THE CAUSAL EFFECTS OF INFLATION UNCERTAINTY ON HOUSEHOLD'S BELIEFS AND ACTIONS

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The views expressed in the paper are those of the authors and do not necessarily reflect the views of the ECB or the Eurosystem. The ordering of authors' names is randomized.

MOTIVATION

- Recent inflation surge: revived debates about the effects of inflation on the **macroeconomy** and specifically on how **consumers** respond to inflation
  - how inflation expectations amplify and propagate inflationary shocks

- Recent research: focused on **how point predictions** for inflation affect beliefs and actions; but virtually **no evidence** on the (**distinct**) role of consumer **uncertainty about inflation**

- Identifying a causal effect of inflation uncertainty, that is also distinct from point predictions, is **empirically challenging**

EMPIRICAL CHALLENGES

- Expectations are clearly **endogenous** (e.g., correlations with time-varying unobservables, reverse causality, etc.), which makes it empirically challenging to identify their causal effect on households' decisions
- As high inflation tends to be more volatile inflation, inflation uncertainty should be systematically related to point predictions of inflation (i.e., 1st moments), making it **hard to disentangle** uncertainty effects from level effects
- **Measurement** of uncertainty in surveys is a relatively new development and linking it with actual household behavior is quite rare
- With decades of low and stable inflation in advanced economies, there has been **limited historical variation** in inflation uncertainty, making time series methods harder to use

WHAT WE DO

- **Randomized Control Trial**: We use an RCT approach with randomized information treatments to different groups of households to induce *exogenous* variation in household expectations and uncertainty about future inflation in the euro area.

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- **Follow-up Surveys to Measure Outcomes**: By tracking the same households over time, we can measure how/whether the exogenous variation in inflation uncertainty (net of first moment expectations) affected household decisions:
    i. **Spending** (durables and non-durables)
    ii. Propensity to invest and actual **investment** in financial assets
    iii. **Labor** search and employment outcomes
    iv. Other choices (e.g., **mortgage** type; **shopping** intensity)

WHAT WE FIND (PREVIEW)

Higher inflation uncertainty, **net** of first moment expectations, …

- **Reduces** the **spending** of households on 'big' ticket items
- **Reduces** the share of their desired and actual investment portfolio in **risky assets** and **increases** the share in **safe assets**
- **Increases** **job search** intensity leading to higher job acquisition for the unemployed and less under-employment for the employed
- FRM; more intense shopping

AN RCT APPROACH TO THE QUESTION

Elicit (1st & 2nd moment) **prior** expectations and planned decisions

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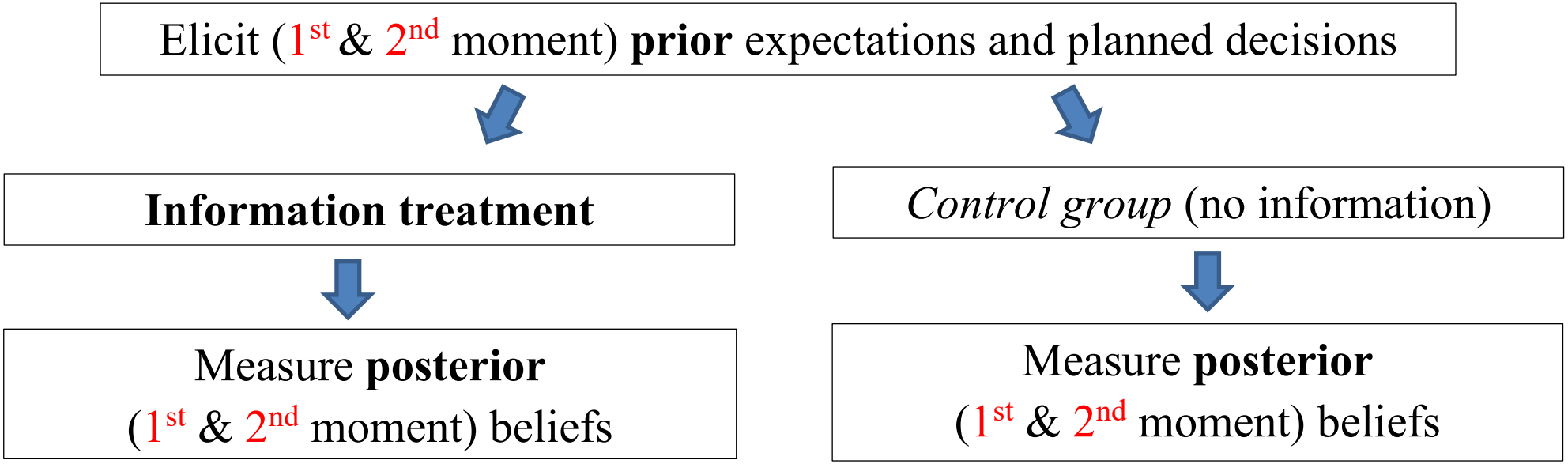
Elicit (1st & 2nd moment) **prior** expectations and planned decisions

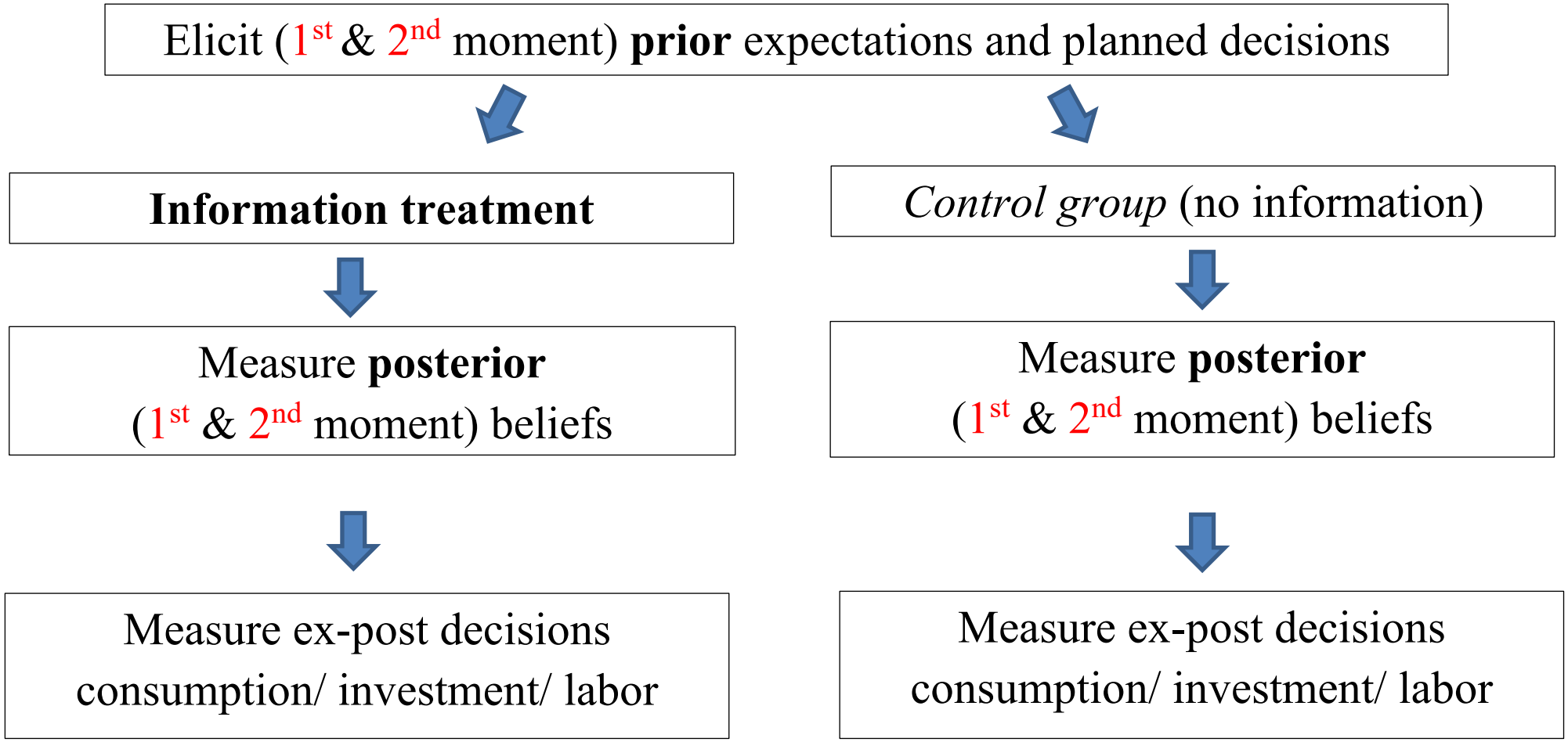
Information treatment

Control group (no information)

AN RCT APPROACH TO THE QUESTION



AN RCT APPROACH TO THE QUESTION



THE RCT IN PRACTICE

- Monthly Internet panel from the ECB Consumer Expectations Survey (CES); eleven largest EA countries; ~ 19,000 households

THE RCT IN PRACTICE

- Monthly Internet panel CES

- **September 2023:** RCT is fielded in a 10 min special-purpose survey following the regular survey wave

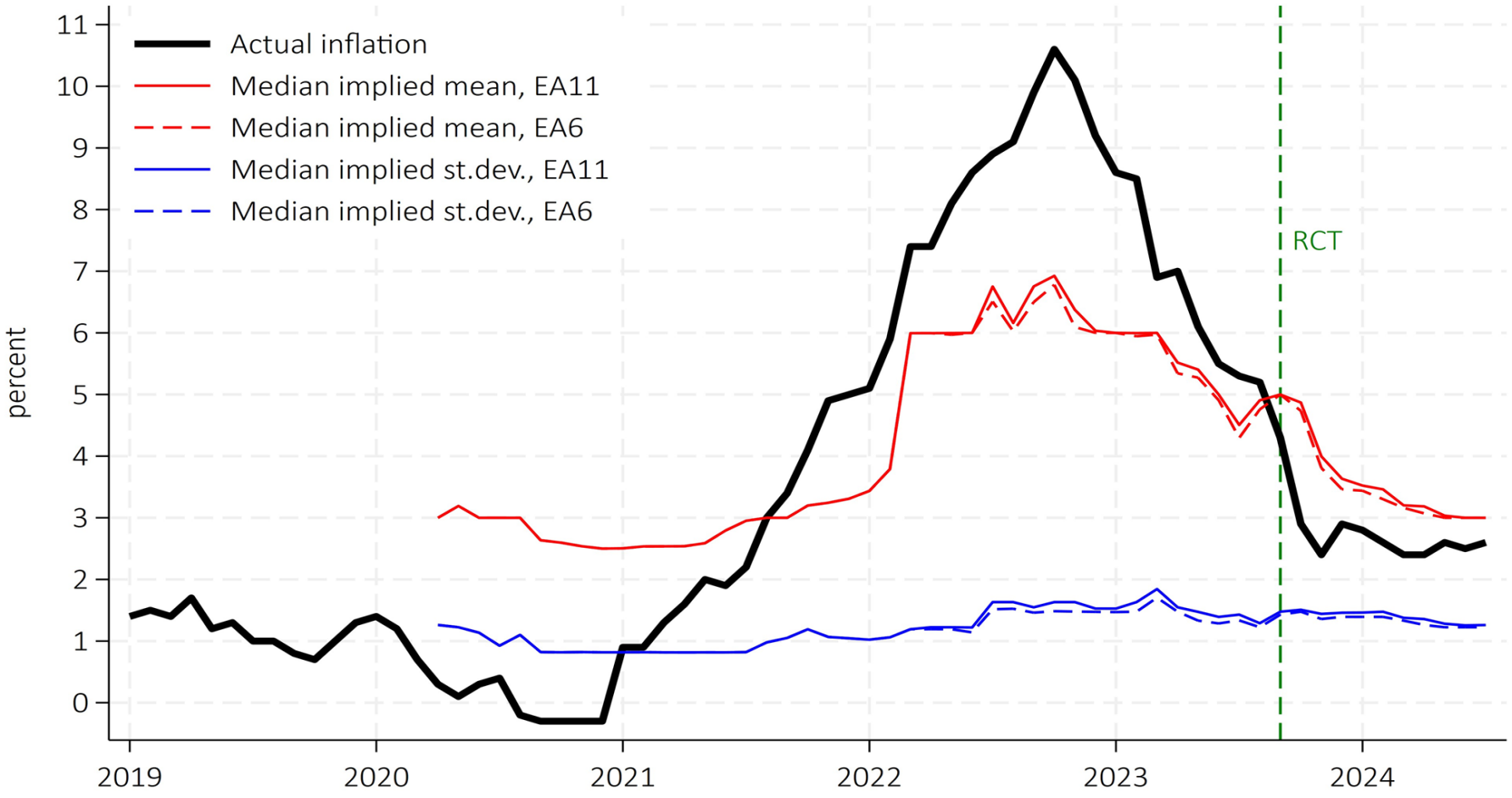
- **October, November, December 2023 & January 2024:** regular survey waves measuring spending, investment and labour market outcomes

Measure prior beliefs about inflation uncertainty and mean forecasts

*Now, we would like you to think about how much prices in general in the country you currently live in are likely to change **in 12 months from now**. We realise that this question may take a little more effort. Below you see ten possible ways in which prices could change. Please distribute 100 points among them, to indicate how likely you think it is that each price change will happen. The sum of the points you allocate should total 100.*

Prices will **increase** by 12% or more	_____
Prices will **increase** by 8% or more, but less than 12%	_____
Prices will **increase** by 4% or more, but less than 8%	_____
Prices will **increase** by 2% or more, but less than 4%	_____
Prices will **increase** by 0% or more but less than 2%	_____
Prices will **decrease** by more than 0% but less than 2%	_____
Prices will **decrease** by 2% or more, but less than 4%	_____
Prices will **decrease** by 4% or more, but less than 8%	_____
Prices will **decrease** by 8% or more, but less than 12%	_____
Prices will **decrease** by 12% or more	_____

Inflation Expectations and Uncertainty



1st and 2nd moments of inflation expectations were elevated at the time of the experiment

Measure posterior beliefs about inflation uncertainty and mean forecasts

Below you see three possible scenarios, starting with the LOWEST percentage change in prices in general and ending with the HIGHEST percentage change over the next 12 months. What do you think will be the approximate percentage change in prices in general for each of the scenarios?

Subsequently, respondents were asked to provide specific inflation/ deflation rates for each of the three scenarios:

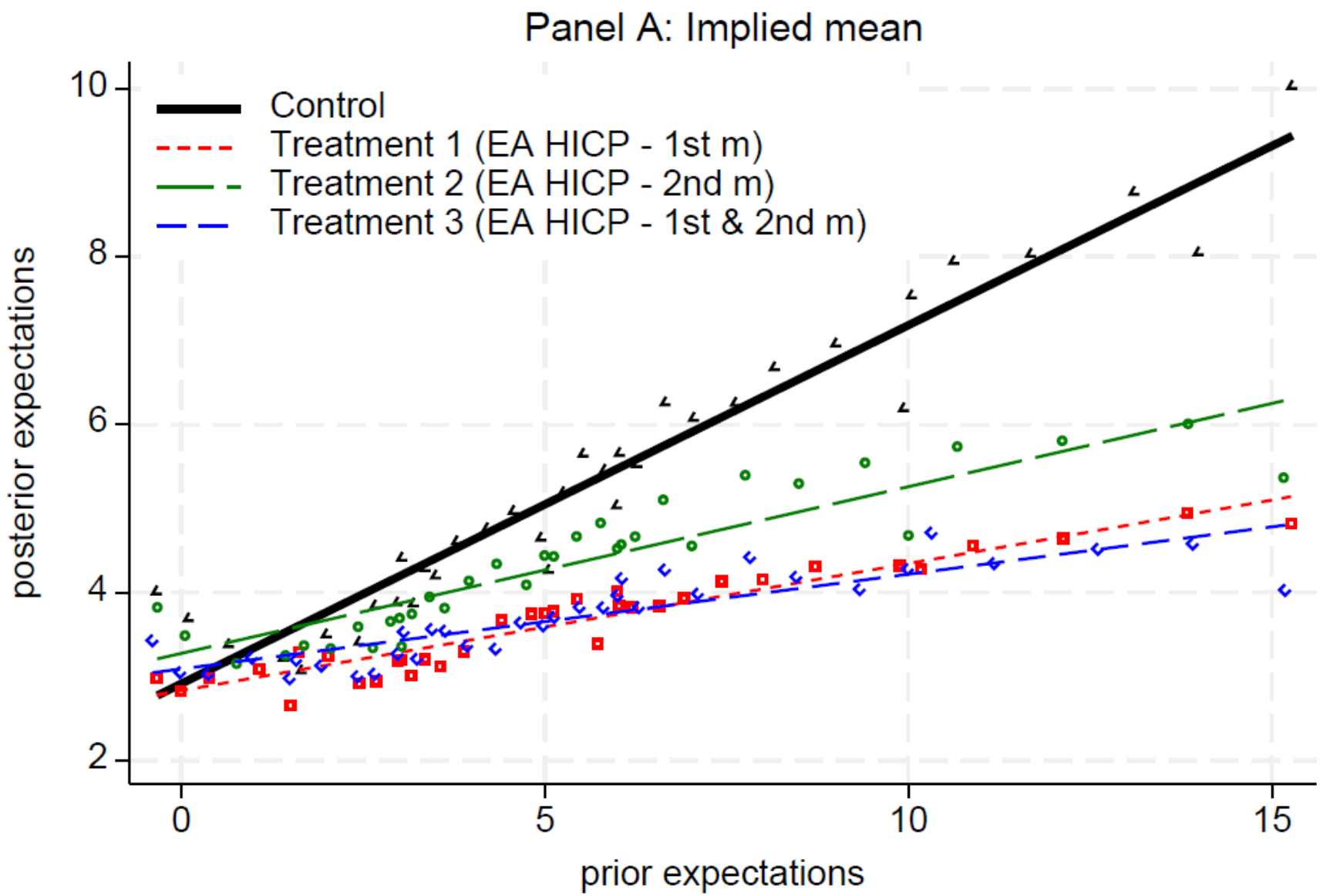
Now we ask you to think about the chance of the changes in prices you entered in the previous screen actually happening over the next 12 months. Please assign a percentage chance to each of the price changes you entered to indicate how likely you think it is that this price change will actually happen over the next 12 months. Your answers can range from 0 to 100, where 0 means there is absolutely no chance that this price change will happen, and 100 means that it is absolutely certain that the price change will happen. The sum of the points you allocate should total to 100.

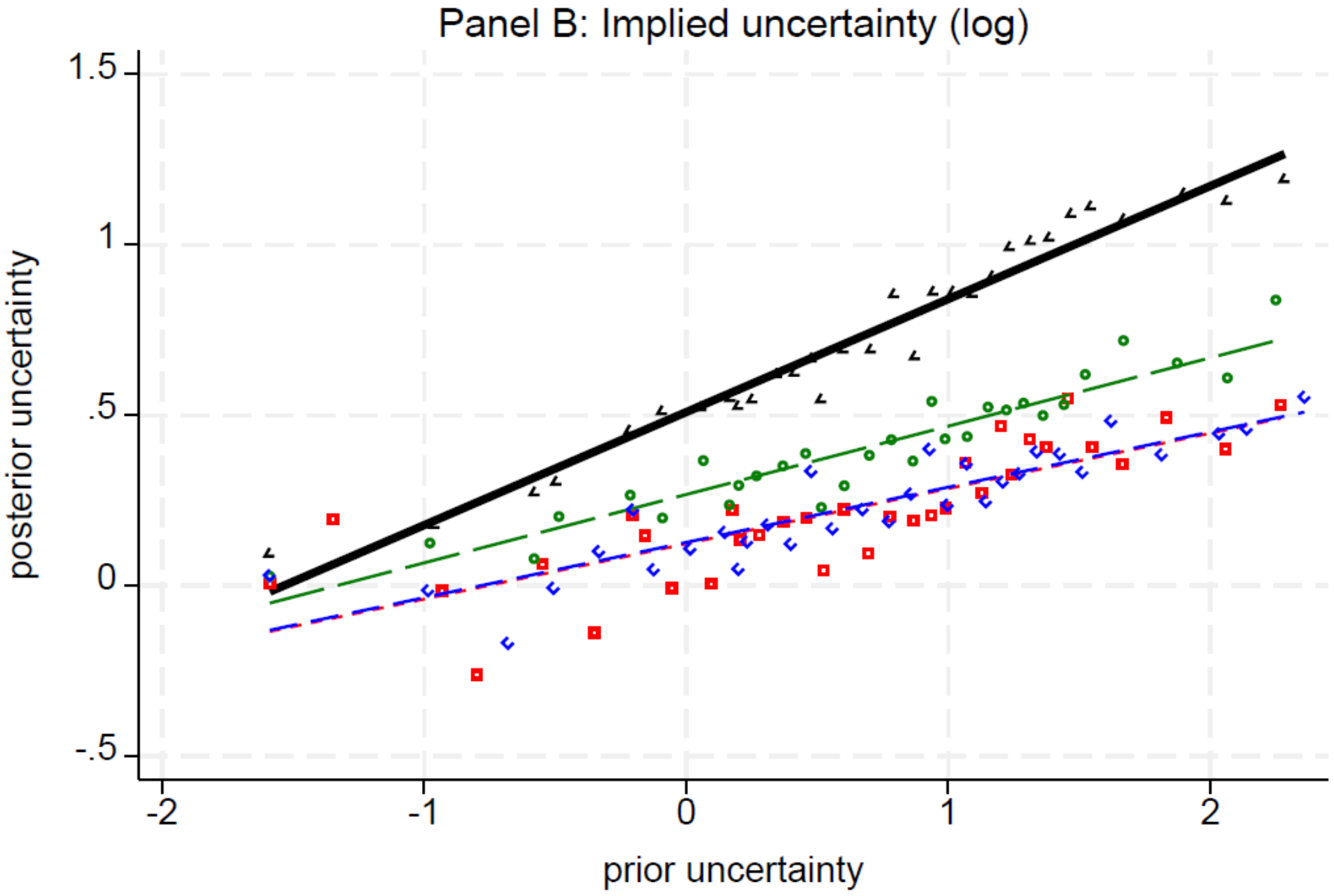
Information Treatments

T1 (first moment): *The average prediction among professional forecasters is that inflation in the euro area will be at 2.5% over the next 12 months.*

T2 (second moment): *Professional forecasters are exceptionally uncertain right now about inflation compared to recent years. As a result, there is a significant difference of 3.1 percentage points between the lowest and the highest predictions about inflation in the euro area over the next 12 months.*

T3 (first and second moment): *The average prediction among professional forecasters is that inflation in the euro area will be at 2.5% over the next 12 months. At the same time, professional forecasters are exceptionally uncertain right now about inflation compared to recent years. As a result, there is a significant difference of 3.1 percentage points between the lowest and the highest predictions about inflation in the euro area over the next 12 months.*


Panel A: Implied mean
Control
Treatment 1 (EA HICP - 1st m)
Treatment 2 (EA HICP - 2nd m)
Treatment 3 (EA HICP - 1st & 2nd m)
posterior expectations
prior expectations
10
8
6
4
2
0
5
10
15


Panel B: Implied uncertainty (log)
posterior uncertainty
1.5
1
.5
0
-.5
-2
-1
0
1
2
prior uncertainty

POST-TREATMENT BEHAVIOR: ESTIMATION

$$(\boldsymbol{Y_i}) = \alpha_1 Post_i^{mean} + \beta_1 Post_i^{uncert} + \alpha_0 Prior_i^{mean} + \beta_0 Prior_i^{uncert} + Controls + error_i$$

$$Post_i^{mean} = a_0 + \sum_{j=1}^{3} a_j \times I\{i \in Treat\ j\} + \sum_{j=1}^{3} b_j \times I\{i \in Treat\ j\} \times Prior_i^{mean} + \sum_{j=1}^{3} c_j \times I\{i \in Treat\ j\} \times Prior_i^{uncert} + Controls + error_i$$

$$Post_i^{uncert} = \tilde{a}_0 + \sum_{j=1}^{3} \tilde{a}_j \times I\{i \in Treat\ j\} + \sum_{j=1}^{3} \tilde{b}_j \times I\{i \in Treat\ j\} \times Prior_i^{mean} + \sum_{j=1}^{3} \tilde{c}_j \times I\{i \in Treat\ j\} \times Prior_i^{uncert} + Controls + error_i$$

POST-TREATMENT BEHAVIOR I: CONSUMPTION

Consumer spending on durables & non-durables

'Big ticket' items (extensive margin) [**October, November, December 2023 & January 2024 wave**]:

- house,
- car,
- durables,
- holidays,
- luxury goods
- other

Non-durable goods **[October 2023 & January 2024 waves]**

Purchases of durable goods: One-month post-treatment

Dependent variable: indicator variable is a durable good is purchased*100

	Home	Durable	Car	Holiday package	Luxury items	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Posterior mean	0.421	4.812***	0.483	1.934	0.539*	0.451
	(0.268)	(1.369)	(0.315)	(1.578)	(0.283)	(0.863)
Posterior uncertainty (log)*100	-0.025**	-0.230***	-0.024*	-0.091	-0.021**	-0.055*
	(0.010)	(0.057)	(0.013)	(0.065)	(0.011)	(0.034)
Observations	11,514	11,509	11,504	11,513	11,519	11,481
R-squared	0.00	-0.04	-0.00	0.10	0.02	0.03
1st stage F-stat (mean)	118.5	114.7	117.6	115	117.7	112.4
1st stage F-stat (uncert)	99.38	99.33	98.19	100.5	100.6	100.1
KP Wald test	10.69	9.451	10.46	10.53	10.49	10.32

IU has sizeable negative effects, net of first moments, on spending

Purchases of durable goods: Two months post-treatment

Dependent variable: indicator variable is a durable good is purchased*100						
	Home	Durable	Car	Holiday package	Luxury items	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Posterior mean	0.747***	4.768**	1.283***	3.934**	0.686	2.254**
	(0.285)	(1.956)	(0.375)	(1.578)	(0.426)	(1.106)
Posterior uncertainty (log)*100	-0.026**	-0.228***	-0.051***	-0.163**	-0.037**	-0.099**
	(0.011)	(0.076)	(0.016)	(0.065)	(0.017)	(0.041)
Observations	10,825	10,818	10,809	10,815	10,812	10,804
R-squared	-0.00	-0.04	-0.02	0.06	0.05	0.05
1st stage F-stat (mean)	112.9	110.5	112	111.2	112.5	109.9
1st stage F-stat (uncert)	99.76	100.5	100.1	98.98	100.7	100.6
KP Wald test	9.678	9.329	9.257	9.199	9.052	9.462

Negative IU effects persist two months after the RCT…

Purchases of durable goods: Three months post-treatment

Dependent variable: indicator variable is a durable good is purchased*100						
	Home	Durable	Car	Holiday package	Luxury items	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Posterior mean	0.045	-0.538	0.409	2.997**	0.997**	2.669***
	(0.253)	(1.803)	(0.371)	(1.383)	(0.422)	(0.900)
Posterior uncertainty (log)*100	-0.011	-0.029	-0.028*	-0.141**	-0.052***	-0.143***
	(0.010)	(0.075)	(0.016)	(0.059)	(0.017)	(0.036)
Observations	6,525	6,528	6,528	6,507	6,520	6,521
R-squared	0.01	0.06	0.01	0.01	0.06	0.00
1st stage F-stat (mean)	68.31	66.52	67.12	65.50	68.30	68.71
1st stage F-stat (uncert)	57.86	58.52	58.51	56.02	59.87	59.92
KP Wald test	6.508	5.343	5.849	6.684	6.654	6.216

…and three months after the RCT, while they are no longer significant in Jan 2024

Purchases of durable goods: first-moment only

	Dependent variable: indicator variable is a durable good is purchased.					
	Home	Durable	Car	Holiday package	Luxury items	Other
	(1)	(2)	(3)	(4)	(5)	(6)
One month after treatment						
Posterior mean	-0.305***	-1.695***	-0.325***	-1.158**	-0.208***	-1.452***
	(0.066)	(0.400)	(0.078)	(0.501)	(0.071)	(0.267)
Observations	8,654	8,645	8,645	8,637	8,677	8,634
R-squared	0.01	0.05	0.02	0.12	0.04	0.03
1st stage F-stat (mean)	344.8	326.6	341.2	329	346.3	329.1

- very similar results two- and three-months post-treatment
- helps to reconcile with results from earlier RCTs on inflation expectations (Coibion et al. 2022 & 2023)

Purchases of durable goods: OLS, one month post-treatment

	Dependent variable: indicator variable is a durable good is purchased*100					
	Home	Durable	Car	Holiday package	Luxury items	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Posterior mean	0.077	-0.014	0.120	0.246	0.217***	0.685***
	(0.081)	(0.332)	(0.083)	(0.273)	(0.082)	(0.215)
Posterior uncertainty (log)*100	-0.131	3.383**	0.140	0.086	-0.465	-0.790
	(0.430)	(1.645)	(0.312)	(1.351)	(0.339)	(1.074)
Observations	11,514	11,506	11,502	11,512	11,519	11,483
R-squared	0.02	0.06	0.01	0.11	0.03	0.05

- small estimates of beliefs on durable goods purchases when using OLS, consistent with significant endogeneity of expectations
- similar results for longer horizons

Purchases of non-durable goods: one & four months post-treatment

Dependent variable: log monthly purchases of non-durable goods and services				
	One month after treatment	One month after treatment	Four months after treatment	Four months after treatment
	(1)	(2)	(3)	(4)
Posterior mean	-3.19	0.45	0.30	1.03
	(2.50)	(0.77)	(2.58)	(0.83)
Posterior uncertainty (log)	16.30		1.09	
	(9.97)		(10.40)	
Observations	11,250	8,445	8,641	6,519
R-squared	0.24	0.26	0.29	0.28
1st stage F-stat (mean)	114	210.3	96.73	189.3
1st stage F-stat (uncert)	101.4		86.99	
KP Wald test	10.61		9.498	

No discernible effects for non-durables

POST-TREATMENT BEHAVIOR II: INVESTMENT

II A) Propensity to Invest [**September wave, post-RCT**]: *"Imagine that you receive €10,000 to save or invest in financial assets. Please indicate in which of the following asset categories you will save/invest this amount."*

- current and savings accounts;
- stocks and shares;
- mutual funds and collective investments;
- retirement or pension products;
- short term bonds;
- long term bonds;
- Bitcoin or other crypto assets.

Portfolio shares out of 10k hypothetical windfall

	Cash	Current/Saving account	Stocks	Mutual funds	Retirement account	Bonds	Crypto assets	Other
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Posterior mean	0.52	-2.35	-0.88	1.14	1.04*	-0.23	0.16	0.44
	(1.07)	(1.64)	(0.66)	(0.71)	(0.60)	(0.55)	(0.20)	(0.52)
Posterior uncertainty (log)	-4.48	17.34***	2.48	-4.94	-6.50***	0.09	-0.87	-2.46
	(4.16)	(6.62)	(2.86)	(3.03)	(2.49)	(2.32)	(0.85)	(2.12)
Observations	13,601	13,601	13,601	13,601	13,601	13,601	13,601	13,601
R-squared	0.10	0.05	0.05	0.08	0.02	0.11	0.02	0.05
F (mean)	143.9	143.9	143.9	143.9	143.9	143.9	143.9	143.9
F (uncertainty)	122.5	122.5	122.5	122.5	122.5	122.5	122.5	122.5
KP Wald	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.78

Positive IU allocation effects into savings/ Negative IU allocation effects into retirement assets out of a 10k windfall

POST-TREATMENT BEHAVIOR II: INVESTMENT

II B) Actual portfolio allocation [November wave, Household Finance Module]

Do you/ your family own and, if yes, how much have you invested in each of the following assets

- current and savings accounts;
- stocks and shares;
- mutual funds and collective investments;
- retirement or pension products;
- short term bonds;
- long term bonds;
- Bitcoin or other crypto assets.
- Other

Actual portfolio shares

	Cash	Current/Saving account	Stocks	Mutual funds	Retirement account	Bonds	Crypto assets	Other
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Posterior mean	-0.36	-5.06***	0.71	-2.40***	3.79***	1.84***	-0.06	1.76***
	(0.36)	(1.50)	(0.45)	(0.54)	(1.01)	(0.32)	(0.06)	(0.66)
Posterior uncertainty (log)	1.43	24.03***	-3.69**	10.21***	-16.20***	-8.21***	-0.01	-7.78***
	(1.39)	(6.22)	(1.87)	(2.36)	(4.11)	(1.31)	(0.27)	(2.68)
Observations	9,121	9,121	9,121	9,121	9,121	9,121	9,121	9,121
R-squared	0.07	0.02	0.05	-0.04	-0.05	-0.11	0.01	0.06
F (mean)	101.1	101.1	101.1	101.1	101.1	101.1	101.1	101.1
F (uncertainty)	91.79	91.79	91.79	91.79	91.79	91.79	91.79	91.79
KP Wald	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30

Higher IU induces portfolio rebalancing away from risky and towards safe assets

POST-TREATMENT BEHAVIOR III: LABOR SUPPLY

- How many job applications do you plan to send out in the coming month? (all respondents)
- What is the likelihood that you will find a job over the next three months? (unemployed workers)
- What is the likelihood that you will loose your job over the next three months? (employed workers)
- What is the probability of looking for a job in the next three months? (employed workers)
- First and second moments of household net income growth over the next year (all respondents, September post-RCT)

Job search: one-month after treatment

	Job search intensity (# of job application)	Subj. prob. of finding a job in 3 months	Subj. prob. of losing a job in 3 months	Subj. prob. of looking for a job in 3 months
Posterior mean	-1.15***	-10.24**	-0.27	-1.81**
	(0.42)	(4.89)	(0.93)	(0.74)
Posterior uncertainty (log)	5.56***	36.50**	1.60	5.34*
	(1.71)	(17.07)	(3.44)	(3.04)
Observations	1,411	461	7,597	7,251
1st stage F-stat (mean)	11.03	2.383	70.18	75.18
1st stage F-stat (uncertainty)	10.14	3.878	65.76	69.30
KP Wald	1.887	1.232	5.896	9.996

Among the employed, higher uncertainty leads to higher expectation of searching for a new job but not because they expect to lose their job

Labor supply: Employment status four-months after treatment

	Employed (any)	Employed (full-time)	Employed (part-time)	Unemployed	Other (out of labor force, laid-off, etc.)
	(1)	(2)	(3)	(4)	(5)
Posterior mean	-0.259	-2.327	2.173*	0.822	-0.716
	(1.886)	(2.026)	(1.201)	(0.565)	(1.854)
100×log(Post. uncertainty)	0.044	0.161**	-0.121**	-0.071***	0.026
	(0.076)	(0.082)	(0.049)	(0.022)	(0.075)
Observations	8,666	8,666	8,666	8,666	8,666
R-squared	0.41	0.35	0.01	0.02	0.43
1st stage F-stat (mean)	96.75	96.75	96.75	96.75	96.75
1st stage F-stat (uncertainty)	85.54	85.54	85.54	85.54	85.54
KP Wald	8.570	8.570	8.570	8.570	8.570

With higher uncertainty, shifts out of UE and PT into FT work, consistent with increased search by employed and unemployed

Income growth: mean and uncertainty (post-RCT)

VARIABLES	Income growth, Mean	Income growth, Uncertainty, log
Posterior mean	-0.13	-0.03
	(0.22)	(0.03)
Posterior uncertainty (log)	1.07	0.35**
	(0.88)	(0.13)
Observations	13,448	13,418
R-squared	0.05	0.19
F (mean)	138.6	138.2
F (uncertainty)	119.7	116.3
KP Wald test	12.58	11.24

POST-TREATMENT BEHAVIOR III: OTHER CHOICES

Shopping intensity: "*In the next 12 months, how much time do you plan to spend searching and shopping for goods and services (e.g. visit shops, compare offers, search the internet) compared to what you currently do?"*

Mortgage type: "*Suppose you have to take out a mortgage to finance the purchase of a house/apartment today. Which one of the following types would you choose?*"

Inflation return to target: "*How long do you think will it take before inflation is close to 2% in the country you currently live in?*"

ECB perceived credibility: *"How likely do you think it is that the ECB will maintain price stability in the euro area economy over the next 3 years?"*

Additional Margins

	Shopping intentions	Mortgage choice: FRM	Time expected for inflation to return to 2% log(months)	ECB credibility
Posterior mean	-0.09***	-1.74*	0.01	-0.35
	(0.04)	(1.03)	(0.03)	(1.00)
Posterior uncertainty (log)	0.44***	13.10***	0.32**	0.06
	(0.14)	(4.46)	(0.13)	(3.87)
Observations	14,227	14,192	14,236	11,551
R-squared	0.08	0.01	0.07	0.43
1st stage F-stat (mean)	145.9	148.8	145.9	116.4
1st stage F-stat (uncertainty)	124.9	123.8	124.9	104
KP Wald	12.42	12.26	12.56	11.04

CONCLUSIONS

- Multiple treatments in an RCT: separate direct and indirect effects of expectations changes on decisions
- Particularly important for inflation expectations, since the 1st and 2nd moments are strongly positively correlated but generally have opposing effects on decisions

- Large and persistent effects of inflation uncertainty on household **durable goods** purchases, their **portfolio allocations,** and their **labor supply** decisions, net of first moment effects

- For policy purposes, the total effect is generally the most relevant statistic. Still, knowing how decisions respond to inflation expectations and uncertainty can be useful in designing communication strategies
  - To boost spending, we could try to raise inflation expectations **OR** reduce inflation uncertainty (doing both would be particularly effective)

Thank you!

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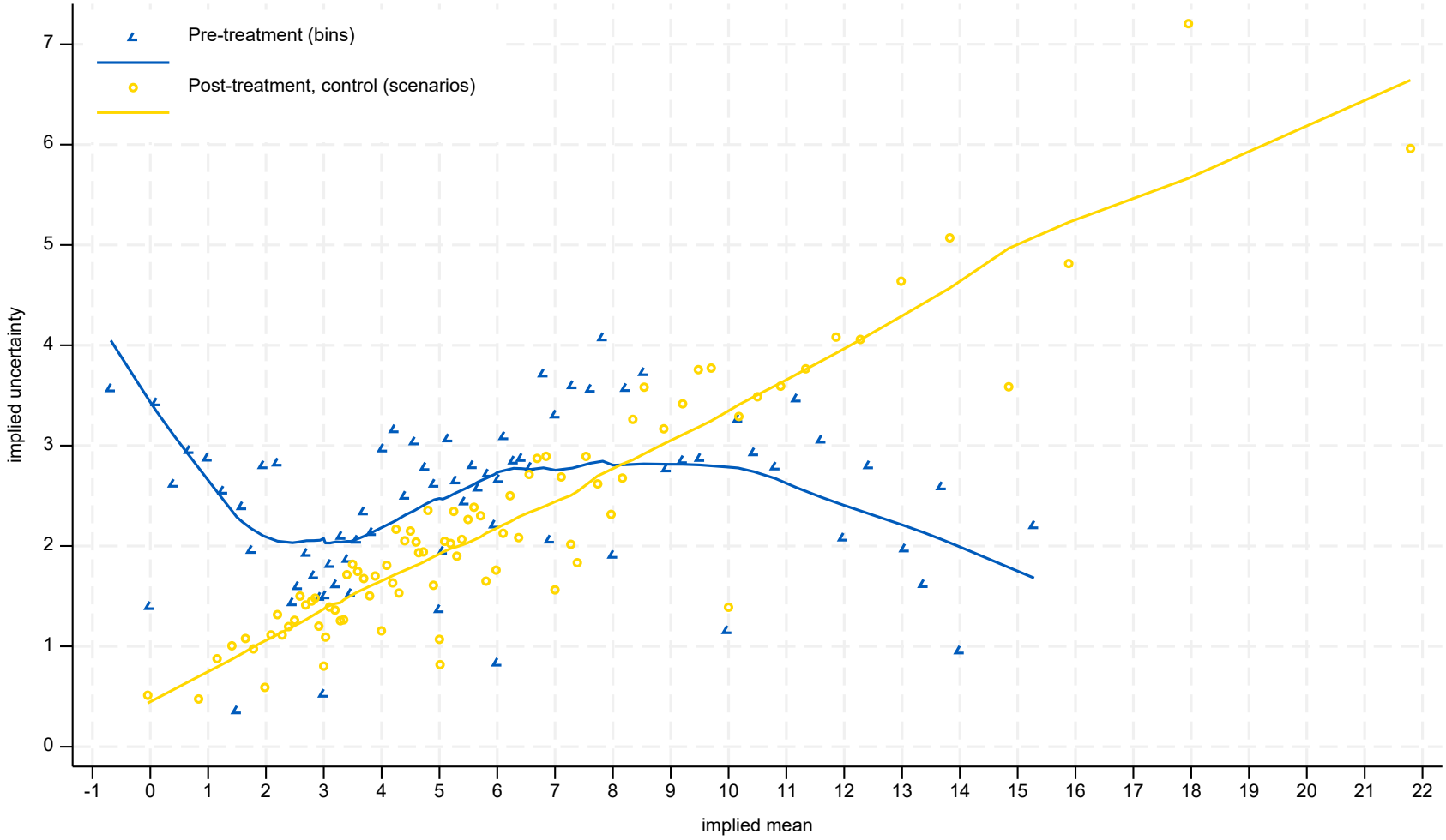

1st and 2nd moments of inflation expectations are positively correlated