Empirical Behavioral Macroeconomics

Chris Roth
U Cologne, ECONtribute, CEPR, NHH

Joint Spring Conference on Monetary Policy and Expectations of Households and Firms, April 24, 2025

What is Behavioral Macro?

Behavioral macroeconomics is the study of how **psychological factors** influence **aggregate economic outcomes**.

- Objects of interest: aggregate outcomes (e.g. consumption, investment, employment, inflation)
- The (strategic) interactions of agents matter
- To go from micro to macro, we need to account for **GE effects**

New Exciting Methods

- Hypothetical **vignettes** to measure mental models.
- Open-ended questions as a powerful tool **to measure narratives and the attentional foundations** of expectation formation.
- **Speech recordings** and **AI interviews** as new opportunities.
- **LLMs** as a powerful tool to analyze unstructured data
- See Haaland, Roth, Stantcheva, Wohlfart (forthcoming, JEL) for guidance on methodological issues.

Nature of expectations

- Lots of **dispersion** in expectations.
- People's expectations are many times **not stable or well-defined** (Enke & Graeber, 2023; Bordalo et al., 2025; Woodford, 2020).
- **Models of associate memory:** Instead, households and firms form their expectations on-the-fly depending on **contextual cues** and their **experiences** (see Bordalo et al., 2023).
- Humans as **story machines** that engage in analogical reasoning.
- Importance of **emotions** in driving expectations.
- Humans as **social animals** – critical role of social dynamics.

Nature of expectations

- Lots of **dispersion** in expectations.
- People's expectations are many times **not stable or well-defined** (Enke & Graeber, 2023; Bordalo et al., 2025; Woodford, 2020).
- **Models of associate memory:** Instead, households and firms form their expectations on-the-fly depending on **contextual cues** and their **experiences** (see Bordalo et al., 2023).
- Humans as **story machines** that engage in analogical reasoning.
- Importance of **emotions** in driving expectations.
- Humans as **social animals –** critical role of social dynamics.

"[...] there is the instability due to the characteristic of human nature that a large proportion of our positive activities depend on **spontaneous optimism** rather than on a **mathematical expectation**."

— *The General Theory, Keynes*

Today

- Subjective Models
- Narratives
- Attention
- **Directions for Future Research**

Outline of talk

Motivation

Andre, Pizzinelli, Roth, Wohlfart, 2022

- Well-documented empirical fact: Substantial **disagreement** in survey expectations about the macroeconomy (Coibion and Gorodnichenko, 2012; Coibion et al., 2018).
  - Holds true for households, firms and professional forecasters.
  - Disagreement matters for the transmission of policies.
- Heterogeneity in survey expectations is often attributed to **differences in information** about the current state of the economy across economic agents.
- Alternative driver of disagreement in survey expectations: heterogeneity in **subjective models of the macroeconomy**.

Subjective Models of the Macroeconomy

Andre, Pizzinelli, Roth, Wohlfart, 2022

- Method: **Hypothetical vignettes**.
- Respondents predict future unemployment and inflation under different macroeconomic shocks, holding constant information about the state of the economy.
- Consider four canonical macro shocks: oil prices, taxes, government spending and **interest rates (focus of today)**.
- Advantage of hypothetical vignettes: we can fix beliefs about the reasons underlying the shock.

Subjective Models of the Macroeconomy

Andre, Pizzinelli, Roth, Wohlfart, 2022

What does the general population think? How do major shocks affect the macroeconomy (u and π)? Example today: Change in federal funds rate.
Method: Prediction of u and π in two hypothetical scenarios identifies perceived causal effect.

Scenario: Federal funds rate stay constant (shortened)

Imagine the **federal funds rate** stays **constant**. The Federal Open Market Committee announces that it will keep the rate constant at 2.5%. The committee announces it does so with no changes in their assessment of the economic conditions.

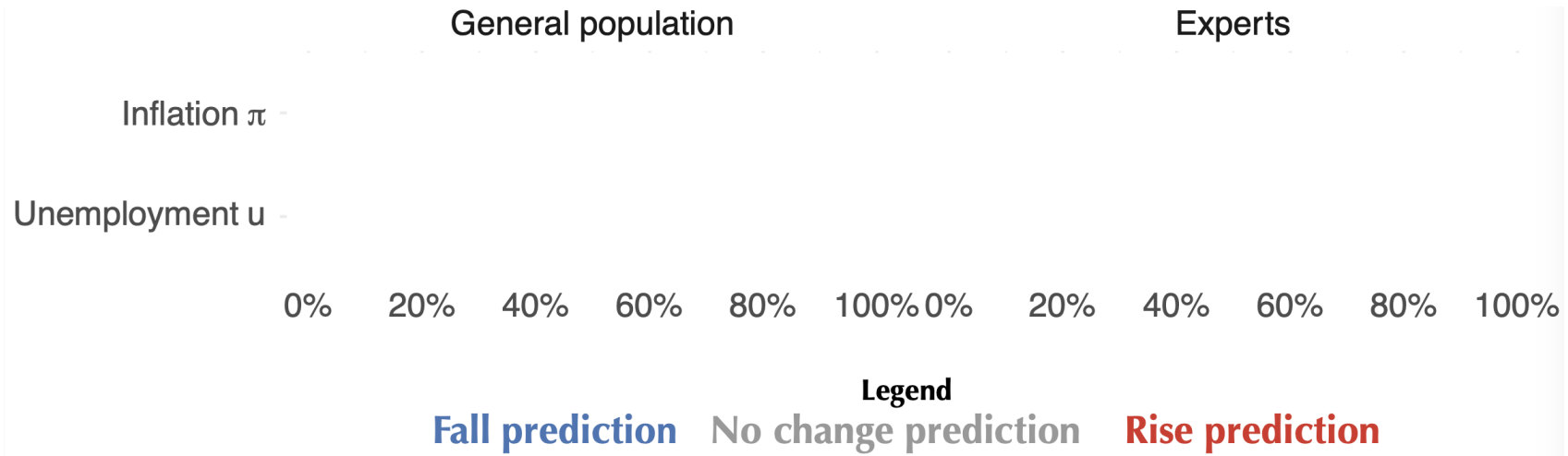
Scenario: Federal funds rate rises (shortened)

Imagine the **federal funds rate** is unexpectedly **0.5 percentage points higher**. The Federal Open Market Committee announces that it is raising the rate from 2.5% to 3%. The committee announces it does so with no changes in their assessment of the economic conditions.

Subjective Models of the Macroeconomy

Andre, Pizzinelli, Roth, Wohlfart, 2022

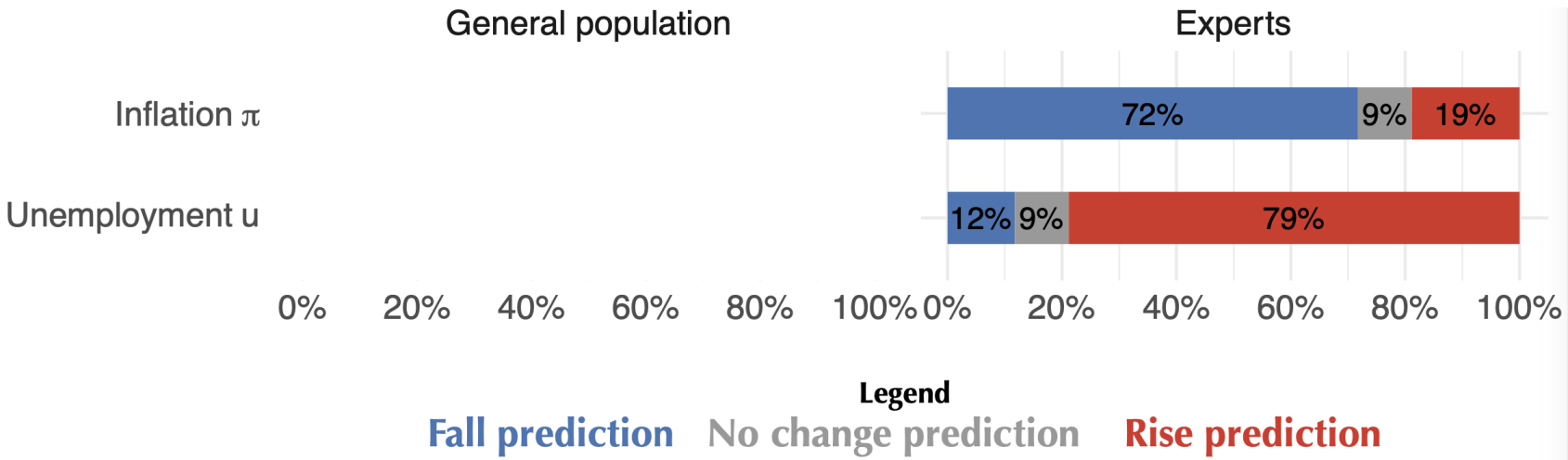
Respondents indicate the expected unemployment and inflation rates in the different hypothetical scenarios.



Subjective Models of the Macroeconomy

Andre, Pizzinelli, Roth, Wohlfart, 2022

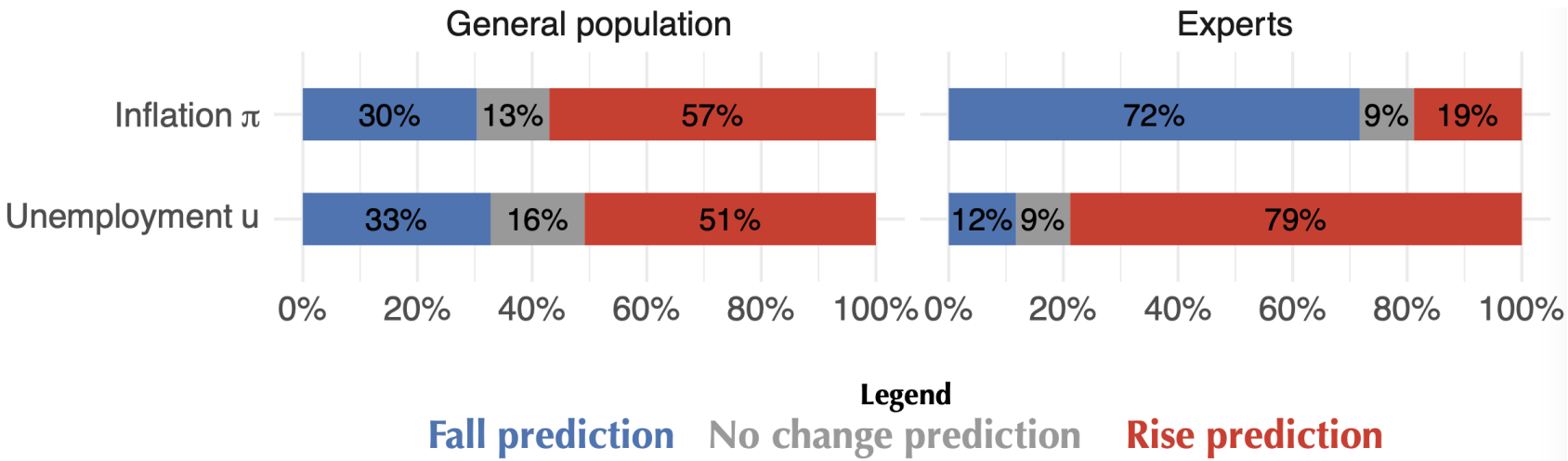
Respondents indicate the expected unemployment and inflation rates in the different hypothetical scenarios.



Subjective Models of the Macroeconomy

Andre, Pizzinelli, Roth, Wohlfart, 2022

Respondents indicate the expected unemployment and inflation rates in the different hypothetical scenarios.



The Role of Selective Recall

Sources of heterogeneity: Role of associations

Andre, Pizzinelli, Roth, Wohlfart, 2022

- What drives heterogeneity in predictions within and between households and experts?
- One potential explanation: differences in **associations** that come to respondents' minds.
  - Experts may think of **textbook models**.
  - Households selectively think of **specific propagation mechanisms** and may not account for the full general equilibrium effects of a shock.
- To shed light on the role of the associations, we directly measure respondents' **thoughts** while they make their predictions.

Measuring thoughts: Dual approach

Andre, Pizzinelli, Roth, Wohlfart, 2022

Design similar to main experiment, but measuring **associations** using a dual approach:

1. Elicitation of thoughts in **open-ended text responses** on prediction screen:
   - No priming and less plagued by ex-post rationalization.
   - But necessarily noisy and incomplete.
2. **Structured question** on a list of 6-7 vignette-specific propagation channels on the next screens:
   - Measure attention to specific channels for which open-text responses are not sufficiently nuanced.
   - Easy to compare across respondents (no judgment calls in coding necessary).
   - Subject to ex-post rationalization and desirability bias.
     - Address ex-post rationalization with an experiment shifting attention.

Measuring thoughts: Prediction screen

Andre, Pizzinelli, Roth, Wohlfart, 2022

Your thoughts

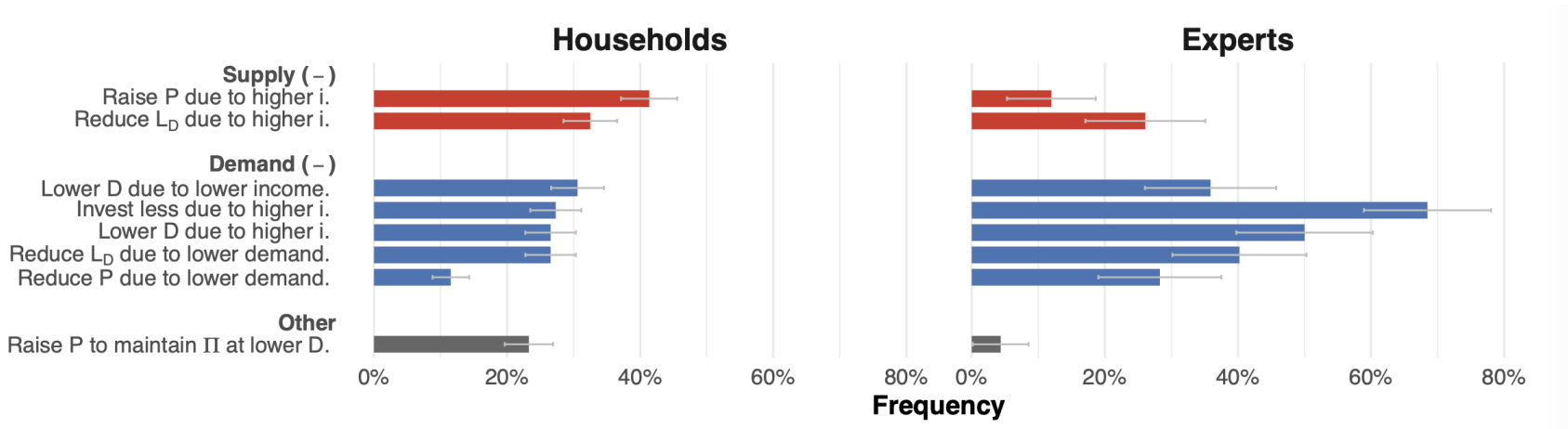
Above, you predict how the change in the alternative scenario affects the US economy.
Please tell us how you come up with your predictions.
What are your main considerations in making those predictions?
Please respond in 2-3 sentences.

→

- Analyze this data using text-analysis tools and hand-coding of responses.

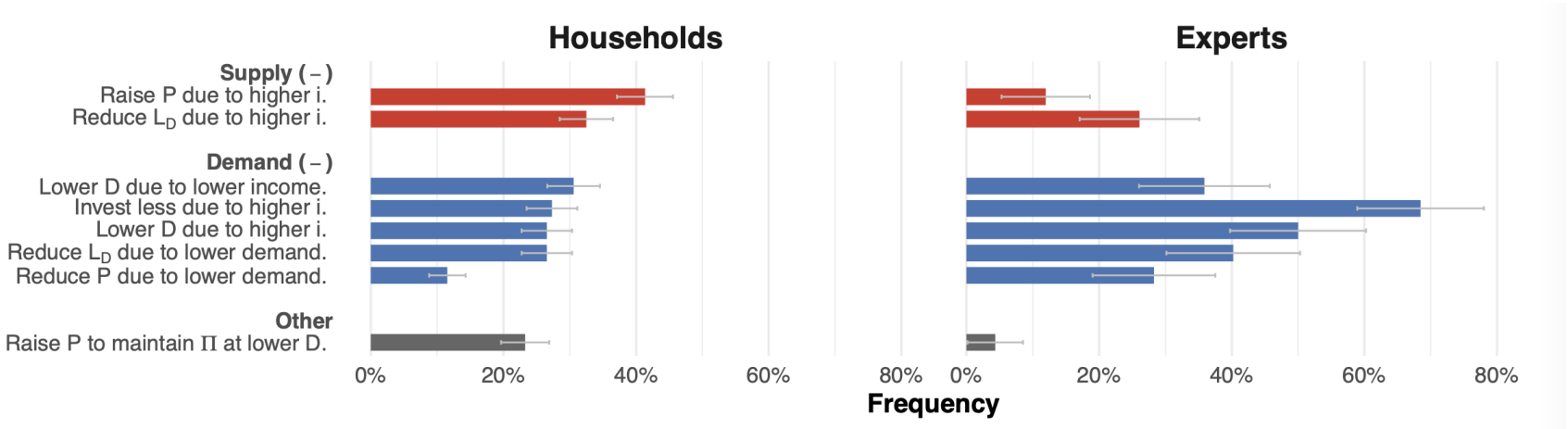
Attentional foundations of mental models I

Andre, Pizzinelli, Roth, Wohlfart, 2022



Attentional foundations of mental models II

Andre, Pizzinelli, Roth, Wohlfart, 2022



- Substantial heterogeneity in thoughts about transmission mechanisms.
- Relatively less demand-side and more supply-side narratives among households

Some qualitative data

Andre, Pizzinelli, Roth, Wohlfart, 2022

Thoughts about a cost channel	Thoughts about demand-side channels
"If the cost to borrow funds goes up, then a business will have to pay more to pay back a loan. Thus, businesses will have to raise prices. This will result in inflation. A business may not be able to pay employees and have to let them go or a business will not be able to pay back the load and the business will fail. The employees will lose their jobs and raises unemployment"	"with change in fed funds rate upward, unemployment is likely to rise (as cost to business to borrow increases and invest less in expansion) and inflation should in theory be kept in check and even fall."
"I believe if the fed rate increases, the inflation rate will as well because companies will be paying more on their credit and they will pass that on to consumers. Do not think it will affect unemployment."	"Interest rates rising will increase the cost of investment. This will make companies lay people off. However, with higher interest rates, less money will be invested and it will cause inflation to fall."
"If the Fed rate is increased, the following usually happens—the cost of borrowing money for businesses increases—the business has to raise prices—there is usually a corresponding effect on the unemployment rate as employers find they have to cut staff to remain competitive "	"when the interest rate goes up I believe the unemployment rate goes up as well. Inflation will also hurt the job market. If people are not buying the jobs decrease."
"The higher federal funds rate causes the cost of borrowing to rise. As a result, prices are raised. And employment is lowered to cover cost of borrowing."	"the demand will decrease and the investment will be less than usual also saving will be increased"
"When the interest rate rises that would mean that it would cost more for companies to borrow money and so they would charge more for their products (inflation would go up) and they would not have money to expand and hire more people (unemployment would go up). I really don't know if the exact amounts of the inflation and unemployment rises would be the same as the % that the inflation rate rose but I thought maybe it would."	"With the target rate going up, money will become more expensive to borrow, consumer credit rates will rise. This will cause consumer demand to drop and possibly put people out of work"
"The cost of business goes up so business will try to raise prices to make a profit. Business will try to cut costs by employing fewer workers."	"when interest rates increase there is less spending no new jobs"
	"Interest rate hike will cause less overall spending slightly more unemployment and greater inflation as prices adjust to this rate hike."

Associative memory

- Where do associations come from?
- Human memory is known to be associative, selective, and to draw on personal experiences (Bordalo et al., 2023).
- Theories of associative memory predict that
  - **contextual cues** affect the forecasts people make by changing the associations that come to their minds.
  - **different personal experiences** in the memory database should be reflected in differences in associations and forecasts.

Contextual cues

Andre, Pizzinelli, Roth, Wohlfart, 2022

- Contextual cues shape people's selective retrieval of propagation mechanisms and, thereby, **causally** affects forecasts.

- **Priming experiment** with households:
  - Focus on **monetary policy vignette** and **inflation forecast**.
  - Ask subgroups to predict effects on production **costs** or product **demand** before forecasting inflation on the survey screen.
  - Pure control group forecasting inflation only.
  - Experiment shows that exogenous attention manipulation causally shifts inflation expectations.
  - Open-text data post-treatment allows us to verify an **attentional first-stage**.
- We also provide evidence that **experiences are predictive of associations and forecasts**.

Narratives about the Macroeconomy

Outline of talk

Narratives about the Macroeconomy

Andre, Haaland, Roth, Wiederholt, Wohlfart, 2025

Why has the inflation rate increased?

In previous years, the US inflation rate has mostly varied between 1.5% and 2.5%. At this rate, a bundle of goods and services that costs $1,000 in one year, would cost between $1,015 and $1,025 in the next year.

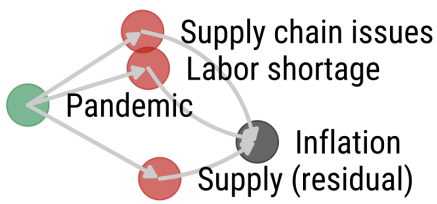
Recently, however, the inflation rate has increased. It is now at 6.8%. At this rate, a bundle of goods and services that costs $1,000 in one year, would cost $1,068 in the next year.

Which factors do you think caused the increase in the inflation rate? Please respond in full sentences.

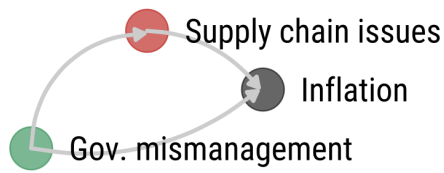
Narratives about the macroeconomy: Examples responses

Andre, Haaland, Roth, Wiederholt, Wohlfart, 2025

"I think the biggest factor in the large inflation rate over the last year or so is probably the pandemic. With labor shortages and business shutdowns because of the pandemic, certain goods are harder to get a hold of, and supply chains have been heavily impacted."



"I fully believe that our President is responsible for this disaster of inflation. [...] Our President has not helped with the backflow of container ships sitting out in the harbors. [...]"

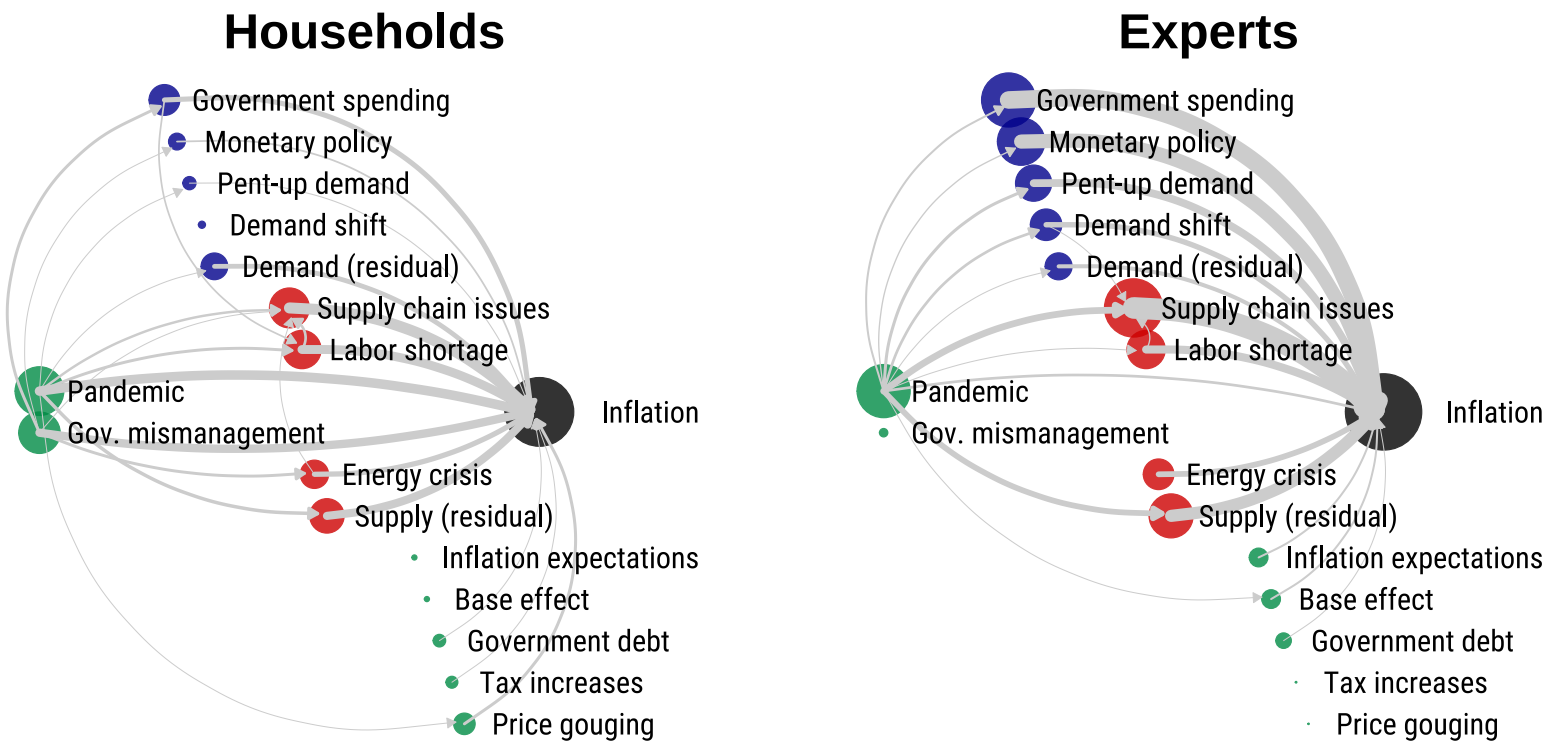


Narratives about the macroeconomy

Andre, Haaland, Roth, Wiederholt, Wohlfart, 2025

Narratives about the macroeconomy

Andre, Haaland, Roth, Wiederholt, Wohlfart, 2025



Take-aways:

- Lots of heterogeneity both within and across samples.
- Households more likely to engage in supply-side thinking compared to demand-side thinking.

The consequences of narratives

Andre, Haaland, Roth, Wiederholt, Wohlfart, 2025

We conduct a series of additional experiments which demonstrate that narratives...

- have a direct impact on **inflation expectations**
- shape the **interpretation of new information**

Theoretical analysis incorporates narratives into an otherwise conventional New Keynesian model.

- Narratives formalized as beliefs about which factors have contributed to the current inflation rate (and by how much)
- Agents use these subjective models to form their expectations
- Demonstrates narrative's importance for aggregate outcomes **through their effect on agents' expectations.**

New approaches

Digression I: Speech data to measure narratives

Graeber, Noy and Roth (2024) and Graeber, Roth and Schesch (2024)

- Recent innovation: measuring narratives with **speech recordings** embedded in online experiments.

- **Advantages of Speech Recordings**
  - Captures the spontaneity and natural flow of thoughts.
  - Includes emotional tones, emphasis, and disfluencies.
  - Potentially reduces cognitive cost relative to writing.

- **Disadvantages of Speech Recordings**
  - Potential self-consciousness of participants (though most respondents prefer speech recordings over writing).
  - Complexity in analyzing speech (non-verbal cues).
  - Technical issues like poor audio quality, though this rarely occurs in practice.

Digression II: Conducting Qualitative Interviews with AI

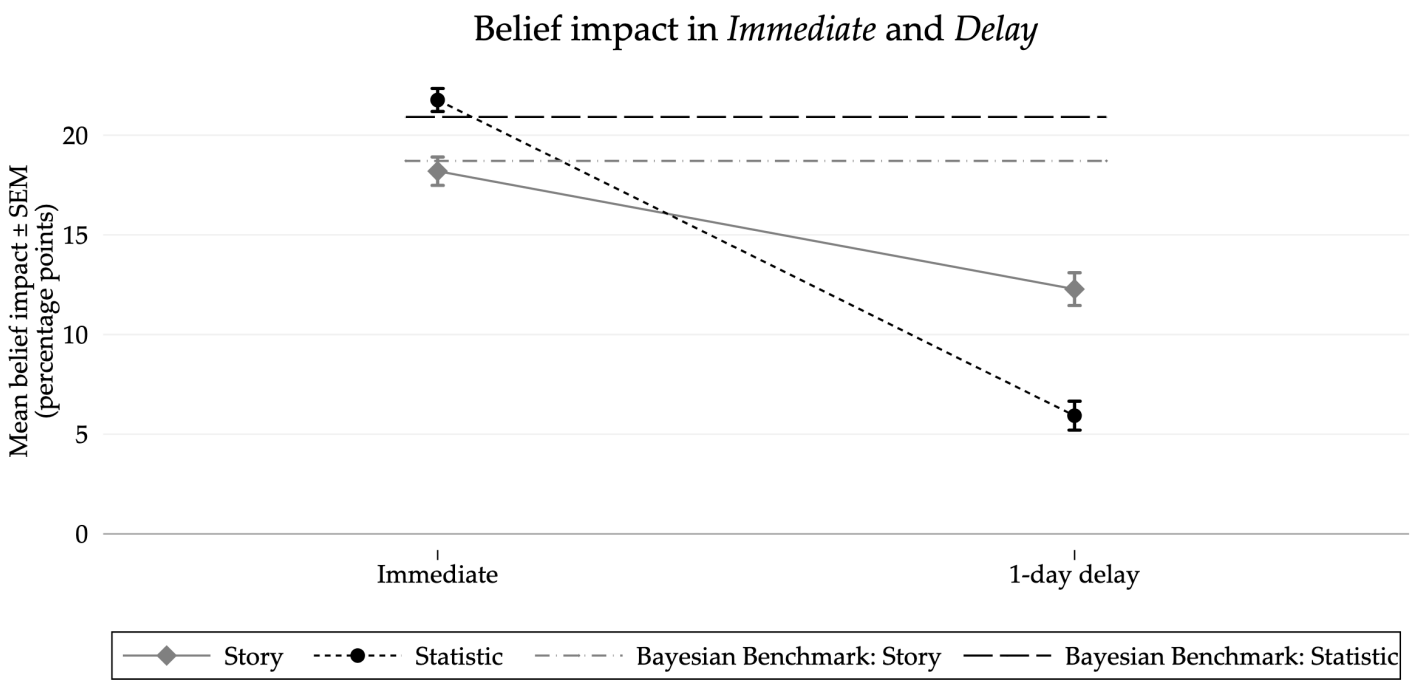
Chopra and Haaland, 2024

- AI interviews go beyond top-of-mind responses by asking a series of probing questions.
  - Use broad, neutral, and non-leading open-ended questions.
  - Adaptive probing helps clarify ambiguities and achieve **greater depth and breadth in responses**
- The interviews are text-based via chat interfaces and can be integrated into survey software like Qualtrics.
  - Builds on a multi-agent LLM model with task specialization.
- Allows for **high-quality interviews** at low cost that are **compatible with large-scale surveys**.
- Allows for the discovery of narratives and mental models that guide economic behavior.
  - Interview data strongly predictive of incentivized behavior measured 8 months after the interview.

Digression III: Stories, Statistics, and Memory

Graeber, Roth, Zimmermann, 2024

- We consume information in various forms
  - **Stories**: qualitative content about individual instances
  - **Statistics**: quantitative data about collections of observations.
- Hypothesis: **information type** – story versus statistic – shapes **selective memory**.



Digression III: Stories, Statistics, and Memory

Graeber, Roth, Zimmermann, 2024

- **The story-statistic-gap in memory**
  - The average impact of statistics on beliefs fades by 73% over the course of a day, but the impact of a story fades by only 32%.

- Guided by a model of selective memory, we disentangle different mechanisms and document that **similarity relationships** drive this gap.
  - Recall of a story increases when its qualitative content is more similar to a memory prompt.
  - **Interference**: Irrelevant information in memory that is similar to the prompt, on the other hand, competes for retrieval with relevant information, impeding successful recall.

Outline of talk

Attention to the Macroeconomy

Link, Peichl, Pfäuti, Roth and Wohlfart, 2025

- Novel measures of households' and firms' attention to the economy using **open-ended survey questions** during a large inflation shock (December 2020 to March 2023).
  - *What topics come to mind when you think about the economic situation of your household/company?*

- Tests theories of rational, **goal-optimal attention allocation**.
  - Attention exhibits large and persistent cross-sectional heterogeneity.
  - Heterogeneity is linked to **exposure** to the economy and **information costs**.
  - Attention responds strongly to shocks:
    - Attentive respondents update expectations more often.
    - They are **more confident** and hold **fewer misperceptions** about current inflation.

Attention to the Macroeconomy

Link, Peichl, Pfäuti, Roth and Wohlfart, 2025

- Patterns **inconsistent with goal-optimality**
  - More attentive agents' expectations about future inflation deviate more from expert benchmarks.
- We propose a model of **selective memory** where attention can be "**non-goal-optimal**":
  - Prior experiences shape attention and belief formation.
  - Attention to other variables can spill over to inflation expectations.
- Data **confirm** the predictions of the **selective memory model**.

Outline of talk

Subjective Models of the Macroeconomy
- Measuring Mental Models
- The Role of Selective Recall
- Associative memory and the nature of associations

Narratives
- Measuring Narratives
- The consequences of narratives

Attention to the Macroeconomy
- Measurement

Areas for future research

Big Technological Trends

- **Rapid innovations in LLMs** faciliate the analysis of qualitative data
  - Builds on long tradition in macro on qualitative data (Bewley 1995; Blinder, 1998; Case and Shiller, 2003)
- **Speech recordings** and **qualitative interviews** led by AI
- Availability of high quality online samples for households and firms

Exciting areas of research: Emotions

- **Emotions and expectation formation**
  - Gorodnichenko et al. (2023) use NLP techniques to study the emotions conveyed by the voice of the Fed chairman.

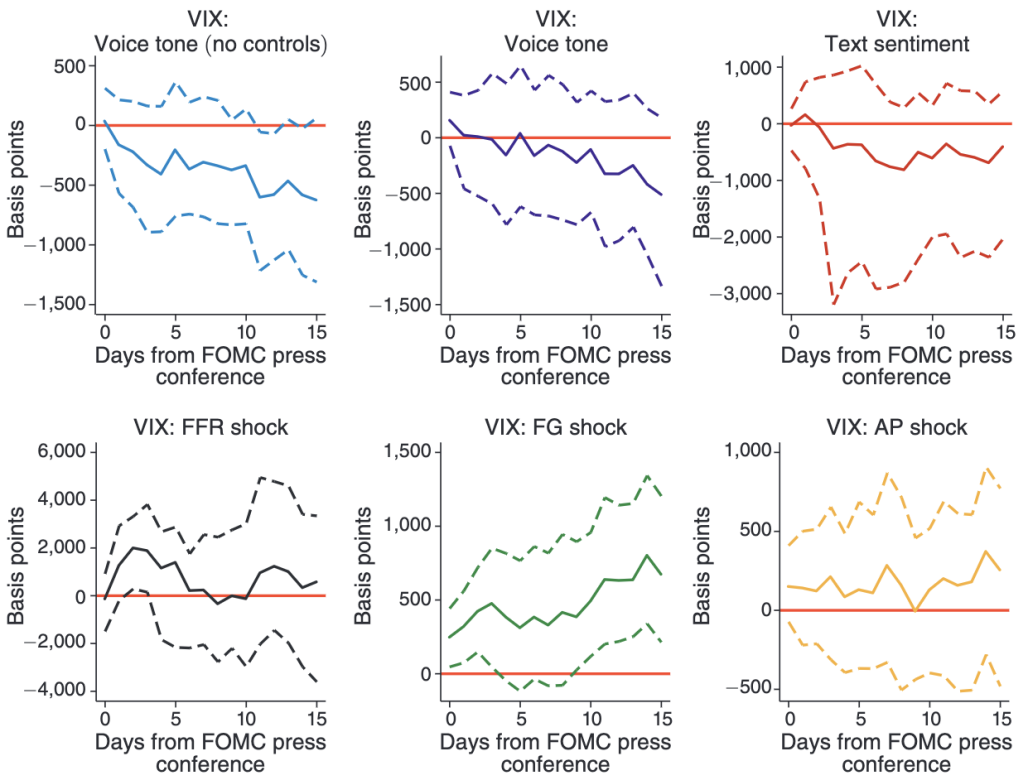


FIGURE 4. RESPONSE OF VIX (CBOE VOLATILITY INDEX) TO POLICY ACTIONS AND MESSAGES

Exciting areas: **Measuring Animal Spirits**

- Surprisingly little work on measuring **consumer sentiment or economic anxieties**.
- Could elicit people's expectations about their personal future situation using **speech recordings** or **video recordings**.
- Could **extract emotions** from the recordings using recent advances in AI/ML.

Exciting areas: **Social Animals**

> *"**It is better for reputation to fail conventionally than to succeed unconventionally.**"*
>
> — *The General Theory, Keynes*

When people have a shallow understanding of financial and economic matters, they may use simple heuristics and follow basic instincts.

- How do social incentives shape what goes viral (e.g. narratives about housing booms and busts)?
- Did FOMO fuel bubbles like crypto surges and meme stocks (e.g., GameStop, Dogecoin)?

Which Beliefs are Decision-relevant?

- Too little evidence on mechanisms underlying real world decisions.
- Need more **descriptive evidence** on the reasoning processes underlying **important high stakes decisions**.
  - Buying a house
  - Making a large investment
  - Taking out a loan
- Important implications for which variables should be **integrated into macro models**.

Exciting areas: **Linking surveys to theory**

How should we integrate survey based measures of expectations and attention into our (macro)models?

- Roth, Wiederholt and Wohlfart (2023) **feed in expectations under different policy counterfactuals** into a simple HANK model.
- This allows to **capture GE effects** without making strong assumptions about agents being able to account for those.

Exciting areas: **Experiences and Memory**

- Much of prior work relies on fairly crude measures of experiences.
- Leverage recent innovations in survey technology to collect richer and more nuanced measures of experiences.
  - Experiences of poverty/economic hardship during impressionable years
- Huge potential of LLMs to analyze unstructured datasets that do not impose considerations sets.

LLMs for Agent-Based Macroeconomic Modeling

- **Challenge:** Macro models often rely on representative agents or fixed-rule heterogeneity
- **Opportunity:** Use LLMs to endow agents with adaptive, belief-driven behavior
- **Why LLMs?**
  - Agents can interpret news, narratives, and policy signals
  - Enable richer feedback loops between expectations, decisions, and aggregate outcomes
  - Allow for heterogeneous learning, bounded rationality, and social influence
- **Macro Applications:**
  - Consumption and investment under narrative shocks
  - Belief formation and inflation dynamics
  - Financial instability and crisis propagation
  - Policy communication and public trust