How Inflation Expectations De-Anchor: The Role of Selective Memory Cues

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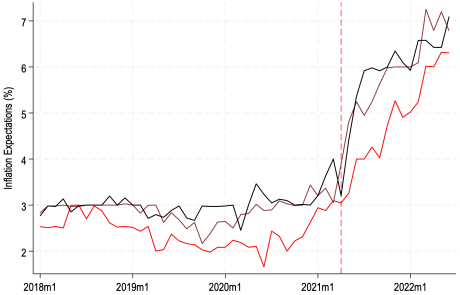
Introduction: How Do We Form Inflation Expectations?

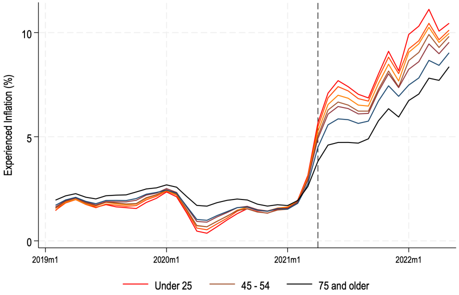
- Conventional belief: Inflation expectations are sticky
  - Depend on time-discounted slow-moving measures of life-time inflation experiences (Malmendier and Nagel (2011, 2016, 2021)); Processing costs lead to inattention and rigidity in belief updating (Sims (2003), Woodford (2009), Carroll (2003), Carroll et al. (2020), Bracha and Tang (2022))
- Often depend on experiences and attributes of respondents:
  - Socio-demographic characteristics (e.g. d'Acunto et al. (2021), Bruine de Bruin et al. (2010), Armantier et al. (2013), Binder et al. (2024)); mental models (Andre et al. (2022), Zuellig (2022)); social networks (Hajdini et al. (2023))
  - Role of recent, salient prices and price changes of groceries and gasoline (d'Acunto et al. (2022, 2023, 2024), Cavallo et al. (2017), Coibion and Gorodnichenko (2015), Gelman et al. (2016), Binder (2018))

Introduction: How Do We Form Inflation Expectations?

- This paper:
  - The data show de-anchoring in 2021, not stickiness
  - Present a model of inflation expectations based on memory and *selective* recall as in Bordalo et al. (2023, 2025)
  - Evidence for new state-dependent inflation expectations formation, micro-founded in cognitive psychology (Baddeley 1997, Kahana 2012) — rigid expectations when inflation is anchored, but sharp instability during inflation surges
  - Instability is cohort-specific, depends on experiences.
  - Whether expectations are elicited as density or point forecasts changes average expectations
- The evidence is inconsistent with either a Bayesian model or mechanical experience effects. Points to a psychologically realistic memory model.

Motivation State-Dependent Element in Inflation Expectations

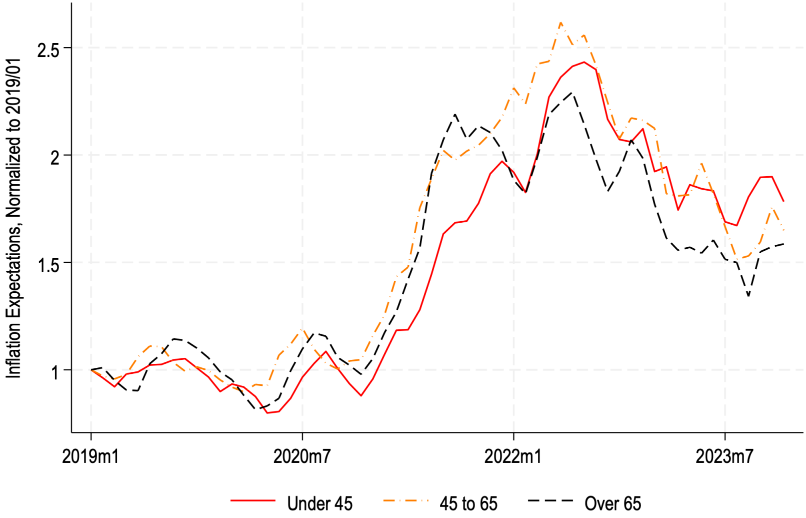




1. Rapid belief updating during recent inflation surge – more rapid for older cohorts
2. Puzzling because new data has less impact on older cohort's database; also, older cohorts experienced *less* current CPI inflation.

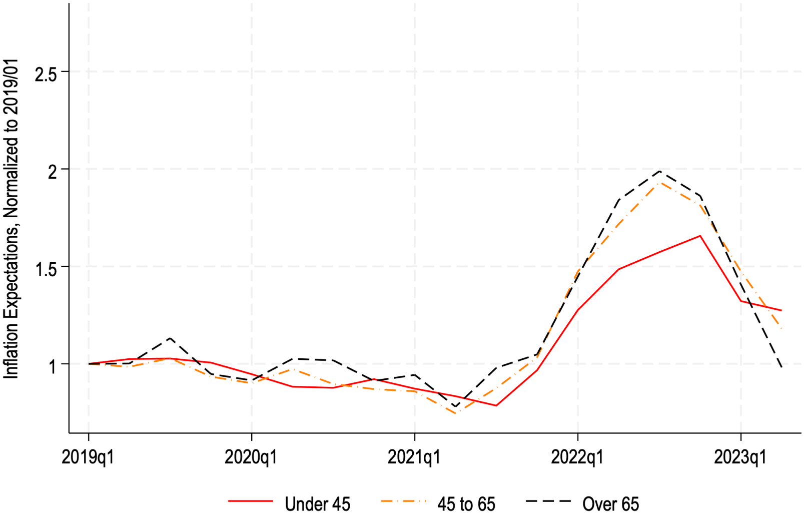
Theory of *selective* recall (of high-inflation episodes) to explain.

Further Motivation: US Michigan Survey of Consumers

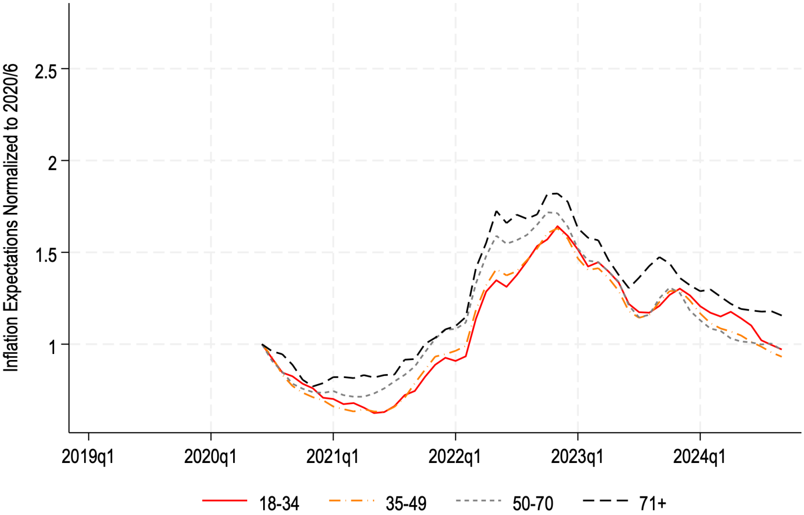


- Older cohorts increased inflation expectations faster than younger cohorts who catch up

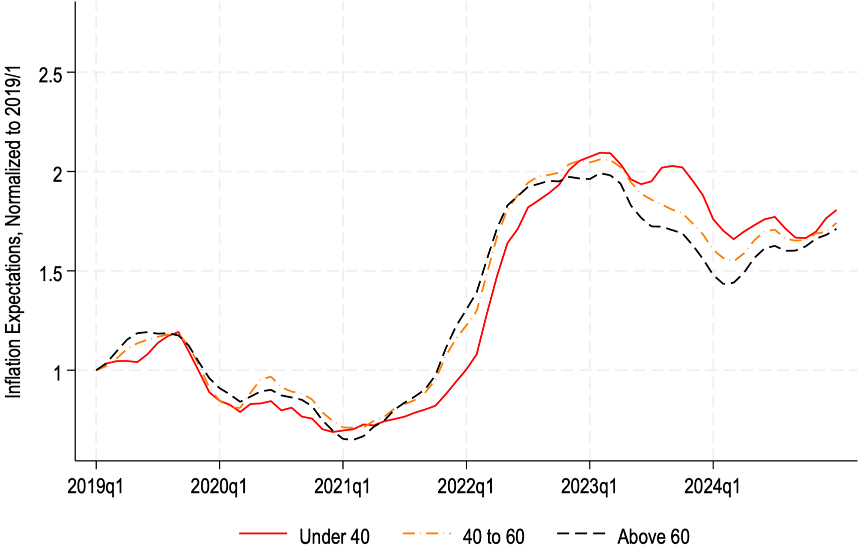
Further Motivation: Bank of England Inflation Attitudes Survey



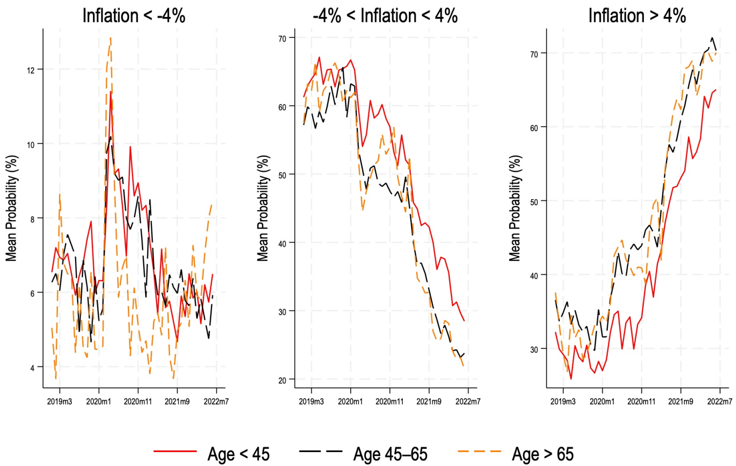
Further Motivation: ECB Consumer Expectations Survey (EU)



Further Motivation: Cabinet Office Consumer Trend Survey (Japan)



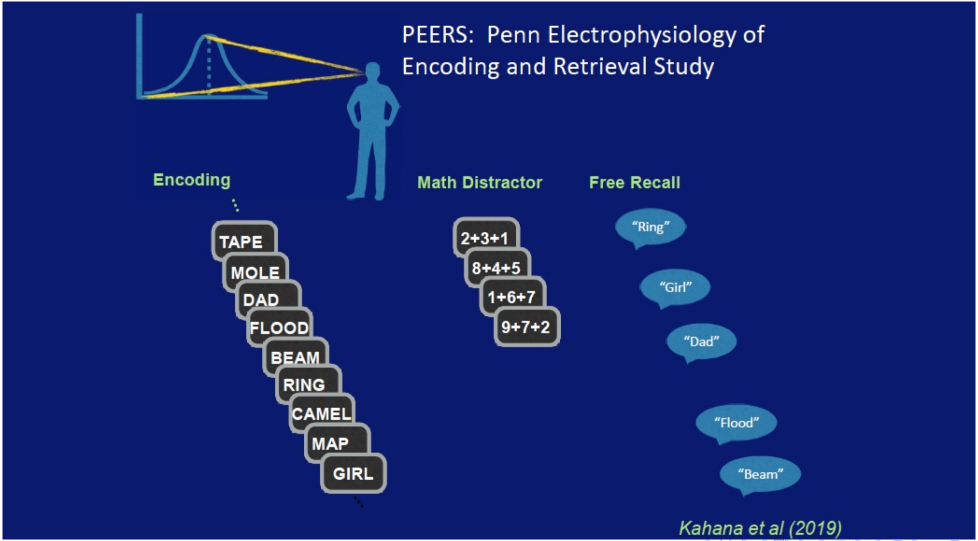
Further Motivation: Age-Dependent Dis-Anchoring



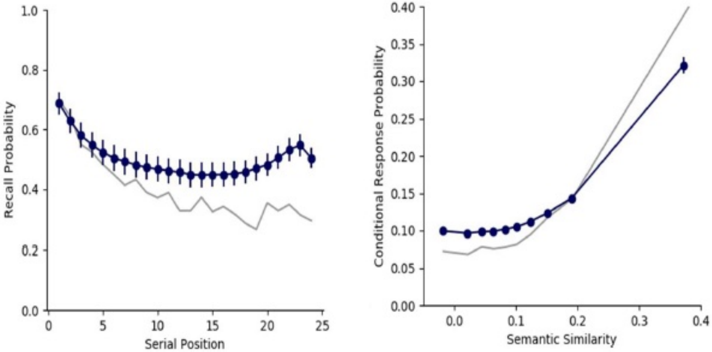
- In elicited forecast densities, the old in the US shifted weight to higher inflation ranges ($> 4\%$) while the young stick more to middle ranges (-4% to 4%).

Basis for Model: Regularities on Selective Recall from Cognitive Science

- Experiments: How do we recall what we studied/experienced?



Basis for Model: Primacy, Recency and Similarity



- Retrieval of experiences from memory database depends on similarity in
  - temporal context, in a U-shaped fashion: recency, but also primacy
  - semantic context; similarity between cue and experiences
    - cued with “parent:” more likely to recall dad than girl
    - cued with 11% inflation: more likely to recall 11% than 3% inflation

Next Steps:

1. How to think about these regularities in an economic model of inflation expectations
2. Evidence from U.S. inflation expectations data

Model: Setup

- Bordalo et al. (2023, 2025): Individuals selectively recall experiences from their memory database given a cue to form inflation expectations. Similarity of experiences with cue determines recall probabilities.
- Database at time t: quarterly inflation rates experienced by an individual of age a since age 16, $\Pi_t = (\pi_{t-s})_{s \leq a}$ with $s = 16, ..., a$. Robust to earlier start dates.
- Cue at time t: temporal context and inflation estimation task, including the event E considered. Three features embedded in $\pi_{t,E} = (t, \pi_t, \bar{\pi}_{E,t})$.
  - Temporal context t implies similarity to recent and early experiences (relative to a.)
  - Task implies numerical similarity to current inflation π_t the decision-maker sees, and event E she thinks about, described by average experienced inflation in E, $\bar{\pi}_{E,t}$.

Model: Setup

- Similarity: exponentially decays in "divergence" of features:

$$d(\pi_{t-s};\pi_{t,E}) \quad = \quad \beta(s/a)+\sigma q_1(\pi_{t-s}-\pi_t)^2+\sigma q_2(\pi_{t-s}-\bar{\pi}_{t,E})^2$$

  - Primacy and recency effects captured by inverse U-shaped divergence: $\beta(x)=-\beta_1(x)^2+\beta_2 x$ with $\beta_1,\beta_2\geq 0$.
  - Numerical similarity: π_{t-s} harder to recall if different from current task, π_t, and average experienced value in E, $\bar{\pi}_{t,E}$. $\sigma>0$ captures the strength of similarity, $q_i>0$ the relative weight of each dimension.

- Subjective recall probability :

$$r(\pi_{t-s}|\pi_{t,E}) \propto e^{-d(\pi_{t-s};\pi_{t,E})}$$

  - More frequently experienced inflation rates in the database are more likely to be retrieved; less similar inflation rates are less likely to be retrieved

Model: Survey Beliefs and Expectations

- Belief about inflation range R, e.g. $R = [2\%, 4\%]$ (explicitly or implicitly depending on E):

$$Pr(R|\pi_{t,E}) = \sum_{\pi_{t-s} \in R \cap \Pi_t} r(\pi_{t-s}|\pi_{t,E})$$

- Point expectations:

$$E[\pi_{t+1}|\pi_{t,\mathfrak{R}}] = \sum_{\pi_{t-s} \in \Pi_t} r(\pi_{t-s}|\pi_{t,\mathfrak{R}})\pi_{t-s}$$

  - Recall and hence beliefs are state-dependent via π_t and $\bar{\pi}_{t,E}$
  - Beliefs depend on which event is elicited in the forecast task – important implications for consistency across survey belief elicitations

Next: Testable Propositions

Two typical elicitations in surveys:

- Point expectation $E = \mathfrak{R}$
- Forecast density $E_1, ..., E_k$ with $\bigcup E = \mathfrak{R}$

Two sets of predictions:

1. In both elicitations, beliefs depend on temporal and numerical cues, interacted with frequency in the database
2. Systematic inconsistency between the two elicitations. Density-based elicitation *explicitly* prompts recall of rarely experienced events and affects probability weights.

Prediction 2. has a new implication for selective memory:

- rejects any rational model (including Bayesian models) in which agents hold a consistent belief system.

Elicited Point Expectations

- Linearized around zero temporal and numerical similarity around $\beta_1 = \beta_2 = \sigma = 0$:

$$
\begin{aligned}
\mathbb{E}(\pi_{t+1}|\pi_{t,\mathfrak{R}}) &\approx \bar{\pi}_{t-1} \\
&+ \beta_1 \cdot \mathrm{cov}_t\left(\frac{s^2}{a^2}, \pi_{t-s}\right) - \beta_2 \cdot \mathrm{cov}_t\left(\frac{s}{a}, \pi_{t-s}\right) \\
&- \sigma \cdot q_1 \cdot \mathrm{cov}_t\left[\pi_{t-s}, (\pi_{t-s} - \pi_t)^2\right] - \sigma \cdot q_2 \cdot \mathrm{cov}_t\left[\pi_{t-s}, (\pi_{t-s} - \bar{\pi}_{t-1})^2\right]
\end{aligned}
$$

Interpretation:

- Higher inflation during lifetime, $\bar{\pi}_{t-1}$: higher inflation expectations in the future.
- Covariance captures interference. Easier for a person to recall high inflation if
  - her high inflation experiences are very early or close to present
  - her high inflation experiences are numerically similar to π_t (and $\bar{\pi}_{t-1}$)
- Novel state-dependent element in formation of inflation expectations:
  Sharp belief changes possible due to numerical similarity despite slow-moving database.

Data

- Data from Michigan Survey of Consumers (MSC), and the New York Fed's Survey of Consumer Expectations (SCE).
- Monthly data, 1978-2022 (MSC), 2013-2022 (SCE), rotating panels.
- Point estimates from MSC and SCE, forecast densities from SCE.
- Current and experienced realized inflation from the Shiller database (Shiller, 2005)
- Starting at age 16, measure experiences at a quarterly frequency, using annualized quarterly CPI growth rate.
- Current-inflation cue: annualized quarterly inflation rate realized three months preceeding forecast.
- Complementary data: CPI inflation forecasts from the Survey of Professional Forecasters (SPF).

Elicited Point Expectations: Results

Panel A. MSC					
Average Experienced Inflation: $\bar{\pi}_{t-1}$:	0.280***	0.324***	0.554***	0.562***	0.319***
	(0.027)	(0.062)	(0.069)	(0.064)	(0.058)
Temporal Context Quadratic Component : $Cov(s^2, \pi_{t-s})/a^2$		-0.056	2.255***	1.947***	1.814***
		(0.526)	(0.589)	(0.518)	(0.527)
Temporal Context Linear Component: $Cov(s, \pi_{t-s})/a$		-0.202	-3.095***	-2.617***	-1.769***
		(0.699)	(0.775)	(0.696)	(0.644)
Dissimilarity average inflation: $Cov((\pi_{t-s}-\bar{\pi}_{it-1})^2, \pi_{t-s})$			-0.003***	-0.002**	-0.002*
			(0.001)	(0.001)	(0.001)
Dissimilarity current inflation: $Cov((\pi_{t-s}-\pi_t)^2, \pi_{t-s})$			-0.002***	-0.004***	-0.006***
			(0.001)	(0.000)	(0.001)
SPF inflation forecast				-0.041	0.234***
				(0.102)	(0.062)
Constant	3.019***	2.849***	2.145***	2.111***	2.321***
	(0.122)	(0.248)	(0.256)	(0.360)	(0.104)
Observations	229,495	229,495	229,495	217,818	217,818
R-squared	0.091	0.091	0.093	0.060	0.044

- Strong evidence for the three memory effects: basic experience effect (row 1); U-shaped temporal context with both primacy and recency (row 2 and 3); numerical similarity (rows 4 and 5)

Elicited Point Expectations: Results

Panel B. SCE					
Average Experienced Inflation: $\overline{\pi}_{t-1}$:	0.212***	0.464*	1.046***	0.931**	2.175***
	(0.074)	(0.242)	(0.392)	(0.395)	(0.374)
Temporal Context Quadratic Component : $Cov(s^2,\pi_{t-s}) / a^2$		5.292**	7.218**	6.371**	19.083***
		(2.555)	(2.853)	(2.835)	(2.790)
Temporal Context Linear Component: $Cov(s,\pi_{t-s})/a$		-6.543*	-9.608**	-8.351**	-26.657***
		(3.564)	(4.061)	(4.040)	(3.942)
Dissimilarity average inflation: $Cov((\pi_{t-s}-\overline{\pi}_{it-1})^2,\pi_{t-s})$			-0.010	-0.009	-0.001
			(0.007)	(0.007)	(0.007)
Dissimilarity current inflation: $Cov((\pi_{t-s}- \pi_t)^2,\pi_{t-s})$			-0.002***	-0.002***	-0.008***
			(0.001)	(0.001)	(0.001)
SPF inflation forecast				0.646*	0.937***
				(0.354)	(0.306)
Constant	5.699***	5.263***	3.810***	2.639**	-0.163
	(0.216)	(0.452)	(0.884)	(1.061)	(0.959)
Observations	139,583	139,583	139,583	139,583	139,583
R-squared	0.114	0.115	0.115	0.115	0.104
Demographic Characteristics	YES	YES	YES	YES	YES
Year Fixed Effect	YES	YES	YES	YES	NO

- Again, strong evidence in SCE data for the three memory effects
- Quantitatively, selective recall of equal economic magnitude

Elicited Point Expectations – Medium Horizons Results (24-36 Months)

	(1)	(2)	(3)	(4)	(5)
	Medium-Term Inflation Expectations (t+24, t+36)				
Average Experienced Inflation: $\bar{\pi}_{t-1}$:	0.148*	0.259	0.945**	0.940**	1.707***
	(0.082)	(0.253)	(0.359)	(0.377)	(0.352)
Temporal Context Quadratic Component : $Cov(s^2,\pi_{t-s}) /a^2$		0.406	0.585*	0.581	1.397***
		(0.334)	(0.347)	(0.362)	(0.333)
Temporal Context Linear Component: $Cov(s,\pi_{t-s})/a$		-1.443	-2.375	-2.355	-5.926***
		(1.368)	(1.431)	(1.501)	(1.389)
Dissimilarity average inflation: $Cov((\pi_{t-s}-\bar{\pi}_{it-1})^2,\pi_{t-s})$			-0.018***	-0.018***	-0.017**
			(0.007)	(0.007)	(0.006)
Dissimilarity current inflation: $Cov((\pi_{t-s}- \pi_t)^2,\pi_{t-s})$			-0.000	-0.000	-0.002**
			(0.001)	(0.001)	(0.001)
SPF inflation forecast				0.023	-0.433
				(0.265)	(0.323)
Constant	5.518***	5.386***	3.586***	3.549***	3.118***
	(0.246)	(0.450)	(0.803)	(0.823)	(0.892)
Observations	139,700	139,700	139,700	139,700	139,700
R-squared	0.079	0.079	0.079	0.079	0.074
Demographic Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	NO

- Key difference from short-term expectations results:
  - Similarity with mean inflation rate more important than similarity with current rate.
- Long-term expectations are shaped by long-term experiences, indicating that different cohorts have different medium-run *inflation anchors*.

Elicited Density Forecasts

- The odds of E_j versus a base E_b, linearized around zero temporal and numerical similarity around $\beta_1 = \beta_2 = \sigma = 0$, given n_k, the frequency of E_k for $k \in (b, j)$, and range midpoints π_k are:

$$\begin{aligned}\frac{\Pr(E_j|\pi_t, E_j)}{\Pr(E_b|\pi_t, E_b)} \quad &\approx \quad \frac{n_j}{n_b} + \beta_1 \cdot \frac{n_j}{n_b} \cdot \frac{\left(\bar{s}_j^2 - \bar{s}_b^2\right)}{a^2} - \beta_2 \cdot \frac{n_j}{n_b} \cdot \frac{(\bar{s}_j - \bar{s}_b)}{a} \\ &- \quad \sigma \cdot q \cdot \frac{n_j}{n_b} \cdot \left[(\pi_j - \pi_t)^2 - (\pi_b - \pi_t)^2\right]\end{aligned}$$

- Prediction: Odds increase in *relative* frequency, temporal context ($\beta_1 > 0, \beta_2 > 0$ defining inverse U-shaped distance) and similarity ($\sigma > 0, q > 0$).
- Additional, amplifying interaction with relative frequency n_j / n_b.
  - If inflation increases from 2% to 10%, the assessed probability of the 8%-12% range should go up for everybody, but especially so for people having lived more 8%-12% experiences.
- Key mechanism due to selective recall: elicitation of E_j itself helps think about this *specific* event, stimulating retrieval.

Elicited Density Forecasts: Same Interaction of Cues with Database

	Odds Ratio				
	(1)	(2)	(3)	(4)	(5)
Frequency Ratio	0.0162***	0.0230***	0.0242***	0.0230***	0.0242***
	(0.000682)	(0.00131)	(0.00131)	(0.00131)	(0.00132)
Relative Frequency Ratio x Relative Recency Squared	0.104***	0.0251***	0.0350***	0.0251***	0.0350***
	(0.00464)	(0.00728)	(0.00755)	(0.00728)	(0.00755)
Relative Frequency Ratio x Relative Recency	-0.106***	-0.0731***	-0.0866***	-0.0731***	-0.0866***
	(0.00412)	(0.00629)	(0.00687)	(0.00629)	(0.00687)
Relative Frequency Ratio x Relative Dissimilarity	-2.26e-05***	-8.20e-06**	-1.06e-05***	-8.23e-06**	-1.06e-05***
	(2.38e-06)	(3.43e-06)	(3.87e-06)	(3.42e-06)	(3.87e-06)
SPF				0.000858	0.00814
				(0.00615)	(0.00521)
Constant	0.0453***	0.171***	0.173***	0.171***	0.173***
	(0.00251)	(0.00293)	(0.00280)	(0.00305)	(0.00272)
Observations	491,072	567,767	570,799	567,775	570,822
R-squared	0.255	0.295	0.307	0.295	0.307
Demographic *x* Range Fixed Effects	No	Yes	Yes	Yes	Yes
Year *x* Range Fixed Effects	No	No	Yes	No	Yes

- Evidence for same three memory effects: basic, relative experience effect increases odds (row 1); U-shaped relative temporal context with both primacy and recency (row 2 and 3); relative numerical dissimilarity decreases odds (row 4)

Elicited Density Forecasts: Elicitations Systematically Inconsistent

- Think of an elicited point forecast as a "weighted" density-based average:

$$\mathbb{E}(\pi_{t+1}|\pi_{t,\mathcal{R}}) = \sum_j w_{jt} \cdot \underbrace{\Pr(E_j|\pi_{E_j,t}) \cdot \pi_j}_{\text{range } j \text{ expected value}} \tag{1}$$

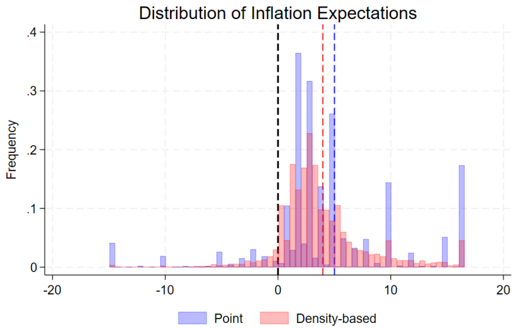
  Under any rational model, $w_{jt} = 1$. Not with selective memory: $w_{jt} < 1$ if range π_j is "forgotten" when forming point expectation.

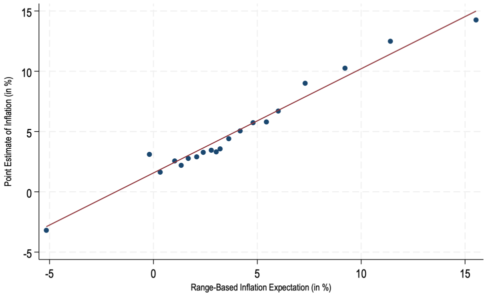
- Point forecasts are above density ones if experiences are more similar to higher π_j:

$$\underbrace{\mathbb{E}(\pi_{t+1}|\mathcal{R}, \pi_t)}_{\text{point expectation}} \approx \underbrace{\mathbb{E}(\pi_{t+1}|R)}_{\text{density-based expectation}} + \sigma \cdot q \cdot \mathbb{E}\left[\pi_j \cdot (\bar{d} - d_j)\,|R\right].$$

  Selective memory: systematic discrepancy across people and based on changing inflation. Disjunction fallacy (Fischoff et al. 1978).

Elicited Point Forecasts > Density Based Forecasts





- Point forecasts exceed density-based forecasts.
- Point expectations exhibit stunted sensitivity to density-based one. Closing of gap with higher forecasts.
- Density-based forecasts more sensitive to time-varying inflation due to selective recall: low-inflation ranges more overweighted for low inflation, weight shifts to high-inflation ranges for high inflation. Point expectations more anchored to slow-moving average experience.

Neglect of Deflation in Micro Data

Next:

- Regress each household's point forecast on the same household's estimated probability of different ranges
  - In a rational model, the coefficient is something close to the range midpoint
  - Under selective memory, the coefficient is smaller in magnitude if the range is neglected when forming point forecasts, and vice versa: Point forecasts exceed density-based means.

Neglect of Deflation

	Inflation Expectations Point Estimate	
	(1)	(2)
Inflation > 12%	0.196***	0.198***
	(0.009)	(0.010)
8% < Inflation < 12%	0.144***	0.156***
	(0.009)	(0.010)
4% < Inflation < 8%	0.088***	0.114***
	(0.009)	(0.010)
2% < Inflation < 4%	0.060***	0.091***
	(0.009)	(0.009)
0% < Inflation < 2%	0.048***	0.080***
	(0.009)	(0.009)
-2% < Inflation < 0%	0.021**	0.054***
	(0.009)	(0.009)
-4% < Inflation < -2%	0.014	0.038***
	(0.010)	(0.010)
-8% < Inflation < -4%	0.005	0.012
	(0.011)	(0.010)
-12% < Inflation < -8%	0.002	-0.025*
	(0.012)	(0.013)
Constant	-2.879***	-5.165***
	(0.918)	(0.932)

- Pattern of coefficients is consistent with the selective memory model:
  - households overweight high-inflation ranges
  - deflation ranges bear non-significant or even positive coefficients:

    If a household assigns higher probability to a deflation range, it even increases their point expectation.

Systematic-Similarity Based Bias

	One-Year-Ahead Inflation Expectation			
	(1)	(2)	(3)	(4)
Range-based inflation expectations	1.094***	1.078***	0.981***	0.919***
	(0.024)	(0.029)	(0.024)	(0.024)
Similarity of high inflation ranges to personal experiences	0.001***	0.001***	0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
(Similarity of high inflation ranges to personal experiences)^2		0.000***		-0.000***
		(0.000)		(0.000)
(Similarity of high inflation ranges to personal experiences)^3		-0.000		0.000***
		(0.000)		(0.000)
Constant	0.873***	0.858***	1.258***	1.455***
	(0.102)	(0.111)	(0.090)	(0.086)

- Estimates align with selective memory model:
  - Coefficient on density-based mean rises from 0.86.
  - Positive sign on similarity: attaching high probability to high inflation ranges different from average experiences lowers similarity so gap shrinks, relative to “normal” inflation.

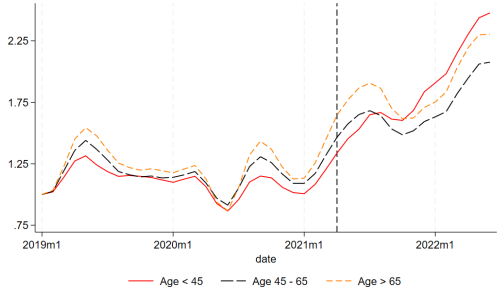
Summary of Results

- Well known regularities in selective recall explain household expectation formation about inflation.
- Strong state $\times$ cohort dependence based on changing inflation, cueing different experiences (interaction of cues and database).
- Strong violation of rationality. Systematic and state-dependent neglect of deflation when forming point forecasts.

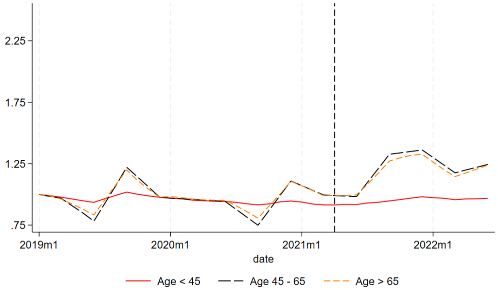
Next:

Quantify importance of selective recall to account for state-dependent de-anchoring especially by the elderly, and for re-anchoring

De-Anchoring of Inflation Expectations: Importance of Similarity



(1) Selective Memory Model



(2) Malmendier and Nagel (2016) Model

- State-dependent cues play quantitatively important role for de-anchoring, especially for stronger initial deanchoring by elderly.
- Experience-based learning can capture level differences in expectations across cohorts (see Malmendier and Nagel (2016)), but no meaningful experience-based instability.
- Combination of slowly evolving databases (Malmendier and Nagel (2016)) with time-varying cues and selective retrieval produces level differences *and* instability in beliefs.

Nowcasting: Re-Anchoring of Inflation Expectations

- Selective memory model: Similarity key to produce re-anchoring of expectations for inflation decline; experience-based learning model too rigid to generate re-anchoring.

Conclusion

- Laws of recall are highly relevant to belief formation
- Expectations are non-rational but not mechanically adaptive. Interaction of experiences and cues. Important for thinking about rigidity and overreaction
- Policy relevance: inflation policy shapes the memory database, realized inflation and communication act as state dependent memory cues