Survey Design Sensitivity in Household Inflation Expectations Data: Micro-Level Inconsistencies and Policy Implications

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Motivation

The Advantages of Probabilistic Survey Questions

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" How should we measure inflation expectations, and how should we use that information for forecasting and controlling inflation? I certainly do not have complete answers to those questions, but I believe that they are of great practical importance"
– Ben Bernanke, at the NBER Summer Institute, July 2007

Research Question

- Are reported inflation expectations internally consistent across survey designs?
- Aggregate inflation moments depend on survey design & aggregation technique

Roadmap

- Recent developments in probabilistic survey design
- Describe survey designs and methodology
- Assess "internal consistency" of inflation expectations responses
- Discuss aggregate inconsistencies, implications, areas for future work

(Survey-Based) Inflation Expectations in Macro

- PC Estimation, Taylor Rule, departures from rational expectations, (Coibion and Gorodnichenko 2015, Coibion, Gorodnichenko, and Kamdar 2018, Hazell et al. 2020)
- Inflation forecasting advantages (Verbrugge and Zaman 2021, Binder 2015)
- Individual inflation expectations in consumption and price- and wage-setting behavior (D'Acunto, Malmendier, and Weber 2022, Coibion et al. Forthcoming).

NY Fed: "Advantages of Probabilistic Survey Questions"

- person-level uncertainty
  - predictor of economic behavior
  - possible explanation for expectations divergence across surveys (Michigan vs. SCE)

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- person-level uncertainty
  - predictor of economic behavior
  - possible explanation for expectations divergence across surveys (Michigan vs. SCE)
- comparison across individual uncertainty (vs Likert scale)
- Manski 2004 shows respondents are willing and able to report subjective probabilities

Recent Developments in Expectations Survey Design & Methodology

- Point forecasts: Livingston Survey, Survey of Professional Forecasters, Michigan Survey
- Manski (2004): proposes triangular individual PDF
- **NY Fed Survey of Consumer Expectations (2013)**: Bins-based PDF
- **Bloom et. al (2020)**: Scenarios-based PDF

Eliciting Inflation Expectations in the NY Fed Survey of Consumer Expectations

"Now we would like you to think about the different things that may happen to inflation over the next 12 months. We realize that this question may take a little more effort. In your view, what would you say is the percent chance that, over the next 12 months..."

The rate of inflation will be 12% or higher (bin 1) _____

_____ percent chance the rate of inflation will be between 8% and 12% (bin 2)

_____ percent chance the rate of inflation will be between 4% and 8% (bin 3)

_____ percent chance the rate of inflation will be between 2% and 4% (bin 4)

_____ percent chance the rate of inflation will be between 0% and 2% (bin 5)

_____ percent chance the rate of deflation (opposite of inflation) will be between 0% and 2% (bin 6)

_____ percent chance the rate of deflation (opposite of inflation) will be between 2% and 4% (bin 7)

_____ percent chance the rate of deflation (opposite of inflation) will be between 4% and 8% (bin 8)

_____ percent chance the rate of deflation (opposite of inflation) will be between 8% and 12% (bin 9)

_____ percent chance the rate of deflation (opposite of inflation) will be 12% or higher (bin 10)

TOTAL 100

Nielsen Survey Data

- Cross- section data from a panel of nationally representative households
- $N = 6738$
- Survey period is November 2020 (although time series bins- based data is available (SCE, Nielsen)
- Novel: Individual- level comparison of bins- and scenario - based density forecasts

Bins-Based Inflation Expectations in the Nielsen Survey

"In THIS question, you will be asked about the probability (PERCENT CHANCE) of something happening. The percent chance must be a number between 0 and 100 and the sum of your answers must add up to 100. What do you think is the percent chance that, over the next 12 months..."

the rate of inflation will be 12% or more	_____
the rate of inflation will be between 8% and 12%	_____
the rate of inflation will be between 4% and 8%	_____
the rate of inflation will be between 2% and 4%	_____
the rate of inflation will be between 0% and 2%	_____
the rate of deflation (opposite of inflation) will be between 0% and 2%	_____
the rate of deflation (opposite of inflation) will be between 2% and 4%	_____
the rate of deflation (opposite of inflation) will be between 4% and 8%	_____
the rate of deflation (opposite of inflation) will be between 8% and 12%	_____
the rate of deflation (opposite of inflation) will be 12% or more	_____
% Total	_____

Scenarios-Based Inflation Expectations in the Nielsen Survey

"Over the next 12 months, which approximate inflation rate (as measured by the Consumer Price Index) would you assign to each of the following scenarios? If you think there was inflation, please enter a positive number. If you think there was deflation, please enter a negative number. If you think there was neither inflation nor deflation, please enter zero."

A LOW inflation rate would be about: _____
A MEDIUM inflation rate would be about: _____
A HIGH inflation rate would be about: _____

"Please distribute 100 points to the percentage changes you just entered to indicate how likely you think it is that each inflation rate will happen. The sum of the points you allocate should total to 100."

The likelihood of realizing a "LOW" inflation rate would be _____
The likelihood of realizing a "MEDIUM" inflation rate would be _____
The likelihood of realizing a "HIGH" inflation rate would be _____
% Total _____

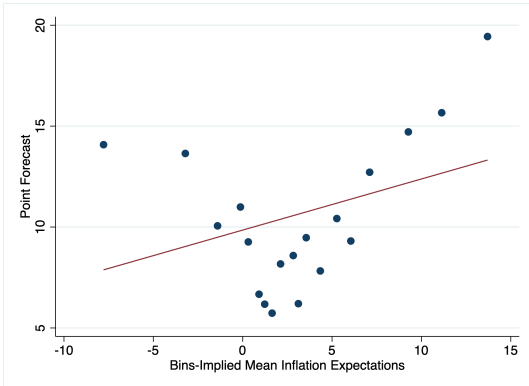
Point Forecasts in the Nielsen Survey

"What do you think the inflation rate (as measured by the Consumer Price Index) is going to be over the next 12 months? Please provide an answer as a percentage change from current prices."

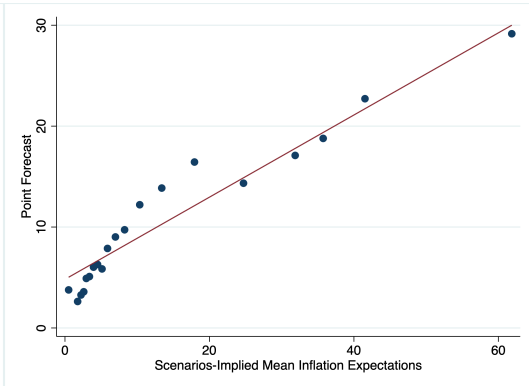
Preliminary Findings: Aggregate Moments

	Mean	Median	Huber Mean
Inflation Point Forecast	10.59	5.00	5.17
Bins Implied Mean	2.93	2.40	2.94
Scenarios Implied Mean	14.18	6.45	5.96
Bins Mean Uncertainty	4.31	3.84	4.18
Scenarios Mean Uncertainty	4.41	2.64	2.80
Observations	6738		

Bivariate Regressions: $E[\pi_i] = \alpha + \beta\pi_i^e + \epsilon_i$

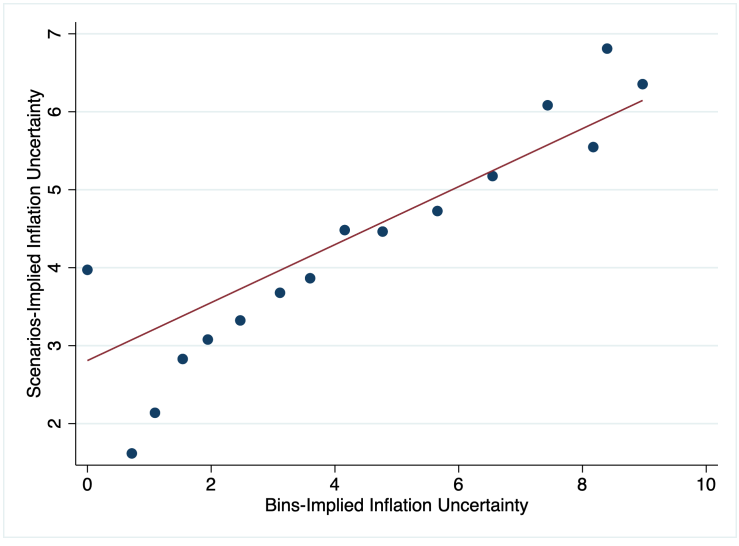


$\beta = .25, SE = .04, R^2 = .0044$



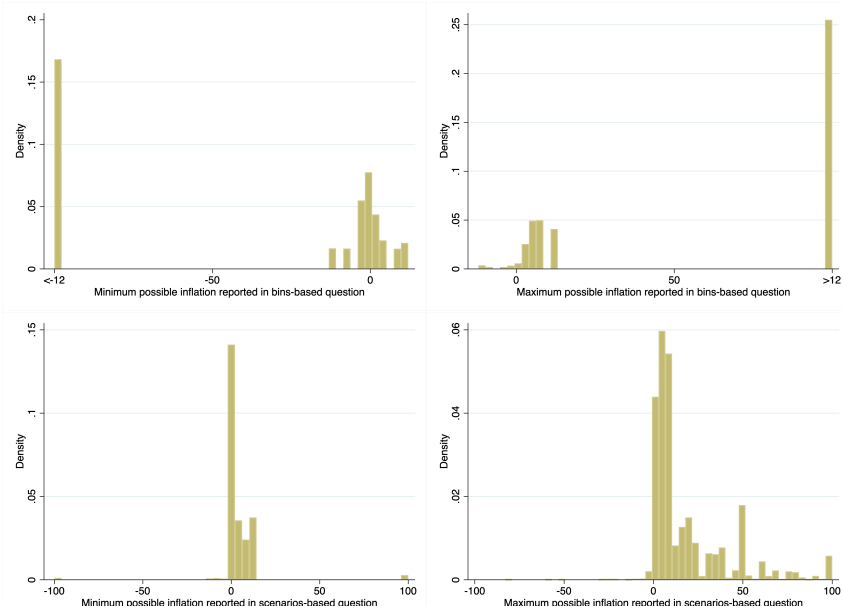
$\beta = .40, SE = .01, R^2 = .1314$

Bivariate Regression: $\sigma_{i,scen} = \alpha + \beta\sigma_{i,bins} + \epsilon_i$

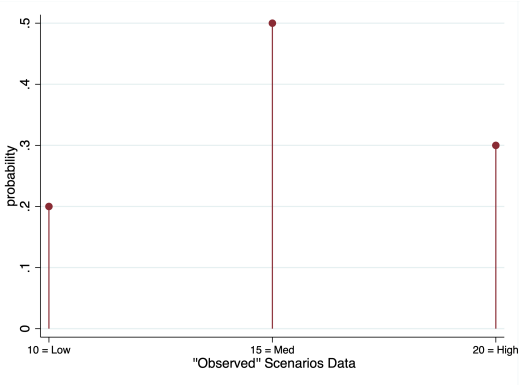


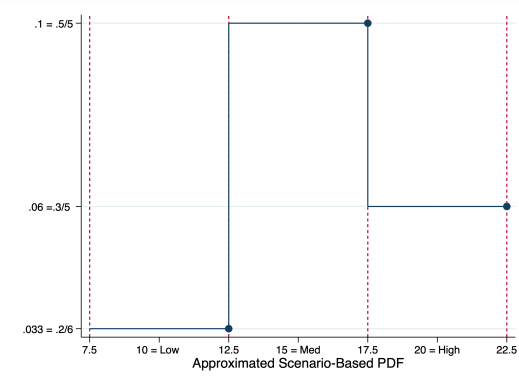
$\beta = .37, SE = .01, R^2 = .0894$

Survey Design Sensitivity in Expected Inflation Value Ranges

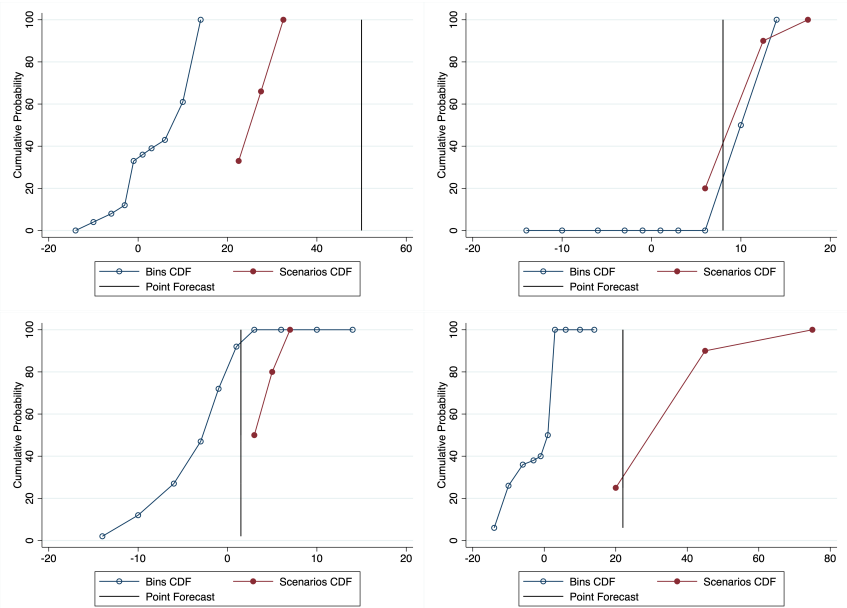


Scenarios-Based PDFs



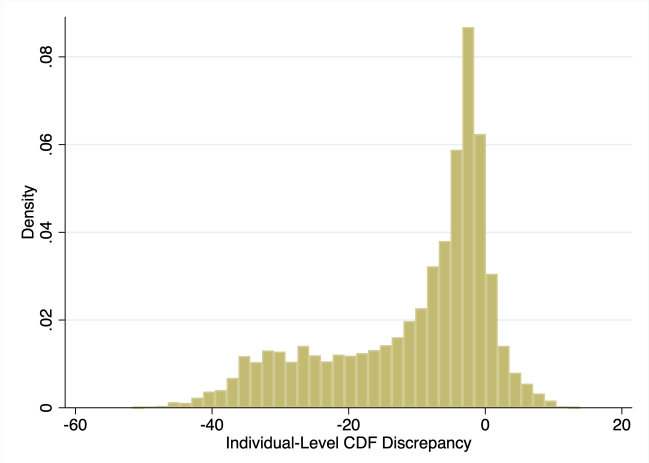


Micro-Level Evidence: A Few Typical Cases



Micro-Level Evidence: CDF Discrepancy

$$\int_{\pi_i^e} CDF_{scen,i} - CDF_{bins,i} d\pi_i^e$$



Internal Consistency of Responses

- Measure 1 "Strict": Check whether implied extrema of reported inflation values match (binary variable)

Internal Consistency of Responses: Measure 1 (Endpoint Matching)

Compare the extreme values of reported inflation ranges in each survey question.

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For the **bins responses**, we use these formulae:

$$LB^i_{bins} = \min\{b^L_n\} \text{ s.t. } \Pr_i[b_n] > 0$$

$$UB^i_{bins} = \max\{b^R_n\} \text{ s.t. } \Pr_i[b_n] > 0$$

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Example bins response:

bin number	b_n range	$\Pr^i[b_n]$
1	$[-100, -12]$	0
⋮	⋮	0
7	$[2, 4]$	.3
8	$[4, 8]$	.35
9	$[8, 12]$	.35
10	$[12, 100]$	0

The implied extrema are $\{2, 12\}$.

Internal Consistency of Responses: Measure 1 (Endpoint Matching)

Compare the extreme values of reported inflation ranges in each survey question.
For the **scenarios responses**, we use these formulae:

$$LB^i_{scen} = \min\{\pi^e_{i,low}, \pi^e_{i,med}, \pi^e_{i,high}\} \text{ s.t. } \Pr[\pi^e_i > 0]$$

$$UB^i_{scen} = \max\{\pi^e_{i,low}, \pi^e_{i,med}, \pi^e_{i,high}\} \text{ s.t. } \Pr[\pi^e_i > 0]$$

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Example scenarios response:

	π^e_i	$\Pr_i[\pi^e]$
Low	2	0
Medium	5	.75
High	10	.25

The implied extrema are {5, 10}.

Internal Consistency of Responses: Measure 1 (Endpoint Matching)

- Bins extrema are $\{2, 12\}$.
- Scenarios extrema are $\{5, 10\}$.
- To compare extrema, **push scenario values to the grid implied by the bins:**

Internal Consistency of Responses: Measure 1 (Endpoint Matching)

- Bins extrema are $\{2, 12\}$.
- Scenarios extrema are $\{5, 10\}$.
- To compare extrema, **push scenario values to the grid implied by the bins:**

Recall the bins: [-100,-12], [-12, -8], [-8, -4], [-4, -2], [-2, 0], [0, 2], [2, 4], [4,8], [8,12], [12, 100] Example:

$$LB_{i,scen} = 5 \to 4 = LB'_{i,scen}, \text{ since } 5 \in [4, 8]$$
$$UB_{i,scen} = 10 \to 12 = UB'_{i,scen}, \text{ since } 10 \in [8, 12]$$

Internal Consistency of Responses: Measure 1 (Endpoint Matching)

- $UB_{i,bins} = 12 = UB'_{i,scen}$
- However, $LB_{i,bins} = 2 \neq 4 = LB'_{i,scen}$

Internal Consistency of Responses: Measure 1 (Endpoint Matching)

- $UB_{i,bins} = 12 = UB'_{i,scen}$
- However, $LB_{i,bins} = 2 \neq 4 = LB'_{i,scen}$

The response is **inconsistent** since the endpoints do not match.

Internal Consistency of Responses: Measure 1 (Endpoint Matching)

	Not Consistent %	Consistent %	Total %
1 (Bins)	16.21	3.67	19.88
2	12.77	1.31	14.08
3	6.92	0.85	7.76
4	7.50	0.21	7.71
5	9.00	0.15	9.15
6	3.70	0.00	3.70
7	2.83	0.01	2.84
8	3.07	0.01	3.08
9	4.40	0.01	4.41
10	27.28	0.10	27.38
Total	93.67	6.33	100.00

Internal Consistency of Responses

- Measure 2 "Less Strict": Calculate the percent of values reported as possible in both survey questions.

Internal Consistency of Responses: Measure 2 (Percent Overlap of Value Ranges)

Calculate the percent of values reported as possible in both survey questions.

Denote the set of overlapping values $O_i = [O_{i,L}, O_{i,R}]$.

The percent overlap for an individual i is calculated as:

$$\overline{O_i} = \frac{2 \times (O_{i,R} - O_{i,L} + 1)}{(UB'_{i,scen} - LB'_{i,scen} + 1) + (UB_{i,bins} - LB_{i,bins} + 1)},$$

Internal Consistency of Responses: Measure 2 (Percent Overlap of Value Ranges)

Example:

$$\{LB_{i,bins}, UB_{i,bins}\} = \{2, 12\}$$
$$\{LB'_{i,scen}, UB'_{i,scen}\} = \{4, 12\}$$

The percent overlap of the inflation value ranges is given by:

Internal Consistency of Responses: Measure 2 (Percent Overlap of Value Ranges)

Example:

$$\{LB_{i,bins}, UB_{i,bins}\} = \{2, 12\}$$
$$\{LB'_{i,scen}, UB'_{i,scen}\} = \{4, 12\}$$

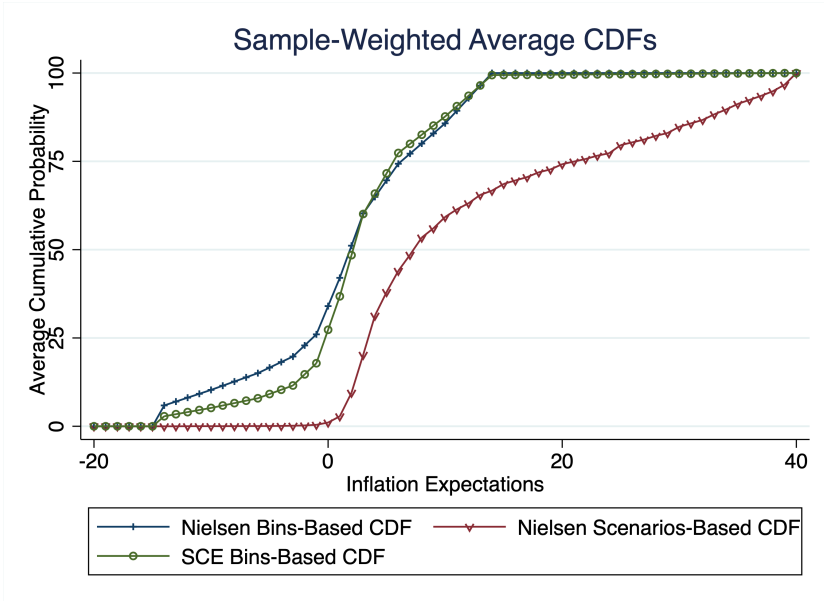
The percent overlap of the inflation value ranges is given by:

$$\begin{aligned}\overline{O_i} &= \frac{2 \times (O_{i,R} - O_{i,L} + 1)}{(UB'_{i,scen} - LB'_{i,scen} + 1) + (UB_{i,bins} - LB_{i,bins} + 1)} \\ &= \frac{2 \times (12 - 4 + 1)}{(12 - 4 + 1) + (12 - 2 + 1)} \\ &= \frac{18}{20} \\ &= 90\% \text{ overlap}\end{aligned}$$

Internal Consistency of Responses: Measure 2 (Percent Overlap of Value Ranges)

	Average % Overlap
1 (Bins)	33.86
2	43.09
3	54.32
4	44.68
5	41.61
6	37.70
7	35.86
8	36.47
9	31.97
10	33.68
Total	38.44

Aggregate Empirical Findings



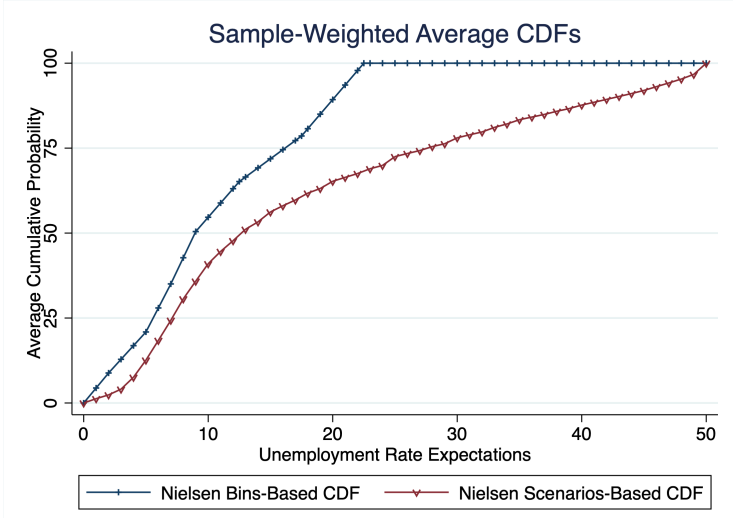
Key Takeaways

- Nielsen bins CDF behaves similarly to SCE data from the same period (Nov. 2020)
- Aggregate bins and scenarios CDFs diverge
- bins- based probability of deflation is 25% vs. $\simeq$ 0% in scenarios cdf
- roughly 40% of scenarios cdf density lies above the bins cdf's conventional cut- off value of 14.

Unemployment Rate Aggregate CDFs

Comparing unemployment with inflation CDFs suggests 3 interacting sources:

priming, conceptual difficulty with inflation, math literacy issues



Potential Sources of Divergence

1. **Priming**
   - deflation probability divergence
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   - scenarios question emphasizes inflation rather than deflation

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2. **Conceptual difficulty** with inflation (deflation). Combined with priming, could make bins responses hard to interpret.
   - Evidence from qualitative surveys: Schiller (1997), Leiser and Drori (2005), Andre et al. (2021)
   - Inflation vs. deflation

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   - Evidence from qualitative surveys: Schiller (1997), Leiser and Drori (2005), Andre et al. (2021)
   - Inflation vs. deflation
3. **Mathematical literacy issues**
   - percentages vs. level changes
   - deflation, i.e., negative numbers particularly challenging
   - unemployment CDFs exhibit less divergence and higher internal consistency, which suggests a combo of 2.) and 3.)

Conclusions

- **Implications for policy**: Household inflation expectations are not reliably captured by existing survey designs, methods.
- Unclear whether expectations are anchored, and at what level.

Conclusions

- **Implications for policy**: Household inflation expectations are not reliably captured by existing survey designs, methods.
- Unclear whether expectations are anchored, and at what level.
- **Areas for future research**: Gather causal evidence on what drives response sensitivity to question design, i.e., priming, inflation confusion, mathematical literacy
- Analyze time series data comparing individual responses to learn about expectations stability, systematic variation over time