Measuring mental models of the economy

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PhD Course on Subjective Beliefs in Macroeconomics and Household Finance

Motivation

- Well-documented empirical fact: Substantial **disagreement** in survey expectations about the macroeconomy (Coibion and Gorodnichenko, 2012; Mankiw et al., 2003).

  - Holds true for households, firms and professional forecasters.

- Heterogeneity in survey expectations is often attributed to **differences in information** about the current state of the economy across economic agents (Carroll, 2003; Coibion and Gorodnichenko, 2012; Link et al., 2021).

- According to such explanations, conditional on the same information set, economic agents would predict **homogeneous reactions** of the economy to innovations.

- Alternative driver of disagreement in survey expectations: heterogeneity in **subjective models of the macroeconomy**.

Motivation

- This lecture is based on the paper *"Subjective Models of the Macroeconomy: Evidence from Experts and Representative Samples"* by Peter Andre, Carlo Pizzinelli, Chris Roth and Johannes Wohlfart.

- Focus of this lecture on both:
  - i) **findings** related to expectation formation.
  - ii) **methods** we use to measure mental models of the economy (including respondents' thoughts / associations when thinking about macroeconomic shocks).

Research questions

1. How do households and experts predict unemployment and inflation to respond to macroeconomic shocks?

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2 How much heterogeneity is there i) within and ii) between households and experts?

3 What is the role of associations and memory in driving heterogeneity in predictions?

Challenges

- Response of survey expectations to actual macroeconomic shocks is **uninformative**, as fractions of the population will be inattentive to these shocks (Coibion and Gorodnichenko, 2012).

- People's beliefs should be measured in a way that enables a **comparison** with benchmarks from the theoretical and empirical literature.

- Beliefs should be measured using survey questions that are **comprehensible** to individuals without an economics education.

- Thoughts and associations difficult to measure.

This paper

Samples
Representative samples of the **US population** (n≈5,800) and a set of leading **experts** (n≈1,300).

Methods
Hypothetical vignettes in which respondents predict future unemployment and inflation under different macroeconomic shocks, holding constant information about the state of the economy.

- oil price
- government spending
- monetary policy
- income taxes

In mechanism experiments we measure **associations** respondents have while making their predictions.

Data

Online samples of the US population (n≈5,800), **representative** in terms of age, gender, region, income and education:

- Wave 1 (n=1,085): February and March 2019, *Research Now*.

- Wave 2 (n=1,151): July 2019, *Lucid*.

- Wave 3 (n=2,126): February 2021, *Lucid*.

- Wave 4 (n=1,521): February 2021, *Lucid*.

Expert samples (n≈1,300):

- Wave 1 (n=179): February and March 2019
    - Co-authors or discussants at major macro **conferences** (NBER, Cowles, SITE, . . .).
    - Experts in **policy institutions** (IMF, Bundesbank, ECB, . . .).
    - PhD students working in macro at Frankfurt, Bonn and Oxford.

- Wave 2 (n=908): July 2019, *ifo World Economic Survey*

- Wave 3 (n=375): February 2021, invited authors of published macro papers and PhD students at leading departments.

Vignettes

Two variables are predicted ...

- unemployment *u*
- inflation π

... in four vignettes

- price of crude oil
- total government spending
- federal funds target rate
- income tax rates

Goals

- identical for general population and expert sample
- accessible for the general population, but comparable to benchmarks from macroeconomic models and empirical estimates
- fix beliefs about current levels of u and π
- plausibly *exogenous* shocks to identify perceived effects of shock on u and π

Vignettes: Structure

Vignette Structure
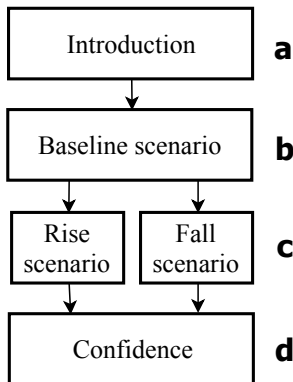
Belief measurement

Use difference in predictions as outcome variable.

- **Perceived inflation response**
  $\Delta\pi_{i,r/f} = \pi_{i,r/f} - \pi_{i,baseline}$
- **Perceived unemployment response**
  $\Delta u_{i,r/f} = u_{i,r/f} - u_{i,baseline}$

Example: Oil price constant scenario

We would like you to think about the following hypothetical scenario.

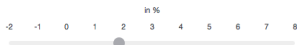---

Scenario: Oil price stays constant

Imagine that the average **price of crude oil** stays **constant** over the next 12 months. That is, on average, the price of oil over the next 12 months will be the same as the current price.

Reminder: Please account for the actions of policymakers that you would expect in this scenario and include them in your predictions.

Inflation rate

Under this scenario, what do you think the US **inflation rate** will be over the next 12 months?
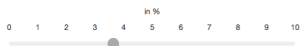
Note: The default position of the slider is the current level of the inflation rate: 1.8%

in %

| -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

Unemployment rate

Under this scenario, what do you think the US **unemployment rate** will be 12 months from now?

Note: The default position of the slider is the current level of the unemployment rate: 3.6%

in %

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Example: Oil price increase scenario

We would like you to think about the following hypothetical scenario.

Scenario: Oil price rises

Imagine the average **price of crude oil** unexpectedly **rises** due to a problem with the local production technology in the Middle East. On average, the price will be $30 higher **for the next 12 months** than the current price.

Reminder: Please account for the actions of policymakers that you would expect in this scenario and include them in your predictions.

Inflation rate
Under this scenario, what do you think the US **inflation rate** will be over the next 12 months?

Note: The default position of the slider is the current level of the inflation rate: 1.8%

in %

-2   -1   0   1   2   3   4   5   6   7   8

Unemployment rate
Under this scenario, what do you think the US **unemployment rate** will be 12 months from now?

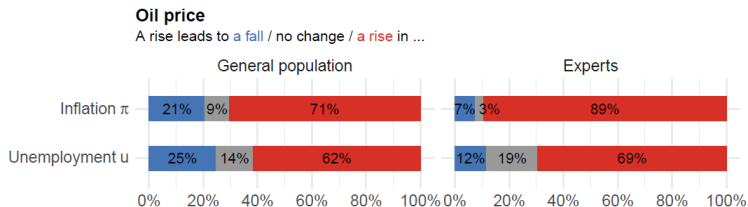*Note: The default position of the slider is the current level of the unemployment rate: 3.6%*

in %

0   1   2   3   4   5   6   7   8   9   10

Example: Interest rate decrease scenario

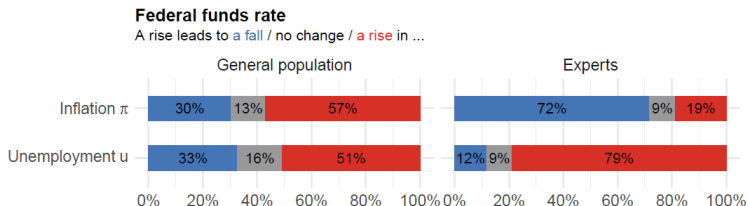**Scenario: Federal funds target rate falls**

Imagine the **federal funds target rate** is unexpectedly **0.5 percentage points lower**. That is, in its next meeting, the Federal Open Market Committee announces that it is reducing the rate from 2.5% to 2%.

Imagine the committee announces it does so with no changes in their assessment of the economic conditions.

Main results: Oil price shock - directions

Oil price
A rise leads to a fall / no change / a rise in ...

General population / Experts

Inflation π: General population — 21%, 9%, 71%; Experts — 7%, 3%, 89%

Unemployment u: General population — 25%, 14%, 62%; Experts — 12%, 19%, 69%

Main results: Monetary policy shock - directions

Federal funds rate
A rise leads to a fall / no change / a rise in ...

General population

Inflation π	30% 13% 57%
Unemployment u	33% 16% 51%

Experts

Inflation π	72% 9% 19%
Unemployment u	12% 9% 79%

Main results: Heterogeneity in subjective models - quantitative

(A) Average beliefs
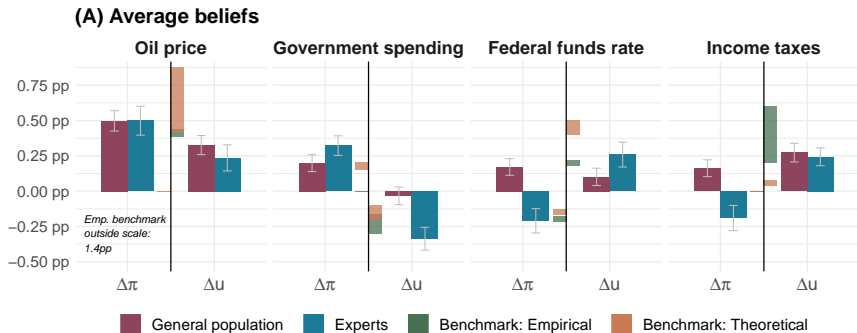
Sources of heterogeneity: Role of associations

- What is driving 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 in wave 3.

Measuring thoughts: Dual approach

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 immune to ex-post rationalization.
   - But necessarily noisy and incomplete.

2. **Structured questions** on overall forecasting approach and 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 nuanced enough.
   - Easy to compare across respondents (no judgment calls in coding necessary).
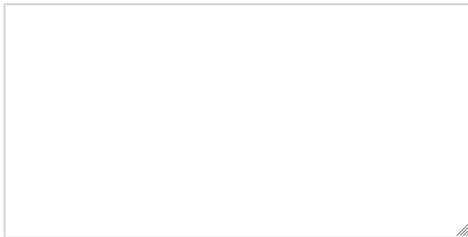   - But may be subject to ex-post rationalization.

Measuring thoughts: Prediction screen

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.

→

Measuring thoughts: Structured question on propagation channels

How did you come up with your predictions?

The following statements describe different thoughts you might have had on your mind while making your predictions for the alternative scenario. **Did you have any of these thoughts on your mind?** Please tick all that you had on your mind.

- ☐ Because there is less demand for their products, businesses reduce their workforce.
- ☐ Businesses face lower demand for their products, so they increase their product prices to keep profits at the same level.
- ☐ To make up for the higher cost of borrowing, businesses reduce their workforce.
- ☐ Because there is less demand for their products, businesses reduce their product prices.
- ☐ Because higher interest rates make it more attractive to save and less attractive to borrow, households cut back on their spending.
- ☐ Due to the higher cost of borrowing, businesses pursue fewer investment projects.
- ☐ To make up for the higher cost of borrowing, businesses increase product prices.
- ☐ Because of lower incomes or job loss, households cut back on their spending.
- ☐ *None of the above.*

Measuring thoughts: Structured question on approach

How did you come up with your predictions?

Please think once more about the predictions you made in the preceding scenarios.

Please tell us which of the following factors you thought about most when you made your predictions in the alternative scenario?
Select all answers that apply.

☐ My memories of economic events in the past.
☐ My personal economic situation today.
☐ My knowledge of economics.
☐ I simply responded based on my gut feeling.
☐ Things I read or heard in the news.
☐ Other (*please specify*) [   ]

Response types open-text responses

(A) Response types
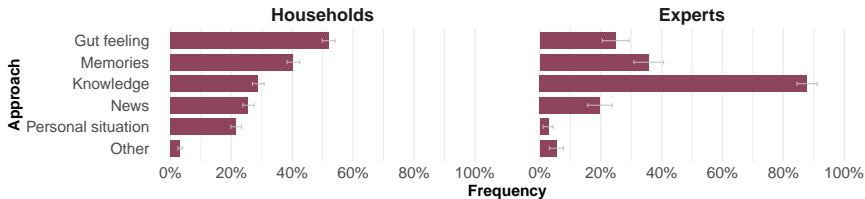Open associations question, manually coded, multiple codes possible
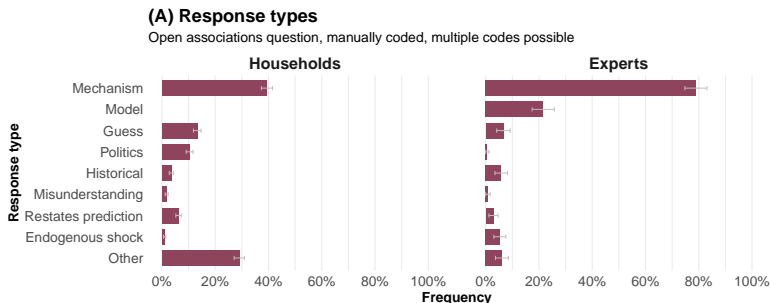
- Each response double hand-coded.
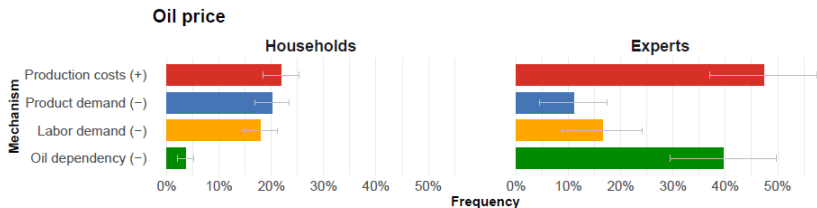- Multiple categories possible.

Forecasting approaches according to structured question
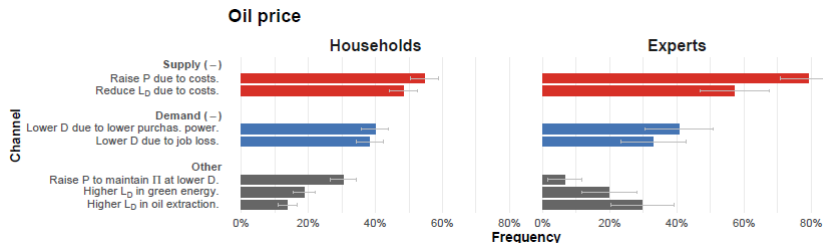

(B) Prediction approaches

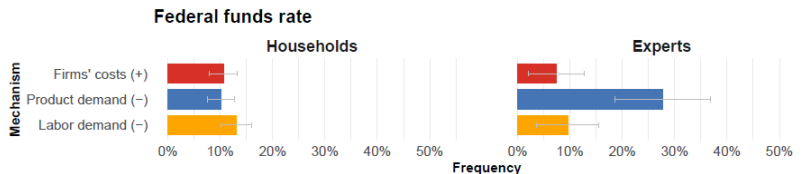Structured question, selection of multiple items possible

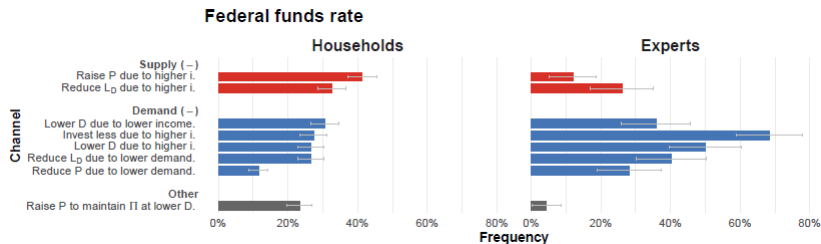# Mechanism associations in open-text responses: Oil price shock

Thoughts about propagation channels (structured question): Oil price shock

Mechanism associations in open-text responses: Monetary policy shock

Thoughts about propagation channels (structured question): Monetary policy shock

The causal effect of attention to propagation mechanisms

- Mechanism associations (open-text) and thoughts about propagation channels (structured question) **correlated** with unemployment and inflation forecasts.

- Are these correlations **causal**?

- **Priming exercise** in wave 4 of the household survey:
  - Ask subgroups to predict effects on production **costs** or product **demand** before forecasting inflation on the survey screen.
  - Focus on monetary policy vignette and inflation forecast.
  - Elicitation of thoughts using **open-ended question** on prediction screen.
  - Control group forecasting inflation only.

Causal effect of mechanism associations

	Mechanism associations		Word usage		Inflation
	Firms' costs (+)	Product D. (–)	Costs words	Demand words	$\Delta\pi$
	(1)	(2)	(3)	(4)	(5)
Costs prime	0.063***	−0.030**	0.086***	0.007	0.021
	(0.020)	(0.015)	(0.023)	(0.020)	(0.031)
Demand prime	−0.008	0.041**	−0.021	0.077***	−0.057**
	(0.016)	(0.019)	(0.017)	(0.023)	(0.029)
Constant	0.073***	0.083***	0.093***	0.106***	0.366***
	(0.009)	(0.010)	(0.010)	(0.011)	(0.017)
p: **Costs**$\neq$ **Demand**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.028**
Observations	1,521	1,521	1,521	1,521	1,521
R^2	0.010	0.008	0.017	0.010	0.004

Notes: Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Sources of associations: Role of memory

- What are the **sources** of associations?

- Study role of **memory**.

- Focus on **OPEC oil embargo** in the 1970s.

- Are memories of this event correlated with i) mechanism associations and ii) inflation and unemployment forecasts?

Memories of the OPEC oil embargo and mechanism associations

Effect on mechanism associations

	Production costs (+)			Product demand (–)		
	(1)	(2)	(3)	(4)	(5)	(6)
<1962	0.085**			0.092**		
	(0.039)			(0.037)		
<1962× OPEC mem.		0.096**			0.091**	
		(0.047)			(0.045)	
<1962× Uses mem.			0.144***			0.102**
			(0.049)			(0.046)
Constant	−0.328	−0.315	−0.311	−0.356*	−0.342	−0.338
	(0.214)	(0.213)	(0.211)	(0.213)	(0.212)	(0.211)
Controls	Demo.	Demo.	Demo.	Demo.	Demo.	Demo.
Observations	521	521	521	521	521	521
R^2	0.029	0.028	0.039	0.034	0.031	0.033

Notes: Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Memories of the OPEC oil embargo and inflation and unemployment forecasts

Effect on predictions

	Inflation $\Delta\pi$			Unemployment Δu		
	(1)	(2)	(3)	(4)	(5)	(6)
<1962	0.218***			0.204***		
	(0.043)			(0.042)		
<1962× OPEC mem.		0.249***			0.218***	
		(0.051)			(0.048)	
<1962× Uses mem.			0.266***			0.173***
			(0.046)			(0.048)
Constant	0.105	0.137	0.147	0.127	0.157	0.166
	(0.259)	(0.258)	(0.261)	(0.280)	(0.283)	(0.284)
Controls	Demo.	Demo.	Demo.	Demo.	Demo.	Demo.
Observations	521	521	521	521	521	521
R^2	0.069	0.066	0.072	0.066	0.060	0.047

Notes: Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Other evidence in the paper

- **Symmetry** of forecasts to positive vs negative shocks.

- Predictions about the **joint response** of unemployment and inflation to shocks.

- Potential of associations to account for differences between households and experts.

- Alternative/additional **mechanisms** driving forecasts:
  - Perceived past correlations between macroeconomic variables.
  - Rational inattention.
  - Numeracy.
  - …

- Relative importance of different mechanisms.

- Extensive **robustness** checks:
  - Dropping inattentive respondents.
  - Dropping extreme predictions in baseline scenarios.
  - Focusing on assistant/associate/full professors in expert sample.
  - …

Summary and implications

- Substantial **heterogeneity** in beliefs about response of economy to shocks, among experts and even more so among households.
  - This could drive part of the observed disagreement in survey expectations.

- Households' beliefs on average aligned with experts in many cases, with some exceptions:
  - Opposite beliefs about inflation response to monetary policy and tax shocks.
  - Households on average see no effect of government spending shocks on unemployment.

- **Associations** and thoughts about differential propagation channels seem to be an important driver of forecasts, both among experts and households.

Take-away: Methods

- Use of **hypothetical vignettes** to study expectation formation holding constant beliefs about state of the economy.

- Use of open-ended questions and text data to study associations and thoughts.

- Combining priming and text data to study the **causal effect** of changes in attention to particular mechanisms.

Carroll, Christopher D, "Macroeconomic Expectations of Households and Professional Forecasters," *The Quarterly Journal of Economics*, 2003, *118* (1), 269–298.

Coibion, Olivier and Yuriy Gorodnichenko, "What Can Survey Forecasts Tell us about Information Rigidities?," *Journal of Political Economy*, 2012, *120* (1), 116–159.

Link, Sebastian, Andreas Peichl, Christopher Roth, and Johannes Wohlfart, "Information frictions among firms and households," 2021.

Mankiw, N Gregory, Ricardo Reis, and Justin Wolfers, "Disagreement About Inflation Expectations," *NBER Macroeconomics Annual*, 2003, *18*, 209–248.