Asymmetries in Indian Inflation Expectations

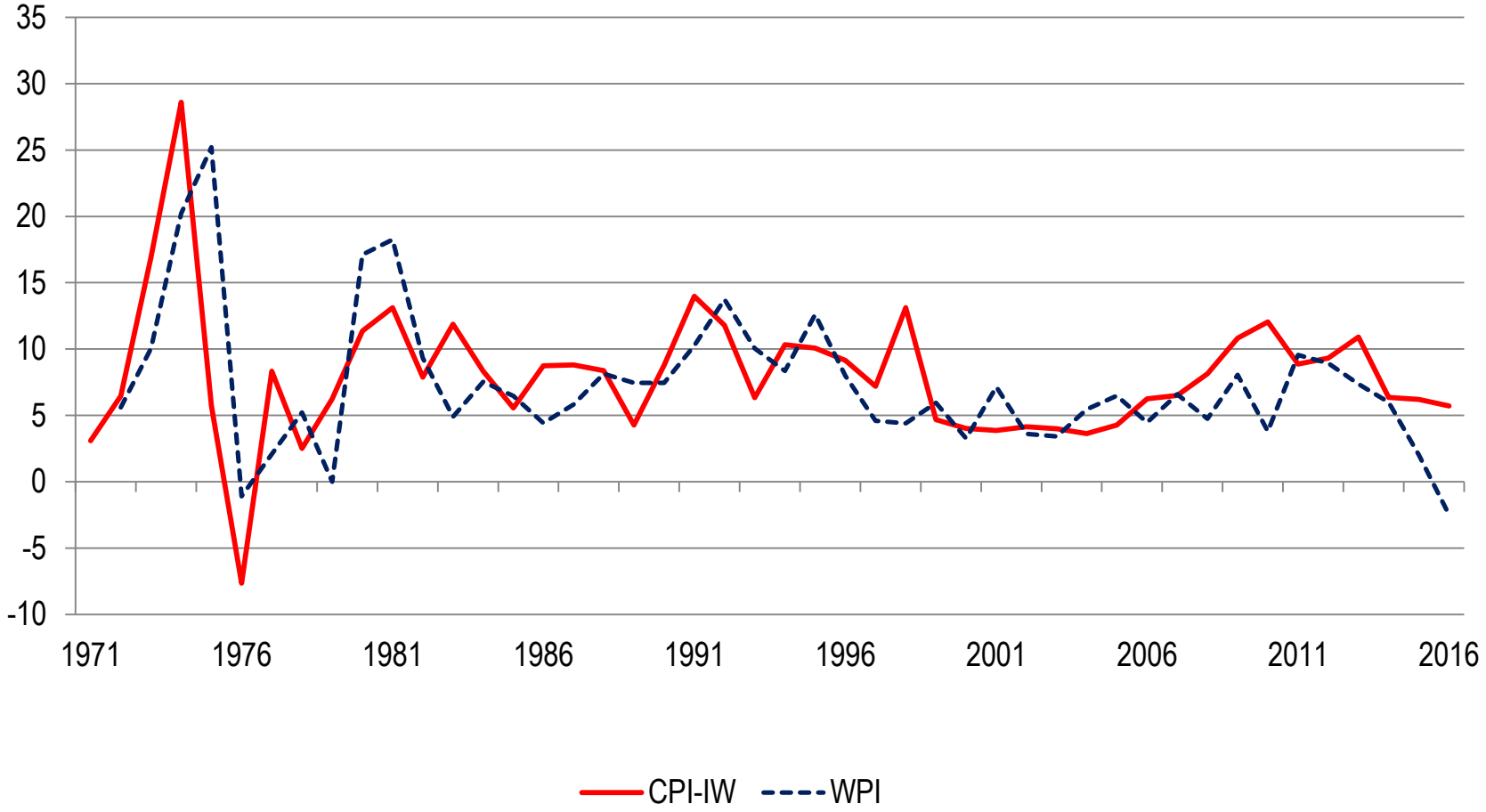
Abhiman Das[1] Kajal Lahiri[2] Yongchen Zhao[3]

[1]Indian Institute of Management Ahmedabad, India
[2] University at Albany, SUNY
[3] Towson University

Workshop on “Forecasting Issues in Developing Economies”
April 26-27, 2017
IMF, Washington, D.C.

CPI and WPI Inflation: 1971 to 2016

Inflation rate – a historical perspective



IESH Survey

Inflation Expectations Survey of Households

- IESH is a quarterly survey started in 2005Q3, covering 4000 households from 12 cities.
  - 500 households each from Chennai, Kolkata, Delhi and Mumbai.
  - 250 households each from Ahmedabad, Bangalore, Bhopal, Jaipur, Guwahati, Hyderabad, Lucknow, and Patna
- Starting from 2012Q4, four new cities are added with 250 households each, bringing the total sample size up to 5000.
  - Bhubaneswar, Kolhapur, Nagpur, and Thiruvananthapuram
- Since 2005, the survey went through several significant changes before it was stabilized in 2008Q3. So the data used here contains 117,418 individual responses from 2008Q3 to 2015Q1.

IESH Survey

Inflation Expectations Survey of Households

- Block 1: For each respondent, we have information on gender, age group, employment category, and city of residence.

- Block 2: Expectations of respondent on prices in next 3 months
  Block 3: Expectations of respondents on prices in next one year
  - Possible responses: “i. Price increase more than current rate”, “ii. Price increase similar to current rate”, “iii. Price increase less than current rate”, “iv. No change in prices”, and “v. Decline in prices”

- Block 4: Perception, 3-month-ahead expectation, 1-year-ahead expectation
  - Quantitative responses: 1% to 16%.

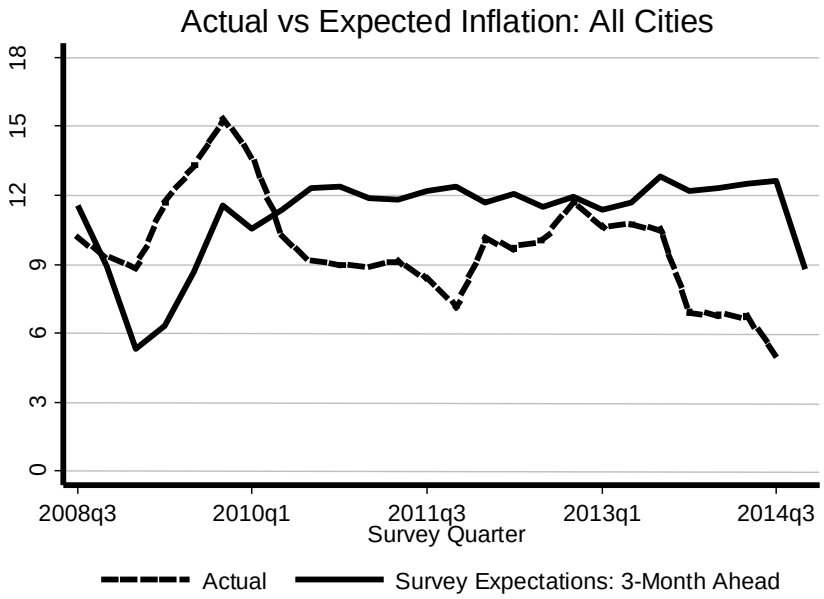
IESH Survey

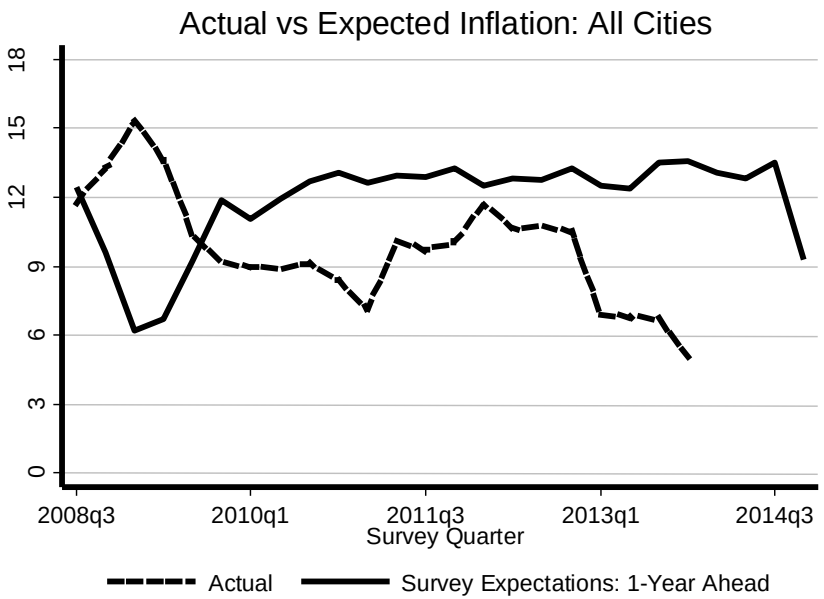
Inflation Expectations Survey of Households

- From each household, we also have quantitative expectations on current (perceptions), 3-month-ahead, and 1-year-ahead overall inflation rate.
- These quantitative responses are recorded in 18 categories: <1%, 1-2%, 2-3%,…,15-16%, >16%, or no idea.
- Note that quantitative responses are only available for overall inflation, unlike qualitative responses.

Quantitative Inflation Expectations

3-month and 1- year-ahead expectations: all cities

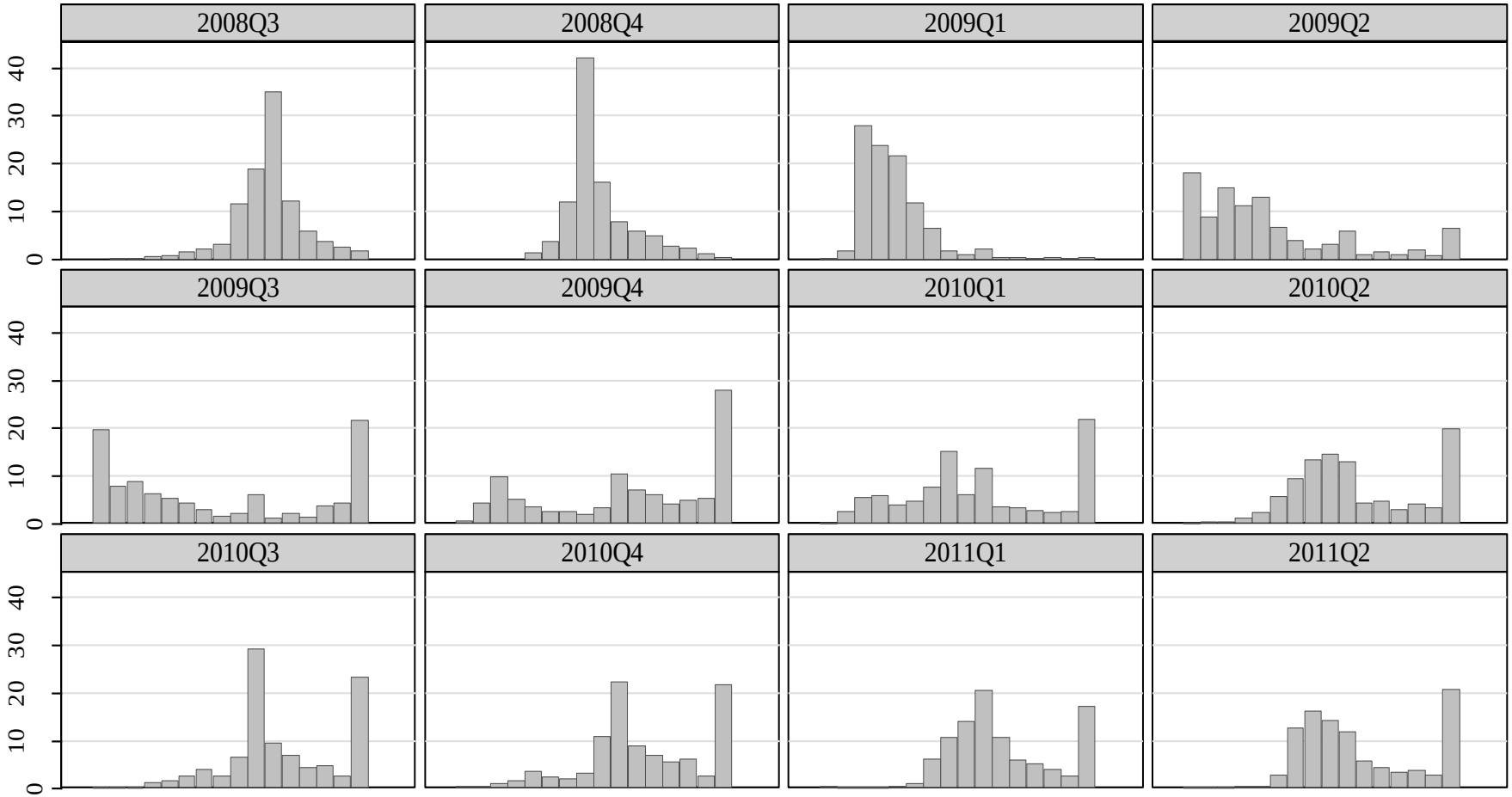




Distribution of Quantitative Expectations

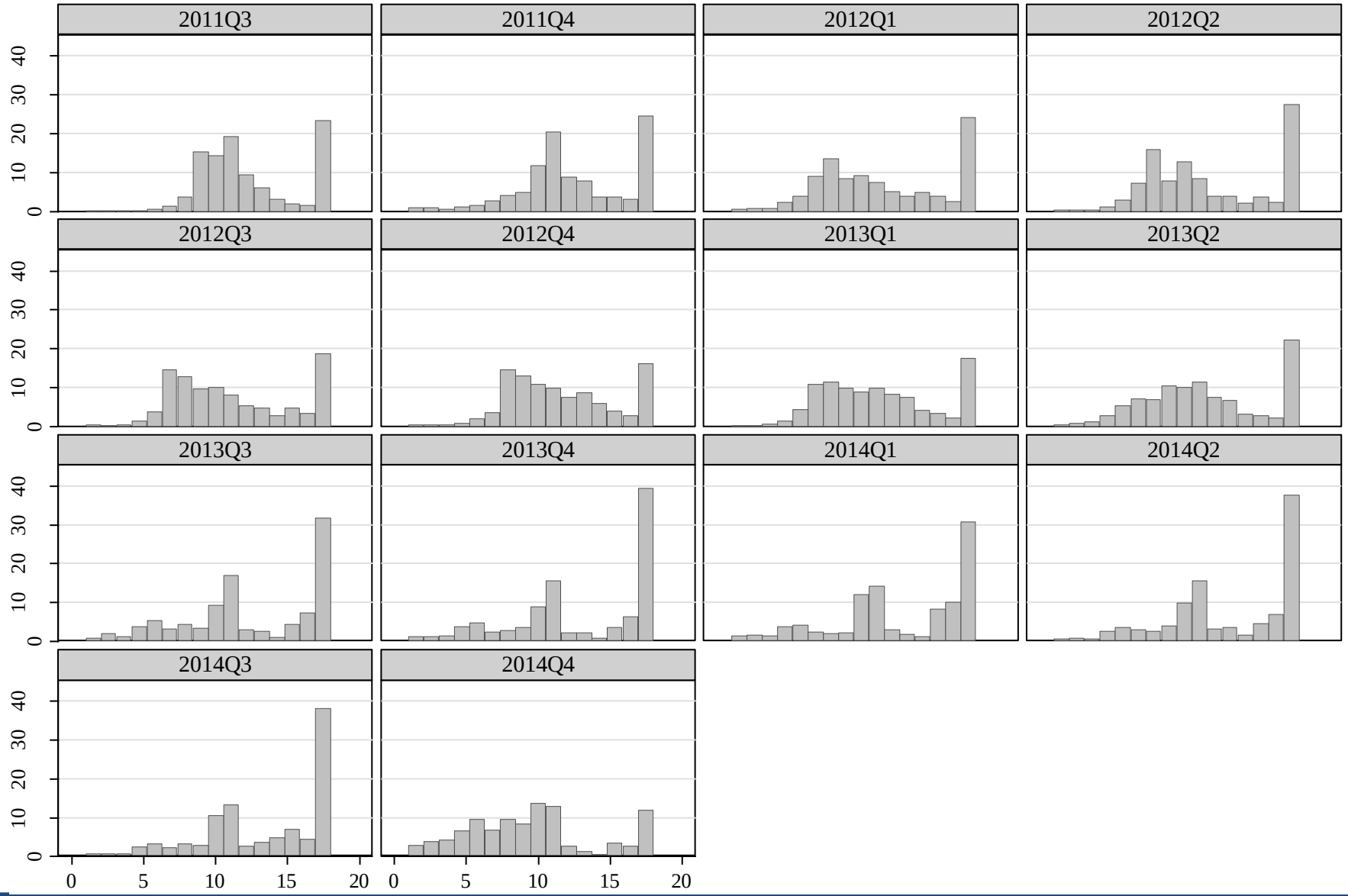
3-month-ahead inflation expectations: all cities

- Vertical axis shows percentage of responses. Horizontal axis goes from 1% to 16%.



Distribution of Quantitative Expectations

3-month-ahead inflation expectations: all cities (cont.)



Differences across Cities

Where are the high responses coming from?

City	Perception		3-Month Expectations		1-Year Expectations		Average Actual Inflation
	15% or Below	16% or Above	15% or Below	16% or Above	15% or Below	16% or Above	
	Percentages						
Ahmedabad	6.4%	3.5%	6.3%	3.9%	6.0%	5.3%	8.74
Bangalore	3.7%	13.4%	3.6%	12.8%	3.5%	11.0%	8.85
Bhopal	6.8%	1.9%	6.9%	2.1%	7.0%	2.8%	8.97
Bhubaneswar	2.3%	1.1%	2.3%	0.7%	2.4%	0.9%	9.18
Chennai	13.5%	4.4%	13.7%	4.7%	14.6%	4.7%	8.14
Delhi	12.4%	8.2%	11.9%	9.9%	11.8%	9.9%	7.59
Guwahati	6.2%	3.8%	6.4%	3.8%	6.7%	3.5%	7.61
Hyderabad	6.2%	4.2%	6.1%	5.2%	6.3%	4.7%	7.75
Jaipur	4.0%	12.1%	4.2%	10.9%	3.5%	11.0%	8.34
Kolhapur	1.0%	5.6%	0.9%	5.8%	0.9%	4.7%	9.21
Kolkata	13.2%	5.5%	13.2%	4.8%	14.0%	4.8%	8.54
Lucknow	5.6%	6.2%	5.7%	6.6%	5.8%	6.1%	9.15
Mumbai	8.9%	20.6%	9.1%	19.7%	8.2%	19.8%	9.04
Nagpur	1.4%	4.1%	1.4%	4.3%	1.2%	4.2%	9.99
Patna	6.4%	3.5%	6.4%	3.9%	6.5%	4.3%	8.79
Thiruvananthapuram	1.9%	2.0%	2.0%	1.1%	1.6%	2.3%	9.04
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	

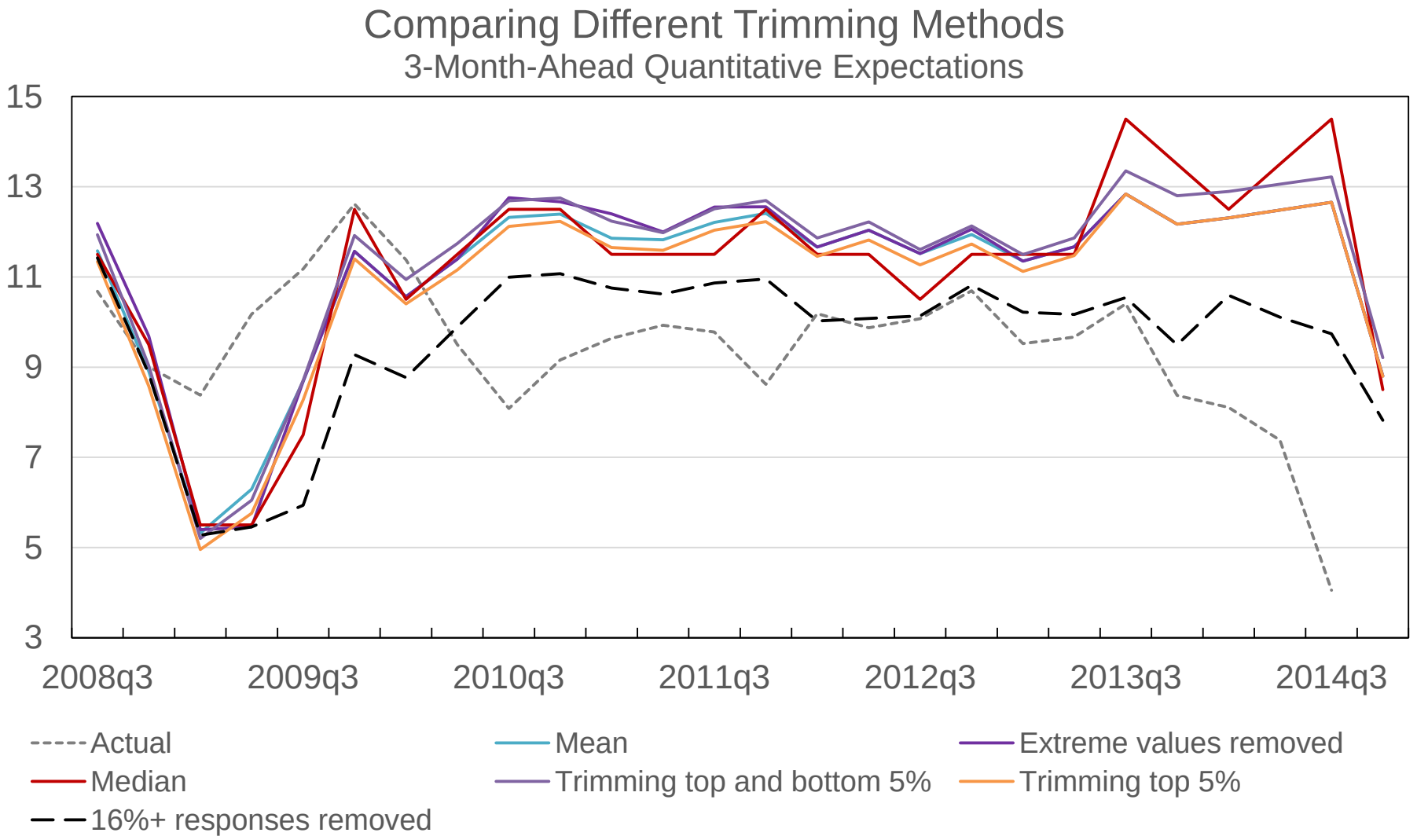
Quantitative Inflation Expectations: Trimming

Could we eliminate the bias simply by trimming?

- Quantitative responses are often trimmed before averaged.
- Several measures considered:
  - Trim 5% of the responses from both the higher end and the lower end.
  - Trim 5% of the responses from the higher end only.
  - Trim all the responses outside lower and higher bounds:
    - Lower bond = 1st Quartile – 1.5 x Interquartile Range
    - Higher bond = 3rd Quartile + 1.5 x Interquartile Range
  - Median
  - Remove all the “16%+” responses

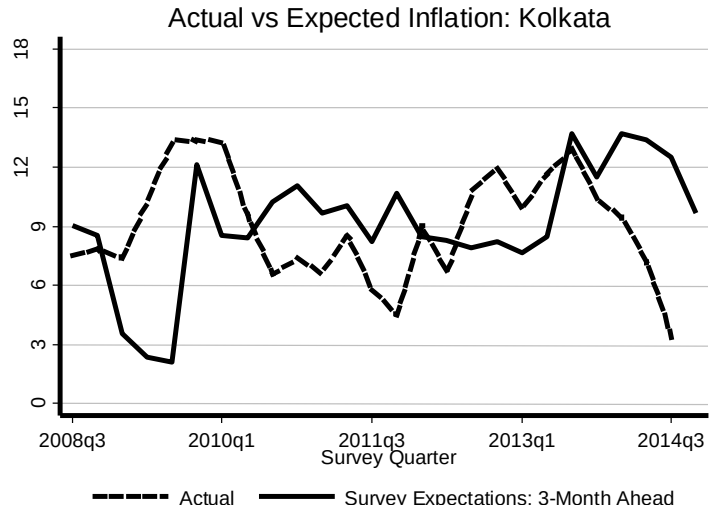
Effect of Trimming on Quantitative Inflation Expectations

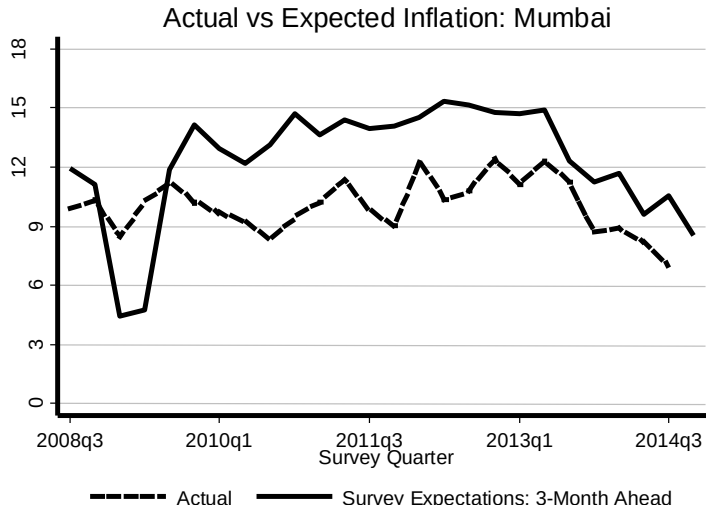
Simple trimming methods insufficient for bias correction

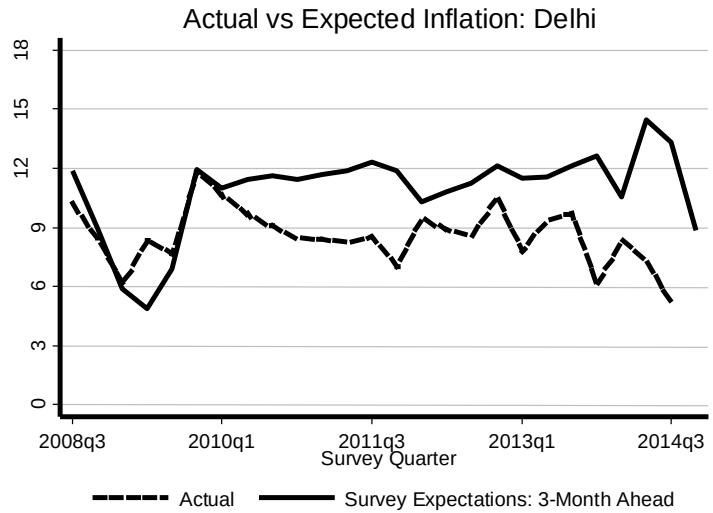


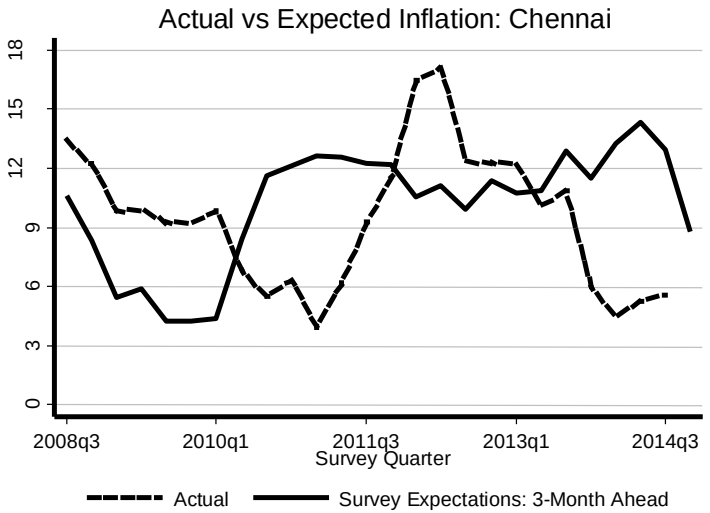
Differences across Cities

3-month-ahead expectations compared with city-level actual inflation



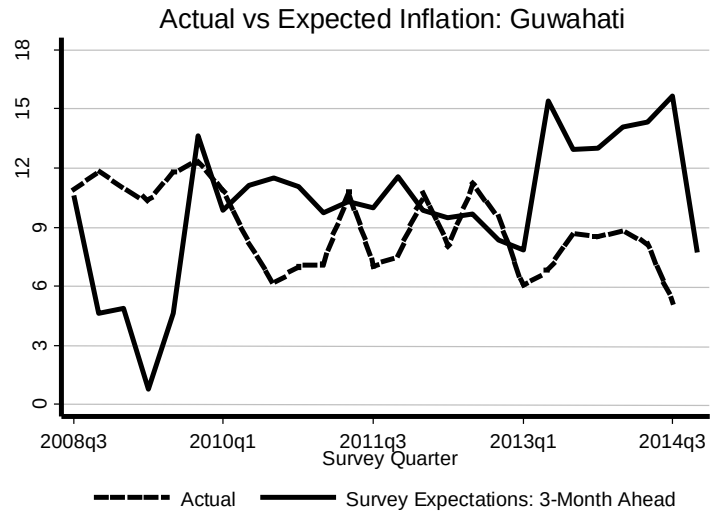


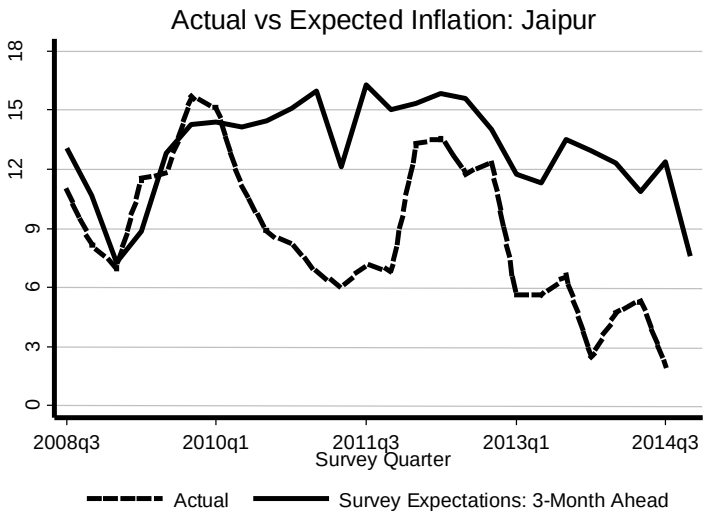


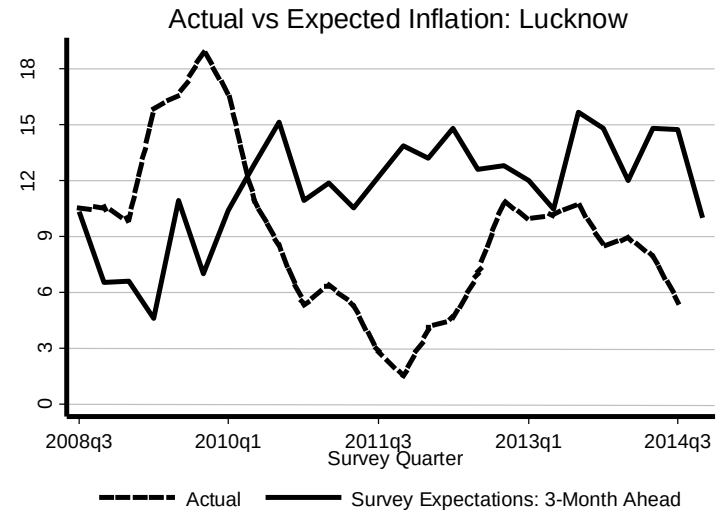


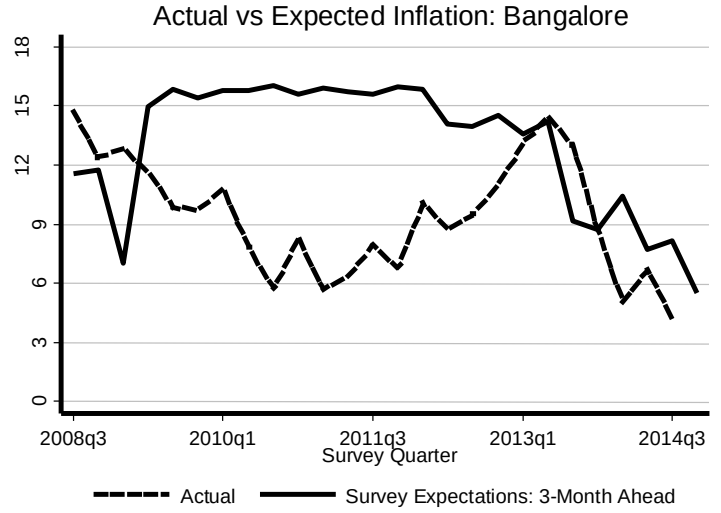
Differences across Cities

3-month-ahead expectations compared with city-level actual inflation (cont.)









Aggregation of Inflation Expectations

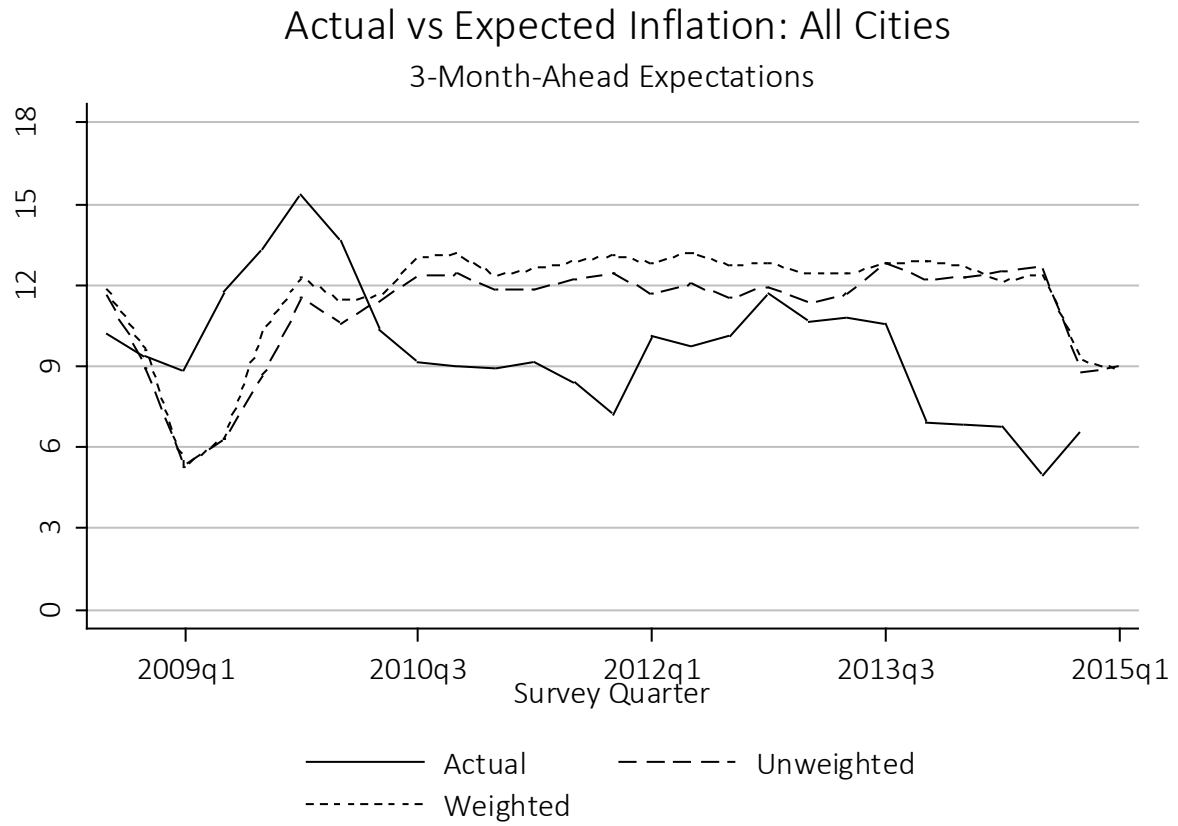
Could consumption-based weighting be the answer?

- Souleles (2004) provides the motivation: weights should reflect the scale of spending, or the sensitivity of spending to sentiment.
- We attempt to construct an aggregate expectations measure by weighting individual expectations according to the consumption profile of a typical individual with the same characteristics.
- Consumption data are from the Employment and Unemployment Situations in India (2011-12) survey of the National Sample Survey Office (NSSO). We tried total, durable, and non-durable consumption.
- Within a city, we match individuals by employment category and age group. City-level expectations are then weighted according to a city's weight in the official inflation statistics. This gives the overall aggregates.

Aggregation of Inflation Expectations

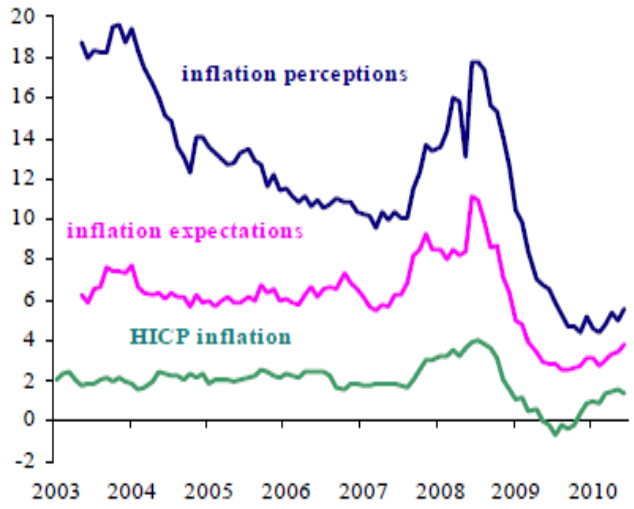
Could consumption-based weighting be the answer?

- Weighted expectations show slightly smaller bias than unweighted expectations, but the difference is rather small.



Inflation Expectations Do Diverge

Chart 4 – Euro area consumers' quantitative estimates of inflation perceptions and expectations *(annual percentage changes)*

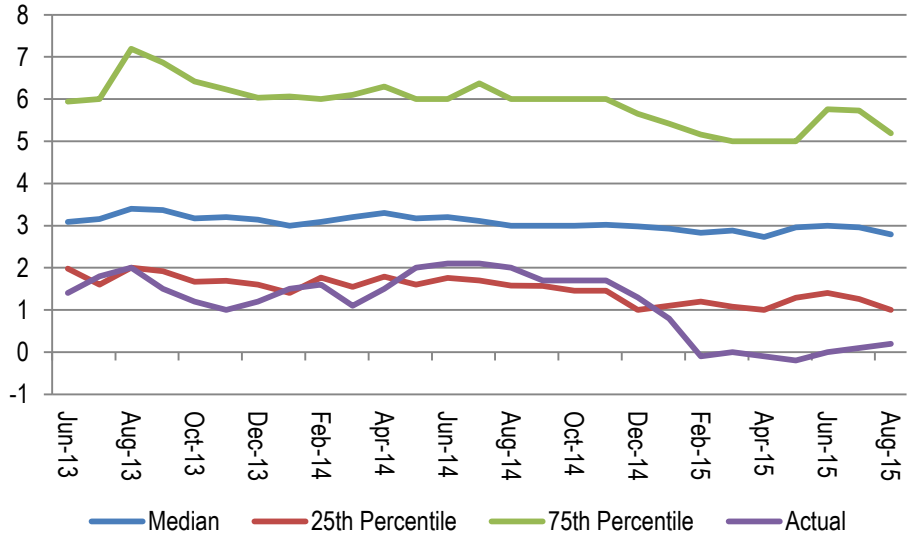


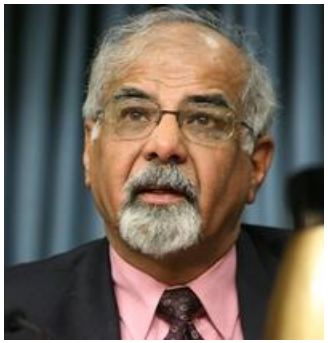
Note: last observation June 2010.

Sources: European Commission and Eurostat.

Source: Biau, et al., 2010

US Consumer Inflation expectations





- "And yes, …… please junk inflation expectations survey before it causes more damage.
- Making repo policy on the basis of the inflationary expectations survey is exactly the same as making policy according to a random noise generator.
- Pure junk was never defined better than the results of the RBI expectations survey, the very same that the RBI uses for information on anchoring inflationary expectations.
- …….the junk RBI expectations survey (when will they stop?)"

- Surjit Bhalla (2014)

“I think people thrash inflation expectations survey too easily. These are real people who have expectations about inflation. They may not be reading the financial newspapers or have sophisticated sort of model in mind, but they are the people whose inflation expectations matter. So while we are not necessarily focused on the level, the changes do tell us that expectations are changing.”

Raghuram Rajan, December 2, 2014

Explaining Errors in Perception

Who are giving the highest responses?

- As an attempt to explain errors in perception, we regress the difference between actual inflation rate and perceived inflation rate (error in perception) on:
  - City dummies
  - Quarter dummies
  - Age group dummies
  - Gender dummy
  - Employment category dummies

Explaining Errors in Perception

Regressing error in perception on individual characteristics

Variable Group	Variable	Model 3	Model 4	Model 5	Model 6
Age Group (Baseline: < 25)	25 to 30 years	0.048			0.082*
	30 to 35 years	-0.062			-0.052
	35 to 40 years	-0.114*			-0.118**
	40 to 45 years	-0.125*			-0.171***
	45 to 50 years	-0.266***			-0.274***
	50 to 55 years	-0.239***			-0.366***
	55 to 60 years	-0.340***			-0.336***
	60 years and above	-0.546***			-0.474***
Gender	Female		-0.287***		0.029
Employment Category (Baseline: financial sector workers)	Other Employees			-0.047	-0.176***
	Self-Employed			-0.235***	-0.260***
	Housewife			-0.523***	-0.527***
	Retired Persons			-0.537***	-0.197**
	Daily Workers			-0.721***	-0.647***
	Other Category			0.316***	-0.092
Constant		-1.528***	-1.552***	-1.362***	-1.564***
Observations		117308	117310	117308	117308
Adjusted R Square		0.001	0.001	0.003	0.452

Model 6 also include quarter and city dummies, which are omitted from this table.

Effect of Energy and Food Price Inflation

Could certain prices have disproportionally large effect on IE?

- We first estimate a set of baseline regressions:
  - LHS: household inflation perceptions/expectations,
  - RHS: four lags of actual inflation rate, dummy variables for city, age group, gender, and employment category.
- Then, we add food and/or energy inflation variable to the RHS, and examine the coefficient, significance, and the change in the model's adjusted R square.
- We conduct this exercise by pooling observations from all cities, as well as city-by-city (where the baseline regression obviously does not have city dummies).

Effect of Energy and Food Price Inflation

Could certain prices have disproportionally large effect on IE?

City	Perceptions				3-Month-Ahead Expectations				1-Year-Ahead Expectations			
	Baseline Adj. R Sq.	Inc. Adj. R Sq.	Coefficient Energy	Coefficient Food	Baseline Adj. R Sq.	Inc. Adj. R Sq.	Coefficient Energy	Coefficient Food	Baseline Adj. R Sq.	Inc. Adj. R Sq.	Coefficient Energy	Coefficient Food
All Cities	0.168	0.020	0.000	**-0.226**	0.134	0.018	**0.020**	**-0.257**	0.146	0.021	**0.064**	**-0.261**
		0.016	**0.038**			0.013	**0.064**			0.016	**0.108**	
		0.020		**-0.226**		0.018		**-0.274**		0.020		**-0.315**
Ahmedabad	0.116	0.018	**-0.041**	0.025	0.123	0.035	**-0.170**	**-0.130**	0.101	0.030	**-0.081**	**-0.147**
		0.018	**-0.053**			0.032	**-0.111**			0.025	-0.015	
		0.017		**0.059**		0.025		0.006		0.028		**-0.082**
Bangalore	0.039	0.169	**0.651**	**0.741**	0.041	0.108	**0.488**	**0.601**	0.059	0.130	**0.529**	**0.565**
		0.064	**0.533**			0.035	**0.392**			0.053	**0.439**	
		0.071		**0.616**		0.050		**0.508**		0.049		**0.463**
Bhopal	0.020	0.029	**-0.132**	**-0.263**	0.024	0.024	**-0.144**	**-0.333**	0.020	0.010	**-0.090**	**-0.295**
		0.014	**-0.106**			0.004	**-0.111**			-0.005	**-0.061**	
		0.018		**-0.226**		0.014		**-0.293**		0.006		**-0.270**
Bhubaneswar	0.071	0.106	**-2.347**	**0.730**	0.067	0.005	0.040	**0.608**	0.024	0.023	**-0.815**	**0.692**
		0.100	**-2.976**			0.002	**-0.485**			0.019	**-1.411**	
		0.070		**1.857**		0.005		**0.589**		0.020		**1.083**
Chennai	0.062	0.154	**0.396**	**-0.292**	0.055	0.194	**0.479**	**-0.345**	0.049	0.165	**0.439**	**-0.460**
		0.124	**0.479**			0.158	**0.577**			0.116	**0.570**	
		0.078		**-0.447**		0.098		**-0.533**		0.103		**-0.632**

Effect of Energy and Food Price Inflation

Could certain prices have disproportionally large effect on IE?

City	Perceptions				3-Month-Ahead Expectations				1-Year-Ahead Expectations			
	Baseline Adj. R Sq.	Inc. Adj. R Sq.	Coefficient Energy	Food	Baseline Adj. R Sq.	Inc. Adj. R Sq.	Coefficient Energy	Food	Baseline Adj. R Sq.	Inc. Adj. R Sq.	Coefficient Energy	Food
Delhi	0.129	0.037	**0.135**	**0.336**	0.115	0.036	**0.124**	**0.352**	0.132	0.060	**0.252**	**0.452**
		0.019	0.002			0.019	-0.014			0.031	**0.074**	
		0.031		**0.223**		0.031		**0.247**		0.040		**0.240**
Guwahati	0.157	0.074	**-0.330**	**0.242**	0.182	0.031	**-0.164**	**0.239**	0.159	0.031	**-0.094**	**0.342**
		0.062	**-0.367**			0.021	**-0.200**			0.010	**-0.146**	
		0.024		**0.350**		0.021		**0.293**		0.027		**0.373**
Hyderabad	0.088	0.057	**0.106**	**-0.330**	0.076	0.040	**0.109**	**-0.201**	0.058	0.031	**0.108**	**-0.141**
		0.037	**0.130**			0.033	**0.124**			0.028	**0.118**	
		0.052		**-0.348**		0.035		**-0.219**		0.027		**-0.158**
Jaipur	0.104	0.054	**0.174**	**-0.287**	0.063	0.032	**0.123**	**-0.233**	0.075	0.022	**0.108**	**-0.152**
		0.038	**0.278**			0.023	**0.207**			0.017	**0.163**	
		0.043		**-0.408**		0.027		**-0.319**		0.017		**-0.227**
Kolhapur	0.097	0.105	**1.835**	**-0.314**	0.177	0.080	**1.701**	**-0.280**	0.152	0.073	**1.427**	-0.014
		0.097	**1.416**			0.075	**1.327**			0.073	**1.407**	
		0.026		**0.395**		0.021		**0.377**		0.037		**0.537**
Kolkata	0.215	0.129	**-0.126**	**-0.961**	0.145	0.110	**-0.057**	**-1.012**	0.149	0.100	**-0.125**	**-0.981**
		0.010	-0.019			0.009	**0.056**			0.008	-0.015	
		0.121		**-0.906**		0.108		**-0.987**		0.094		**-0.926**

Effect of Energy and Food Price Inflation

Could certain prices have disproportionally large effect on IE?

City	Perceptions				3-Month-Ahead Expectations				1-Year-Ahead Expectations			
	Baseline	Inc. Adj.	Coefficient		Baseline	Inc. Adj.	Coefficient		Baseline	Inc. Adj.	Coefficient	
	Adj. R Sq.	R Sq.	Energy	Food	Adj. R Sq.	R Sq.	Energy	Food	Adj. R Sq.	R Sq.	Energy	Food
Lucknow	0.073	0.008	**0.094**	**-0.261**	0.077	0.004	0.008	**-0.174**	0.095	-0.001	0.015	0.014
		0.001	0.026			0.001	-0.037			-0.001	0.018	
		0.006		**-0.198**		0.004		**-0.169**		-0.001		0.023
Mumbai	0.101	0.061	**0.408**	**0.382**	0.093	0.070	**0.445**	**0.236**	0.085	0.119	**0.542**	**0.287**
		0.032	**0.211**			0.062	**0.324**			0.106	**0.394**	
		0.009		**0.057**		0.025		**-0.119**		0.045		**-0.145**
Nagpur	0.237	0.162	**-1.218**	**-1.340**	0.263	0.057	0.185	**-0.864**	0.352	0.033	**0.325**	**-0.656**
		0.032	**-1.662**			0.000	-0.101			0.000	0.108	
		0.145		**-1.404**		0.057		**-0.854**		0.032		**-0.639**
Patna	0.087	0.029	**-0.109**	**-0.267**	0.073	0.028	**-0.093**	**-0.266**	0.041	0.042	**0.044**	**-0.285**
		0.002	**-0.038**			0.000	-0.022			0.009	**0.120**	
		0.021		**-0.217**		0.022		**-0.224**		0.041		**-0.305**
Thiruvananthapuram	0.211	0.120	**2.081**	**-0.523**	0.069	0.066	**1.299**	-0.067	0.057	0.161	**1.870**	**-0.191**
		0.100	**1.226**			0.066	**1.189**			0.159	**1.557**	
		0.036		**0.380**		0.043		**0.496**		0.095		**0.620**

Expectation Formation

How quickly do expectations respond to changes in actual inflation?

- We are interested in if aggregate IE is consistent with Frankel (1975) hypothesis:
- Short run IE affected by two factors: (1) difference between actual and expectation; (2) difference between actual and its long-run expectation.
- Long-run expectation is measure using 5-year-ahead forecasts from Indian SPF (also conducted by the RBI).

Expectation Formation

How quickly do expectations respond to changes in actual inflation?

- The model is $y^*_{i,t+1} - y^*_{i,t} = \alpha + \beta\left(y_{i,t} - y^*_{i,t}\right) + \gamma\left(\bar{y}_t - y_{i,t}\right) + u_{i,t}$
- When $\gamma = 0$, it becomes the simple adaptive expectations model.

- We start with city-level actual inflation rate and expectations to set up an seemingly unrelated regression (SUR) model.
- Long-run expectations from the SPF not available at city level, so we pool city level data and estimate the model as a panel.

Expectation Formation

How quickly do expectations respond to changes in actual inflation?

- When γ is constrained to be 0, the rate of adaptation β is estimated to be 0.18
- This means that around 18% of households adapt their expectations to the latest actual rate each quarter.

- When γ is allowed to be non-zero, estimated β is around 0.4, and γ is around 0.37.
- This is arguably more realistic description of the expectation formation process – a mixture of adaptive and regressive elements.
- It means that people not only adapt to latest actual rate, they also expect inflation to return to its expected level in the long-run.

Quantification

Can we obtain better IE estimates using qualitative data?

- Using the framework in Lahiri and Zhao (2015), we quantify the qualitative responses from the IESH survey.
- Individual responses are modeled using a hierarchical ordered probit model.

$$y_{it} = \sum_{j=1}^{J} \left[j \times \mathbf{I}\left\{ \delta_{it,j-1} < y_{it}^{*} \leq \delta_{it,j} \right\} \right]$$

$$\delta_{it,1} = \gamma_0 + \exp\left(\mathbf{W}_{it-h}\beta_{1w}\right) \qquad \delta_{it,2} = \delta_{it1} + \exp\left(\mathbf{W}_{it-h}\beta_{2w}\right)$$

$$\sigma_{it} = \exp\left(\mathbf{Z}_{it-h}\beta_z\right);$$

$\mathbf{W}_{it-h} \in \mathbf{X}_{it-h}$ and $\mathbf{Z}_{it-h} \in \mathbf{X}_{it-h}$ are independent variables

and $\{\gamma_0, \beta_{1w}, \beta_{2w}, \beta_z, y_t^{*}\}$ are to be estimated.

Quantification

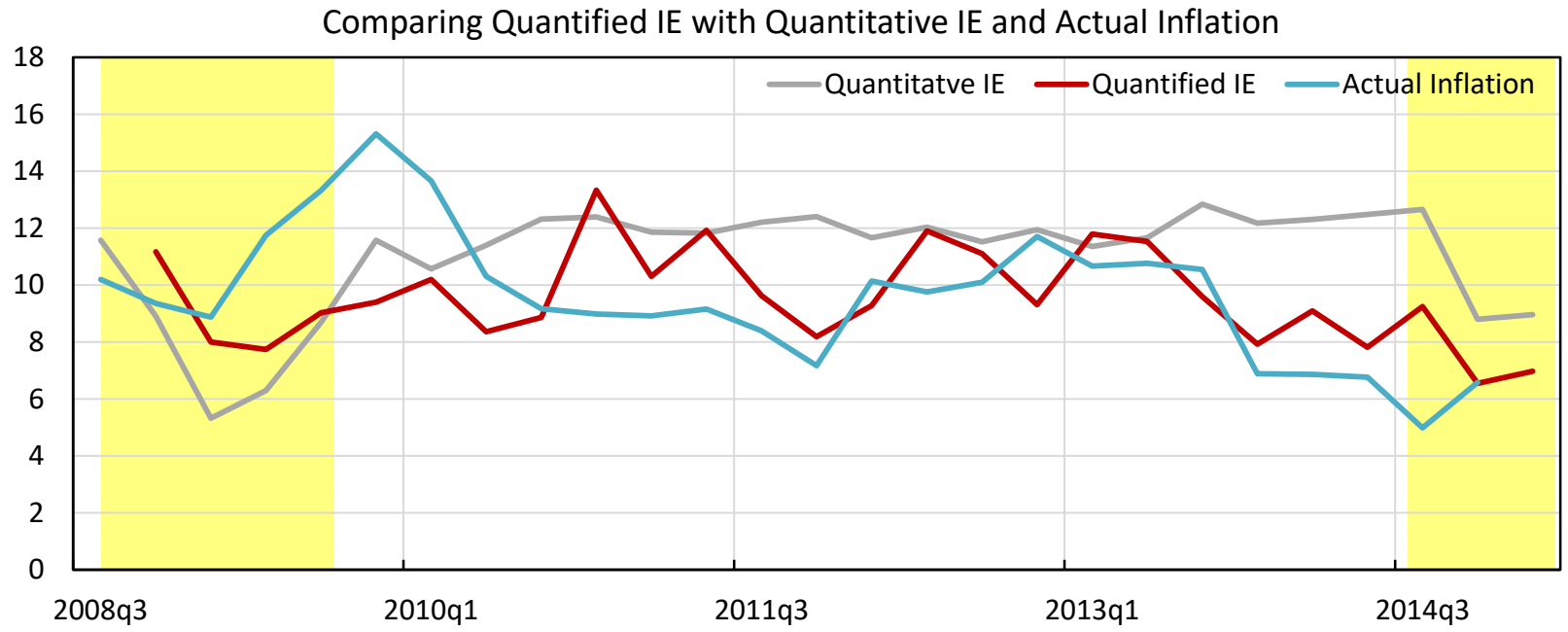
Can we obtain better IE estimates using qualitative data by filtering out of extreme responses?

- We allow the thresholds to vary across individuals according to their characteristics, such as age, location of residence, type of employment, etc.
- We do not assume strict unbiasedness over the entire sample period. Instead, we calibrate quantified IE against quantitative IE during stable periods without many of extreme responses.
- In the future, with a longer time dimension, calibration can be performed using alternative methods (or under alternative assumptions), such as time-varying parameter model.

Quantification

Can we obtain better IE estimates using qualitative data?

- Correlation between quantified IE and quantitative IE is around 0.4. Correlation between quantified IE and actual is around 0.25.
- So in terms of correlations, quantified IE seems better.



Concluding Remarks

- We document some remarkable patterns of inflation expectations in the IESH data.
- Older persons and daily workers experience significantly higher inflation rates.
- There is a high level of persistence in inflation expectations due to low rate of adaptation, which help explain the consistent overestimation during 2010-13 period.
- Using qualitative data, we obtain arguably more accurate measures of inflation expectations.

Concluding Remarks

- There is a significant amount of variations across regions in household perceptions and expectations.
- Certain cities are found to be excessively sensitive to food and energy price inflation – indicating a potential mismatch between the consumption bundle used to calculate the official statistic and what people actually purchase.
- Our results highlight the important role of regional heterogeneity and local inflation experience.
- Uniform monetary policy at the national level seem to have diverse regional effect. Understanding this heterogeneity is important to policy makers.

Thank you

IESH – Recent Trends