Inflation Uncertainty - Survey Evidence on Knightian and Bayesian Households

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Motivation

- Rapidly growing literature on measuring subjective beliefs
  - traditionally: qualitative answers or forecasts
  - recently: surveys elicit probabilities
    - $\rightarrow$ uncertainty = risk (Bayesian uncertainty)
- This project: do households think in probabilities?
  - our survey question: will inflation increase or not?
  - option to answer by probability or probability *interval*
    - $\rightarrow$ uncertainty can be Bayesian or Knightian
- Who is Knightian, who is Bayesian?
  - use rich set of covariates in online survey
- Inflation expectations/uncertainty
  - important for monetary policy

Message

1. Knightian responses reflect uncertain outlook
   - 23% Knightians overall, close to 50% away from certainty
   - Bayesian share driven by respondents near certainty
   - more Knightians among the precariously employed

   → suggests role for time-varying Knightian uncertainty

2. Knightian responses don't reflect lack of sophistication
   - more common for highly educated, rich, city dwellers
   - no relation to subjective difficulty of survey

   → consistent with rational theories of Knightian uncertainty

3. Knightian attitude does not shade forecasts
   - Bayesian & Knightian forecast distributions very close

   → cannot identify Knightian attitude with pessimism

Survey Question

"The current inflation rate in Germany is 2.0%. How likely do you think it is that inflation will increase in the next 12 months? You can either provide a probability (%) or a probability interval (between % and %). I would like to provide ..."

- a probability (%)
- a probability interval (between % and %)

The survey provided "Don't know"-options as well (chosen by only a very small fraction).

Then new survey frame where respondents could put in their numbers.

Data Cleaning

- Point probabilities:
  - Eliminate those that repeat just their inflation expectation
  - Eliminate entries < 10 & $\neq 5$
- Probability intervals:
  - Eliminate lower bound answers < 10 & $\neq 5$
  - Eliminate upper bound answers < 20 & $\neq 5, 10, 15$
  - Keep 1-30, 1-50, 1-99, 1-100 (one each)
- Inflation expectations:
  - Eliminate lower and upper 2.5%: keep inflation expectations in $[-2\%, 15\%]$

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Drawback of a one-off survey: can't distinguish!

Digression: ifo Business Tendency Survey

Additional Evidence: It's Likely a Choice

- New quantitative questions on realized and expected sales growth: 19 waves 2013:Q2 - 2017:Q4
- Participation stable: 400-500 firms per wave, focus on firms with 5 observations at least, that is, $>$ 4,000 firm-wave observations
- Firms asked at beginning of quarter
  - *You can either answer with a probability or a probability interval: how do you assess the probability (in percentage terms) that your sales will increase in the current quarter relative to last quarter...*
    - probability is
    - probability lies between . . . and . . .
    - don't know

Additional Evidence: It's Likely a Choice

- In any given quarter, 20-30% of firms choose a Knightian response.
- The fraction of Knightian households in the inflation survey falls also in that range: 23.1%.
- But 72% of firms choose a Knightian response at least once.
- Neglecting the time series dimension underestimates the preference for Knightian uncertainty expression in the population.
- Idiosyncratic churn of Knightian and Bayesian responses:

	Knightian in t	Bayesian in t
Knightian in t-1	0.39	0.61
Bayesian in t-1	0.16	0.84

Back to the Bundesbank's household survey . . .

Knightian Responses are associated with . . .

. . . better education:

Education	**Knightians**	**Diff. to rest**	
	%	diff	p-val
Vocational School	19.1	-0.043	0.1299
Professional School	19.7	-0.048	0.0372
A-levels plus	26.4	0.068	0.0027
Joint F-test: F-stat = 3.08, pval = 0.027			

Knightian Responses are associated with . . .

. . . higher income:

Income	**Knightians**	**Diff. to rest**	
	%	diff	p-val
Below 2,000 Euro	17.5	-0.067	0.0172
Above 2,000 Euro	24.2	0.067	0.0172
Joint F-test: F-stat = 5.69, pval = 0.017			

Knightian Responses are associated with . . .

. . . city dwellers:

City Size	**Knightians**	**Diff. to rest**	
	%	diff	p-val
Below 20,000	19.6	-0.057	0.0113
Above 20,000	25.3	0.057	0.0113
Joint F-test: F-stat = 6.43, pval = 0.011			

Knightian Responses are *not* associated with . . .

. . . perceived difficulty of survey:

Difficulty	**Knightians**	**Diff. to rest**	
	%	diff	p-val
Difficult	24.0	0.015	0.5827
OK	22.3	-0.010	0.6628
Easy	22.8	-0.001	0.9643
Joint F-test: F-stat = 0.16, pval = 0.85			

Knightian Responses and X-sectional Characteristics

Knightianism is not associated with unsophistication or innumeracy; quite the contrary!

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Confirms a related result from the ifo survey, where we see that Knightian firms use similarly sophisticated statistical methods in their sales planning as Bayesian firms.

Knightian Responses and Labor Market Status

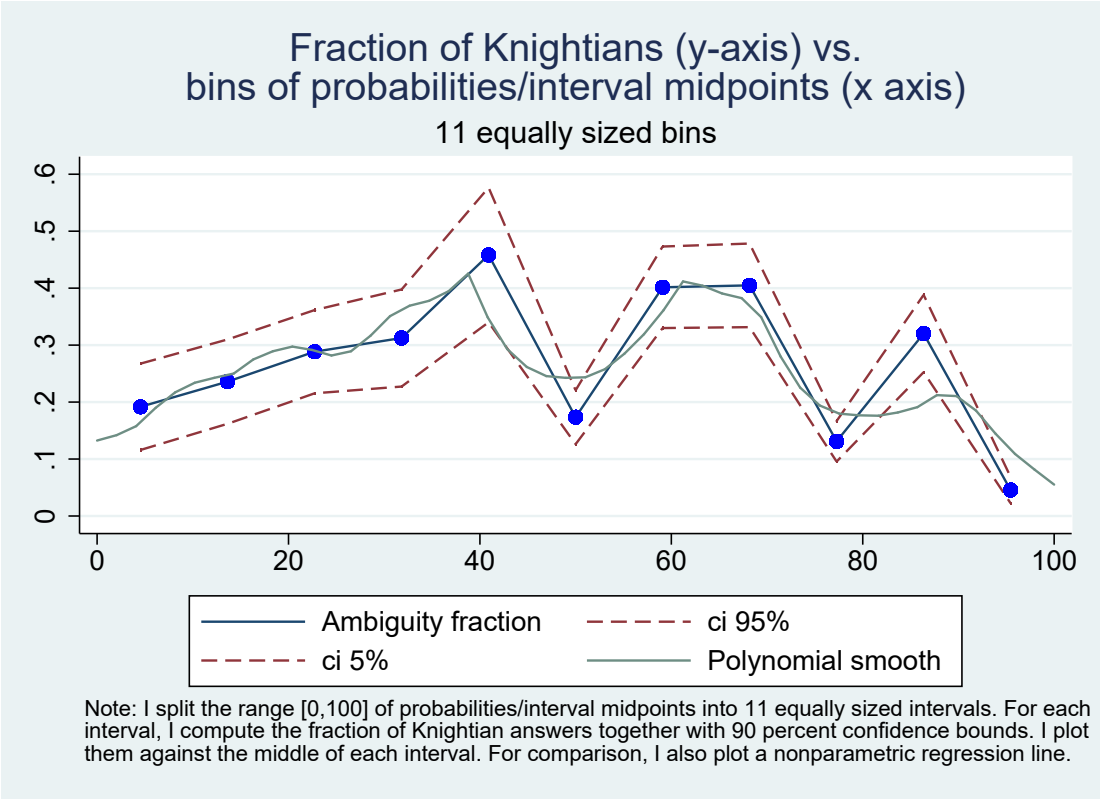
Part-time employed, mini-jobers, one-euro-jobers: highest fraction of Knightian responses!

Labor Market Status	**Knightians**	**Diff. to rest**	
	%	diff	p-val
Employed, full-time	20.3	-0.051	0.0249
Employed, part-time	29.8	-0.083	0.0133
Unemployed	25.0	-0.001	0.5989
Out of the labor force	22.7	-0.001	0.9543
Joint F-test: F-stat = 2.71, pval = 0.044			

Uncertainty expression a function of idiosyncratic but time-varying state.

Knightian Responses and Probabilities

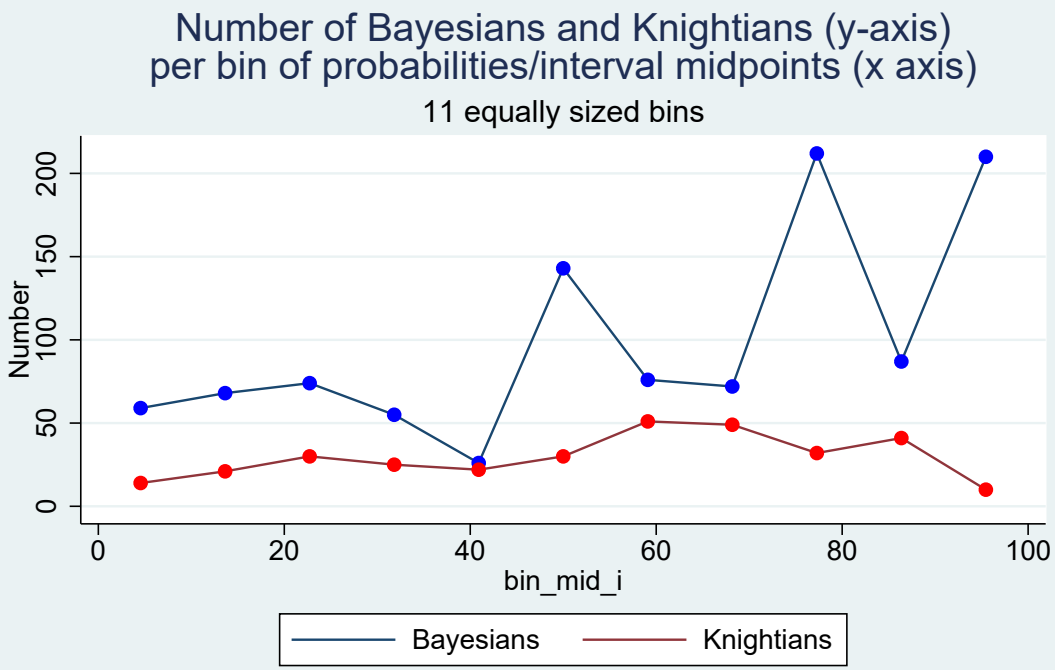
When households are relatively certain about an inflation increase, they choose a Bayesian answer.



Note: I split the range [0,100] of probabilities/interval midpoints into 11 equally sized intervals. For each interval, I compute the fraction of Knightian answers together with 90 percent confidence bounds. I plot them against the middle of each interval. For comparison, I also plot a nonparametric regression line.

Knightian Responses and Probabilities

Exception: 50% Bayesians.



Note: I split the range [0,100] of probabilities/interval midpoints into 11 equally sized bins. For each bin, I compute the number of Bayesian and Knightian answers and plot them against the middle of each bin.

Knightian Responses and Probabilities

Also interesting: the fact that in that survey wave many respondents are relatively certain that inflation will increase might be varying with *aggregate conditions*.

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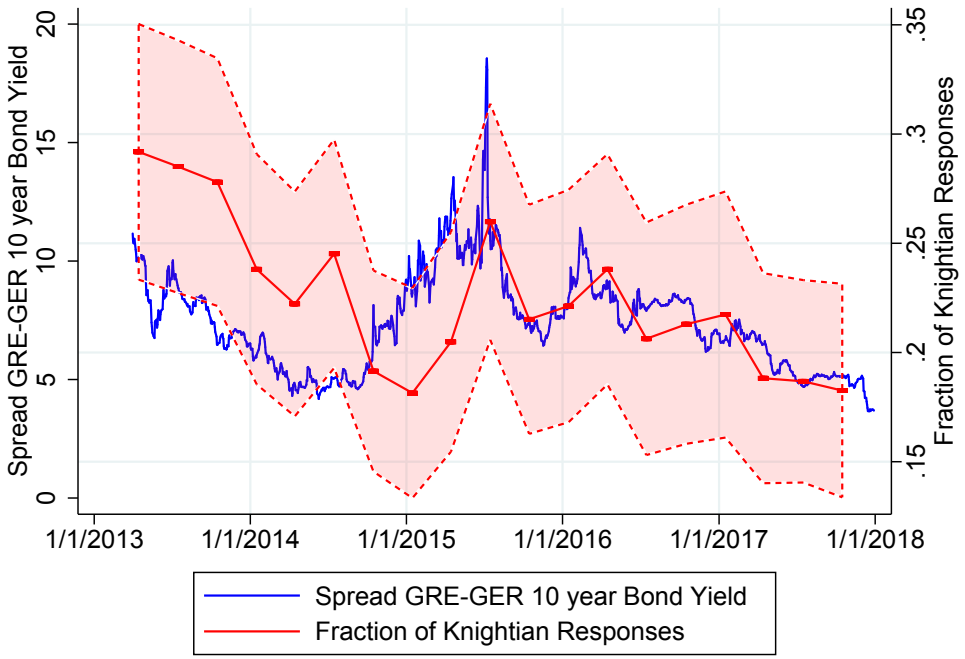
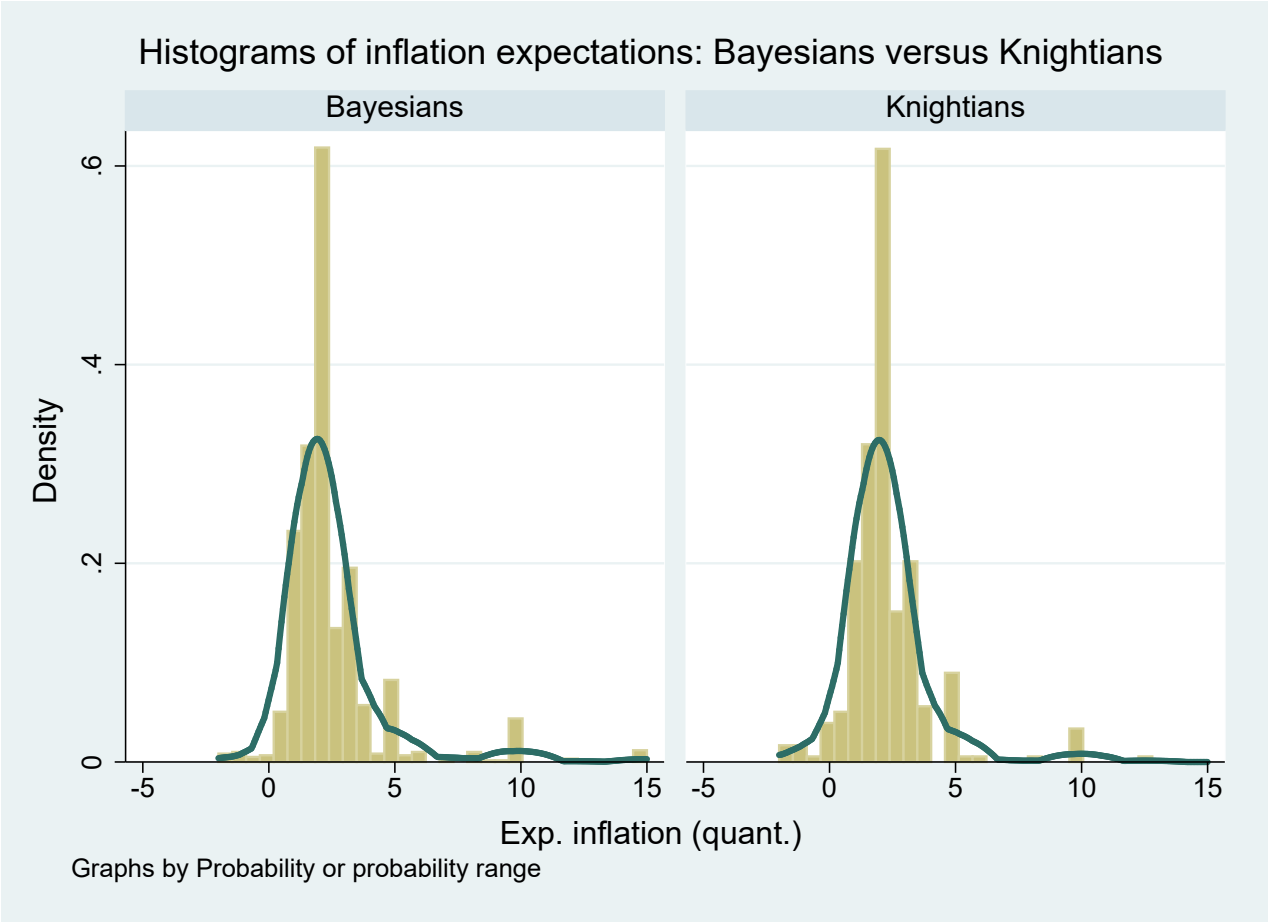


Dashed lines are 95% confidence bands.

Knightian Responses and Inflation Expectations

No difference in the distribution of inflation expectations.



Knightian Responses and Inflation Expectations

	nobs	mean	sd	5%	10%	25%	50%	75%	90%	95%
Overall	1407	2.4	2.0	0.7	1.0	1.5	2.0	2.5	4.0	5.0
Bayesians	1082	2.5	2.0	0.8	1.0	1.5	2.0	2.5	4.5	5.5
Knightians	325	2.3	1.7	0.3	1.0	1.5	2.0	2.5	3.5	5.0

Bayesians and Knightians capture *uncertainty attitudes* $\Rightarrow$
yet their inflation expectations are distributionally the same.

Unlikely households think in risk-neutral probabilities.

Summary

- Knightian responses: 23% of respondents
- Knightian responses
  - more prevalent for the highly educated, larger city dwellers, higher income
  - no relation to subjective difficulty of survey
  - most prevalent for the part-time employed
  - most prevalent for intermediate probabilities and intermediate probability interval positions
- Inflation expectation distributions no different for Bayesian & Knightian responses

Wish List

- Would like to combine with the question whether respondents think that a higher or lower than expected inflation rate would be good.
- Knightian responses as a way to express uncertain is likely time-varying:
  - Would like to know for unemployment rate, financial stability, etc.
- Knightian responses are associated with a particular form of uncertainty and do not indicate unsophistication.
  - Would like to confirm this in the time series.
- Indication that survey responses are not risk-neutral probabilites.
  - Would like to confirm this in the time series.