

A Choice-Based Approach to the Measurement of Inflation Expectations

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Measuring inflation expectations

- Subjective inflation expectations are measured because they ...
 - ...are relevant for the transmission of policy (firms' prices and wages, households' decision)
 - ... help to produce economic forecasts
- Survey question on probability distribution about future outcomes – *“Bin” method* (Manski, 2004)
 - No ambiguity about first moment (mean vs. mode)
 - Allows to estimate individual-level uncertainty

Measuring inflation expectations: Probabilistic „Bins“

In your opinion, how likely is it that the rate of inflation will change as follows over the next twelve months?

Note: The aim of this question is to determine how likely you think it is that something specific will happen in the future. You can rate the likelihood on a scale from 0 to 100, with 0 meaning that an event is completely unlikely and 100 meaning that you are absolutely certain it will happen. Use values between the two extremes to moderate the strength of your opinion. Please note that your answers to the categories have to add up to 100. You can also leave fields empty; these will be saved as a 0.

- a = The rate of deflation (opposite of inflation) will be 12% or higher _____
- b = The rate of deflation (opposite of inflation) will be between 8% and less than 12% _____
- c = The rate of deflation (opposite of inflation) will be between 4% and less than 8% _____
- d = The rate of deflation (opposite of inflation) will be between 2% and less than 4% _____
- e = The rate of deflation (opposite of inflation) will be between 0% and less than 2% _____
- f = The rate of inflation will be between 0% and less than 2% _____
- g = The rate of inflation will be between 2% and less than 4% _____
- h = The rate of inflation will be between 4% and less than 8% _____
- i = The rate of inflation will be between 8% and less than 12% _____
- j = The rate of inflation will be 12% or higher _____

Measuring inflation expectations

- Subjective inflation expectations are measured because they ...
 - ...are relevant for the transmission of policy (firms' prices and wages, households' decision)
 - ... help to produce economic forecasts
- Survey question on probability distribution about future outcomes – “*Bin*” method (Manski, 2004; NY FED, Bbk, ECB-CES)
 - No ambiguity about first moment (mean vs. mode)
 - **Allows to estimate individual-level uncertainty regarding expected inflation**
- *Recent episode of high and volatile inflation highlighted limitations of the measure*
 - Limits comparison over time and space (high vs. low inflation)
 - Scale designed to reflect better small values – weaker performance in times of high/volatile inflation (Weber et al., 2022)
 - Non-trivial assumptions on cognitive and numerical abilities of respondents (D’Acunto et al, 2023)
 - Bin structure affects responses (Becker et al., 2023)

New method

- We propose a new method to elicit inflation expectations (*any beliefs with uncertainty*):
 - Rooted in decision theory (Baillon, 2008)
 - Simple binary comparisons, no need to assess probability as such
 - Elicitation driven by respondent - **no anchoring on any exogenously provided frame**
 - No magnitude-dependency; applicable to any economic environment
 - Allows comparison across time and across countries with very different levels of inflation.
 - Can be used to simultaneously elicit macroeconomic expectations of different magnitude (high inflation, low economic growth)

Exchangeability method: General idea

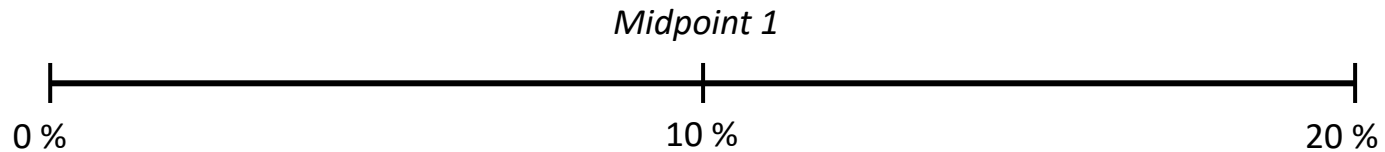
- Works by splitting the state space into subjectively equally likely events.
- Involves several series of chained choices:
 - Median is always elicited first (twofold partition)
 - Subsequent partition into two equally likely subevents (P25 / P75)
 - Further partition is also possible
- Finish when required precision is achieved

Exchangeability method: Implementation

- Start by asking for a subjective **minimum** (b_0) and **maximum** (b_1) possible level of inflation
 - Prevents researcher-imposed starting point of process
 - Bounded interval helps participants to structure their expectations.
 - Informative (Pavlova, 2024)
- Then a bisection process starts: (median)
 - The first **midpoint** is calculated as: $b_0 + \frac{b_1 - b_0}{2}$
 - The first choice set thus involves the following options:
$$\left(b_0, b_0 + \frac{b_1 - b_0}{2} \right] \text{ and } \left(b_0 + \frac{b_1 - b_0}{2}, b_1 \right)$$
 - Respondent indicates which one more likely. This implies how to adjust the intervals to approximate 2 subjectively equally likely intervals.
 - Continue depending on required precision.
- Then new bisection process starts to split elicited intervals further (P25, etc.)

Exchangeability method: Illustration

- Minimum (b_0): 0 % Maximum (b_1): 20 %
- Set required precision at 1.5%
- Find Median:



Q: Which of the following two scenarios regarding the rate of inflation over the next twelve months do you consider more likely?

Option A

0 % - 10 %

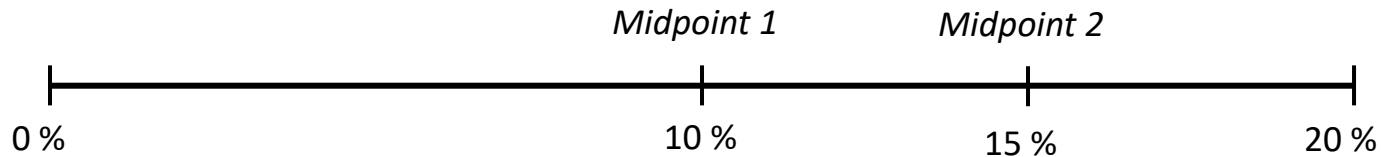
Option B

10 % - 20 %

- Calculate **new Midpoint** based on updated lower (10 %) and upper bound (20 %) for the median.
- Midpoint 2 = 15 %

Exchangeability method: Illustration

- Minimum (b_0): 0 % Maximum (b_1): 20 %
- Find Median: [Step 2]



Q: Which of the following two scenarios regarding the rate of inflation over the next twelve months do you consider more likely?

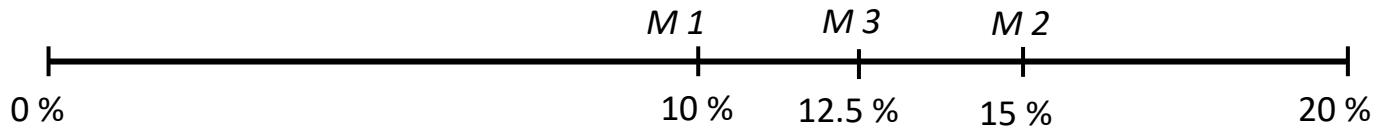
Option A

Option B

- Calculate new Midpoint based on lower (10 %) and updated upper bound (15 %) for the median.
- Midpoint 3 (M3) = 12.5 %

Exchangeability method: Illustration

- Minimum (b_0): 0 % Maximum (b_1): 20 %
- Find Median: [Step 3]



Q: Which of the following two scenarios regarding the rate of inflation over the next twelve months do you consider more likely?

Option A 0 % - 12.5 %

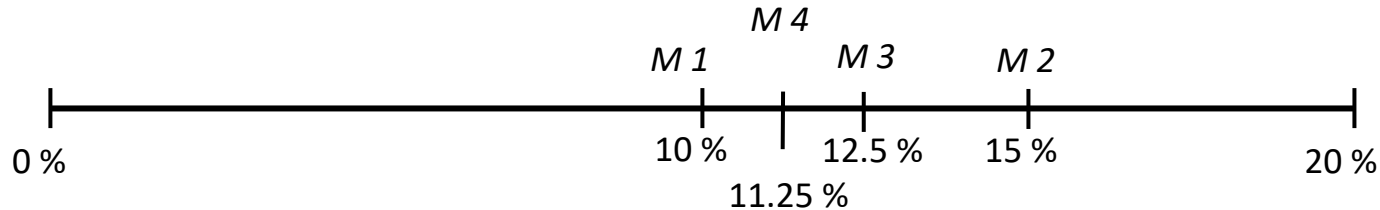
Option B

12.5 % - 20 %

- Calculate new Midpoint based on lower (10 %) and upper bound (12.5 %) for the median.
- Midpoint 4 (M_4) = 11.25 %

Exchangeability method: Illustration

- Minimum (b_0): 0 % Maximum (b_1): 20 %
- Find Median: [Step 4]



Q: Which of the following two scenarios regarding the rate of inflation over the next twelve months do you consider more likely?

Option A

0 % - 11.25 %

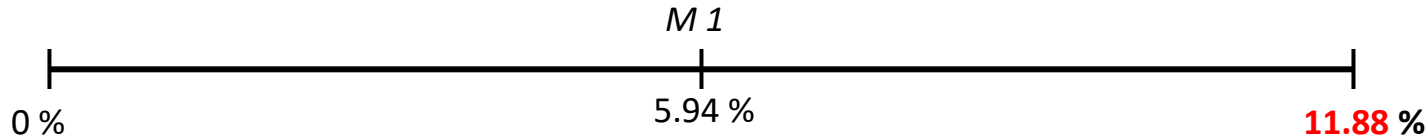
Option B

11.25 % - 20 %

- Calculate new Midpoint based on updated lower (11.25 %) and upper bound (12.5 %) for the median.
- Midpoint 5 (M_5) = 11.875%; Median in Range [11.25% , 12.5%] , given *required precision* of 1.5% we set **Median = 11.875%**

Exchangeability method: Illustration

- **Find 25%-percentile:** [Step 1]
- Minimum (b_0): 0 % Median: **11.875 %**



Q: Which of the following two scenarios regarding the rate of inflation over the next twelve months do you consider more likely?

Option A

0 % - 5.94 %

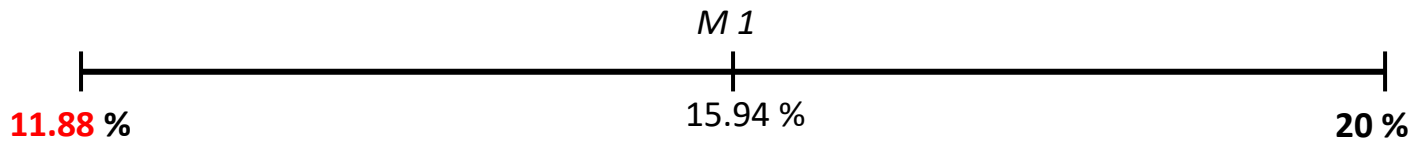
Option B

5.94 % - 11.88 %

- Calculate new Midpoint
- Continue choice iterations till required precision is achieved

Exchangeability method: Illustration

- Find 75%-percentile: [Step 1]
- Median: 11.875 % Maximum (b_1): 20 %



Q: Which of the following two scenarios regarding the rate of inflation over the next twelve months do you consider more likely?

Option A

11.88 % - 15.94 %

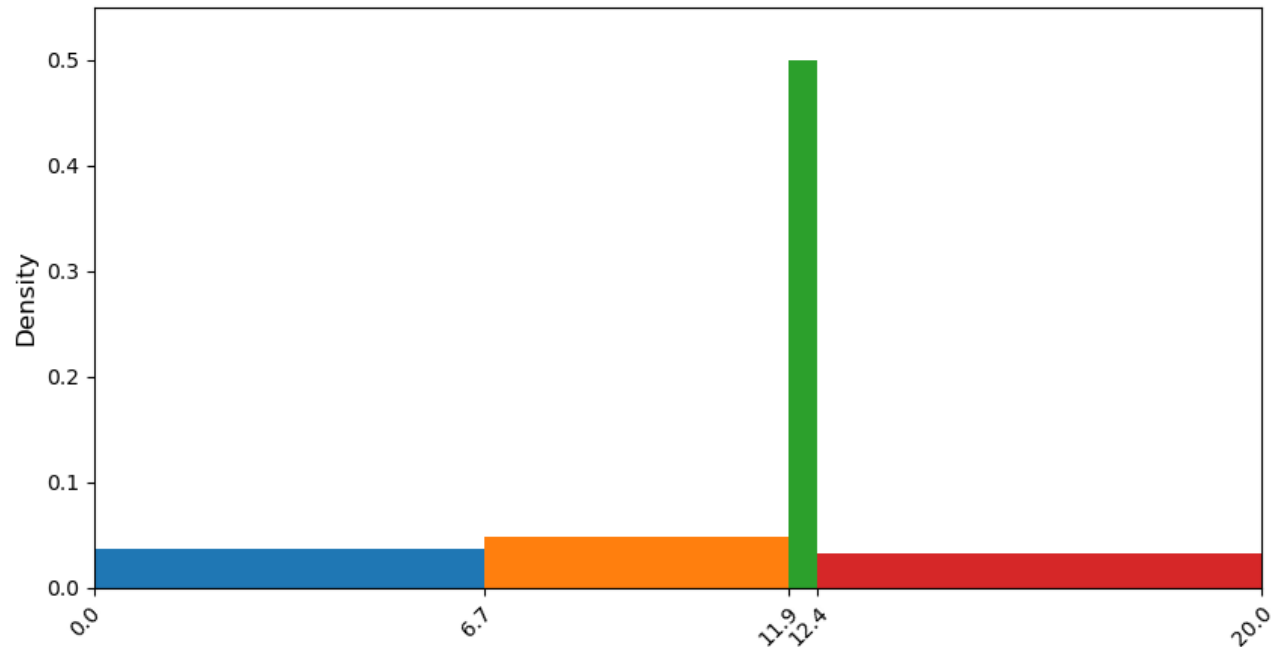
Option B

15.94 % - 20 %

- Calculate new Midpoint
- Continue choice iterations till required precision is achieved

Exchangeability method: Illustration – Results Example

- Result: “Bins” where bin width is individual-specific; each bin contains 25% probability mass
- Assumptions: Required precision and uniform distribution within-bin



Application

- UK respondents, general population, *Prolific* pool, online (N = 811)
- Survey includes 4 groups:
 - “Bin” method as used in Bundesbank Online Panel
 - “Bin” method with response scale around point prediction (Central Bank of Turkey)
 - Midpoint method as presented with an endogenous number of steps and precision
 - Midpoint method with a fixed number of 2 steps and precision for median, p25, and p75
- Data collected in September, 2023
- Latest Office for National Statistics UK release for CPI for September 2023 was 6.3%

Application: Survey Structure

There are relevant differences in structure

- **All methods:**
 - Introductory instructions
 - Point prediction
- **Bins:**
 - 1 screen, with several entries.
- **Midpoint method:**
 - 2 screens for b_0 and b_1 (question + confirmation screen)
 - 1 screen introducing sequence for median, screens with sequence for median
 - 1 screen introducing P25, screens with sequence for P25
 - 1 screen introducing P75, screens with sequence for P75

Survey Questions: Midpoint questions (sub-sample)

Inflation Expectations

In your opinion, what is the minimum rate of inflation over the next twelve months for which you think that there is absolutely no chance the true rate of inflation will be lower?

Note: The aim of this question is to determine the absolute lowest possible rate of inflation (or negative numbers if you expect deflation) that you would consider realistic over the next twelve months.

 %

In your opinion, what is the maximum rate of inflation over the next twelve months for which you think that there is absolutely no chance the true rate of inflation will be higher?

Note: The aim of this question is to determine the absolute highest possible rate of inflation (or negative numbers if you expect deflation) that you would consider realistic over the next twelve months.

 %

Next

Survey Questions: Midpoint questions (sub-sample)

Question 1/2

Which of the following two scenarios regarding the rate of inflation over the next twelve months do you consider more likely?

- 0.0% to 10.0%
- 10.0% to 20.0%

Next

Survey results: Practicability

Perceived

	Difficulty	Length	Time Taken	Time Taken
	(1 – 5)	(1 – 5)	for Method (in seconds)	for Survey (in seconds)
2-Step	2.45 (1.06)	2.00 (0.17)	108.13 (91.23)	409.16 (229.90)
Endogenous	2.38 (1.07)	1.99 (0.14)	109.62 (84.56)	417.45 (267.93)
Bins SCE	2.48 (1.20)	2.00 (0.20)	116.72 (94.70)	418.48 (263.48)
Bins Shift	2.56 (1.11)	1.99 (0.20)	122.00 (108.54)	442.90 (286.46)

→ Midpoint method at least as easy and fast as bin methods, despite more steps, screens.

Survey results: Implied means, uncertainty, disagreement

	Treatments				Differences		
	Midpoint 2-Step (N=200)	Midpoint Endo (N=205)	Bins SCE (N=200)	Bins Shift (N=206)	Midpoints vs. Bins	Midpoints vs. Bins SCE	Midpoints vs. Bins Shift
Implied Mean Forecast	6.19	6.22	5.09	6.27	0.52** (2.07)	1.12*** (3.77)	-0.06 (0.19)
Disagreement	3.65	3.65	2.98	3.88	0.14 (0.93)	0.67*** (0.67)	-0.23 (1.13)
Uncertainty	1.51	1.41	3.78	3.14	-2.46*** (18.60)	-2.32*** (17.53)	-2.02*** (15.24)

- Comparing “bins” and “midpoint” methods; *actual inflation at 6.3%*
 - Higher means than “Bins SCE” / no difference with “endogenous bin” -> anchoring at bin?
 - Higher disagreement
 - Much lower uncertainty than bins method
 - Most differences with SCE method; less differences with Bins Shift method

Survey results: Implied means vs point prediction

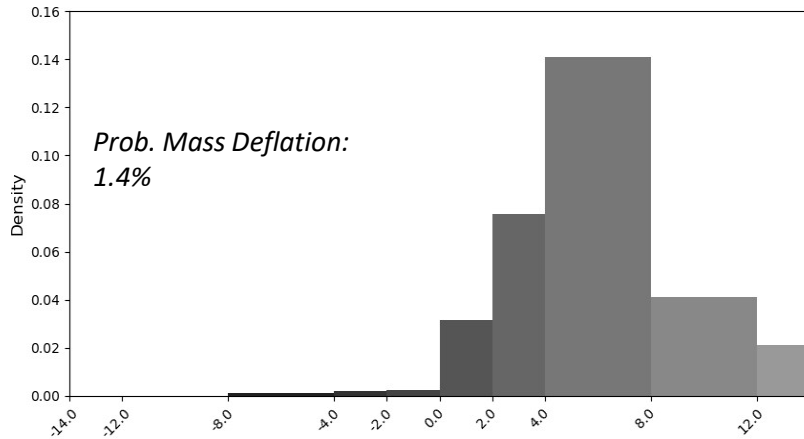
	Point Estimate	Implied Mean	Correlation
2-Step	5.56	6.19	0.78***
Endogenous	5.49	6.22	0.68***
Bins SCE	5.45	5.09	0.51***
Bins Shift	5.50	6.27	0.85***

Note: ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. None of the differences in point predictions between treatments are significant at the 10% level.

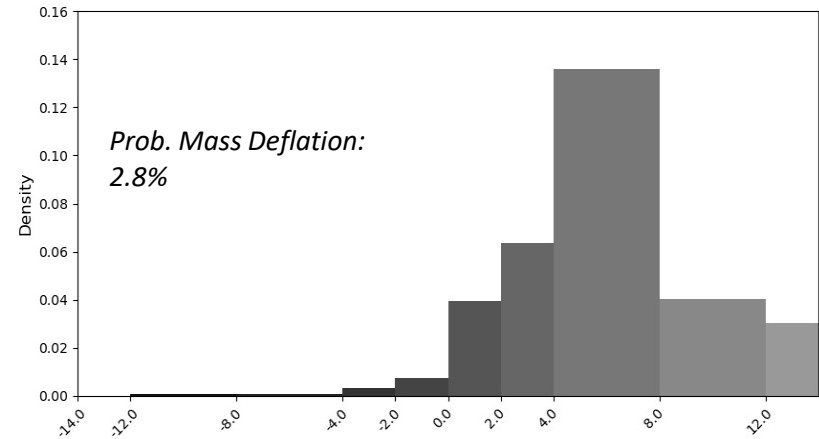
- High correlation with point prediction
- Despite no direct “Number entry”, only comparison of the intervals!

Survey results: Probability of deflation

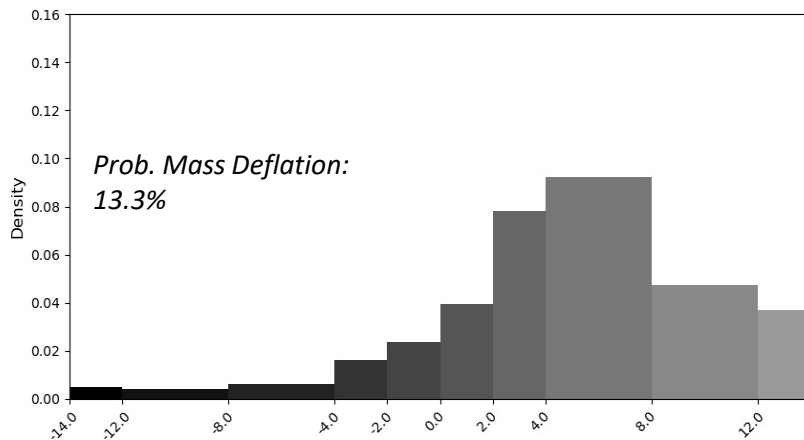
2-Step *



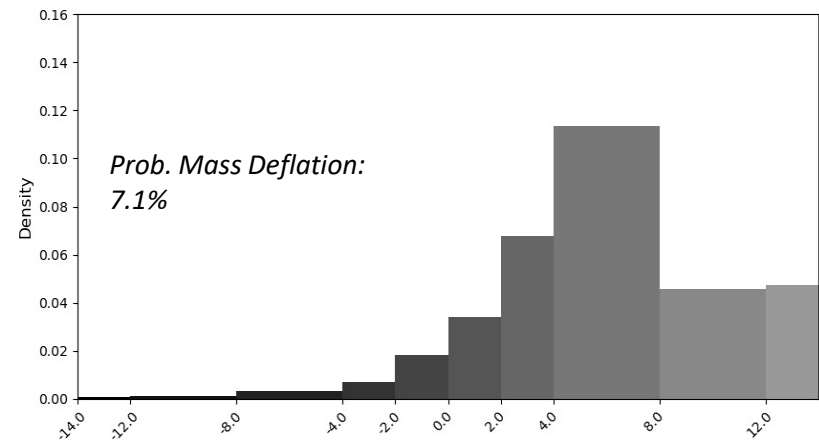
Endogenous *



Bins SCE (Bbk)



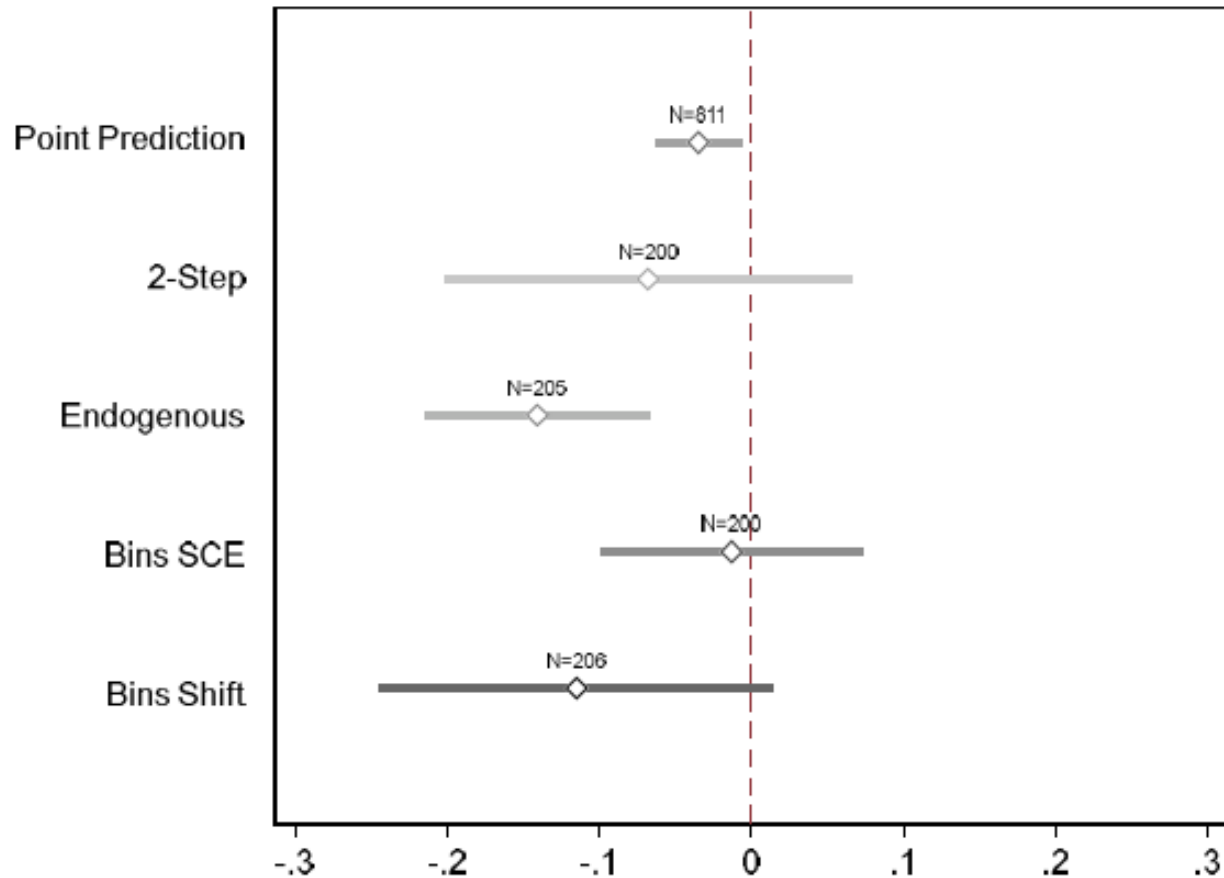
Bins Shift



* Calculated assuming uniform distribution within endogenous bins for each respondent

Survey results: Link to Planned Spending

Figure 5: Inflation Expectations and Durable Consumption



- Strongest (negative) relation with midpoint endogenous method
- 2-Step method performs comparatively well

Conclusion

- Propose new method to elicit distribution of inflation expectations (or any other macroeconomic expectation)
 - Does not use bins or any other external framing or anchor
 - Can be used in any context (high and volatile environment) or across different variables
 - Perceived as easy; low cognitive or **educational** requirements
- Application: Measuring inflation in countries with high inflation and high heterogeneity in education of the population
 - *Experiment in Turkey: Planning phase*

Discussion: Exchangeability method - Practical issues

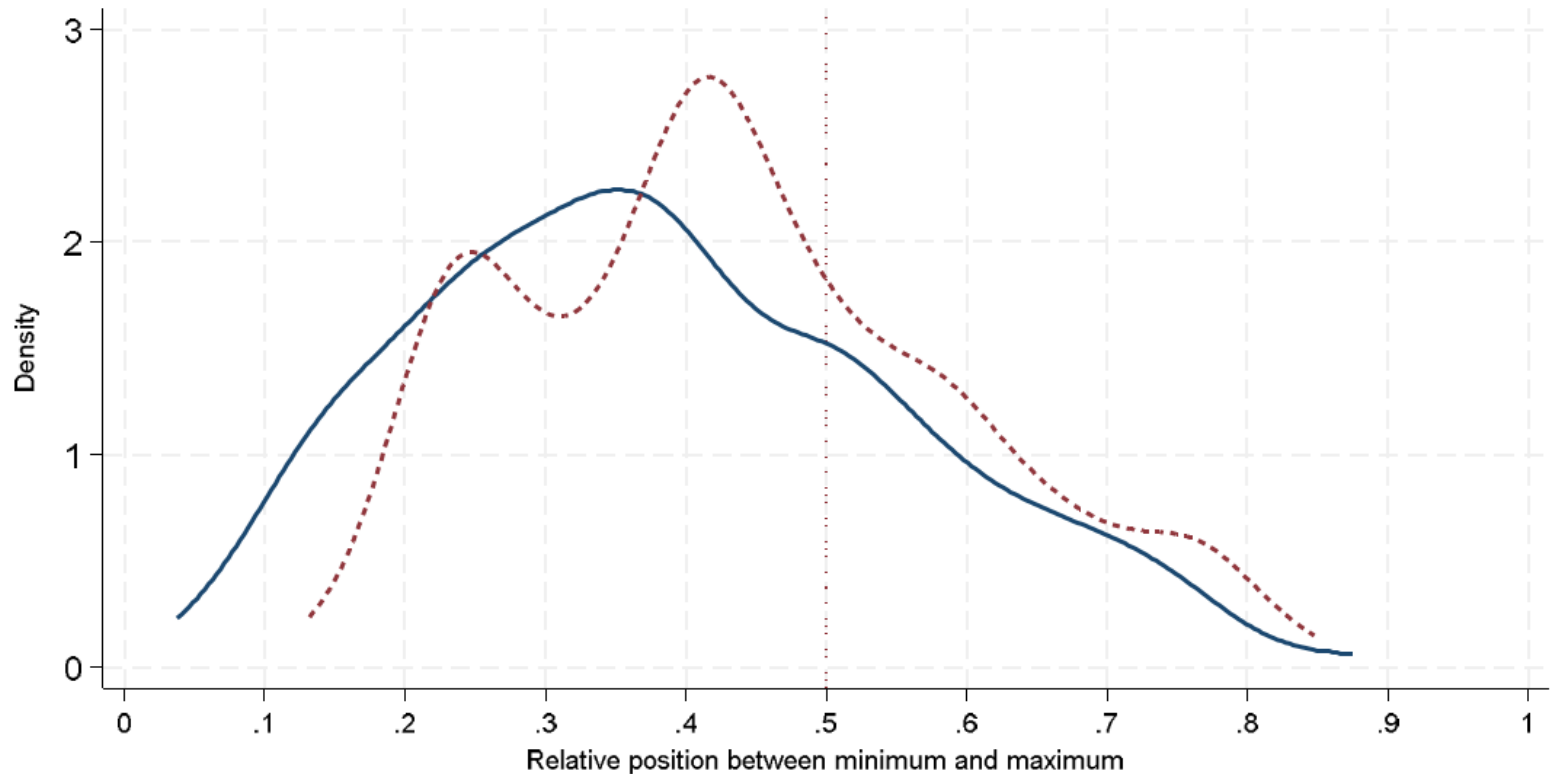
- **Wide range (b_0, b_1)**
 - Does not harm precise elicitation of percentiles.
 - But: May lead to large outer percentiles that are mostly empty; violates mass at midpoint assumption
 - Problem can be mitigated by further splitting percentiles endogenously depending on their size
- **Random choice in later questions**
 - Implied by approaching indifference as we converge to the true median etc.
 - Add “cannot say” or “consider equal”; modest error if later in the sequence.
- **Midpoints exactly equal to elicited percentile.**
 - If some midpoint is exactly equal to the percentiles we initially move away from the true value with the choice sequence, then re-approach it.
 - E.g., in elicitation of median assume that true median is 10. With precision of 1.5% as in example, the process would have stopped at 10.624%.
 - Unlikely to happen? Reduce by requiring higher precision; “consider equal”
 - See graph simulation.

Application: Summary Statistics

	Mean	Standard Deviation	Median	Min	Max
Point Forecast	5.51	4.43	6	-30	40
<i>Bin Treatments:</i>					
#Bins used (SCE)	<u>6.01</u>	2.65	<u>5</u>	1	10
Bin Size (SCE)	21.11	12.15	20	10	100
#Bins used (Shift)	<u>6.69</u>	2.53	<u>7</u>	1	10
Bin Size (Shift)	18.37	10.94	14.29	10	100
<i>Midpoint Treatments:</i>					
Minimum (2-Step)	3.41	2.49	4	<u>-8</u>	15
Maximum (2-Step)	10.18	6.23	9	1	<u>60</u>
Number of Steps (2-Step)	1.61	0.39	2	1	2
Minimum (Endogenous)	3.58	3.09	4	<u>-10</u>	17
Maximum (Endogenous)	10.06	6.15	9	1	<u>50</u>
Number of Steps (Endogenous)	<u>2.11</u>	0.86	2	1	4

Application: Location of Point Forecast and Implied Mean relative to individual's Min and Max

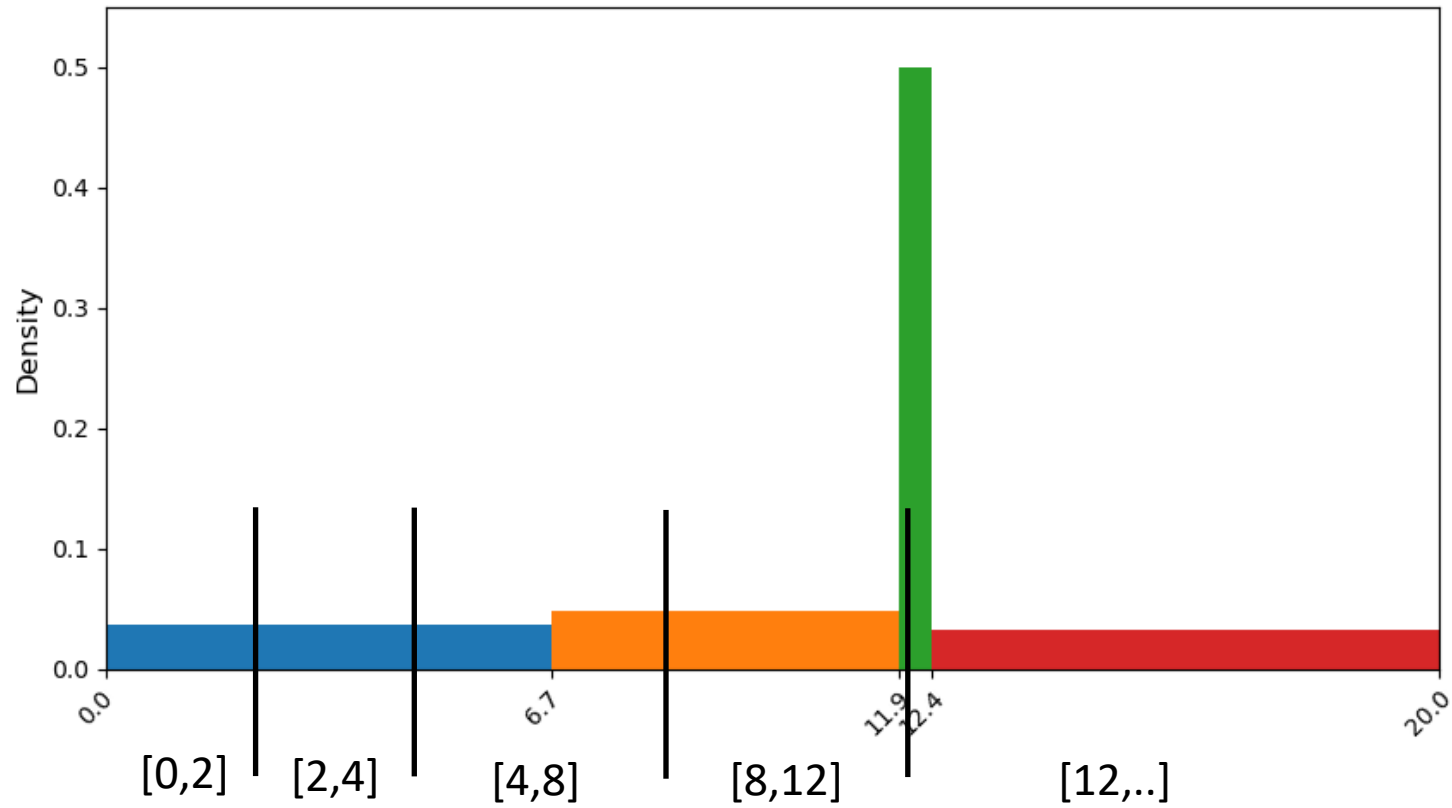
Figure 2: Sample Distribution of the Relative Position of Inflation Estimates between the Minimum and Maximum



- 0 = Prediction identical to minimum expected inflation; 1 = identical to maximum
- Suggest predictions are not random (otherwise centered around 0.5)

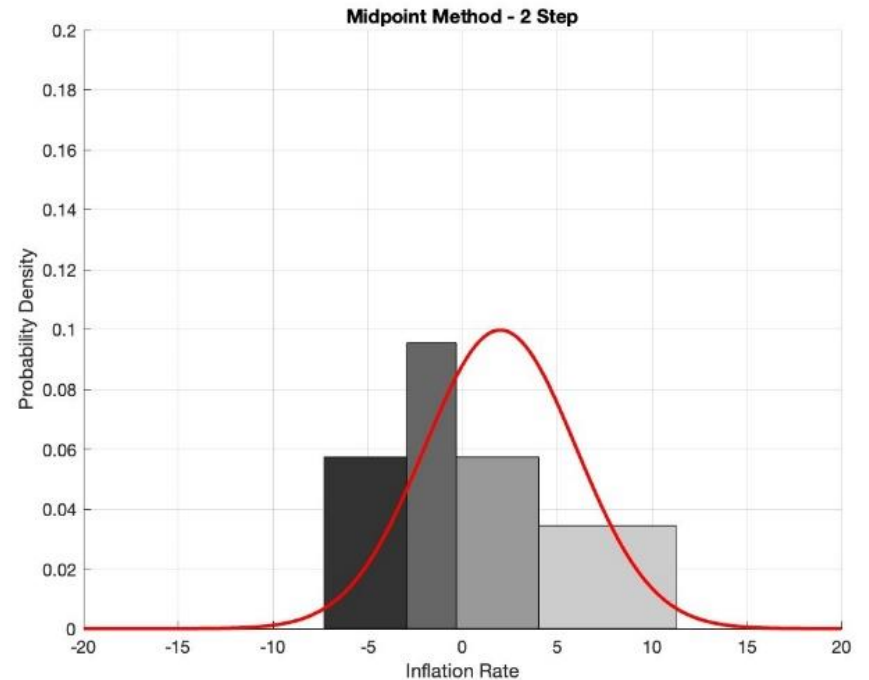
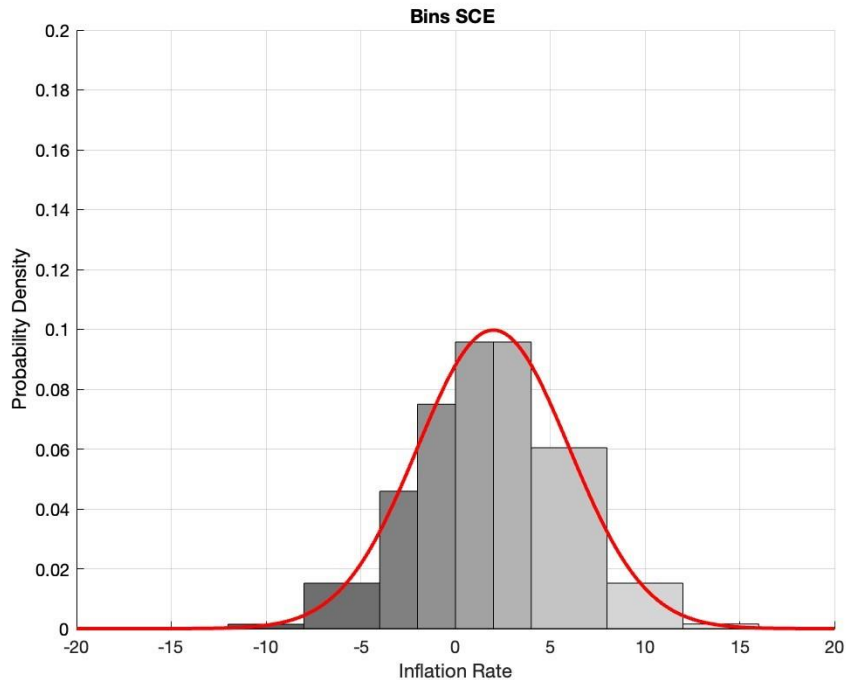
— Point - - - - Implied Mean

Quality control: Comparison of distributions



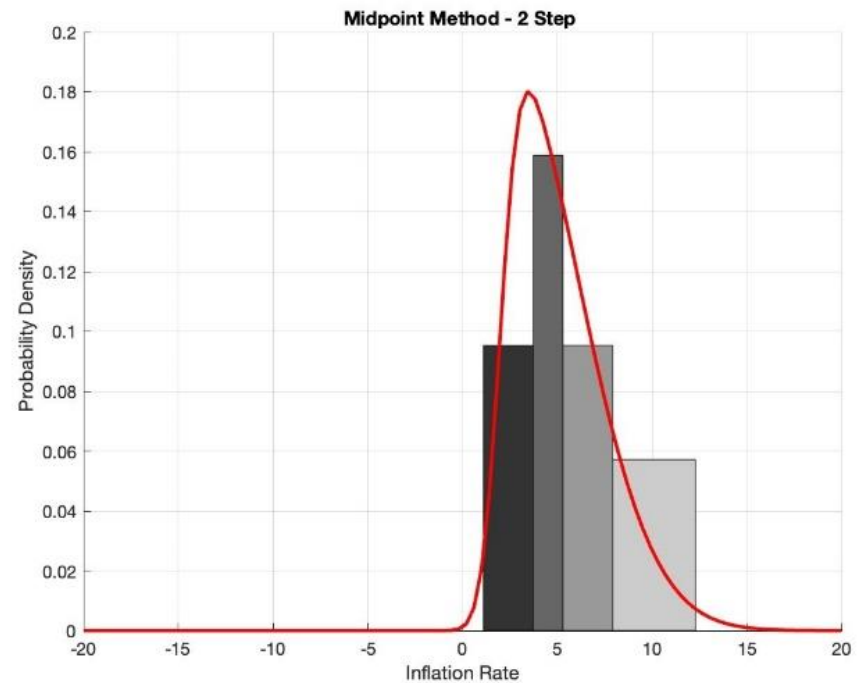
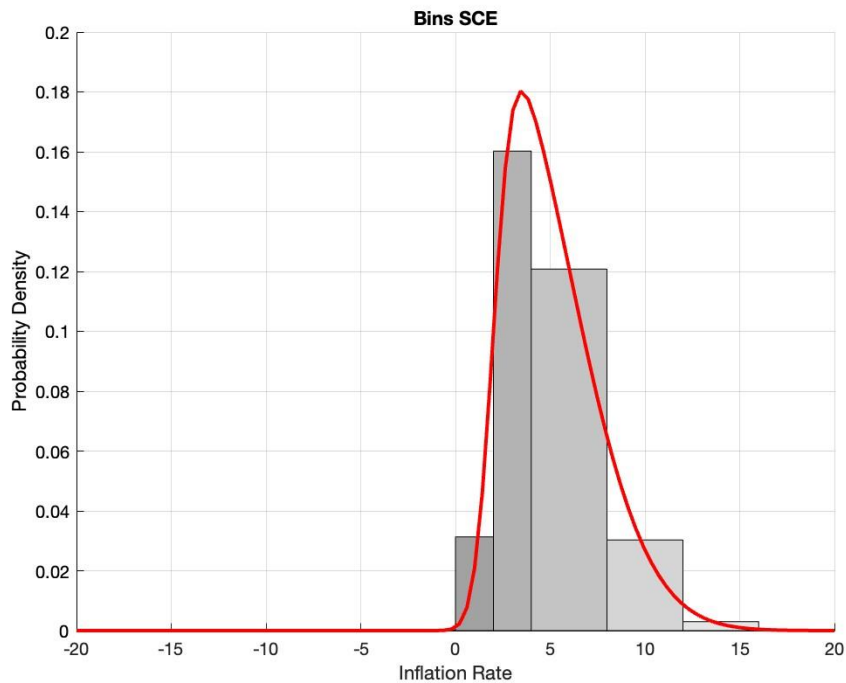
Mapping of latent on elicited beliefs

Symmetric normal distribution (mean $\mu = 2$, standard deviation $\sigma = 4$); min-max 1st and 99th percentile

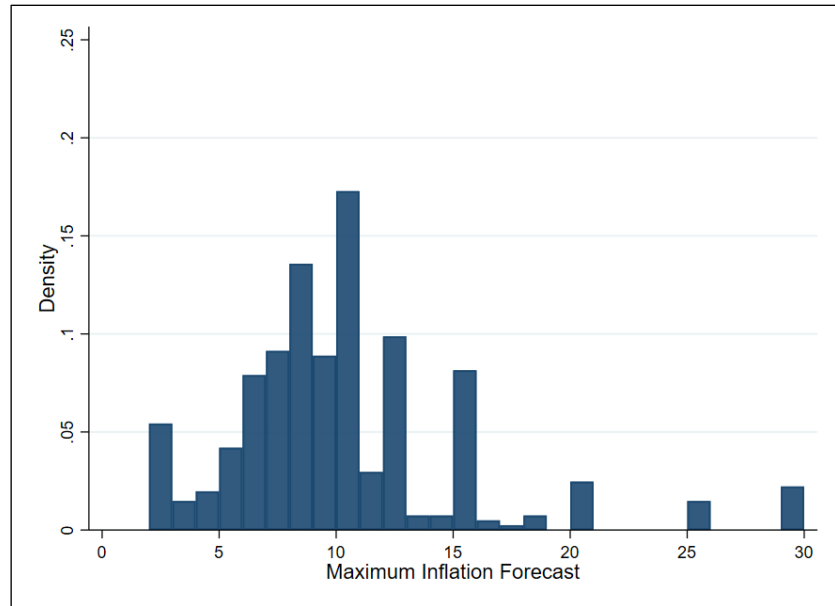
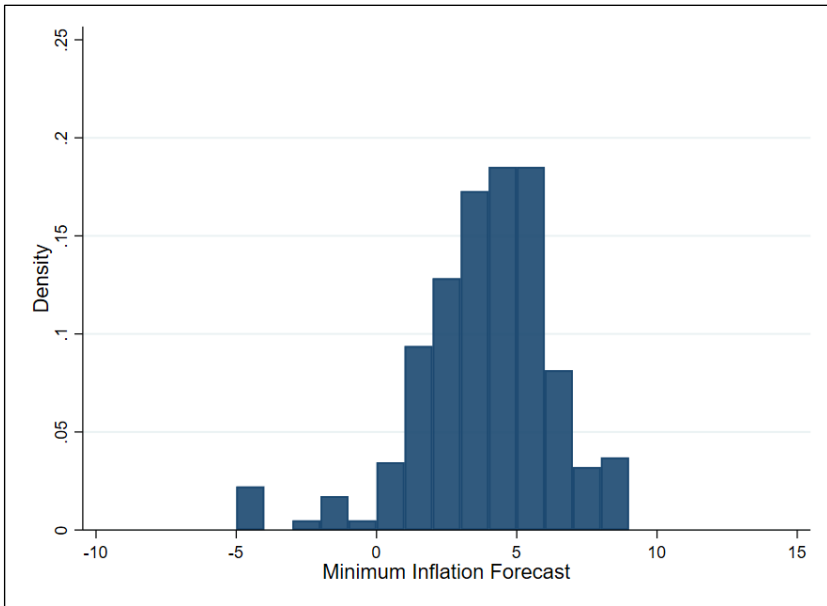
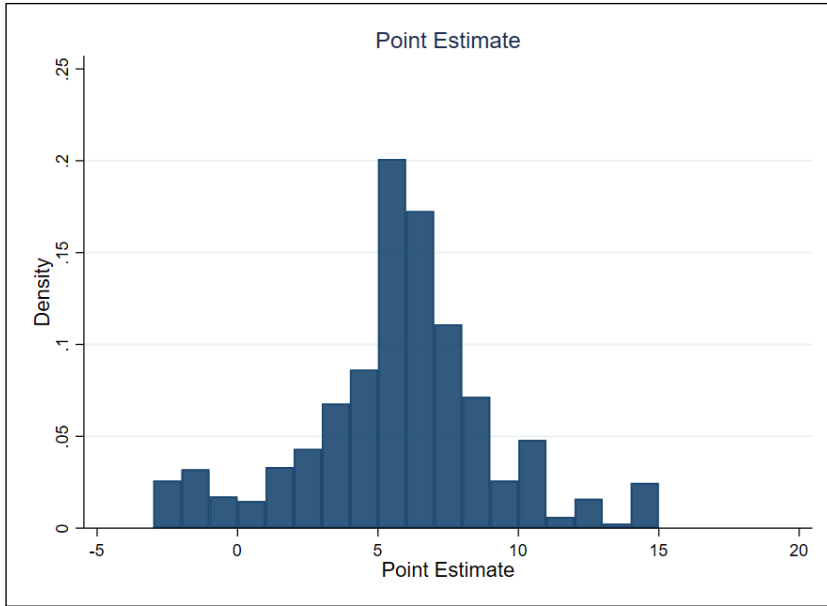


Mapping of latent on elicited beliefs

Skewed normal distribution (mean $\mu = 2$, standard deviation $\sigma = 4$, skewness $\alpha = 5$); min-max 1st and 99th percentile



Application: Distribution of Beliefs (winsorized)



Application: Distribution of Beliefs (winsorized)

