Inflation and Trading

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Introduction

- Inflation is key risk for financial-market participants
- Negative relation exists empirically b/w inflation and stock returns
  (e.g., de Rubio Cruz et al., 2023; Fama, 1981; Fama and Schwert, 1977; Fang, Liu, and Roussanov, 2022)
- Many theories explain this relation that is at odds with intuition
  (e.g., Bhamra et al., 2023; Campbell, Pflueger, and Viceira, 2020; Modigliani and Cohn, 1979)
- Evidence on how inflation affects investor beliefs and choices scant

This paper

- Study directly how investors respond to inflation
- Exogenous variation in beliefs about inflation and its return impact
  - Randomized information experiment with customers of German bank
  - Mix of info about inflation and returns during past inflation
- Analyze effects of information provision on beliefs and choices
  - Elicit return expectations, mental models, etc. in survey
  - Track investors' trading choices using bank data
- Preview of results:
  - Estimates of return impact of inflation heterogeneous and too high
  - Info $\rightarrow$ return expectations $\downarrow$ b/c beliefs about impact of inflation $\downarrow$
  - Info $\rightarrow$ net purchases of stocks $\downarrow$ in survey and bank data

Plan for the talk

- Data and experimental design
- Prior beliefs about inflation and asset returns
- Treatment effects on return expectations
- Expectations and trading

Data

- Online survey experiment with customers of large German bank
- Invite all bank customers with brokerage account
- 2,843 completed responses, 18 min median response time
- Match survey responses to bank data
  - Set of demographics: age, zip code, marital status, etc.
  - Month-end portfolio holdings and each security transaction

Survey period

$\Rightarrow$ Inflation high and rising at time of and after intervention

Sample characteristics

Statistics:	Mean	SD	P25	P50	P75
Demographics and portfolio					
University completed (0/1)	0.66	0.47	0.00	1.00	1.00
Gross wealth (€ k)	345.09	302.76	87.50	375.00	750.00
Portfolio value (€ k)	127.88	256.08	5.64	28.75	114.59
Equity share (%)	0.84	0.23	0.77	0.95	1.00
Monthly trades (no.)	2.17	3.94	0.00	0.50	2.58
Monthly net buys (€)	607.96	1863.34	0.00	24.22	615.51
Perceptions and expectations					
Inflation rate today (%)	4.99	1.62	4.00	5.00	5.00
Inflation rate today relative to 1yr ago (%)	3.12	1.97	2.00	3.00	4.00
Inflation as recent trading motive (0/1)	0.42	0.49	0.00	0.00	1.00
Inflation top financial-market risk (0/1)	0.26	0.44	0.00	0.00	1.00

$\Rightarrow$ Sample: well-off, accurate inflation perception, inflation matters

Experimental design

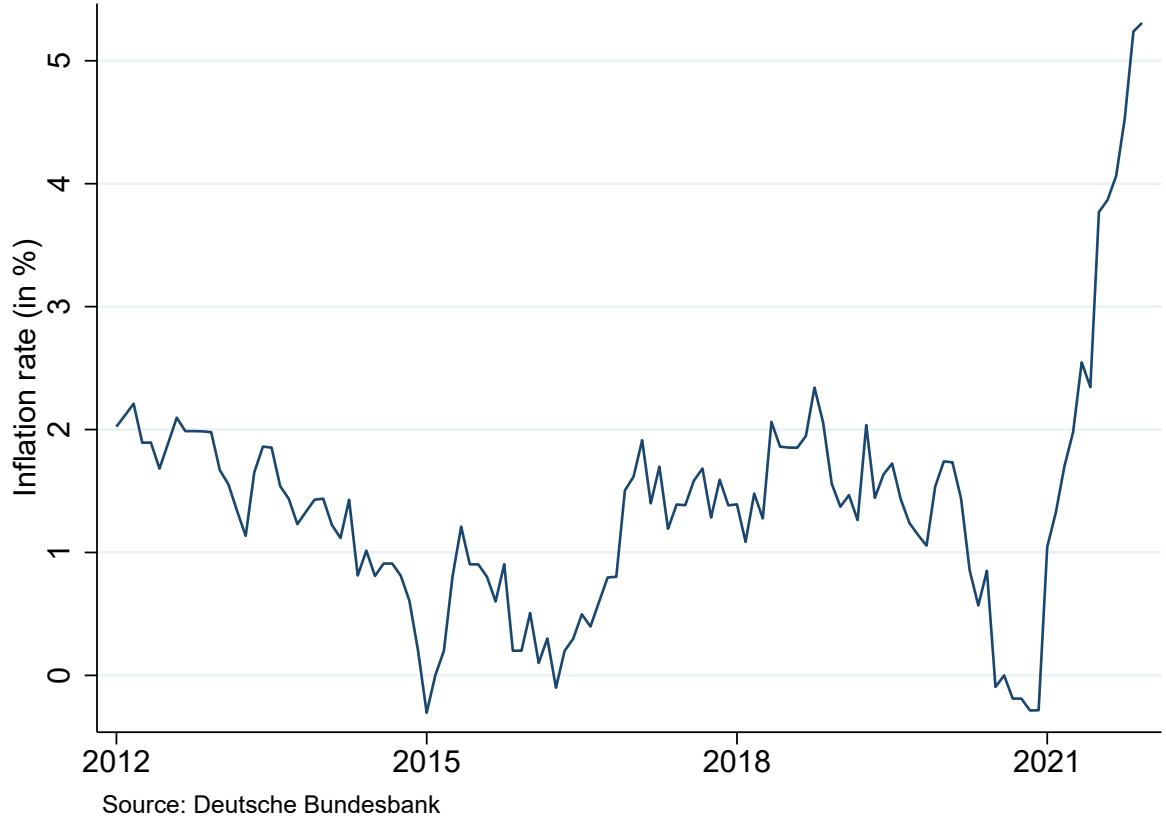
1. Pre-treatment section
   - Inflation beliefs and trading motives
   - Past unconditional and inflationary-period asset returns
2. Treatment section
   - Control group receives no information
   - T1: high current inflation and possibility of further rise
   - T2: actual returns during past inflationary periods
   - T3: T1 + T2 + explanations of past returns
3. Post-treatment section
   - Beliefs about inflation and economy, mental models
   - Return expectations and hypothetical portfolio choice

- Track investors over time to investigate actual trading choices

T1: high current inflation and possibly further rise

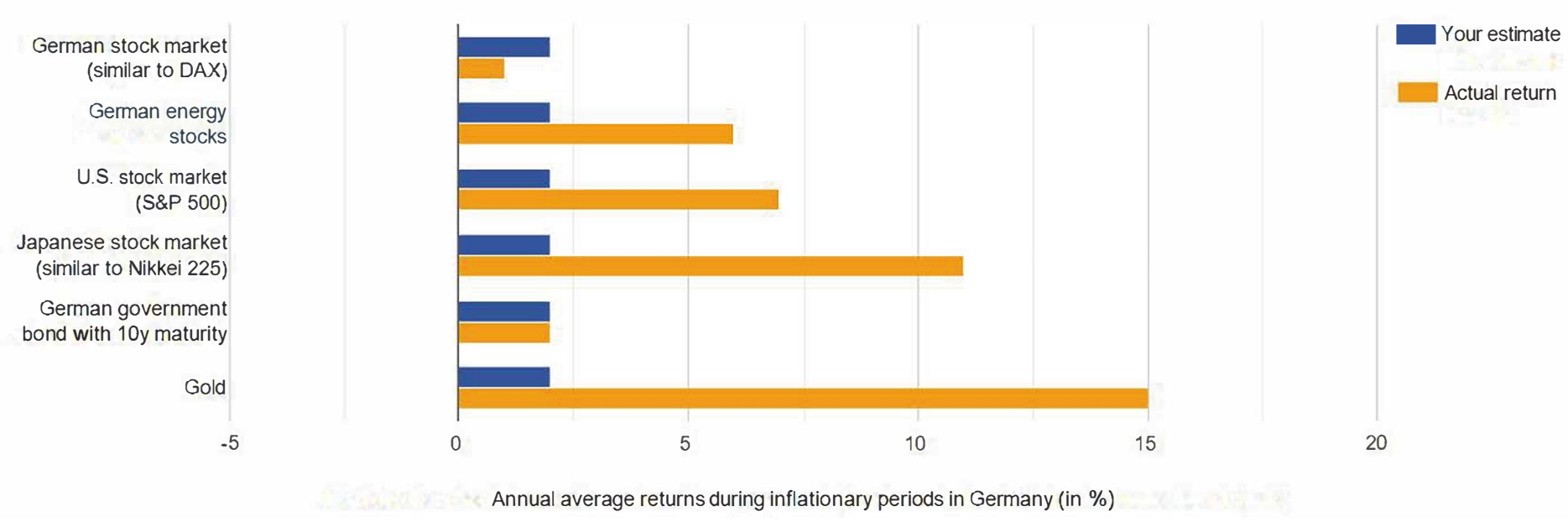
- Inflation 3x higher than 10-year average + figure below
- Policymakers recently discussed possibility of further increase
- List of reasons for inflation surge

(Andre et al., 2022)



T2: actual returns during past inflationary periods

- Initially display respondent's past-return estimates (blue bars)
- Click on button to display actual returns one-by-one (orange)
- One sentence contrasting both returns for each asset



T3: T1 + T2 + explanations of past returns

- International diversification can protect against local inflation
- Commodities (such as energy) often drive inflation
- Gold perceived as a safe harbor during inflationary periods
- Calculations and explanations similar to existing work for US
  (Neville et al., 2021)
- Giving context to returns might increase treatment effectiveness
  (Andre et al., 2022; Goetzmann, Kim, and Shiller, 2022; Shiller, 2017)

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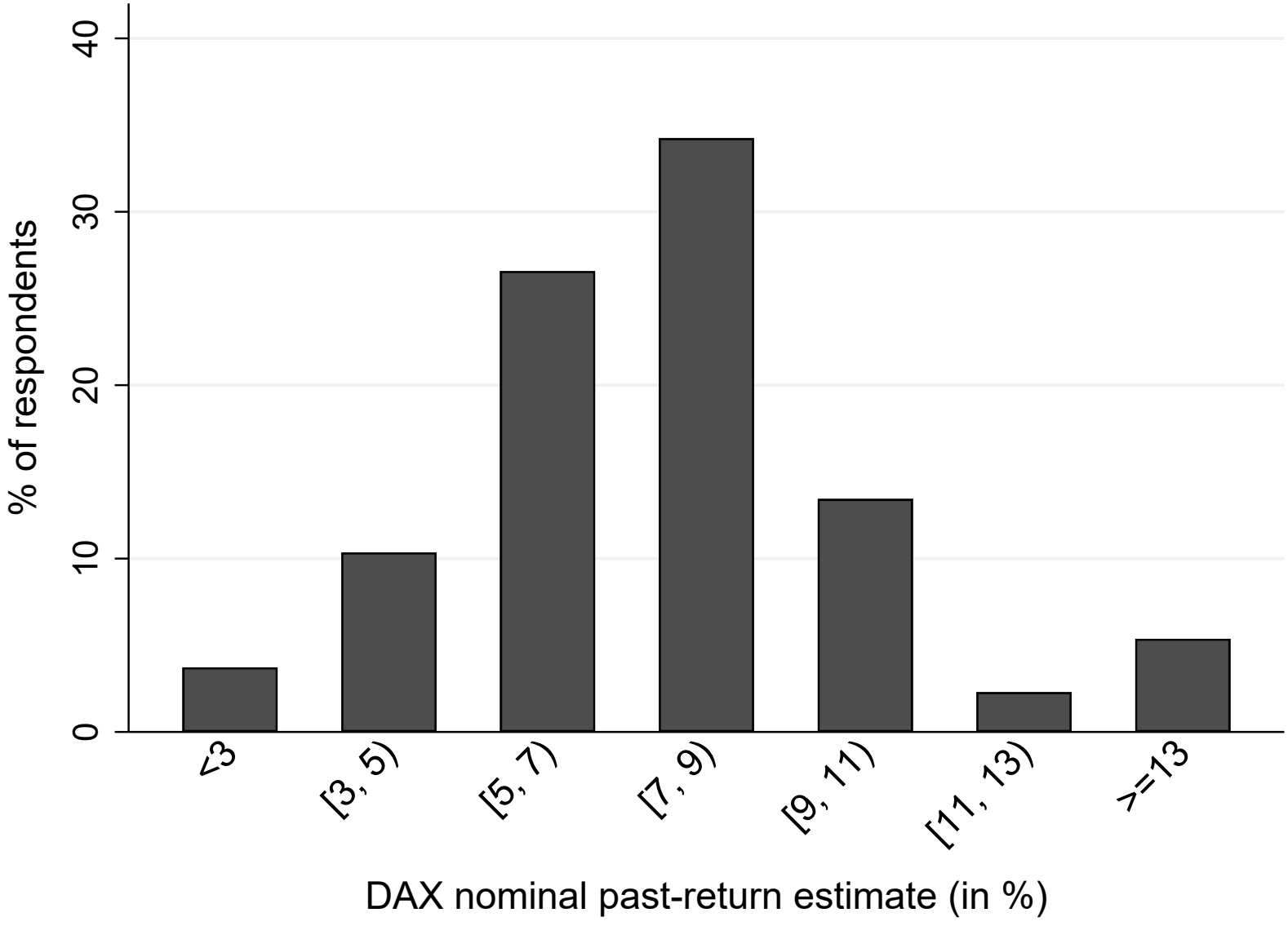
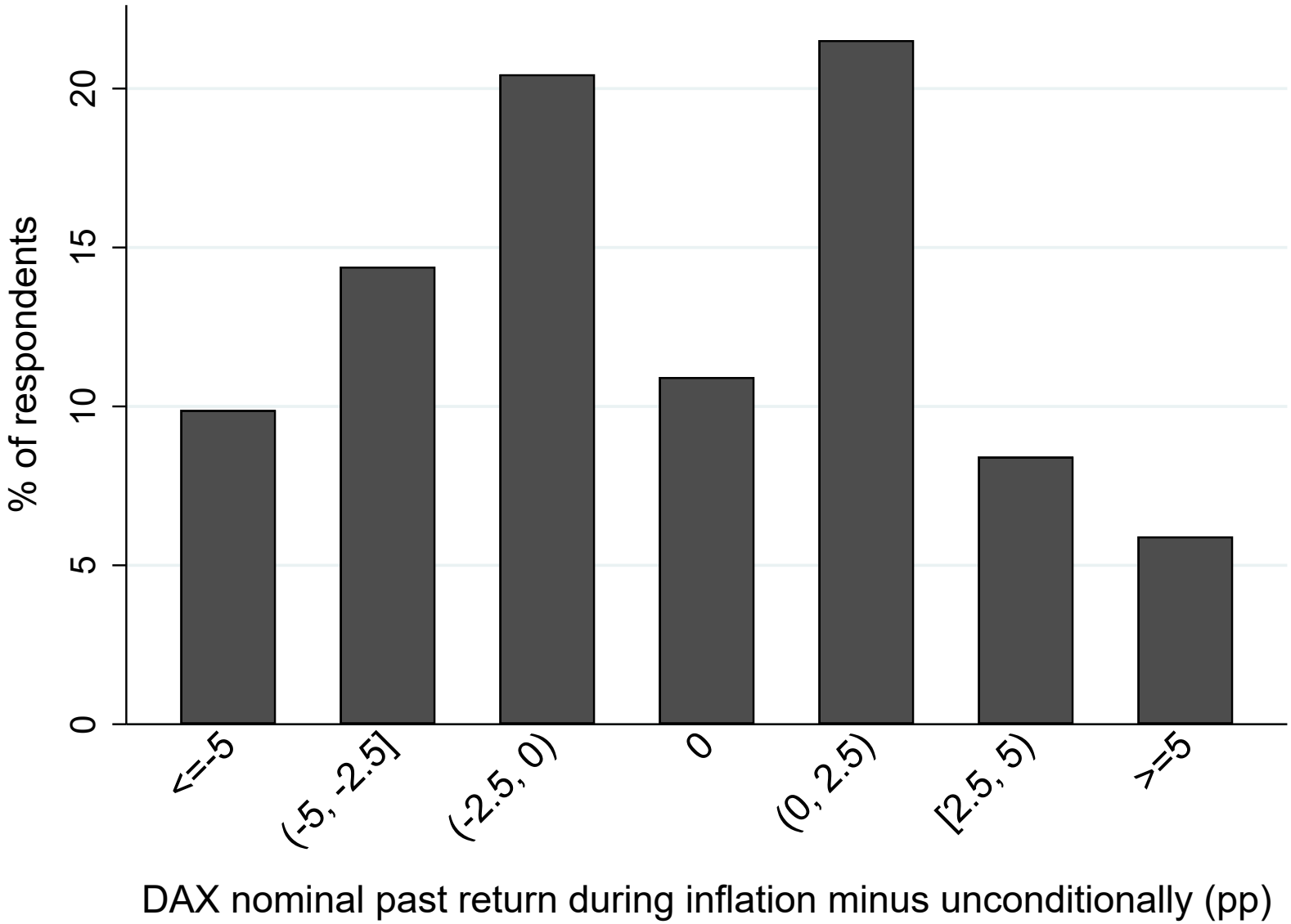
Perceived unconditional historical stock-market returns



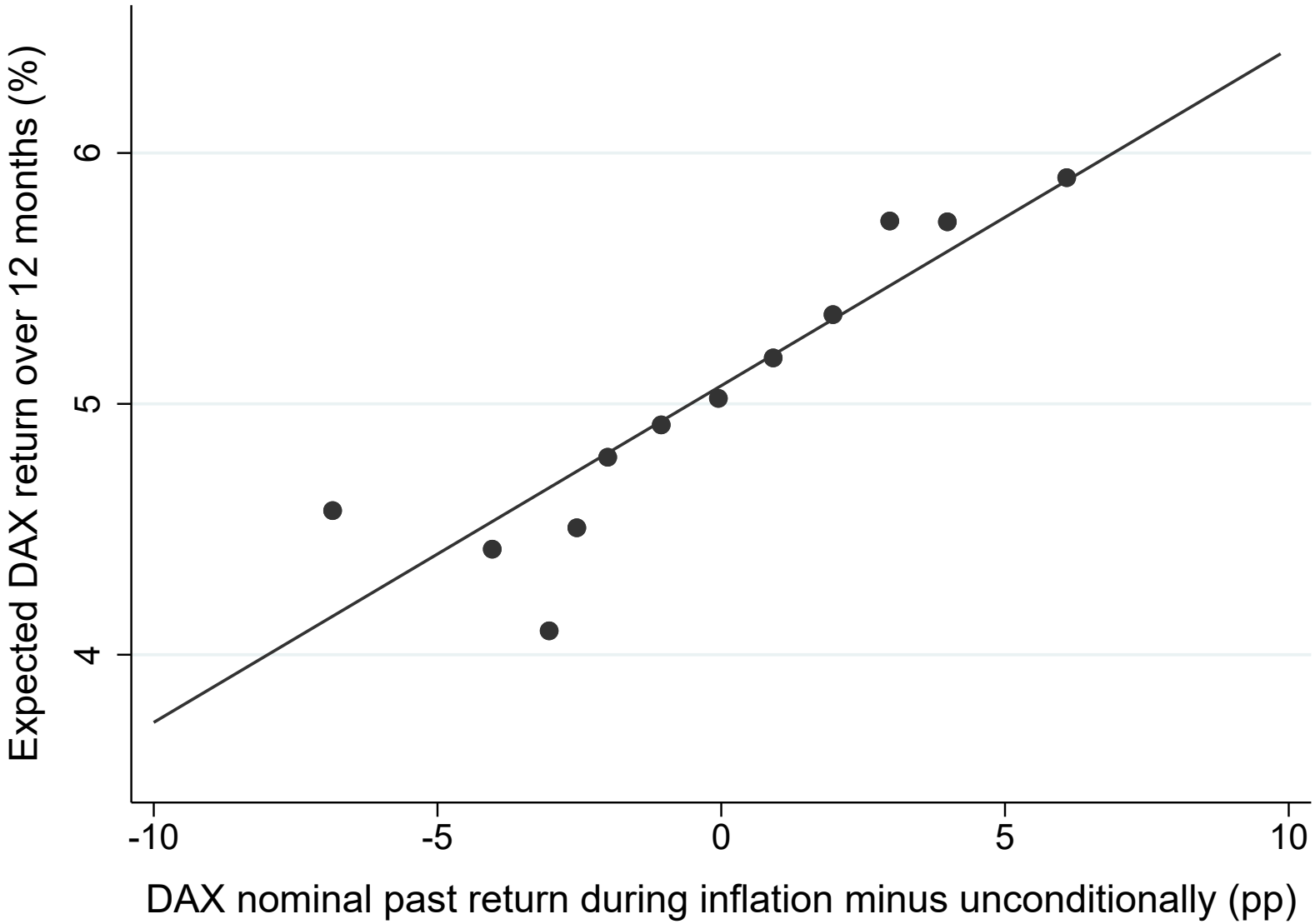
$\Rightarrow$ High awareness of average past stock returns

Perceived historical stock-return impact of inflation



$\Rightarrow$ Disagreement and overoptimism about stock return-inflation relation

Passthrough to return expectations

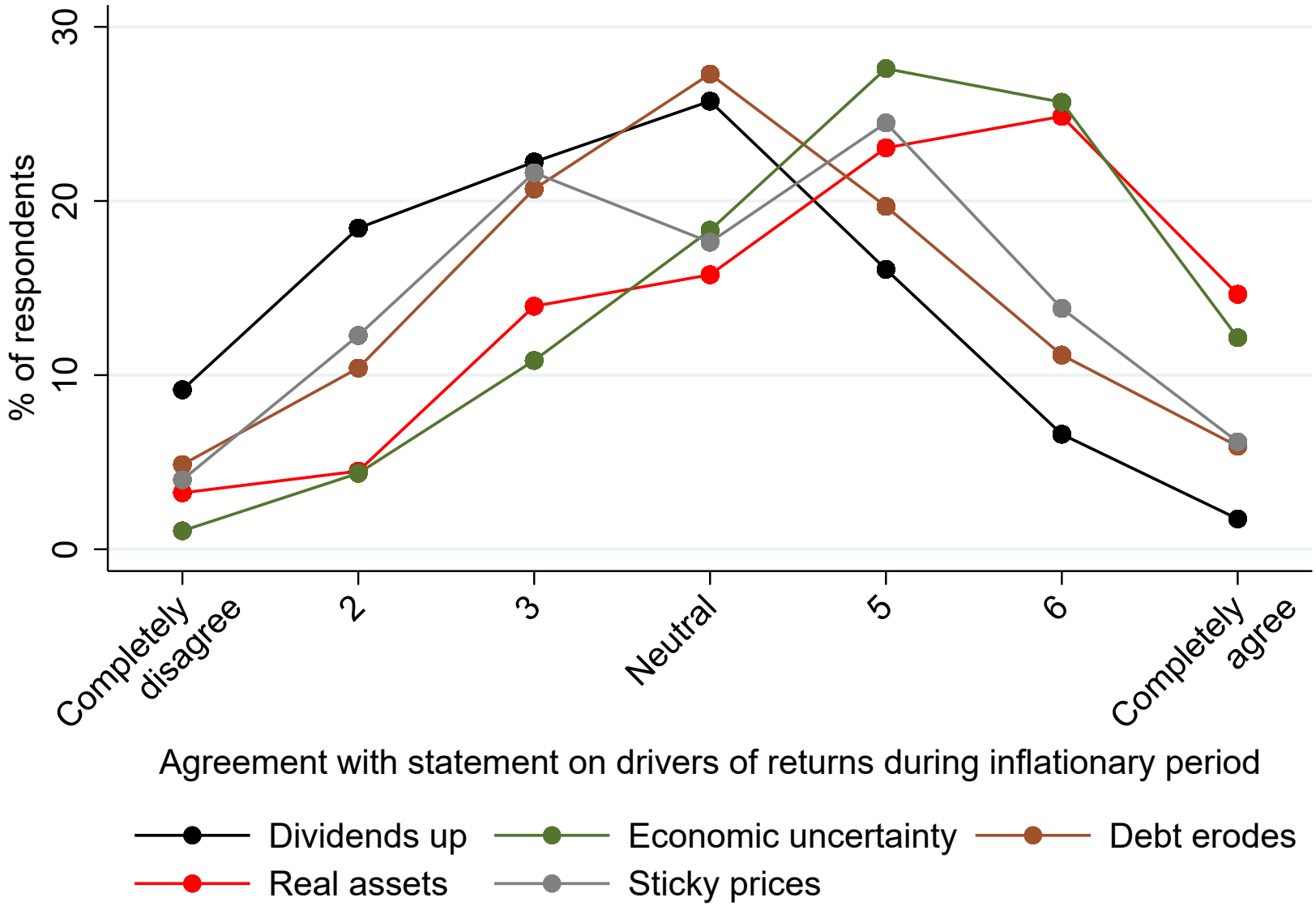


$\Rightarrow$ Perceived return impact of inflation $\uparrow$ 1 pp $\rightarrow$ expected return $\uparrow$ 0.13 pp

Mental models behind return impact of inflation

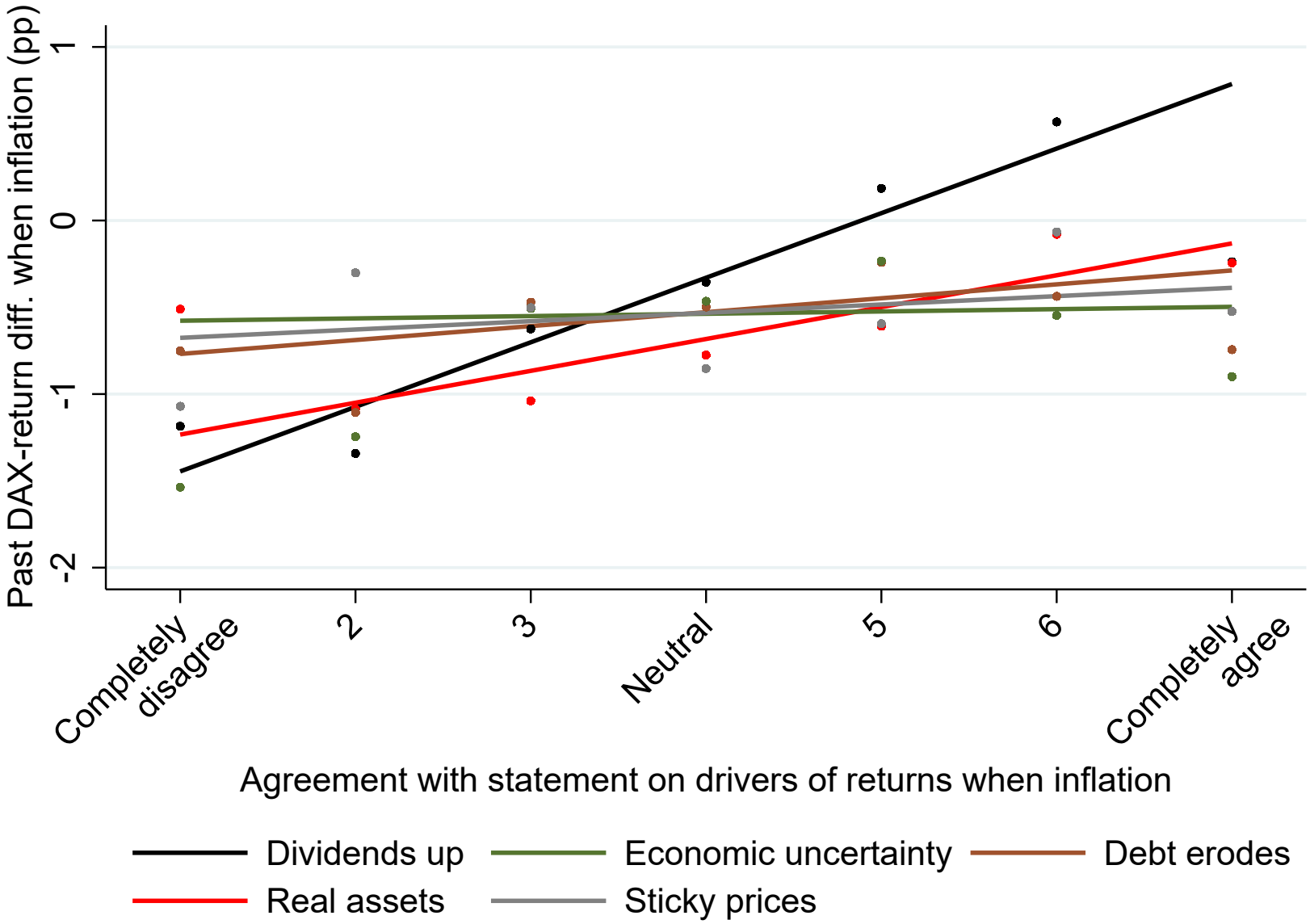
- Elicit agreement with theories on stock return-inflation relation
- Real assets protect against money erosion
  (e.g., Fang, Liu, and Roussanov, 2022)
- Fisher channel: inflation erodes nominal debt
  (e.g., Doepke and Schneider, 2006; Fisher, 1933; Schnorpfeil, Weber, and Hackethal, 2023)
- Money illusion: constant nominal CF discounted w/ higher rate
  (e.g., Cohen, Polk, and Vuolteenaho, 2005; Modigliani and Cohn, 1979)
- Inflation precedes economic uncertainty
  (e.g., Boons et al., 2020; Campbell, Pflueger, and Viceira, 2020; Fama, 1981)
- Firms have limited ability to raise prices
  (e.g., Bhamra et al., 2023; Gorodnichenko and Weber, 2016; Weber, 2015)

Mental models behind return impact of inflation



⇒ Large heterogeneity in reasoning behind stock return-inflation relation

Mental models behind return impact of inflation



⇒ Money illusion appears to be strongest predictor of return beliefs

Plan for the talk

- Data and experimental design
- Prior beliefs about inflation and asset returns
- Treatment effects on return expectations
- Expectations and trading

Equation to estimate treatment effects on return beliefs

$$\hat{y}_i = \alpha + \sum_{k=1}^{3} \beta_k I(x_i = x^k) + \theta \boldsymbol{X}_i + \epsilon_i,$$

with

- $\hat{y}_i$ = post-treatment 12-month return expectation of respondent i
- $I(x_i = x^k)$ = indicator that respondent i receives treatment k
- $\boldsymbol{X}_i$ denotes set of controls from survey and bank data:
  - Age, risk tolerance, inflation and return perceptions, wealth and debt
  - Dummies for gender, marital status, education, financial literacy, financial advice, trading activity, timing of survey participation

Treatment effects on 12-month return expectations

$$\hat{y}_i = \alpha + \sum_{k=1}^{3} \beta_k I(x_i = x^k) + \theta \boldsymbol{X}_i + \epsilon_i$$

Dependent variable:	DAX	DE energy	S&P 500	Nikkei 225	Bunds 10y	Gold
	(1)	(2)	(3)	(4)	(5)	(6)
T1: inflation	0.092	0.243	0.051	−0.163	−0.087	−0.026
	(0.181)	(0.189)	(0.203)	(0.166)	(0.103)	(0.170)
T2: past returns	−0.684***	0.505***	−0.035	1.066***	0.123	1.909***
	(0.184)	(0.189)	(0.205)	(0.200)	(0.102)	(0.214)
T3: 1+2+reason	−1.049***	0.429**	−0.114	1.490***	0.164	2.354***
	(0.185)	(0.180)	(0.205)	(0.194)	(0.109)	(0.219)
Observations	2,568	2,572	2,499	2,578	2,644	2,525
R-squared	0.14	0.10	0.16	0.18	0.16	0.22
Controls	Y	Y	Y	Y	Y	Y
Avg. Y control group	5.0	4.6	5.9	4.1	1.4	4.0

- Inflation treatment has no effect on return expectations
- Info on low German stock returns reduces expectations
- Info on high returns of other assets has large effects

Treatment effects on return beliefs by perception gaps

- Learning might be stronger when priors deviate more from signals
- Focus on degree of updating as function of news in signal:

$$\hat{y}_i = \sum_{k=1}^{3} \beta_k I(x_i = x^k)\,(x^{ret} - \hat{x}^{ret}_{i,prior}) + \mu_k I(x_i = x^k) + \delta_k (x^{ret} - \hat{x}^{ret}_{i,prior}) + \theta \boldsymbol{X}_i + \epsilon_i$$

- $(x^{ret} - \hat{x}^{ret}_{i,prior}) =$ gap b/w realized return and prior estimate
- μ_k measures treat effects that are independent of priors
- δ_k captures posteriors across respondents w/ different priors

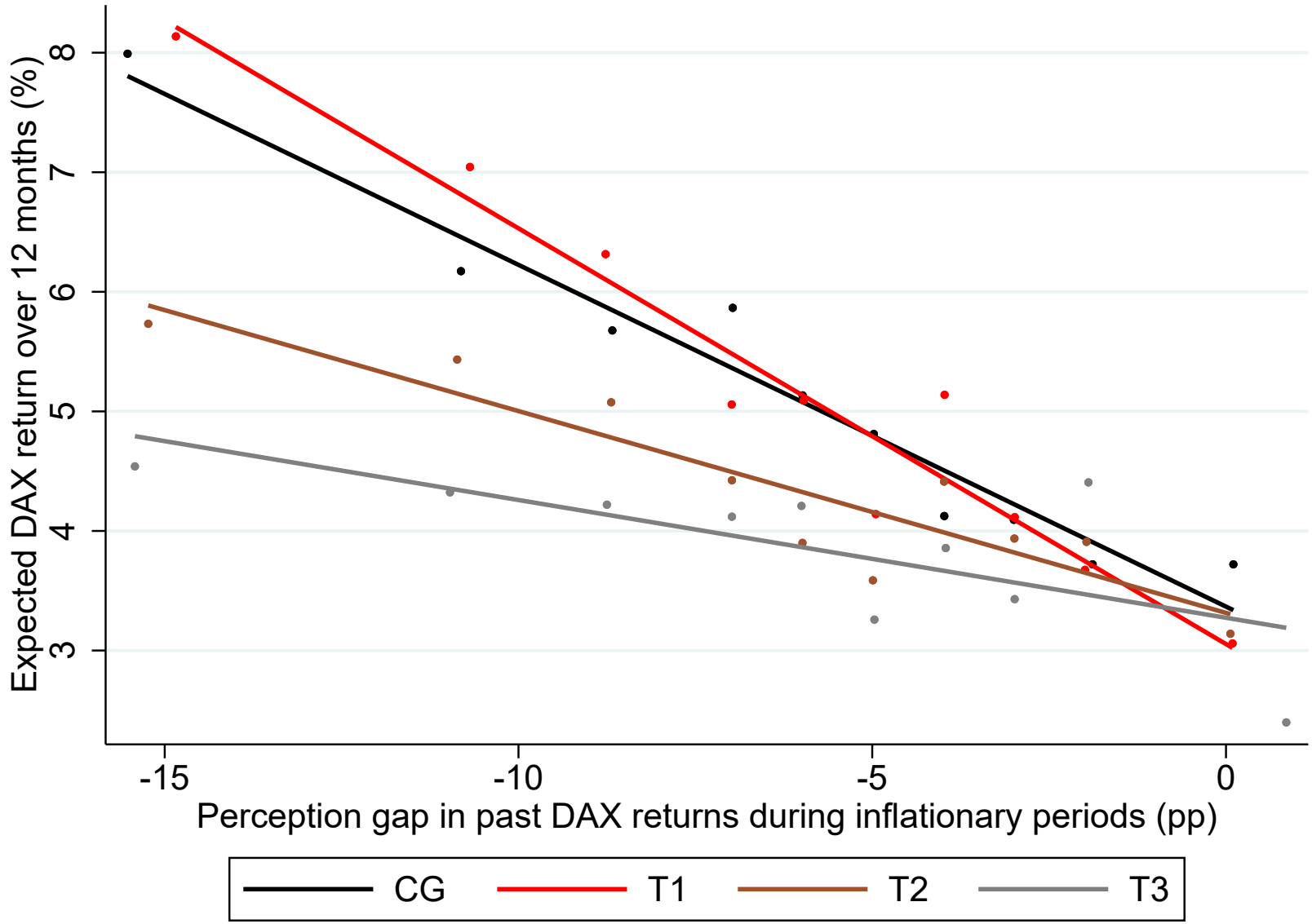
Treatment effects on return beliefs by perception gaps

$$\hat{y}_i = \sum_{k=1}^{3} \beta_k I(x_i = x^k)\,(x^{ret} - \hat{x}^{ret}_{i,prior}) + \mu_k I(x_i = x^k) + \delta_k(x^{ret} - \hat{x}^{ret}_{i,prior}) + \theta \boldsymbol{X}_i + \epsilon_i$$

Dependent variable:	DAX	DE energy	S&P 500	Nikkei 225	Bunds 10y	Gold
	(1)	(2)	(3)	(4)	(5)	(6)
Perception gap	−0.191***	−0.271***	−0.206***	−0.184***	−0.101***	−0.171***
	(0.040)	(0.038)	(0.044)	(0.049)	(0.033)	(0.036)
T1: inflation	−0.222	0.345*	0.061	−0.123	−0.031	0.891*
	(0.304)	(0.193)	(0.197)	(0.401)	(0.113)	(0.515)
T2: past returns	0.006	0.547***	0.112	0.571	0.169	1.679***
	(0.310)	(0.193)	(0.202)	(0.450)	(0.110)	(0.530)
T3: 1+2+reason	−0.196	0.395**	0.054	0.846*	0.315***	2.479***
	(0.317)	(0.178)	(0.205)	(0.459)	(0.115)	(0.586)
T1 x perception gap	−0.037	−0.039	−0.075	−0.004	0.044	−0.107**
	(0.052)	(0.057)	(0.054)	(0.056)	(0.048)	(0.048)
T2 x perception gap	0.131**	0.215***	0.109**	0.103	0.020	0.029
	(0.051)	(0.051)	(0.055)	(0.065)	(0.045)	(0.053)
T3 x perception gap	0.172***	0.145***	0.155***	0.129**	0.070	−0.017
	(0.054)	(0.050)	(0.053)	(0.066)	(0.052)	(0.058)

- Learning increases with gap b/w actual returns and priors
- Some treatment effects that are independent of priors

Treatment effects on return beliefs by perception gaps



$\Rightarrow$ Return info (T2/T3) weakens association b/w prior and posterior

Inflation beliefs and return expectations

- Inflation info (T1/T3) $\rightarrow$ 12m inflation expectations $\uparrow$ by 0.5 pp
  ▸ Table
- Info does not tighten relation b/w priors and return expectations
  ▸ Table
- Return-info effect similar when paired w/ higher inflation f/cast (T3)
  ▸ Table

$\Rightarrow$ When inflation high, small inflation f/cast shifts w/ limited effects

(Andrade, Gautier, and Mengus, 2023; Pfäuti, 2024)

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Treatment effects on hypothetical trading

$$\hat{y}_i = \alpha + \sum_{k=1}^{3} \beta_k I(x_i = x^k) + \theta \boldsymbol{X}_i + \epsilon_i$$

Dependent variable:	DAX	DE energy	S&P 500	Nikkei 225	Bunds 10y	Gold
	(1)	(2)	(3)	(4)	(5)	(6)
T1: inflation	−73.6	42.8	−50.5	−58.4	−25.8	−3.7
	(120.5)	(61.8)	(121.0)	(41.3)	(41.2)	(83.5)
T2: past returns	−830.6***	155.3**	−231.1*	383.4***	30.7	397.3***
	(123.7)	(63.7)	(124.8)	(55.9)	(40.3)	(94.9)
T3: 1+2+reason	−1288.1***	372.0***	−125.8	522.3***	21.2	456.8***
	(120.8)	(65.8)	(123.0)	(57.8)	(40.1)	(91.1)
Observations	2,597	2,594	2,529	2,599	2,648	2,549
R-squared	0.11	0.06	0.16	0.09	0.04	0.09
Controls	Y	Y	Y	Y	Y	Y
Avg. Y control group	3,444.3	771.8	2,963.2	488.0	264.9	1,024.4

- Inflation treatment has no effect on hypothetical trading
- Return info alters allocations in expected direction (except US)
- T3 effects larger; in particular, 1/3 less invest in German market

Treatment effects on actual trading

$$\hat{y}_i = \alpha + \sum_{k=1}^{3} \beta_k I(x_i = x^k) + \theta \boldsymbol{X}_i + \epsilon_i$$

Dependent variable:	Gross buys DE securities in EUR			Net buys DE securities in EUR		
Post-treat window:	2m	4m	6m	2m	4m	6m
	(1)	(2)	(3)	(4)	(5)	(6)
T1: inflation	−42.8	−107.6	−100.5	−21.1	−32.4	−16.6
	(178.3)	(132.4)	(123.2)	(114.2)	(88.8)	(80.0)
T2: past returns	−176.9	−158.6	−106.6	−36.9	−98.9	−82.1
	(187.1)	(149.6)	(140.4)	(122.3)	(98.9)	(92.6)
T3: 1+2+reason	−465.6***	−375.9**	−305.8**	−201.3*	−170.1*	−127.4
	(172.1)	(156.1)	(143.4)	(110.6)	(89.9)	(79.5)
Observations	2,792	2,792	2,792	2,792	2,792	2,792
Avg. diff. Y CG	388.7	190.4	-0.1	191.3	156.7	85.4
Avg. Y CG	1,186.8	988.5	798.0	374.2	339.6	268.3

- Hypothetical trading translates into actual trading
- Effect operates primarily through adjustments in gross buys

(e.g., Calvet, Campbell, and Sodini, 2009)

Changes in return expectations and actual trading

- Study return expectations as link b/w info provision and trading
- Estimate following model:

$$a_i = \delta + \kappa \hat{y}_i + \theta \boldsymbol{X}_i + \epsilon_i$$

- Instrument for return expectation, $\hat{y}_i$, using treatment
- Info does not affect set of expectations about economic conditions

▸ Table

Changes in return expectations and actual trading

$$a_i = \delta + \kappa \hat{y}_i + \theta \boldsymbol{X}_i + \epsilon_i$$

Dependent variable:	Gross buys DE securities in EUR			Net buys DE securities in EUR		
Post-treat window:	2m	4m	6m	2m	4m	6m
	(1)	(2)	(3)	(4)	(5)	(6)
12m DAX return	309.6**	197.6*	141.0	121.7	112.0*	88.4
	(134.4)	(114.9)	(104.0)	(85.0)	(67.7)	(61.0)
Observations	2,747	2,747	2,747	2,747	2,747	2,747
1st stage F-stat	17.72	17.72	17.72	17.72	17.72	17.72
Avg. diff. Y CG	388.7	190.4	-0.1	191.3	156.7	85.4
Avg. Y CG	1,186.8	988.5	798.0	374.2	339.6	268.3

$\Rightarrow$ Significant passthrough from subjective return expectations to trading

Conclusion

- Study investors' return beliefs and trading in context of inflation
- In inflationary regime, behavior appears inelastic to infl. expectations
- Heterogeneity and overoptimism about return impact of inflation
- Shifting return beliefs alters expectations and trading
- Results informative for household finance, asset pricing, and macro
  - HF: investors care about inflation but are unaware of hedging
  - AP: shed light on which subjective models guide investor behavior
  - Macro: implications of HH inflation expectations for investments

Appendix

Treatment effects on inflation expectations

$$\hat{y}_i = \alpha + \sum_{k=1}^{3} \beta_k I(x_i = x^k) + \theta \boldsymbol{X}_i + \epsilon_i$$

Dependent variable:	1yr forecast		Revision 1yr forecast		5yr forecast	
	(1)	(2)	(3)	(4)	(5)	(6)
T1: inflation	0.395***	0.488***	0.532***	0.540***	0.294***	0.344***
	(0.101)	(0.089)	(0.094)	(0.092)	(0.096)	(0.087)
T2: past returns	−0.189*	−0.093	−0.198**	−0.176**	−0.140	−0.067
	(0.105)	(0.087)	(0.088)	(0.086)	(0.101)	(0.091)
T3: 1+2+reason	0.417***	0.475***	0.331***	0.410***	0.202**	0.296***
	(0.109)	(0.093)	(0.101)	(0.098)	(0.097)	(0.090)
Controls	N	Y	N	Y	N	Y
Avg. Y control group	5.0	5.0	0.4	0.3	3.7	3.7
Observations	2,747	2,660	2,704	2,631	2,751	2,663
R-squared	0.02	0.27	0.02	0.09	0.01	0.18

◂ Back

Shift in inflation f/cast x prior beliefs about return impact

Dependent variable:	DAX	DE energy	S&P 500	Nikkei 225	Bunds 10y	Gold
	(1)	(2)	(3)	(4)	(5)	(6)
T1: inflation	−0.023	0.339*	0.212	−0.094	−0.106	−0.108
	(0.185)	(0.190)	(0.204)	(0.168)	(0.113)	(0.183)
Return Δ when inflation	0.210***	0.284***	0.174***	0.154***	0.068*	0.171***
	(0.045)	(0.045)	(0.052)	(0.047)	(0.041)	(0.046)
T1 x return Δ	−0.025	−0.029	0.101	0.070	0.002	0.073
	(0.061)	(0.071)	(0.077)	(0.073)	(0.065)	(0.071)
Controls	N	Y	N	Y	N	Y
Observations	1,402	1,387	1,343	1,389	1,424	1,340
R-squared	0.19	0.20	0.24	0.22	0.21	0.24

◂ Back

Shift in inflation f/cast x shift in beliefs about returns

Dependent variable:	DAX	DE energy	S&P 500	Nikkei 225	Bunds 10y	Gold
	(1)	(2)	(3)	(4)	(5)	(6)
T3: 1+2+reason	−0.999***	0.463**	−0.187	1.430***	0.105	2.299***
	(0.193)	(0.181)	(0.212)	(0.200)	(0.111)	(0.227)
Inflation-forecast revision	0.158*	0.161**	0.081	0.148**	0.053	0.039
	(0.085)	(0.079)	(0.097)	(0.067)	(0.044)	(0.081)
T3 x Inflation-fcst revision	−0.179	−0.252**	−0.021	−0.114	−0.007	−0.026
	(0.124)	(0.116)	(0.142)	(0.125)	(0.071)	(0.142)
Controls	N	Y	N	Y	N	Y
Observations	1,289	1,294	1,259	1,295	1,323	1,268
R-squared	0.13	0.13	0.18	0.21	0.16	0.22

◂ Back

Treatment effects on other expectations

$$\hat{y}_i = \alpha + \sum_{k=1}^{3} \beta_k I(x_i = x^k) + \theta \boldsymbol{X}_i + \epsilon_i$$

DV:	Own salary		Own portfolio		Unemployment		Economic growth	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T1	0.003	−0.004	−0.034	−0.067	−0.049	−0.064	0.006	−0.018
	(0.040)	(0.040)	(0.047)	(0.045)	(0.045)	(0.045)	(0.051)	(0.050)
T2	−0.014	−0.003	0.118**	0.078*	0.020	−0.028	0.056	0.018
	(0.042)	(0.041)	(0.048)	(0.046)	(0.049)	(0.049)	(0.054)	(0.053)
T3	0.004	0.018	0.039	−0.009	−0.042	−0.077	−0.081	−0.128**
	(0.041)	(0.040)	(0.048)	(0.047)	(0.048)	(0.049)	(0.053)	(0.053)
Controls	N	Y	N	Y	N	Y	N	Y
Avg. Y	3.3	3.3	3.5	3.5	2.9	2.9	3.1	3.1
N	2,792	2,690	2,792	2,690	2,792	2,690	2,792	2,690
R2	0.00	0.09	0.00	0.10	0.00	0.05	0.00	0.07

◂ Back