate social security and underdeveloped pension schemes. Households do not overreact in comparison to the forecasts of RBI and professional forecasters. But short term reactions are significant and heterogeneous across households. The large speed of adjustment, absence of over-reaction, low response coefficients to commodity shocks in a simultaneous and impact of the RBI's forecasted path bodes well for successfully anchoring household inflation expectations in the process of inflation targeting, but requires that these forecasts are carefully made with a focused use of the expectations channel. Communications have more of an impact on inflation expectations than the interest rate. A repo rise actually raises inflation expectations pointing to the ineffectiveness of the aggregate demand channel and of aggressive rate rises.

Keywords: Inflation expectations of households, rationality, heterogeneity, anchoring, inflation targeting, central bank communication

JEL Code: C30, D83, D84, E52, E58

Acknowledgements:

We would like to thank the committee members Dr. Sudha Narayanan and Dr. Taniya Ghosh for their guidance and Dr. B. K. Bhoi for his valuable inputs.

1. Introduction:

India shifted its monetary policy framework from a multiple indicator approach to flexible inflation targeting in the year 2016, with a Monetary Policy Committee (MPC) as the decision making body. Many studies in developed economies have found a stabilizing and anchoring effect of inflation targeting (IT) on inflation expectations of economic agents.

Bernanke (2007) considers inflation expectations to be well anchored if they are relatively insensitive to incoming data. If long run expectations are influenced by the short run shocks, then the expectations are said to be poorly anchored. IMF Regional Economic Outlook (2018) on Latin America states that more central bank credibility anchors inflation expectations.

Studies on determinants of inflation expectations in advanced economies (Bryan and Venkatu, 2001; Carroll, 2001; Mankiw, Reis and Wolfers, 2003; Lanne et al, 2008; Ehrmann et al, 2017; etc. for the US and Easaw et al, 2010, 2013; Malgarini, 2009; Del Giovanni et al, 2009 for European nations) find a few common factors responsible for households expectation formation namely lagged inflation, expectations of professional forecasters, respondents' own perceptions and news on inflation. Apart from these, many demographic factors like gender, age, income, occupation, etc. also play a significant role in influencing household expectations. Among few studies on emerging economies are Cerisola and Gelos (2005), Teixira et al (2017) for Brazil, Ramos Herrera et al (2013) for Spain, Das et al (2018), Sharma and Bicchal (2018) and Ghosh et al (2017) for India.

Study of household inflation expectations gained prominence since consumer inflation expectations were instrumental in explaining the case of missing disinflation in the aftermath of Global Financial Crisis (Coibion and Gorodnichenko, 2015). They are a crucial part of the transmission of second round effects of inflation. Household inflation expectations influence wage setting and household savings (RBI 2010). As a result, many policy makers have extended efforts towards anchoring inflation expectations.

Consumer inflation expectations are far from rational and tend to be biased (Bruin de Bruine et al, 2009). They are influenced by large price fluctuations as consumers tend to remember highly uncertain events more. Their ideas about inflation are affected more by prices of commodities and services contained in their consumption basket and that too the commodities consumed more frequently (Tversky and Kahneman, 1974). Fluctuations in

food and energy prices have a significant impact on consumers' inflation expectations as compared to other factors (Ueda, 2010). This is especially so in a country like India, where food constitutes a major portion of the consumption basket.

The traditional aggregate demand channel of monetary transmission has not been found to have a large impact on Indian inflation (Goyal 2017). Cost shocks have a dominant role. Since consumers' inflation expectations affect costs, the expectation channel of monetary transmission can be one of the most effective ways in which inflation targeting works in an emerging market (Goyal, 2016). Therefore the study of consumer inflation expectations and the impact on it of policy variables and of the inflation targeting regime gains prominence.

Measures of inflation expectations are primarily classified into survey based measures and market based measures. The survey based measures are the responses by different economic agents like households, professional forecasters, business analysts, etc. expressing their views on inflation expectations. Market based expectations are derived from yields of financial derivatives. This paper analyzes various aspects of consumers' inflation expectations by using a novel dataset namely Inflation Expectations Survey of Households (IESH) collected by the Reserve Bank of India.

We analyze properties of quantitative responses of inflationary expectations of households. Using time series data analysis, we have identified some factors that had an influence on aggregate inflationary expectations of households over ten years. The finding of backward-looking household inflation expectations is in contrast to Easaw et al (2013) where lagged inflation does not play a significant role in influencing inflation expectations. Also, at a disaggregate level, core inflation has a significant long term effect on expectations compared to food inflation. We also incorporate dummies for three events namely Global Financial Crisis (GFC), adoption of IT and change in political regime. Of these, change in political regime and GFC show significant impact.

In contrast to Easaw et al (2013), we find that the Indian households do not overreact in the short run in relation to the projected inflation by the Reserve Bank (RBI) as well as to the expectations of professional forecasters. Findings of heterogeneity of expectations across demographic groups are in line with the literature. Women, older people and homemakers tend to have higher inflation expectations than a majority of their counterparts. Unlike many developed nations where elderly people exhibit lower inflation expectations, retired persons

in India tend to have higher expectations. There are several possible reasons for this finding. First, inflation has historically been high in India, though not as high as many Latin American nations, but high enough for the general public to be concerned about it. This accumulated experience may influence older generations to expect higher inflation due to the adaptive nature of expectations. Second, low returns from pension schemes, lack of appropriate social security net for retirees and burgeoning medical expenses increase concerns about inflation for retired personnel.

Although the IT regime itself may be too recent for its impact to be captured, the results have considerable implications for the operation of IT and the use of IESH results. The large speed of adjustment, absence of over-reaction, low response coefficients to commodity shocks in the presence of controls and impact of the RBI's forecasted path bodes well for successfully anchoring household inflation expectations, but requires that these forecasts are carefully made with a focused use of the expectations channel. Communications have more of an impact on inflation expectations than the interest rate. A repo rise actually raises inflation expectations pointing to the ineffectiveness of the aggregate demand channel and of aggressive rate rises. Perverse effects may be due to impact on costs and inflation expectations. The heterogeneity of expectations, and lack of support for rationality, suggests they must not be used for forecasting or for setting repo rates. They are more useful as qualitative indicators of directions of change. The expectations of financial sector employees are the least volatile, and can be given greater credence.

The paper is structured as follows: The next section explains the IESH dataset in brief followed by descriptive statistics in Section 3; the theoretical model used for analysis is described in Section 4; Section 5 describes the methodology followed by empirical results in Section 6. We discuss some conclusions of the study in Section 7.

2. Inflation Expectations Survey of Households:

This study uses a novel dataset named IESH. It consists of qualitative and quantitative responses of the urban Indian households expressing their views on inflation expectations. It is conducted by the Reserve Bank of India every quarter since September 2005. The respondents are classified based on four categories namely gender, age, profession and city of residence. The survey began with 4 cities (Mumbai, Delhi, Chennai and Kolkata) with 500

respondents from each city. Eight more cities were added to the survey in 2006 with 250 households from the new entrants.[1] The survey was further expanded to sixteen and eighteen cities in January 2012 and January 2015 respectively. The respondents' proportions are very close to the predetermined targets which can be observed from Table 1 below.

Table 1– Sampling of Cohorts

Gender-wise	**Actual**	**Target**
Male	58.50	60
Female	41.50	40
Category-wise	**Actual**	**Target**
Financial Sector Employees	9.82	10
Other Employees	16.21	15
Self-Employed	20.34	20
Homemakers	29.09	30
Retired Persons	9.28	10
Daily Workers	9.25	10
Other category	6.01	5
Age-wise	**Actual**	
Up to 25 years	16.74	
25 to 30 years	15.77	
30 to 35 years	14.01	
35 to 40 years	13.86	
40 to 45 years	10.10	
45 to 50 years	8.52	
50 to 55 years	5.89	
55 to 60 years	5.25	
60 years and above	9.86	

City-wise	**Actual**
Ahmedabad	5.27
Bangalore	5.06
Bhopal	5.31
Bhubaneswar	3.02
Chandigarh	1.65
Chennai	10.50
Delhi	10.51
Guwahati	5.16
Hyderabad	5.50
Jaipur	5.12
Kolhapur	1.67
Kolkata	10.25
Lucknow	5.43
Mumbai	10.70
Nagpur	2.91
Patna	5.58
Raipur	1.76
Ranchi	1.88
Thiruvananthapuram	2.71

Source: Technical Advisory Committee on Survey Report and IESH, RBI

The questionnaire[2] is divided into four blocks. Blocks 1 and 2 keep track of the demographic characteristics of the respondent, namely age, gender, profession and the city of residence. Block 3 records the qualitative responses of the respondents about their views on the inflation expectations three months and one year ahead. The responses are classified as – (i) "Decline in Prices", (ii) "No change in Prices", (iii) "Prices change less than the previous year", (iv) "Price changes are same as the previous year" and (v) "Prices change more than the previous year". These responses are collected for the overall inflation as well as the sub-categories like food, non-food items, household durables, services and housing prices.

[1] The newly added cities are Ahmedabad, Bangalore, Bhopal, Jaipur, Guwahati, Hyderabad, Lucknow and Patna.
[2] The questionnaire can be accessed using the following link https://rbidocs.rbi.org.in/rdocs/content/pdfs/IEPR1729RL0314_I.pdf

Block 4 records the quantitative responses. These responses are collected for the perceptions (current period expectations), three-month and one-year ahead inflation expectations. The responses vary in the range of "less than 1%" to "Greater than 16%" with a class width of 1% per interval. The respondents are asked to specify a numerical response in case their response is "Greater than 16%". The advantage of having such a technique for collecting quantitative responses is minimization of the response of "No Idea".

A problem is quantitative and qualitative responses tend to be discordant. Even if the qualitative response shows a decline in prices, the quantitative response may be double digit inflation as there are many unobserved factors that drive the perceptions of the respondents. Therefore while quantitative surveys provide useful information on the structure household inflation expectations that can be helpful in the process of inflation targeting, they are not reliable as forecasts of inflation, and should not be a major factor in the policy rate decision, as they contain a significant positive bias (Sharma and Bicchal, 2018).

3. Data and Descriptive Statistics:

Our analysis consists of the following data:

3.1 Inflation Expectations:

The correlation between the three types of quantitative responses in the IESH dataset, namely inflation perceptions, 3-month ahead inflation expectations and 1-year ahead inflation expectations is around 0.99. Hence, for most part of our analysis; we use the 1-year ahead inflation expectations. Moreover policy is more concerned about impact on long-term expectations.

3.2 Inflation – Consumer Price Index-Industrial Workers:

The period of analysis for the current study is 2008Q3 to 2018Q2. The newly constructed series on inflation named CPI-C (combined) is available after 2011. So we use inflation based on CPI-IW (Industrial Workers) as a proxy for CPI-C. The weights of commodities and services are very similar for both, as can be seen from Table 2. The inflation rates are measured using year-on-year logarithmic differences for every quarter. The inflation rates used for analysis are lagged by one month. For instance, if the survey is conducted for the

month of September, the corresponding inflation rate used is for the month of August since that is the latest data published in the month of September and valuable to households.

Table 2- CPI-IW vs CPI-C

GROUP AND SUBGROUP	CPI-IW (Base 2001)	CPI-C (Base 2010)
Food, Beverages and Tobacco	48.46	47.13
Fuel and Light	6.43	5.48
Housing	15.27	16.41
Clothing and Footwear	6.58	7.03
Miscellaneous	23.26	23.95

Source: Goyal, 2014

3.3 Oil Prices:

Since India is a small open economy and a price taker in terms of international crude oil, we use international crude oil prices as a proxy for fuel prices, to include the effect of international commodity price movements in our analysis. These are the prices most reported in the media. We use logarithm of the price of crude oil in Indian basket (converted to rupees). Monthly Brent crude oil prices in US dollars are collected from Petroleum Planning and Analysis Cell. They are converted to rupees using average ₹/$ exchange rate of that month.

3.4 Macroeconomic Controls:

We use repo rate and year-on-year growth rate of gross domestic product (GDP) at market price as macroeconomic controls. The repo rate is used interchangeably with other short term market rates like 91-day Treasury Bills and Weighted Average Call Money Rate (WACMR) to test the robustness of the results. We also use the data on rainfall (in logarithms) as an exogenous shock.

3.5 News Variables:

Two variables are used to incorporate the effect of news on inflation expectations. One is 1-year ahead forecasts of inflation by professional forecasters. This data is collected by RBI every quarter till 2014 and every two months after that, by sending a questionnaire to financial experts. This is the most common measure used in literature. Apart from these forecasts, we incorporate the projections made by the RBI itself. These forecasts are obtained from the monetary policy speeches delivered by the Governor every quarter till 2014 and

every two months after that. These forecasts are appropriate to test the effect of news on expectations as newspapers, electronic or any other source of media tend to publish these numbers.

Though the data is available since 2006, the data is used since 2008Q3 as these are internal inconsistencies in data prior to that period (TACS Report, 2010).

Table 3 gives the basic correlations between the variables and Figure 1 plots them. Household expectations are highly correlated with international crude oil prices, repo rate and projections by RBI. Correlation of core inflation with household expectations is higher than that of food price inflation. RBI projections have higher correlations with oil prices and repo rate.

Table 3-Correlations between Variables of Analysis

	HH_INF_ONEYR	CPIIW_FOOD	CPIIW_CORE	OIL	GDPGR	REPO	RBI_PROJ	ONEYR_SPF
HH_INF_ONEYR	1.00							
CPIIW_FOOD	0.30	1.00						
CPIIW_CORE	0.40	0.56	1.00					
OIL	0.71	0.13	0.20	1.00				
GDPGR	0.25	-0.04	0.36	0.01	1.00			
REPO	0.76	-0.03	0.01	0.73	-0.10	1.00		
RBI_PROJ	0.74	0.39	0.38	0.51	0.23	0.63	1.00	
ONEYR_SPF	0.67	0.59	0.65	0.65	0.13	0.39	0.58	1.00

Source: Authors' Calculations

Variables used for the analysis are as follows:

HH_INF_ONEYR – 1-year ahead inflation expectations of households, **CPIIW_FOOD** – Food inflation measured using **CPI-IW**, **CPIIW_CORE** – Core inflation measured using CPI-IW, **OIL** – logarithm of oil prices in rupees, **GDPGR** – year-on-year growth rate of GDP at market price, **REPO** – Repo rate announced by the Reserve Bank of India, **RBI_PROJ** – Inflation projections by the Reserve Bank of India, **ONEYR_SPF** – 1-year ahead inflation expectations of professional forecasters.

Figure 1- Graphs of Variables of Analysis

Source: Authors' Calculations

Figure 1 shows that for all the major variables namely inflation expectations, food price inflation, oil prices and RBI projections for the period of analysis (2008Q3-2018Q2) we observe a sharp dip in 2014. The graphical analysis shows inflation expectations have declined post 2014 along with three factors namely food prices, crude oil prices and RBI projections.

4. Theoretical Background and Motivation:

Many theoretical models have been constructed for modeling inflation expectations of economic agents. The sticky information model by Mankiw and Reis (2002) suggests the information in an economy is sticky. Not all economic agents possess the entire set of information at one point in time. Only a fraction of population updates information at one point. The implications of this model were used by Carroll (2003) along with the literature from epidemiological studies to model inflation expectations of households and professional

forecasters. He states that households form expectations based on news as well as the information available till that point.

Another stream of research pioneered by Sims (2003) suggests households are rationally inattentive. Economic agents can absorb only a specific subset of information available based on their absorption capacity. Another branch of study deals with the learning approach of rationally heterogeneous expectations pioneered by Branch in his seminal paper in 2004. He proposes that the agents learn based on their past and rationally update their expectations, which vary substantially across heterogeneous groups of economic agents.

The current study will follow Carroll (2003), where households update their information based on some source of news and their own past experiences. This suits the Indian context given the fact that news plays a significant role in influencing masses in India, a parliamentary democracy with freedom of speech.

Let $\pi^{e}_{t+1|t}$ be the aggregate inflation expectations of households at time t, where t=1,2,3,…, T. $N_{t+1|t}$ is the news forecast that the agents receive. According to Carroll, inflation expectations are formed using the following equation:

$$\pi^{e}_{t+1|t} = \rho N_{t+1|t} + (1-\rho)\{\rho N_{t|t-1} + (1-\rho)\left(\rho N_{t|t-1} + \cdots\right)\} \quad (1)$$

The terms in the curly brackets asymptotically tend towards $\pi^{e}_{t|t-1}$, giving us equation (2)

$$\pi^{e}_{t+1|t} = \rho N_{t+1|t} + (1-\rho)\pi^{e}_{t|t-1} \quad (2)$$

where ρ is the speed of adjustment of households to the news received. Higher value of ρ suggests a high response of the households to news about inflation expectations.

Most of the studies pertaining to developed nations use the forecasts by professional forecasters as a proxy for $N_{t+1|t}$. They incorporate the effect of news separately by constructing an index based on the number of articles in the newspaper having inflation related news. We do not carry out this study on account of the lack of an open source database on the same. We instead use a proxy for the news variable. With every monetary policy decision, the policy makers announce projected inflation rates and GDP growth rates. We use the projected inflation rates, extracted from every speech of the RBI monetary policy

meet. This is a good proxy because many newspapers, electronic or any other media source publish these figures along with the monetary policy decisions. Hence, the RBI projections are taken as the news variable. In an EM, where news and analysis is thin, the projections of the RBI are expected to have greater weight. Moreover, the use of this variable allows a direct test of RBI guidance.

A preliminary analysis to capture the speed of learning from news has baseline equations:

$$\pi^{e}_{t+1|t} = \rho RBI\_PROJ_{t+1|t} + (1-\rho)\pi^{e}_{t|t-1} + \varepsilon_t \quad (3)$$

$$\pi^{e}_{t+1|t} = \rho SPF_{t+1|t} + (1-\rho)\pi^{e}_{t|t-1} + \varepsilon_t \quad (4)$$

In line with Carroll (2003), we augment these equations by adding recently published prices. They are the realized inflation figures for the previous month. The augmented equations are:

$$\pi^{e}_{t+1|t} = \alpha_1 RBI\_PROJ_{t+1|t} + \alpha_2\pi^{e}_{t|t-1} + \alpha_3\pi_t + \varepsilon_t \quad (5)$$

$$\pi^{e}_{t+1|t} = \alpha_1 SPF_{t+1|t} + \alpha_2\pi^{e}_{t|t-1} + \alpha_3\pi_t + \varepsilon_t \quad (6)$$

Where the restrictions imposed are $\alpha_1 + \alpha_2 + \alpha_3 = 0$

The results of the estimation are given in Table 4.

Table 4- Speed of Adjustment of Households

	BASELINE		AUGMENTED	
	(1)	(2)	(3)	(4)
ρ	0.52***	0.45***		
	(0.01)	(0.00)		
α_1			0.47***	0.50***
			(0.01)	(0.00)
α_2			0.45**	0.54***
			(0.02)	(0.00)
α_3			0.07	-0.04
			(0.30)	(0.79)

Level of Significance- *** - 1%, ** - 5%, * - 10% ; p-values are reported in the parentheses
Equations estimated in the aforementioned columns are
(1) $\pi^{e}_{t+1|t} = \rho RBI\_PROJ_{t+1|t} + (1-\rho)\pi^{e}_{t|t-1} + \varepsilon_t$; (2) $\pi^{e}_{t+1|t} = \rho SPF_{t+1|t} + (1-\rho)\pi^{e}_{t|t-1} + \varepsilon_t$;
(3) $\pi^{e}_{t+1|t} = \alpha_1 RBI\_PROJ_{t+1|t} + \alpha_2\pi^{e}_{t|t-1} + \alpha_3\pi_t + \varepsilon_t$; (4) $\pi^{e}_{t+1|t} = \alpha_1 SPF_{t+1|t} + \alpha_2\pi^{e}_{t|t-1} + \alpha_3\pi_t + \varepsilon_t$

Source: Authors' Calculations

The speed of adjustment for Indian households is around 0.5, which is higher than the developed economies (0.27 for US). This supports the thesis of a larger impact of news, and especially central bank guidance in EMs. Indian households predominantly depend on news while forming their expectations about inflation. It provides a motivation to carry forward this study, suggesting a large probability of an effective expectations channel of monetary policy transmission.

5. Methodology:

We test the following specific hypotheses:

Hypothesis 1: Aggregate level household expectations:

(a) Are not self-fulfilling
(b) Are adaptive

Hypothesis 2: Food inflation has a larger effect on the household inflation expectations than does core inflation.

Hypothesis 3: There exists significant heterogeneity across cohorts

Hypothesis 4: Households tend to overreact in the short run

The following tests are used for testing the hypotheses mentioned above:

Hypothesis 1: Granger Causality, Ordinary Least Squares (OLS) regression

Hypothesis 2: Structural Vector Auto Regression (SVAR), Impulse Response Function (IRF), Forecast Error Variance Decomposition (FEVD) and Auto Regressive Distributed Lags (ARDL)

Hypothesis 3: OLS regression across repeated cross sections and aggregate time series data

Hypothesis 4: Auto Regressive Distributed Lags (ARDL)

5.1 Tests for Hypothesis 1:

One-way causality from inflation expectations to realized inflation implies expectations are self-fulfilling (Xu et al, 2016). If the causality is bi-directional it indicates an inflation spiral.

We use the concept of Granger Causality to test for this. The equation below shows the Granger Causality between two variables in a Vector Auto Regressive (VAR) setup.

$$Z_t = \begin{pmatrix} x_t \\ y_t \end{pmatrix} = \begin{pmatrix} c_1 \\ c_2 \end{pmatrix} + \begin{pmatrix} \phi_{11}^1 & 0 \\ \phi_{21}^1 & \phi_{22}^1 \end{pmatrix} \begin{pmatrix} x_{t-1} \\ y_{t-1} \end{pmatrix} + \cdots + \begin{pmatrix} \phi_{11}^p & 0 \\ \phi_{21}^p & \phi_{22}^p \end{pmatrix} \begin{pmatrix} x_{t-p} \\ y_{t-p} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix} \quad (7)$$

In a two variable VAR framework, when all the coefficients of y in a regression for x are zero, then it is said that y does not Granger Cause x. But it does not say anything about x Granger Causing y.

OLS regressions are used to test whether inflation expectations are rational or adaptive. The equations estimated are similar to Figlewski and Wachtel (1981).

They are given as follows:

Rational Expectations:

Literature gives three forms of rationality namely weakly rational, sufficiently rational and strictly rational. The current study follows the analysis by Sharma and Bicchal (2018) to test weak rationality of inflation expectations by analyzing whether the inflation expectations are unbiased and efficient. Equations (8a) and (8b) are tests for unbiasedness and efficiency properties respectively.

$$\pi_t = \alpha + \beta E_{t-j}\pi_t + \varepsilon_t \quad (8a)$$

Where j is the number of lags based on the forecast horizon (j=0, 1 and 4 for inflation perceptions, 3-month ahead expectations and 1-year ahead expectations respectively). When the combined null hypothesis of $\alpha = 0$ and $\beta = 1$ is accepted, the expectations are considered unbiased.

$$\pi_t - E_{t-j}\pi_t = \alpha + \beta_i \sum_{i=1}^{k} (\pi_{t-i} - E_{t-j}\pi_{t-i}) + \varepsilon_t \quad (8b)$$

Where j is the number of lags based on forecast horizon and k stands for the number of optimal lags chosen using Akaike Information Criterion (AIC). For inflation expectations to be efficient, the combined null hypothesis of $\alpha = 0$ and $\beta_i = 0$ should be accepted.

Adaptive Expectations:

$$\pi_t^e - \pi_{t|t-j}^e = \mu + \lambda(\pi_t - \pi_{t|t-j}^e) + \eta_t \quad (9)$$

Where j is the number of lags based on forecast horizon. When the null hypothesis of $\lambda = 0$ is rejected, the expectations are considered adaptive.

5.2 Tests for Hypothesis 2:

The Structural Vector Auto Regressive (SVAR) Model imposes an underlying structure or theory to an atheoretic reduced form VAR model. Let Z_t be an N x 1 vector with p lags for each variable. Then the pth order SVAR model is written as follows:

$$B_0 Z_t = c^* + B_1 Z_{t-1} + B_2 Z_{t-2} + \cdots + B_p Z_{t-p} + u_t$$

where B_0 matrix gives a structure to the reduced form VAR model and the u_t's are called structural disturbances. The underlying assumption is that these disturbances are serially and mutually uncorrelated i.e.,

$$E(u_t u_\tau') = \begin{cases} D \; for \; t = \tau \\ 0 \; otherwise \end{cases} \quad (10)$$

where D is a diagonal matrix.

The number of restrictions to be imposed on the B_0 matrix can be obtained using the variance covariance matrix Ω as follows:

$$\Omega = B_0^{-1} E(u_t u_\tau')(B_0^{-1})' = B_0^{-1} D (B_0^{-1})' \quad (11)$$

Ω has N(N+1)/2 free parameters out of which N belong to the diagonal matrix D. The remaining N(N-1)/2 free parameters belong to the B_0 matrix. It implies that we have to impose N(N-1)/2 restrictions on B_0 matrix for a just identification.

The benchmark SVAR model for household expectations contains the following short run restrictions:

$$B_0 * Z_t = \begin{pmatrix} 1 & & & & & & \\ b1 & 1 & & & & & \\ b2 & b7 & 1 & & & & \\ b3 & b8 & 0 & 1 & & & \\ b4 & b9 & b12 & b15 & 1 & & \\ b5 & b10 & b13 & b16 & b18 & 1 & \\ b6 & b11 & b14 & b17 & b19 & b20 & 1 \end{pmatrix} \begin{pmatrix} OIL \\ GDPGR \\ FOOD\ INF \\ CORE\ INF \\ REPO \\ RBIPROJ \\ HH\ INF\ EXP \end{pmatrix} \quad (12)$$

We use a recursive model with short run restrictions as given in the equation above. The restrictions are incorporated according to literature (Ueda, 2010; Parmanik and Kamaiah, 2014). Here, we assume no contemporaneous effect of food price inflation on core inflation. Causality from food inflation to core inflation works with lags. This analysis is enhanced using impulse response functions and variance decomposition.

We use likelihood ratio (LR) test to analyze impact of the determinants across different time periods. The formula for LR test is given below:

$$(N\text{-}k)*(\log \Sigma_{ur} - \log \Sigma_r) \quad (13)$$

We incorporate dummies for inflation targeting, change in political regime and GFC. The values taken by the dummies are given below:

dummy_it = 1, if date>= 2015Q1, 0 otherwise

dummy_polreg = 1, if date >=2014Q2, 0 otherwise (14)

dummy_crisis=1, if date<=2010Q1, 0 otherwise

5.3 Tests for Hypothesis 3:

Heterogeneity is analyzed using OLS regressions for the pooled cross sections. Unlike other analyses, the unit of measurement here is the individual household. A panel data analysis is invalid in this case due to the incoherence of the unit of analysis. Same households are not repeated every quarter. The equations for the same are given below.

$$\pi_t^e = \beta_0 + \beta_k DUMMY_t^k + \eta_t \quad (15)$$

$$\pi_t^e = \beta_0 + \beta_t \tau_t + \beta_k DUMMY_t^k + \eta_t \quad (16)$$

We incorporate k dummies for various classifications of cohorts. If there are m classifications per cohort, then k = (m-1): m=2 for gender (male and female), m=7 for profession (homemaker, financial sector employees, daily workers, retired persons, self-employed, other employees, other category), m=9 for age groups (below 25 years, 25-30 years, 30-35 years, 35-40 years, 40-45 years, 45-50 years, 50-55 years, 55-60 years, 60 years and above) and m=2 for cities (Tier 1 cities [Mumbai, Chennai, Delhi, Kolkata, Bangalore and Hyderabad] and Tier 2 & 3 cities). One class is taken as a base for every cohort. Here females, homemakers, below 25 years and tier 2 & 3 cities are taken as the base. A significant value of βk in equations 5 and 6 indicate the presence of heterogeneity. A positive (negative) value of βk implies higher (lower) inflation expectations for that group compared to the base category. Equation 6 checks the robustness of the results across time by incorporating T-1 time dummies where T is the number of observations of a variable.

5.4 Tests for Hypothesis 4:

ARDL models are used to test the short run overreaction of the households. ARDL model separates short run and long run effects. Its advantage over VECM model is that the explanatory variables need not be of the order of integration I(1). Only the dependent variable needs to be first order stationary. Also, the lag order need not be the same for all the variables. Using the framework suggested by Easaw et al (2013), overreaction is estimated using the coefficients of error correction terms and short run relationships. Equations 17 and 18 give the ARDL models for inflation expectations with RBI projections and forecasts by professional forecasters being the only difference between the two. The hypotheses for overreaction are given by equation 19.

$$\Delta\pi_t^e = \theta_1 + \sum_{j=0}^{L_2}\theta_{2j}\Delta RBIPROJECTIONS_{t-j} + \sum_{j=0}^{L_3}\theta_{3j}\Delta FOODINF_{t-j} + \sum_{j=0}^{L_4}\theta_{4j}\Delta COREINF_{t-j} + \sum_{j=0}^{L_5}\theta_{5j}\Delta OIL_{t-j} + \sum_{j=0}^{L_6}\theta_{6j}\Delta GDPGR_{t-j} + \sum_{j=0}^{L_7}\theta_{7j}\Delta REPO_{t-j} + \theta_{ECM}[\pi_{t-1}^e - \phi_1 RBIPROJECTIONS_{t-1} - \phi_2 FOODINF_{t-1} - \phi_3 COREINF_{t-1} - \phi_4 OIL_{t-1} - \phi_5 GDPGR_{t-1} - \phi_6 REPO_{t-1}] + \varepsilon_t \quad (17)$$

Where L_2, L_3, L_4, L_5, L_6 and L_7 are short run lag lengths for RBI projections, food inflation, core inflation, oil prices, GDP growth rate and repo rate respectively. $\theta_{ij}'s$ and ϕ_i's are short run and long run coefficients respectively and π_t^e is the measure for aggregate inflation expectations for all the households as well as for different classes across four cohorts.

$$\Delta\pi_t^e = \theta_1 + \sum_{j=0}^{L_2}\theta_{2j}\Delta SPF_{t-j} + \sum_{j=0}^{L_3}\theta_{3j}\Delta FOODINF_{t-j} + \sum_{j=0}^{L_4}\theta_{4j}\Delta COREINF_{t-j} + \sum_{j=0}^{L_5}\theta_{5j}\Delta OIL_{t-j} + \sum_{j=0}^{L_6}\theta_{6j}\Delta GDPGR_{t-j} + \sum_{j=0}^{L_7}\theta_{7j}\Delta REPO_{t-j} + \theta_{ECM}[\pi_{t-1}^e - \phi_1 SPF_{t-1} - \phi_2 FOODINF_{t-1} - \phi_3 COREINF_{t-1} - \phi_4 OIL_{t-1} - \phi_5 GDPGR_{t-1} - \phi_6 REPO_{t-1}] + \varepsilon_t \quad (18)$$

Where all the characteristics are similar to equation 17 except for L_2 being the lag length for forecasts by professional forecasters (SPF).

$$H_0: \theta_{2j} = -\theta_{ECM} \qquad H_1: -\frac{\theta_{2j}}{\theta_{ECM}} > 1 \quad (19)$$

The overreaction of the household occurs when the short run coefficient of news variable (RBI projections in equation 17 and SPF forecasts in equation 18) given by θ_{2j} is significantly greater than the absolute value of the error correction coefficient (θ_{ECM}).

6. Empirical Analysis

All the variables are adjusted for seasonality using the Census X-13 package. These variables are also tested for stationarity, the results of which are mentioned in Table A1 in the appendix.

6.1 Hypothesis 1- Properties of Inflation Expectations:

Table 5 shows the results for Hypothesis 1(a). The lag length as per the Akaike Information Criterion (AIC) or Schwartz Bayesian Criterion (SBC) is 1. But on testing for normality of residuals post estimation using Jarque-Berra tests, the null of normality of disturbances was rejected. Hence, we checked for the closest smallest possible lag length to provide normally distributed disturbance terms. The lag length thus obtained was 4. Hence, the Granger Causality Test is conducted with the maximum lag length of 4[3]. The results in Table 5 display a unidirectional causality from the realized inflation to inflation expectations. This enables us to accept our Hypothesis 1(a) that the expectations are not self-fulfilling. For expectations to be self-fulfilling in nature, the causality should be unidirectional from expected inflation to realized inflation.

[3] For more details about the procedure, visit https://davegiles.blogspot.com/2011/04/testing-for-granger-causality.html

Table 5- Granger Causality for Testing Self-Fulfilling Property

Granger Causality CPI-IW and Inflation Expectations		
	p-value(CPI-IW to Inf Exp)	p-value(Inf Exp to CPI-IW)
Inflation perceptions	0.00***	0.41
3-month ahead inflation expectations	0.00***	0.61
1-year ahead inflation expectations	0.00***	0.40

Level of Significance- *** - 1%, ** - 5%, * - 10%

Source: Authors' Calculations

The results of the tests for rational and adaptive expectations are given in Table 6. The second and third columns present the results for unbiasedness and efficiency of inflation perceptions and expectations. P-values of Chi-squared tests are provided in these columns. Rejection of null hypotheses in both the scenarios points out to the failure of rationality property of inflation expectations as they are biased and inefficient. These results are in line with Sharma and Bicchal (2018).

Results for the test for adaptive nature of inflation perceptions and expectations are provided in the last column of Table 6. It shows the co-efficient values of λ for all the cases. Even if the λ coefficients have more or less similar values for inflation expectations as well as perceptions, the level of significance increases once the forecast horizon widens. Larger the forecast horizon, more adaptive is the nature of inflation expectations of households. Also, a small value of λ indicates that the households depend more on their past values rather than the realized inflation to form their expectations.

Table 6- Test for Rational and Adaptive Expectations

Variables	Rational Expectations- Unbiased property $\pi_t = \alpha + \beta E_{t-j}\pi_t + \varepsilon_t$ (Null: $\alpha = 0, \beta = 1$)	Rational Expectations- Efficiency property $\pi_t - E_{t-j}\pi_t = \alpha + \beta_i \sum_{i=1}^{k}(\pi_{t-i} - E_{t-j}\pi_{t-i}) + \varepsilon_t$ (Null: $\alpha = 0, \beta_i = 0$)	Adaptive Expectations $\pi_t^e - \pi_{t\|t-j}^e = \mu + \lambda(\pi_t - \pi_{t\|t-j}^e) + \eta_t$ (Null: $\lambda = 0$)
Inflation perceptions	0.00***	0.00***	0.12
3-month ahead inflation expectations	0.00***	0.00***	0.12*
1-year ahead inflation expectations	0.00***	0.00***	0.11**

Level of Significance- *** - 1%, ** - 5%, * - 10%

Source: Authors' Calculations

6.2 Hypothesis 2- Larger Effect of Food Inflation on Expectations:

In the previous sub-section, we found inflation expectations of households to be adaptive. Even though it conveys that realized inflation has a significant effect on inflation expectations, it raises a question regarding which component of inflation affects expectations. Given that the food component of inflation is more volatile and it constitutes a major portion of the consumption basket of the consumers, we hypothesize a larger effect of food inflation on inflation expectations.

To test this hypothesis, we use two kinds of time series models, Structural VAR (SVAR) and ARDL, as mentioned in the previous section. The short run restrictions on SVAR are given in the equation (12). All the variables used in the equations are growth rates in logarithmic form except for the oil prices, repo rate and RBI projections. Since we are considering all the variables to be I(1), the oil prices are taken as log of prices in rupees. Repo rate and RBI projections are already expressed in a percentage form. The ordering of the variables is consistent with the literature (Ueda, 2010; Parmanik and Kamaiah, 2014). Domestic food price inflation is placed before the core inflation due to the existence of unidirectional causality from food inflation to core inflation as seen from Table 7.

Table 7- Granger Causality between Food and Core Inflation

Granger Causality CPI-Food and CPI-Core	
p-value(CPI-Food to CPI-Core)	p-value(CPI-Core to CPI-Food)
0.07*	0.47

Level of Significance- *** - 1%, ** - 5%, * - 10%

Source: Authors' Calculations

The results of Variance Decomposition Analysis of SVAR model are given in Table 8. The effect of shocks in oil prices on inflation expectations is significant over a long run. Food price inflation has a significant effect on impact, but it reduces as the forecast horizon widens. Core inflation has a significant effect on inflation expectations after the second quarter. The effect of repo rate and RBI projections is more or less constant throughout.

Table 8– Variance Decomposition of Household Inflation Expectations One Year Ahead

FORECAST HORIZON	OIL	GDPGR	CPI_FOOD	CPIIW_CORE	REPO	RBI_PROJ	HH_INF_ONEYR
1	3.99	3.73	10.73	0.33	0.07	2.83	78.31
2	30.18	7.38	7.71	5.75	4.83	7.08	37.07
3	37.03	6.63	5.83	11.55	5.70	9.06	24.20
4	38.11	5.80	5.23	16.51	5.32	9.03	20.00
5	37.47	5.22	5.27	20.40	4.83	8.46	18.36
6	36.26	4.90	5.69	23.12	4.53	7.95	17.55
7	34.98	4.83	6.34	24.76	4.44	7.64	17.01
8	33.83	4.97	7.07	25.57	4.48	7.53	16.55
9	32.93	5.27	7.78	25.82	4.55	7.53	16.13
10	32.25	5.64	8.40	25.77	4.60	7.59	15.75

Source: Authors' Calculations

The results of impulse response function are given in the Appendix. This analysis shows that even if food inflation has a higher initial effect on inflation expectations, core inflation tends to have a larger effect in the long run. But a unidirectional causality from food price inflation to core inflation indicates the presence of indirect effects of food inflation on inflation expectations. Low income households plan their expenditure on non-food items after allowing for their expenditure on food. Thus food price inflation plays a significant role in influencing the inflation expectations of such households (Anand et al, 2014; Anand et al, 2016; Bhattacharya, 2017).

We also observe a positive effect of the shocks in repo rate on inflation expectations. The robustness of these results is tested with other short term interest rates. These tests yield similar results.[4] The repo rate may have a positive impact on inflation expectations due to the cost of borrowing channel. Households tend to relate an increase in the repo rate with higher borrowing costs and increase in the cost of loan repayments, leading to an increase in the total household expenditure. It may also be capturing the signaling effect of the accompanying rise in RBI's inflation forecast.

Using Likelihood Ratio (LR) Test, we test for the significance of different dummies. We discover that out of all the dummies incorporated, the dummies for political regime and GFC were significant. The period of NDA government assuming power also coincided with a sudden fall in domestic and international commodity prices (both food and fuel) as well as a proposal for the change in the monetary regime from multiple indicator approach to flexible inflation targeting. Disentanglement of these effects is a question for further research[5]. As a robustness check, we incorporate the same model using rainfall as an exogenous variable. The results do not vary significantly.

6.3 Hypothesis 3- Heterogeneity across Household Groups:

A vast amount of literature is dedicated to the modeling of heterogeneity across different classes of households for US, UK, Sweden, Germany, Italy, etc. (Jonung, 1981; Bryan and Venkatu, 2001; Mankiw et al., 2003; Malgarini, 2009; Menz and Poppitz, 2013; Easaw et al, 2013). All the studies conduct the analysis on household survey data. One common result across all the studies pertaining to heterogeneity suggests that women, younger people, households with low income and low education tend to have higher inflation expectations as compared to their counterparts. We test a similar hypothesis for the Indian households.

To be more specific, hypothesis 3 has the following sub-hypotheses:

(a) Women have higher inflation expectations
(b) Retired people have lower inflation expectations
(c) People belonging to younger age category have highest inflation expectations
(d) Residents of Tier 1 cities have higher inflation expectations

[4] Results available with the authors; can be provided on request.
[5] The results are given in Table A2 in Appendix.

In order to test these hypotheses, we estimate equations (15) and (16). The results are given in Table 9. Females, ages 25 years or less, homemakers and Tier 2 & 3 cities are taken as the base categories for the analysis. A negative (positive) sign of coefficients implies lower (higher) inflation expectations of that cohort in comparison to the base category.

Table 9-Heterogeneity across Households

	INF_PERCEPTIONS		INF_THREE MN		INF_ ONE YR	
	(1)	(2)	(3)	(4)	(5)	(6)
MALE	-0.14***	-0.15***	-0.29***	-0.28***	-0.48***	-0.45***
BASE: FEMALE						
DAILY WORKER	0.29***	0.30***	0.25***	0.25***	0.41***	0.39***
FINANCIAL SECTOR EMPLOYEES	-0.75***	-0.75***	-0.94***	-0.95***	-1.17***	-1.18***
SELF-EMPLOYED	-0.18***	-0.18***	-0.38***	-0.39***	-0.56***	-0.55***
RETIRED PERSONS	0.25***	0.25***	0.18**	0.18**	0.012	0.005
OTHER CATEGORY	-0.95***	-0.95***	-1.08***	-1.07***	-1.22***	-1.20***
OTHER EMPLOYEES	-0.33***	-0.33***	-0.53***	-0.53***	-0.65***	-0.63***
BASE: HOMEMAKER						
LESS THAN 25 YEARS	-0.38***	-0.38***	-0.24***	-0.25***	-0.19***	-0.21**
30-35	0.24***	0.23***	0.28***	0.29***	0.27**	0.29***
35-40	0.41***	0.41***	0.38***	0.39***	0.44***	0.46***
40-45	0.47***	0.47***	0.53***	0.54***	0.67***	0.70***
45-50	0.69***	0.69***	0.59***	0.60***	0.82***	0.84***
50-55	0.82***	0.82***	0.69***	0.70***	0.71***	0.74***
55-60	0.82***	0.82***	0.70***	0.70***	0.75***	0.75***
60 YEARS AND ABOVE	1.01***	1.01***	0.97***	0.97***	1.01***	1.00***
BASE: 25-30 YEARS						
TIER 1 CITIES	-0.40***	-0.41***	-0.62***	-0.63***	-1.03***	-0.99***
BASE: OTHER CITIES						

Level of Significance- *** - 1%, ** - 5%, * - 10%

Source: Authors' Calculations

The results show that females, daily workers, retired persons and older people have higher inflation expectations. In contrast to the findings by Easaw et al (2013) for the Italian households, inflation expectations increase with age for the Indian households. The respondents in the Tier 2 and 3 cities have higher inflation expectations than those in the Tier 1 cities. The results are robust across time as given in columns 2, 4 and 6. The formation of expectations of Indian households is adaptive in nature and hence as the age increases, the households expect a higher inflation due to the past experiences. Retired persons tend to have higher inflation expectations. Due to weak social security net in India, their dependence on

pension, which grows at a lower rate accompanied by burgeoning medical expenses drives up their inflation expectations. Another interesting finding is that the inflation expectations of the households residing in the Tier 1 cities are lower than their counterparts. This can be attributed to the share of food and non-food items in their consumption baskets. Tier 1 city households tend to have more core items in their consumption basket as compared to the Tier 2 and 3 households. Core inflation was declining consistently after 2010. Hence, the expectations of Tier 1 city residents tend to be lower.

6.4 Hypothesis 4- Overreaction of Households:

We test whether the households overreact in the short run using the techniques in line with Easaw et al. (2013). We estimate equations (17) and (18) using ARDL model. This study is conducted using RBI projections and forecasts by professional forecasters interchangeably, to capture the news effect. This overreaction is studied across different cohorts of the households which complements the study of heterogeneity modeling. The results for overreaction are given in Table 10 below:

Table 10- Short Run Reaction of Households

		GENDER		AGE		
	HH_INF_ONEYR	**MALE**	**FEMALE**	**YOUNG**	**MIDDLE AGE**	**OLD**
RBI_PROJECTION	0.35	0.34	0.42	0.41	0.35	0.45
SPF_ONEYEAR	0.47	0.45	0.50	0.53	0.42	0.55
	CATEGORY					
	HOMEMAKER	**DAILY WORKER**	**FINANCIAL SECTOR EMPLOYEE**	**RETIRED PERSON**	**SELF EMPLOYED**	
RBI_PROJECTION	0.48	0.37	0.30	0.41	0.37	
SPF_ONEYEAR	0.49	0.52	0.41	0.57	0.52	

Level of Significance- *** - 1%, ** - 5%, * - 10%, for H_0: $\theta_{2j} = -\theta_{ECM}$ vs H_1: $-\frac{\theta_{2j}}{\theta_{ECM}} > 1$

Source: Authors' Calculations

On the basis of equation (19) we accept the null hypothesis stating that households do not overreact. In fact, they significantly underreact in the short run in the case of India[6]. This can be attributed to high and sticky inflation for most of the time during the period of analysis. Higher inflation expectations coincide with the projections of RBI for a larger span of time due to the prevalence of persistently higher levels of inflation.

[6] The entire table is given in the Appendix.

Even if there is an absence of overreaction, the short run reactions are significantly different across groups, supporting the previous finding of heterogeneity.[7] The short run reaction of females is significantly larger than that of males. Unlike many studies for the developed nations where the overreaction of older generation is lesser, we find a larger short run reaction of retired persons and people aged above 60 years. The financial sector employees have the lowest short run reaction amongst all the cohorts, indicating the significance of financial literacy in the formation of inflationary expectations.

As a robustness check we tested for the rationality of the inflation perceptions and expectations of financial sector employees using equations 8a, 8b and 9. The inflation expectations of financial sector employees fail to satisfy the unbiasedness and efficiency properties of rationality, and are also adaptive. But a larger emphasis is given to the lagged values of realized inflation than their own expectations. This suggests greater economic knowledge of financial sector employees in comparison to their counterparts.[8] There may be a case for decreasing the weight of home-makers (29%) and increasing that of more informed participants in the survey.

7. Summary and Conclusions

Salient findings of the current study are summarized in a tabular format below:

Findings	Conclusion
High value of ρ- speed of adjustment	Possible effectiveness of expectations channel of monetary policy transmission
Adaptive not rational expectations of households	Households are still backward looking
Inflation expectations not efficient	Household inflation forecasts not reliable
Core inflation has a higher long run impact on inflation expectations than food inflation does	Biased sample selection (all respondents belong to the cities); indirect effect of food price inflation via core inflation due to causality from food to core
Repo rate has a positive impact on inflation expectations	Higher household cost of borrowing or signaling impact of higher RBI inflation forecast
Females, homemakers, retired persons and older generations have higher inflation expectations	Sticky and persistent inflation throughout the period of analysis; lack of appropriate social security net, pension schemes for retired people, high medical expenses. Financial sector employees expectations

[7] Results are given in Appendix Table A3
[8] Results are given in Appendix Table A4

	have the lowest over-reaction
Higher inflation expectations in Tier 2 and 3 cities	More expenditure on core components in tier 1 cities, whose inflation declined persistently
Households show high short term reaction but no overreaction with regards to RBI projections	Persistent and sticky inflation throughout the period of analysis, leading to higher expectations by the households; consistent with adaptive nature of expectations; large impact of communication

The properties of the quantitative responses of inflation expectations of Indian households augur well for the anchoring of inflation expectations through inflation targeting and for the effectiveness of monetary policy transmission through the expectations channel. Inflation expectations of Indian households have a higher adjustment speed and a large short-term response to news in RBI projections. This implies the central bank can play a significant role in influencing the expectations of households through its inflation projections. Well anchored long-run inflation expectations do not respond to shocks in commodity prices. Although correlations of one-year household expectations with oil and food shocks are high, and oil accounts for a large part of the FEVD in a SVAR where it is the exogenous variable affecting all other variables, the effect of these variables on expectations is low in an ARDL regression with a simultaneous structure among the variables.

The IT dummy itself was not significant, and inflation expectations rise with the repo rate. This suggests the aggregate demand channel itself is not effective. Household inflation expectations themselves were often over-estimates and are backward looking. Therefore they are not a useful indicator of future inflation and should not affect repo rate setting. In a period of sharp commodity price shocks, moreover, RBI inflation forecasts themselves were often over-estimates (Goyal 2018), thus reducing the effectiveness of the expectation channel.

The monetary policy stance of flexible inflation targeting adopted in 2014 has been remarkably successful in lowering inflation. But it was supported by subdued oil prices and a stable exchange rate along with easing food price inflation. Anchoring inflation expectations during positive commodity shocks will require more careful communication from the RBI.

References

Anand, R., Ding, D., & Tulin, V. (2014). Food Inflation in India: The Role of Monetary Policy. *Working Paper Series, International Monetary Fund*.

Anand, R., Kumar, N., & Tulin, V. (2016). Understanding India's Food Inflation: The Role of Demand and Supply factors. *Working Paper Series, International Monetary Fund*.

Benford, J., & Driver, R. (2008). *Public Attitudes to Inflation and Interest Rates.* Bank of England, Quarterly Bulletin.

Berk, J. M. (1999). Measuring inflation expectations: a survey data approach. *Applied Economics*, 1467-1480.

Bhattacharya, R. (2017). Effectiveness of Monetary Policy in Stabilising Food Inflation: Evidence from Advanced and Emerging Economies. *NIPFP Working Paper Series, No. 209*.

Bryan, M. F., & Venkatu, G. (2001). *The Demographics of Inflation Opinion Surveys.* Cleveland: Federal Reserve Bank.

Campos, M. d., & Teppa, F. (2016). Individual Inflation Expectations in a declining inflation environment: Evidence from survey data . *De Nederlandsche Bank Working Paper, No. 508*.

Carrol, C. D. (2003). Macroeconomic Expectations of Households and Professional Forecasters. *The Quarterly Journal of Economics*, 269-298.

Cerilosa, M., & Gelos, R. G. (2005). *What Drives Inflation Expectations in Brazil? An Empirical Analysis.* International Monetary Fund.

Coibion, O., & Gorodnichenko, Y. (2015). Information Rigidity and the Expectations Formation Process: A Simple Framework and New Facts. *The American Economic Review*, 2644-2678.

Das, A., Lahiri, K., & Zhao, Y. (2018). Inflation Expectations in India: Learning from Household Tendency Surveys. *Working Paper Series, Townson University, Maryland*.

de Bruin, W. B., van der Klaauw, W., & Topa, G. (2012). Expectations of Inflations: The Biasing Effect of Thoughts About Specific Prices. *New York: Federal Reserve Bank* .

Easaw, J., & Golinelli, R. (2010). Households forming Inflation Expectations: Active and Passive Absorption rates. *The B.E. Journal of Macroeconomics, Vol. 10, Iss.1 (Contributions), Article 35.*

Easaw, J., Golinelli, R., & Malgarini, M. (2013). What Determines Households Inflation Expectations? Theory and Evidence from Household surveys. *European Economic Review*, 1-13.

Ehrmann, M., Pfajfar, D., & Santoro, E. (2017). Consumer Attitudes and Their Inflation Expectations. *International Journal of Central Banking, Vol. 13, No. 1,* 225-259.

Figlewski, S., & Wachtel, P. (1981). The Formation of Inflationary Expectations. *The Review of Economics and Statistics, Vol. 63,* 1-10.

Friedman, M. (1968). The Role of Monetary Policy. *The American Economic Review*, 1-17.

Ghosh, T., Sahu, S., & Chattopadhyay, S. (2017). Households' Inflation Expectations in India: Role of Economic Policy Uncertainty and Global Financial Uncertainty Spill-over. *Working Paper IGIDR*.

Goyal, A. (2014). Understanding the High Inflation Trend in India. *ADB South Asia Working Paper Series, No. 24*.

Goyal, A. (2016). Unconventional Monetary Policy in Emerging Markets. *Macroeconomics and Finance in Emerging Market Economies*, 101-108.

Goyal, A. (2017). Monetary Policy Transmission in India. *India Development Report 2017*, S. Mahendra Dev (ed.), chapter 3, 35-48.

Goyal, A. (2018). The Indian Fiscal-Monetary Framework: Dominance or Coordination? *International Journal of Development and Conflict*. 8 (1): 01-13. June.

Gramlich, E. M. (1983). Models of Inflation Expectations Formation: A Comparison of Household and Economist Forecasts. *Journal of Money, Credit and Banking, Vol. 15, No. 2*, 155-173.

Jonung, L. (1981). Perceived and Expected Rates of Inflation in Sweden. *The American Economic Review*, 961-968.

Lanne, M., Luoma, A., & Luoto, J. (2009). A Naïve Sticky Information Model of Households' Inflation Expectations. *Journal of Economic Dynamics and Control*, 1332-1344.

Mankiw, G., & Reis, R. (2002). Sticky Information vs Sticky Price: A Proposal to Replace New Keynesian Phillips Curve. *Quarterly Journal of Economics*, 1296-1328.

Mankiw, G., Reis, R., & Wolfers, J. (2004). Disagreements about Inflation Expectations. *NBER Working Paper, Vol 18*, 209-270.

Paramanik, R. N., & Kamaiah, B. (2014). A Structural Vector Autoregression Model for Monetary Policy Analysis in India. *Margin—The Journal of Applied Economic Research*, 401-429.

Patra, M. D., & Ray, P. (2010). Inflation Expectations and Monetary Policy in India: An Empirical Exploration. *IMF Working Paper Series , No. 84*.

Ramos-Herrera, M. d., & Sosvilla-Rivero, S. (2013). Inflation Expectations in Spain: The Spanish PwC Survey. *Cuadernos de economía*, 109-115.

RBI. (2014). *Report on Expert Committee to Revise and Strengthen Monetary Policy Framewok in India.* (Chairman: Urjit Patel).

RBI. (2010). Inflation Expectations Survey of Households. *RBI Monthly Bulletin*, May.

RBI. (2018). *Monetary Policy Report, April.* Mumbai: RBI.

Sharma, N. K., & Bicchal, M. (2018). The Properties of Inflation Expectations: An Evidence from India. *Economia*, 74-89.

Sims, C. A. (2003). Implications of rational inattention. *Journal of Monetary Economics*, 665-690.

Teixeira, F. O., de Oliveira, I. C., & Ferreira, P. C. (2017). Consumer's Inflation Expectations in Brazil. *Economia*, 509-529.

Tversky, A., & Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases. *Science, New Series, Vol. 185, No. 4157 (Sep. 27, 1974)*, pp. 1124-1131

Ueda, K. (2010). Determinants of Households' Inflation Expectations in Japan and United States. *Journal of The Japanese and International Economies*, 503-518.

Xu, Y., Liu, Z.-X., Chang, H.-L., Peculea, A. D., & Su, C.-W. (2016). Does self-fulfillment of the inflation expectation exist?, *Applied Economics, 49:11*, 1098-1113.

Appendix:

Table A 11- Augmented Dickey Fuller Tests

Null Hypothesis: Series contains Unit Root		
Variables	Level	First Difference
HH_INF_THREEM	0.41	0.00***
HH_INF_ONEYR	0.40	0.00***
HH_INF_PER	0.49	0.00***
CPI-IW	0.35	0.00***
CPIIW-FOOD	0.26	0.00***
CPIIW-CORE	0.55	0.00***
GDPGR	0.26	0.00***
REPO	0.47	0.00***
THREEM-SPF	0.25	0.00***
ONEYR-SPF	0.52	0.00***
OIL	0.58	0.00***

Level of Significance- *** - 1%, ** - 5%, * - 10%

Source: Authors' Calculations

Table A 12- Likelihood Ratio Test

LR Test using Time Dummies	**1-Year ahead Inflation Expectations**
Crisis	27.68***
Adoption of IT	7.02
Change in Political Regime	34.05***

Level of Significance- *** - 1%, ** - 5%, * - 10%

Source: Authors' Calculations

Table A 3- ARDL model of Determinants of Households' Expectations (One Year Ahead)

		GENDER		CATEGORY					AGE		
	HH_ONEYEAR	**MALE**	**FEMALE**	**HOMEMAKER**	**DAILY WORKER**	**FINANCIAL SECTOR EMPLOYEE**	**RETIRED PERSON**	**SELF EMPLOYED**	**YOUNG**	**MIDDLE AGE**	**OLD**
ECM (t-1)	-1.26*	-1.18*	-1.40*	-1.37*	-1.17*	-1.18*	-1.08*	-1.28*	-1.31*	-1.53*	-1.37*
LONG RUN											
RBI PROJECTIONS	0.42**	0.35**	0.47*	0.47*	0.35**	0.36**	0.32	0.43*	0.47*	0.43*	0.39*
CPIIW_FOOD	0.09**	0.12*	0.08*	0.08**	0.10**	0.12*	0.12**	0.12*	0.12*	0.11*	0.10**
CPIIW_CORE	0.14**	0.13***	0.11***	0.14**	0.15***	0.06	0.04	0.09	0.25*	0.02	0.03
OIL	0.02**	0.03**	0.02**	0.02**	0.02**	0.01***	0.02***	0.02**	0.02**	0.01	0.02***
GDPGR	-0.2**	-0.18***	-0.17***	-0.17***	-0.16	-0.16	-0.12	-0.16	-0.25*	-0.09	-0.12
REPO	0.63*	0.70*	0.62*	0.65*	0.78*	0.81*	0.85*	0.68*	0.41**	0.78*	0.82*
SHORT RUN											
RBI PROJECTIONS	0.35**	0.34**	0.42**	0.48***	0.37**	0.30	0.41***	0.37**	0.41**	0.35**	0.45**
CPIIW_FOOD	0.12**	0.14*	0.13*	0.11**	0.12**	0.14*	0.13**	0.15*	0.15*	0.16*	0.13**
CPIIW_CORE	-0.37*	-0.33**	-0.45*	-0.38*	-0.31**	-0.32**	-0.37**	-0.44**	-0.26**	-0.41**	-0.39**
OIL	0.001	0.002	-0.001	-0.002	0.001	-0.006	-0.001	0.003	-0.0003	-0.007	0.003
GDPGR	-0.27***	-0.29***	-0.25	-0.28***	-0.28	-0.20	-0.29	-0.24	-0.37**	-0.23	-0.32***
REPO	0.79**	0.82**	0.87*	0.9*	0.92*	0.96*	0.92*	0.88**	0.53***	1.20*	1.04*
CONST	3.8***	3.10	4.27***	3.74***	2.71	1.90	1.79	2.83	5.19***	3.11	2.76
Adj R-squared	0.79	0.78	0.80	0.81	0.74	0.78	0.72	0.79	0.81	0.79	0.75
OVERREACTION(RBI)	0.35	0.34	0.42	0.48	0.37	0.30	0.41	0.37	0.41	0.35	0.45
OVERREACTION(SPF)	0.47	0.45	0.50	0.49	0.52	0.41	0.57	0.52	0.53	0.42	0.55

Level of Significance- * - 1%, ** - 5%, *** - 10% , Overreaction hypothesis is tested using

H_0: $\theta_{2j} = -\theta_{ECM}$ H_1: $-\frac{\theta_{2j}}{\theta_{ECM}} > 1$

Source: Author's Calculations

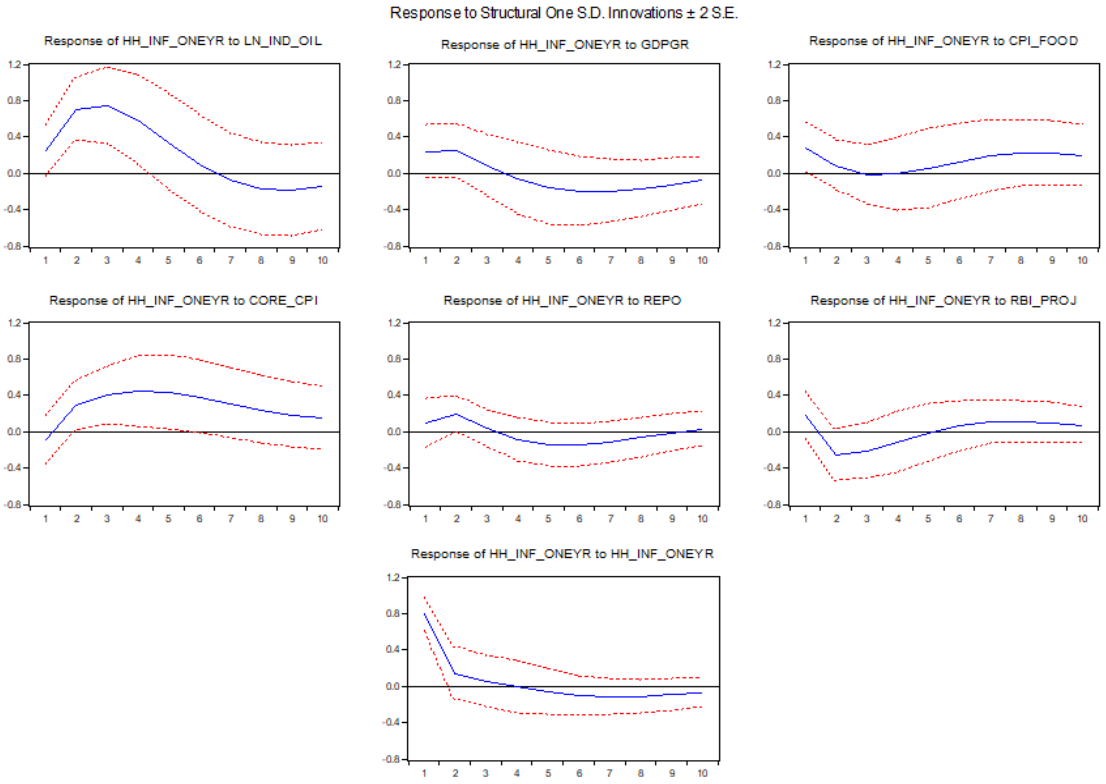
Table A4- Test for Rational and Adaptive expectations of Financial Sector Employees

Variables	Rational Expectations- Unbiased property $\pi_t = \alpha + \beta E_{t-j}\pi_t + \varepsilon_t$ (Null: $\alpha = 0, \beta = 1$)	Rational Expectations- Efficiency property $\pi_t - E_{t-j}\pi_t = \alpha + \beta_i \sum_{i=1}^{k}(\pi_{t-i} - E_{t-j}\pi_{t-i}) + \varepsilon_t$ (Null: $\alpha = 0, \beta_i = 0$)	Adaptive Expectations $\pi_t^e - \pi_{t\|t-j}^e = \mu + \lambda(\pi_t - \pi_{t\|t-j}^e) + \eta_t$ (Null: $\lambda = 0$)
Inflation perceptions	0.00***	0.00***	0.91***
3-month ahead inflation expectations	0.00***	0.00***	0.81***
1-year ahead inflation expectations	0.00***	0.00***	0.78***

Level of Significance- *** - 1%, ** - 5%, * - 10%

Source: Authors' Calculations

Figure A 1- Impulse Response Function for Determinants of Inflation Expectations



Source: Authors' Calculations