# 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

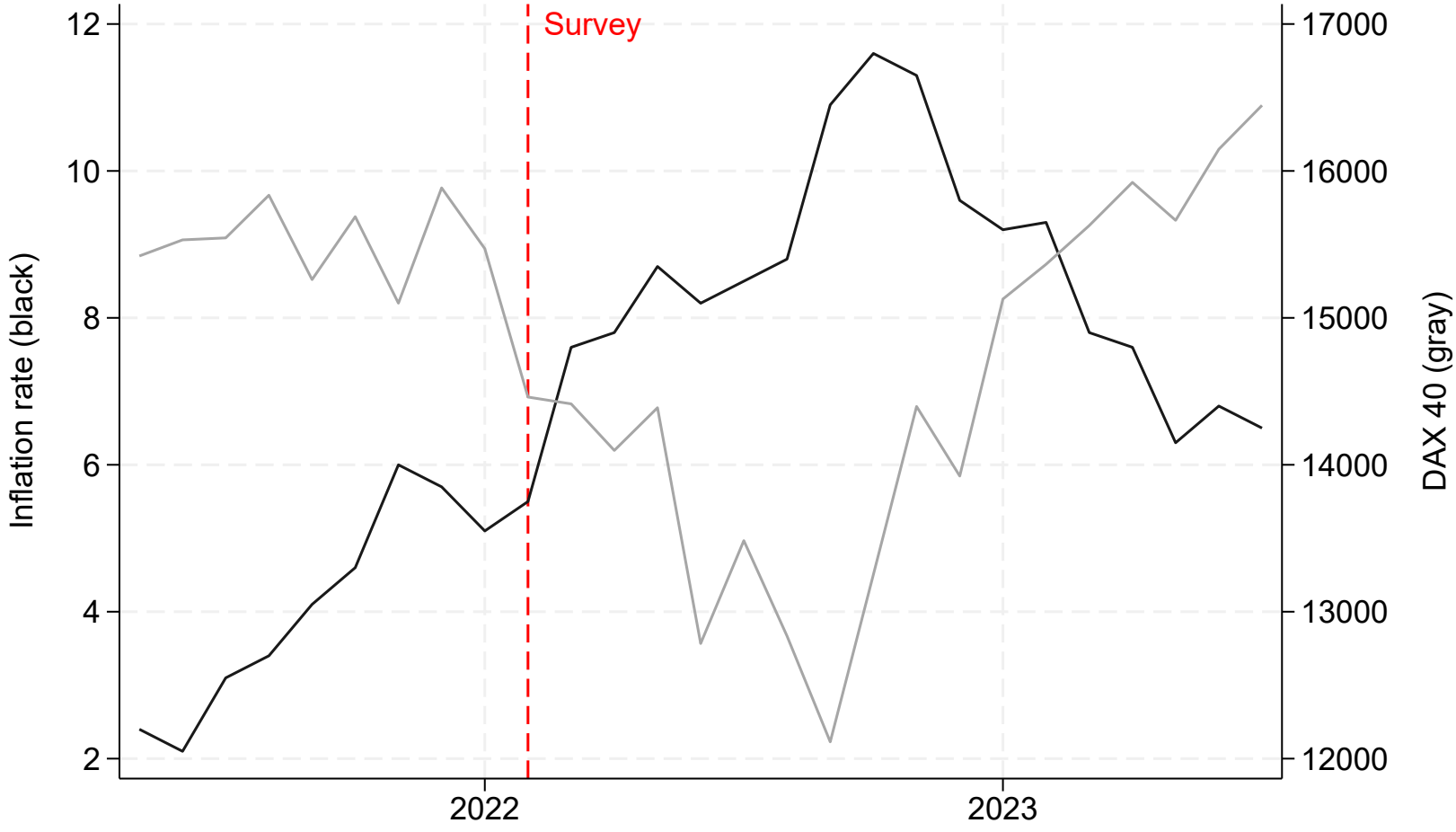
# Plan for the talk

- 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) | 139.61 | 265.61 | 7.38 | 35.96 | 130.74 |
| Equity share (%) | 0.84 | 0.22 | 0.76 | 0.94 | 1.00 |
| Monthly trades (no.) | 2.98 | 4.04 | 0.33 | 1.27 | 3.83 |
| Monthly net buys (€) | 628.01 | 5142.94 | 0.00 | 189.99 | 1061.07 |
| **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, active, accurate perceptions, inflation matters

# Experimental design

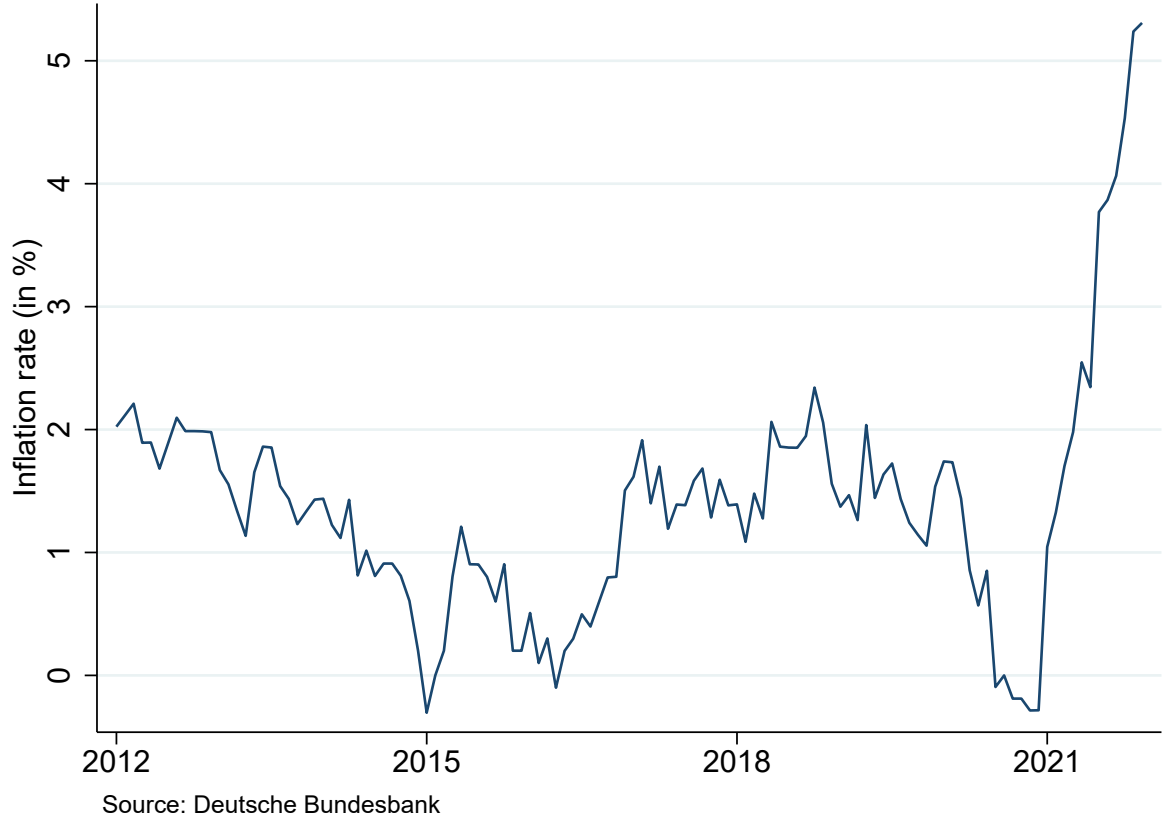
1. Pre-treatment section
   - Inflation beliefs and trading motives
   - Past unconditional and inflationary-period asset returns
2. Treatment section
   - Control group receives no information
   - T1: high current inflation and possibility of further rise
   - T2: actual returns during past inflationary 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

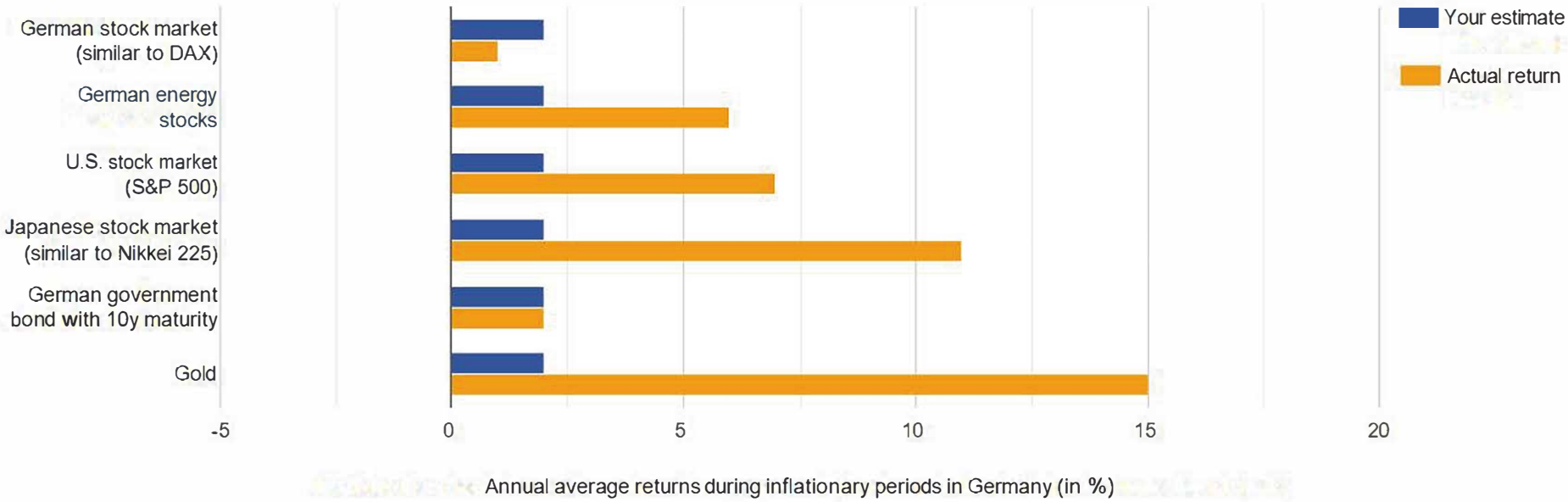
- Inflation 3x higher than 10-year average + figure below
- Policymakers recently discussed possibility of further increase
- List of reasons for inflation surge

(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)

# Plan for the talk

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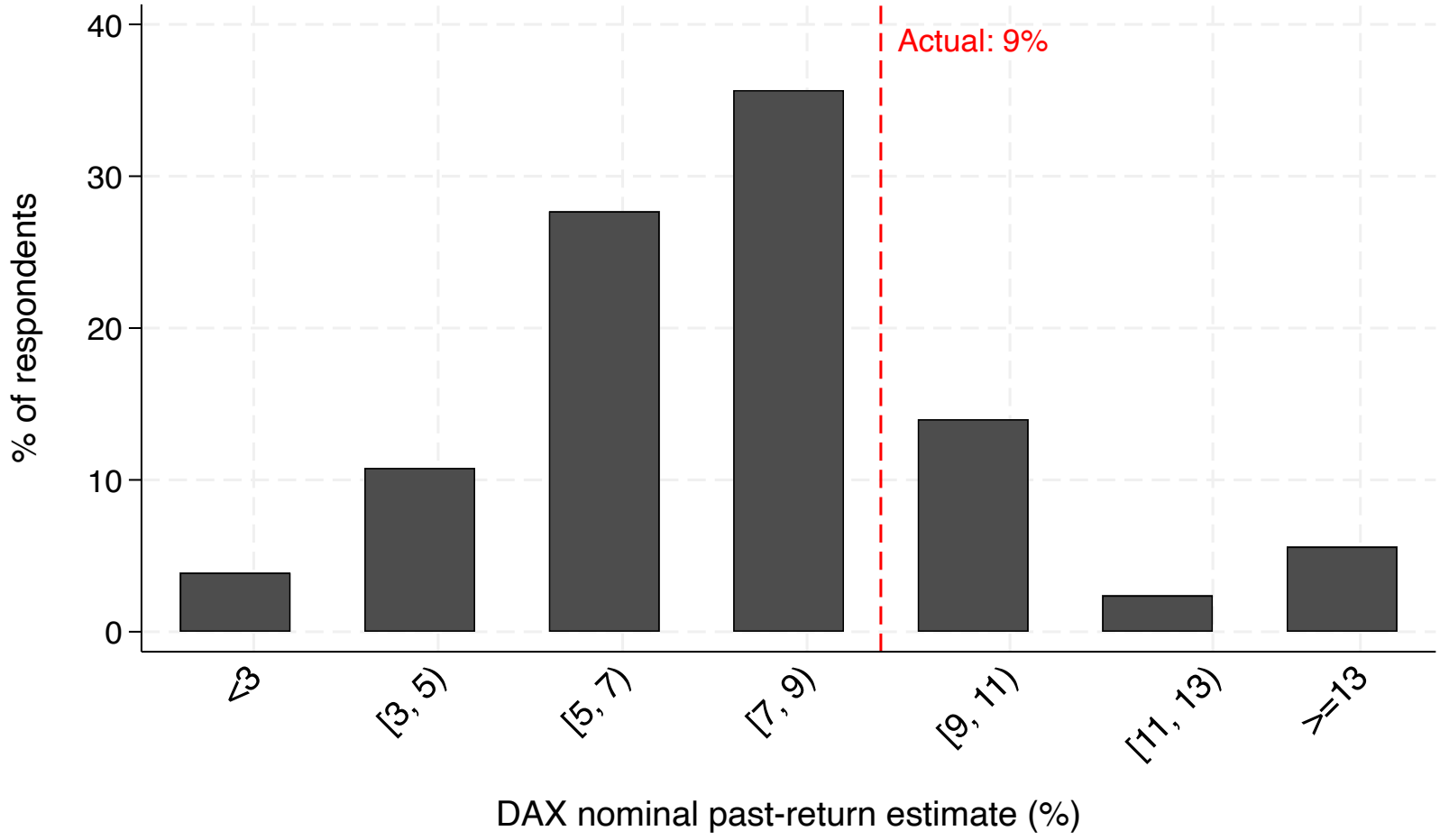
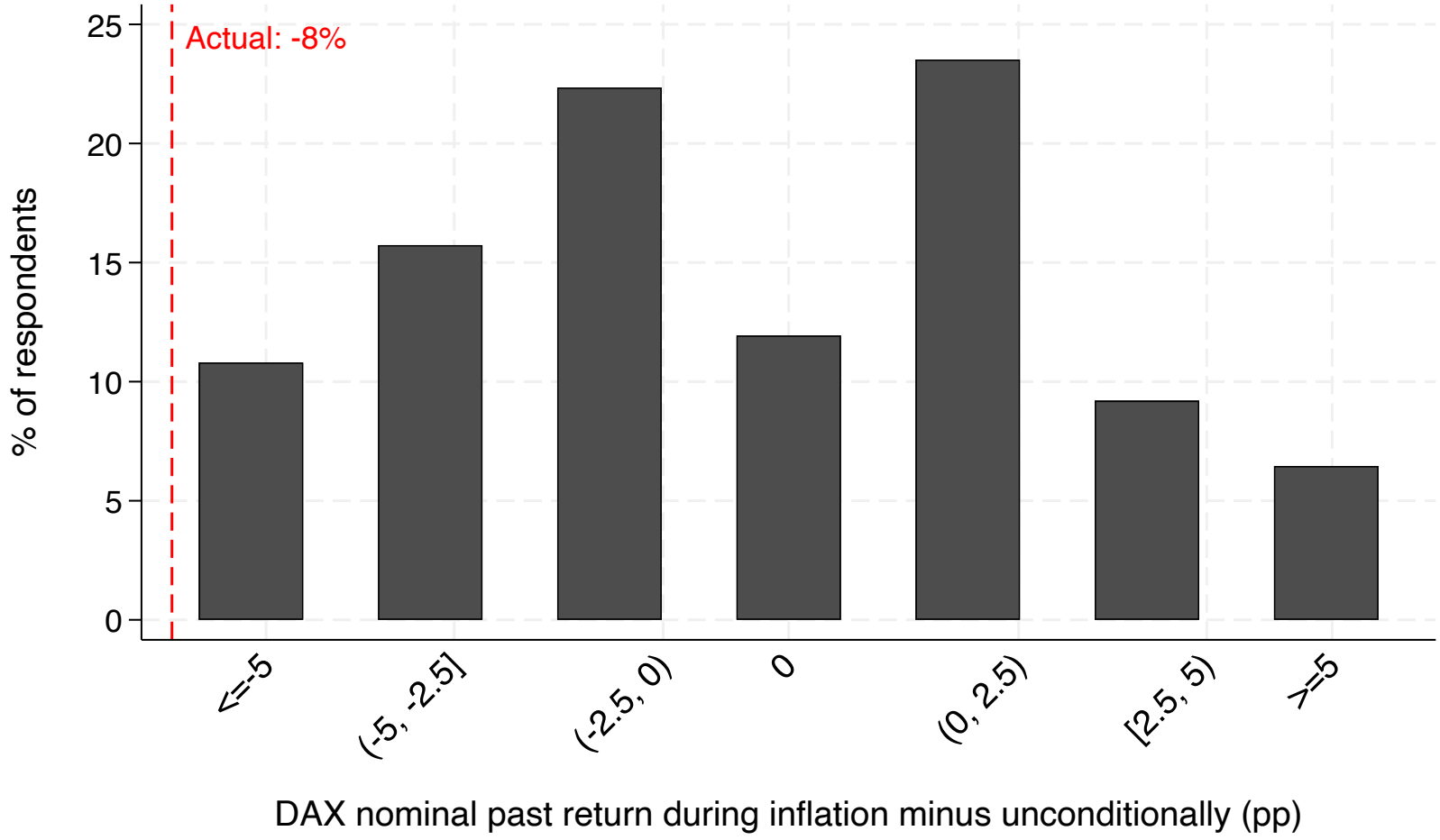
# Perceived unconditional historical stock-market returns



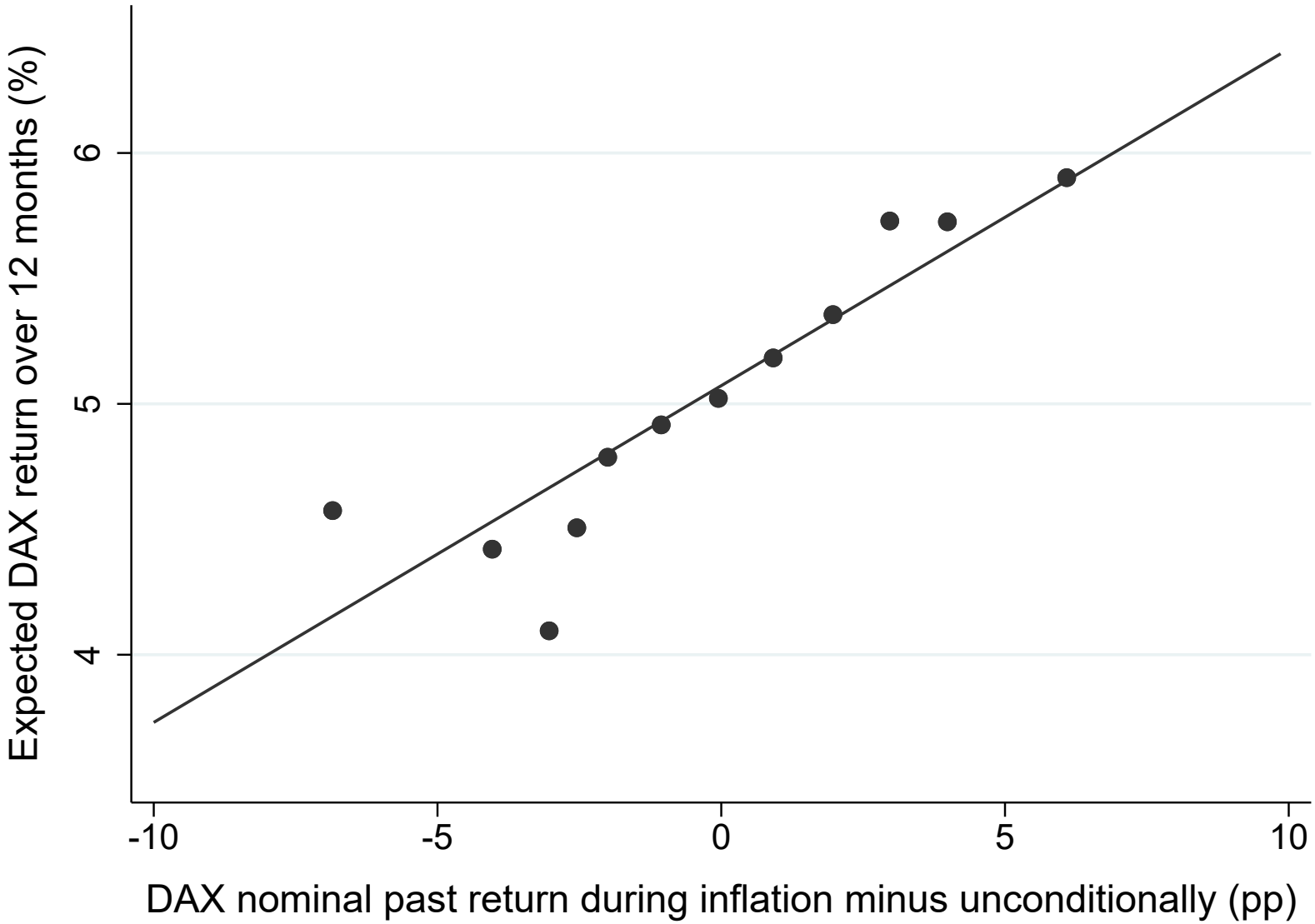

$\Rightarrow$ High awareness of average past stock returns

# Perceived historical stock-return impact of inflation




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

# Passthrough to return expectations

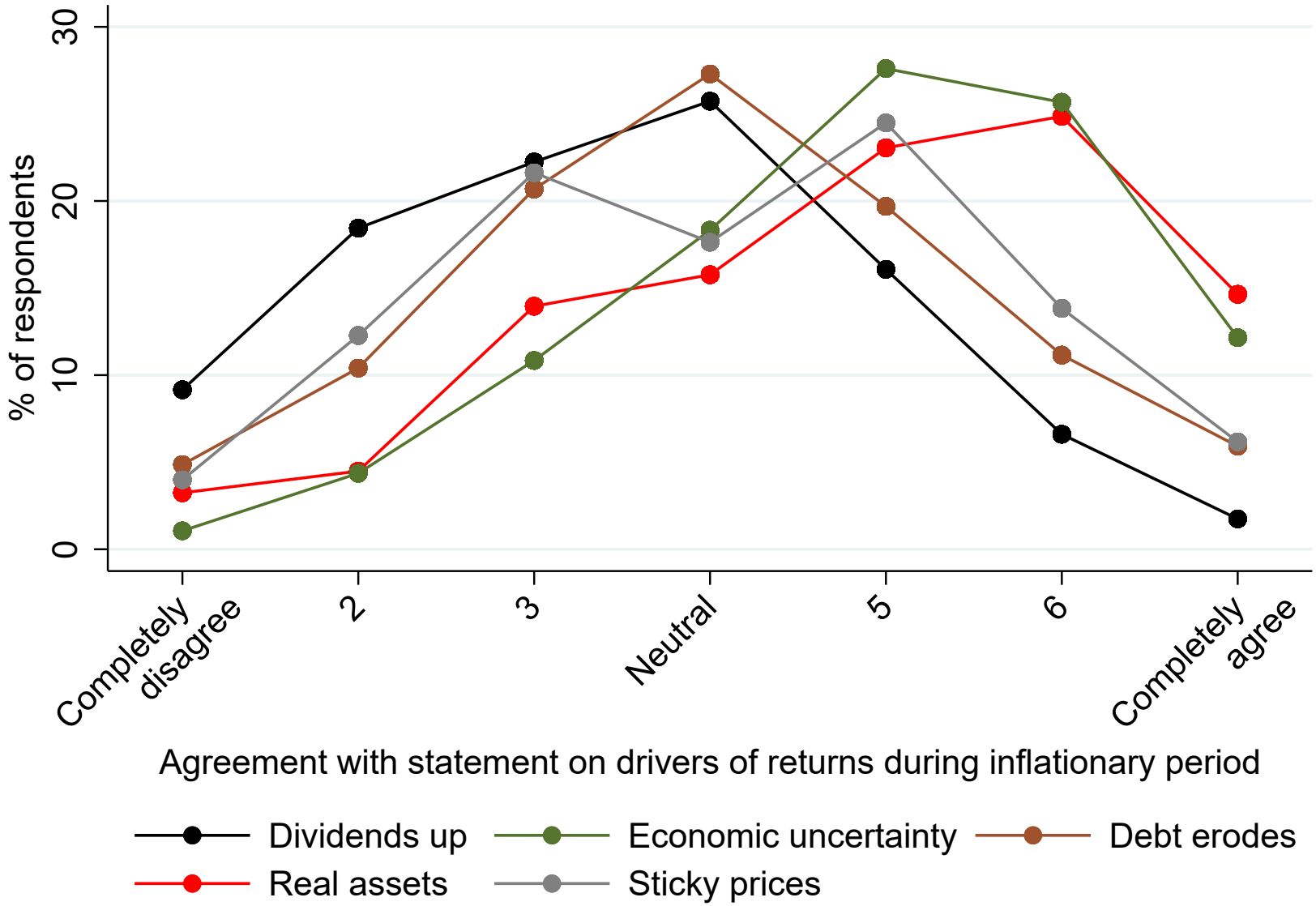



$\Rightarrow$ Perceived return impact of inflation $\uparrow$ 1 pp $\rightarrow$ expected return $\uparrow$ 0.13 pp

# Mental models behind return impact of inflation

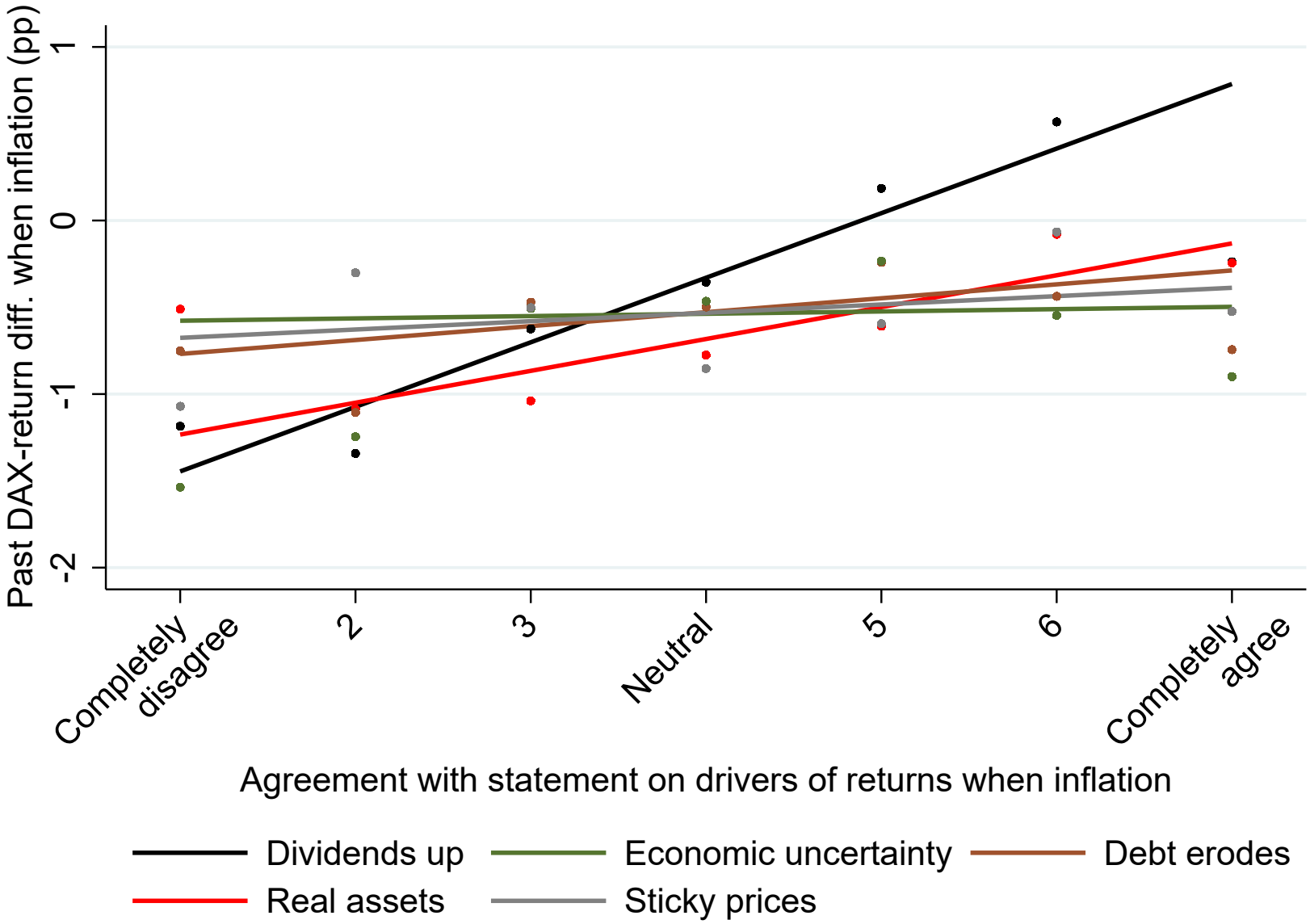
- Elicit agreement with theories on stock return-inflation relation
- Real assets protect against money erosion
  (e.g., Fang, Liu, and Roussanov, 2022)
- Fisher channel: inflation erodes nominal debt
  (e.g., Doepke and Schneider, 2006; Fisher, 1933; Schnorpfeil, Weber, and Hackethal, 2023)
- Money 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
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# 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

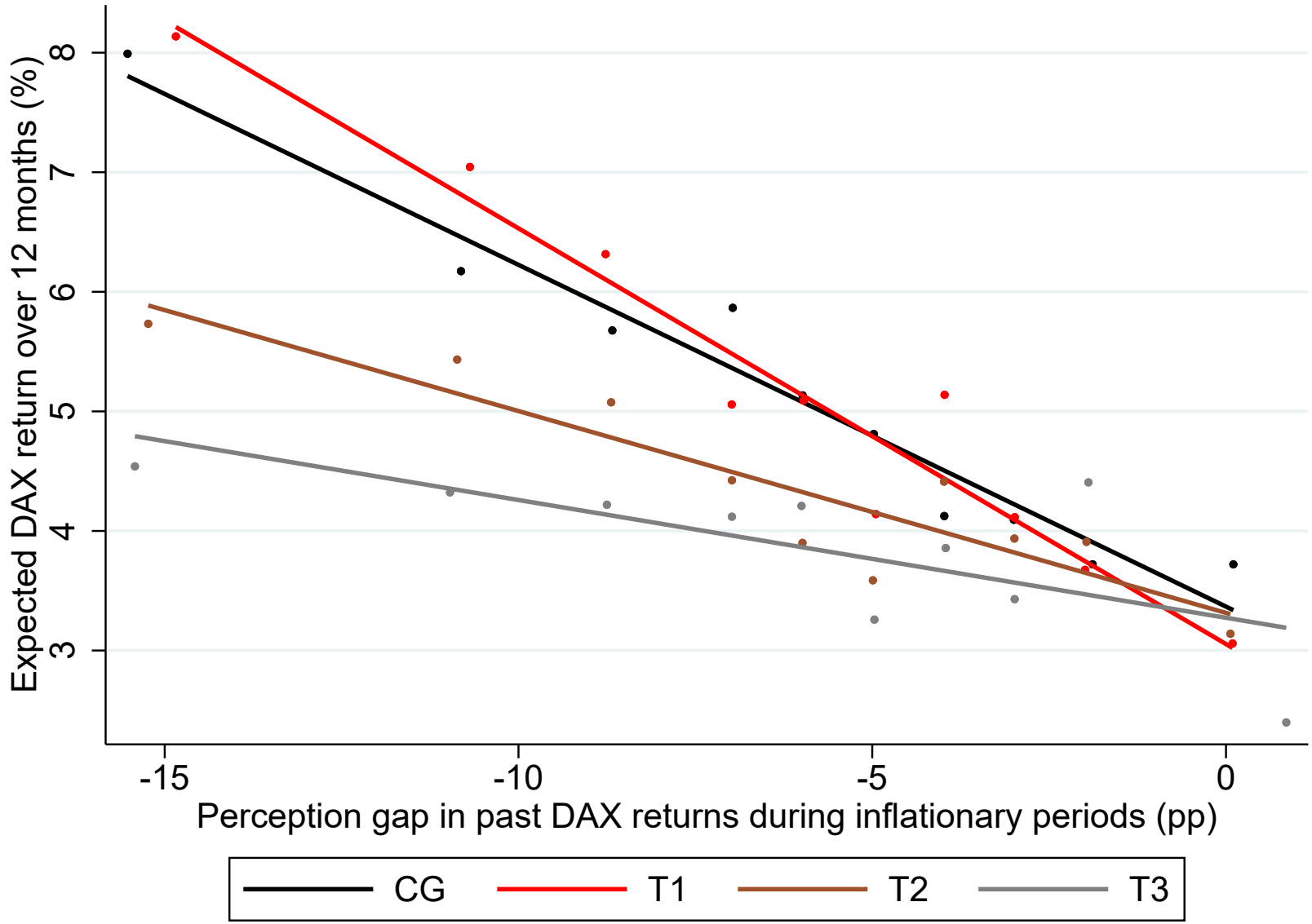
# Treatment effects on return beliefs by perception gaps

- 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
- $\mu_k$ measures treat effects that are independent of priors
- $\delta_k$ captures posteriors across respondents w/ different 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)

# Plan for the talk

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

# 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) |
| N | 1,962 | 1,962 | 1,962 | 1,962 | 1,962 | 1,962 |
| F-stat | 12.78 | 12.78 | 12.78 | 12.78 | 12.78 | 12.78 |
| 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) |
| Inflation-forecast revision | −0.038 | −0.073 | 0.013 | 0.004 | 0.057 | −0.011 |
| | (0.090) | (0.086) | (0.095) | (0.109) | (0.060) | (0.131) |
| Controls | N | Y | N | Y | N | Y |
| Observations | 538 | 542 | 530 | 544 | 557 | 529 |
| R-squared | 0.15 | 0.13 | 0.15 | 0.18 | 0.13 | 0.15 |

◂ 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