Measuring Consumer Uncertainty about Future Inflation

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The views expressed are those of the authors and are not necessarily reflective of views at the Federal Reserve Bank of New York or the Federal Reserve System
Project Team

• Economists
  – Federal Reserve: Olivier Armantier, Mike Bryan, Simon Potter, Rob Rich, Giorgio Topa, Wilbert van der Klaauw, Basit Zafar
  – RAND: Jeff Dominitz, Arie Kapteyn
  – Academic researchers: Chuck Manski (Northwestern); Ken Wolpin (Penn)

• Psychologists
  – Carnegie Mellon University: Wandi Bruine de Bruin, Julie Downs, Baruch Fischhoff
  – Columbia University: Eric Johnson
Project Description: Goals

- Improve our understanding of the Reuters/Michigan Survey inflation measures
- Develop alternative questions
- Measure uncertainty about future inflation
- Track expectations of same individuals over time
- Measure wage growth expectations
- Analyze how people form/update expectations
- Relate inflation expectations to choice behavior
Project Description: Status

• In-depth cognitive interviews;
• Experimental module on inflation expectations (repeated every six weeks) included in RAND American Life Panel internet survey;
• Psychometric surveys: added special modules to ALP; Carnegie Mellon survey;
• Additional experimental module on information updating and links between beliefs and behavior.
Goals of this paper

- Feasibility of asking density questions to measure uncertainty
- Heterogeneity in expressed uncertainty and in density vs point forecasts
- Compare density forecasts to point forecasts
- Characterize inflation forecast uncertainty
- Exploit the panel dimension of our survey.
Point Forecasts

• Over the next 12 months, do you think that prices in general will go up, or go down, or stay where they are now?

[follow up if response is “up” or “down”]

• By about what percent do you think prices in general will go [up/down] on the average, over the next 12 months?
Density forecasts

What is the percent chance that, over the next 12 months, the following things will happen to prices in general?

- Go up by 12% or more _____ percent chance
- Go up by 8% to 12% _____ percent chance
- Go up by 4% to 8% _____ percent chance
- Go up by 2% to 4% _____ percent chance
- Go up by 0% to 2% _____ percent chance
- Go down by 0% to 2% _____ percent chance
- Go down by 2% to 4% _____ percent chance
- Go down by 4% or more _____ percent chance

100% total
Sample and Measures

• Members of RAND’s American Life Panel participated in
  – A one-time special survey (n=559)
  – A panel survey with 22 waves held since Nov 2007 (n~400 per wave)

• All gave point and density forecasts of price inflation and wage inflation

• For each individual, we computed
  – Density median to reflect *density forecast*
  – Density IQR to reflect *forecast uncertainty*
Parametric density estimation

• Approximate underlying density function by a generalized Beta distribution (if more than 2 intervals used) or triangular distribution (for one or two intervals) as in Engelberg, Manski and Williams (2009)

• Use parameter estimates to derive median and IQR for each individual respondent
Average probabilistic responses and fitted densities

<table>
<thead>
<tr>
<th></th>
<th>November 2007</th>
<th>April 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>5.6</td>
<td>6.2</td>
</tr>
<tr>
<td>Median</td>
<td>4.7</td>
<td>5.4</td>
</tr>
<tr>
<td>IQR</td>
<td>6.1</td>
<td>5.9</td>
</tr>
</tbody>
</table>

Source: Fed Mini-Module
# Feasibility of Density question

<table>
<thead>
<tr>
<th></th>
<th>Special</th>
<th>Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item response rate</td>
<td>98.8%</td>
<td>99.6%</td>
</tr>
<tr>
<td>Pct. responses adding to 100%</td>
<td>98.9%</td>
<td>99.1%</td>
</tr>
<tr>
<td>Pct. using adjacent bins</td>
<td>98.7%</td>
<td>98.4%</td>
</tr>
<tr>
<td>Pct. probability in more than one bin</td>
<td>96.4%</td>
<td>89.4%</td>
</tr>
<tr>
<td>Avg Number of Bins with Positive Probability</td>
<td>4.8</td>
<td>3.8</td>
</tr>
<tr>
<td>Proportion with Range Responses</td>
<td>43%</td>
<td>29%</td>
</tr>
<tr>
<td>Correlation btw range use and Uncertainty</td>
<td>0.11</td>
<td>0.05</td>
</tr>
<tr>
<td>Correlation btw range size and Uncertainty</td>
<td>0.58</td>
<td>0.49</td>
</tr>
<tr>
<td>Rating of <em>density forecast</em> difficulty</td>
<td>$M=3.9$</td>
<td>-</td>
</tr>
<tr>
<td>Rating of <em>point forecast</em> difficulty</td>
<td>$M=3.6$</td>
<td>-</td>
</tr>
</tbody>
</table>
## Heterogeneity

<table>
<thead>
<tr>
<th></th>
<th>MDN Point forecast</th>
<th>MDN Density forecast</th>
<th>MDN Density IQR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Female</strong></td>
<td>4.8***</td>
<td>4.7***</td>
<td>2.7***</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>4.1</td>
<td>3.8</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>No college</strong></td>
<td>4.8***</td>
<td>4.9***</td>
<td>2.4</td>
</tr>
<tr>
<td><strong>College</strong></td>
<td>4.1</td>
<td>3.8</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Income &lt;=$75k</strong></td>
<td>4.8***</td>
<td>4.9***</td>
<td>2.6*</td>
</tr>
<tr>
<td><strong>Income &gt;$75k</strong></td>
<td>3.9</td>
<td>3.6</td>
<td>2.4</td>
</tr>
</tbody>
</table>
Heterogeneity in Uncertainty by Financial Behavior

<table>
<thead>
<tr>
<th>Rank correlations</th>
<th>Uncertainty</th>
<th>Pt forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Literacy</td>
<td>-0.24**</td>
<td>-0.26**</td>
</tr>
<tr>
<td>Planning Horizon</td>
<td>-0.18**</td>
<td>-0.14**</td>
</tr>
<tr>
<td>Responsibility Investing</td>
<td>-0.13**</td>
<td>-0.11*</td>
</tr>
</tbody>
</table>
Year-Ahead Inflation Expectations (PG)

Quartiles by Financial Literacy

Low Financial Literacy

High Financial Literacy

NYFed-ALP Panel. 25th, 50th, and 75th percentiles of the distribution of point forecasts of year-ahead ‘prices in general,’ by financial literacy.
NYFed-ALP Panel. 25th, 50th, and 75th percentiles of the distribution of point forecasts of year-ahead ‘wages,’ by financial literacy.
NYFed-ALP Panel.
1 Year Ahead Point Forecasts and Density Means and Medians (WG)

NYFed-ALP Panel.
Point forecasts, density means and density medians

<table>
<thead>
<tr>
<th></th>
<th>Panel</th>
<th>Special</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation btw Point Forecast and Density Median</td>
<td>0.83**</td>
<td>0.71**</td>
</tr>
<tr>
<td>Correlation btw Point Forecast and Density Mean</td>
<td>0.84**</td>
<td>0.72**</td>
</tr>
<tr>
<td>% Observations with Point Forecast in (Density Q3 – Density Q1)</td>
<td>54.7%</td>
<td>56.8%</td>
</tr>
<tr>
<td>% Observations with Point Forecast outside (Density Q3 – Density Q1)</td>
<td>45.3%</td>
<td>43.2%</td>
</tr>
</tbody>
</table>
Measures of Central Tendency and Uncertainty

<table>
<thead>
<tr>
<th>Correlation between individual forecast uncertainty and:</th>
<th>Panel</th>
<th>Special</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point Forecast</td>
<td>0.46**</td>
<td>0.53**</td>
</tr>
<tr>
<td>Density Median</td>
<td>0.44**</td>
<td>0.47**</td>
</tr>
<tr>
<td>Density Mean</td>
<td>0.48**</td>
<td>0.53**</td>
</tr>
</tbody>
</table>
Point Forecasts vs. Uncertainty

Uncertainty vs. Point Forecasts

Fed-ALP December Special module.
Fed-ALP Panel pooled. Values greater than 20 are coded to 20 and values less than -10 are coded to -10.
Average Individual Uncertainty Vs. Variability in Point Forecast
Dynamics - Panel Data Regressions

Estimate (std error) of $a_1$

Model 1: $\text{iqr}(\pi)_it = a_0+a_1 \text{iqr}(\pi)_{i-1} + \epsilon_{it}$  
0.47 (0.05)

Model 2: $\text{iqr}(\pi)_it = a_0+a_1 \text{iqr}(\pi)_{i-1} + X_i' b + \epsilon_{it}$  
0.45 (0.05)

Model 3: $\text{iqr}(\pi)_it = a_0+a_1 \text{iqr}(\pi)_{i-1} + X_i' b + \theta_i + \epsilon_{it}$  
0.05 (0.03)

Model 4: $|\pi_{it}-\pi_{i-1}| = a_0+a_1 \text{iqr}(\pi)_{i-1} + X_i' b + \epsilon_{it}$  
0.52 (0.07)

Model 5: $|\pi_{it}-\pi_{i-1}| = a_0+a_1 \text{iqr}(\pi)_{i-1} + X_i' b + \theta_i + \epsilon_{it}$  
0.39 (0.03)

Fed-ALP Panel micro data – balanced panel. $\pi_{it}$ denotes individual $i$-th point forecast of year-ahead inflation in survey wave $t$, and $\text{iqr}(\pi)_{it}$ denotes individual $i$-th uncertainty (as measured by the density IQR) of year-ahead inflation in survey wave $t$. $X_i$ represents a vector of demographic characteristics of individual $i$, $\theta_i$ is an individual random effect and $\epsilon_{it}$ are i.i.d residuals. Models 3 and 5 were estimated using the Arellano-Bound estimation procedure in Stata.
Conclusions

• Responses to probabilistic questions have internal consistency and measurement reliability.

• Measures of central tendency from density forecasts strongly correlated with point forecasts.

• Forecast uncertainty positively related to point forecasts, and associated with demographics and financial literacy.

• Individuals with higher uncertainty make larger revisions to point forecasts over time.