THE CREDIBILITY REVOLUTION IN INFLATION EXPECTATIONS

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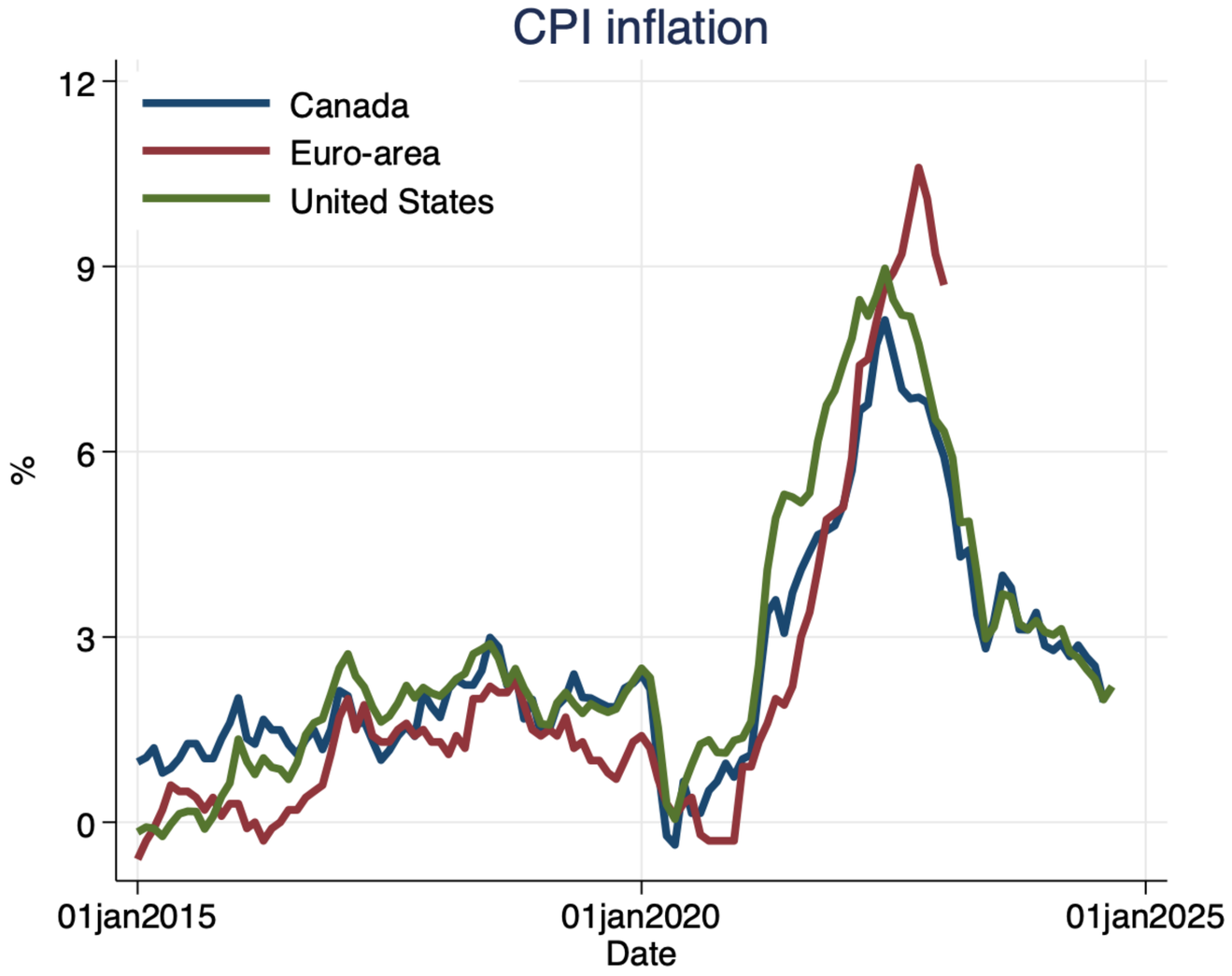
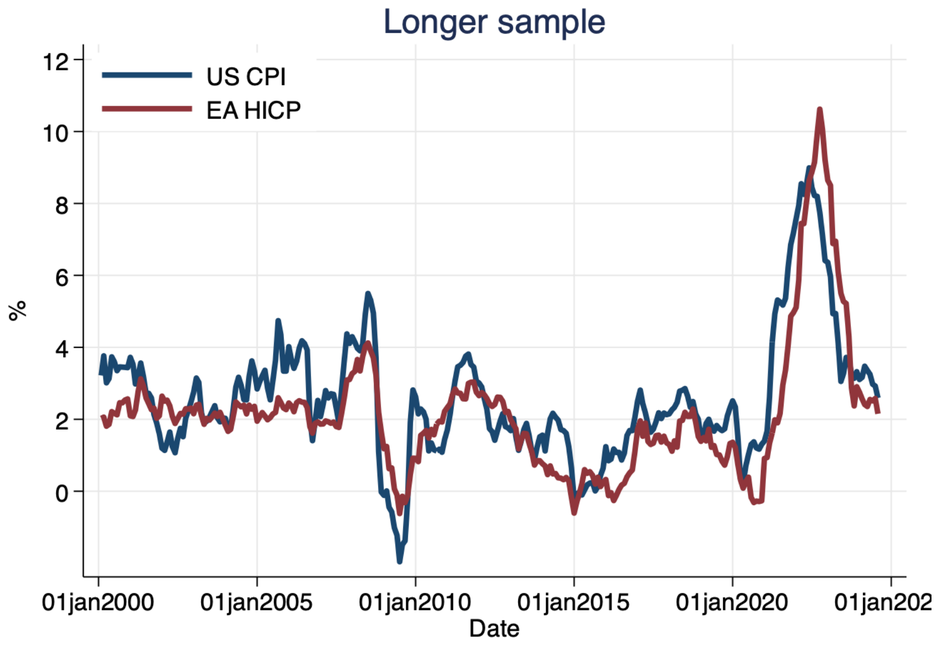
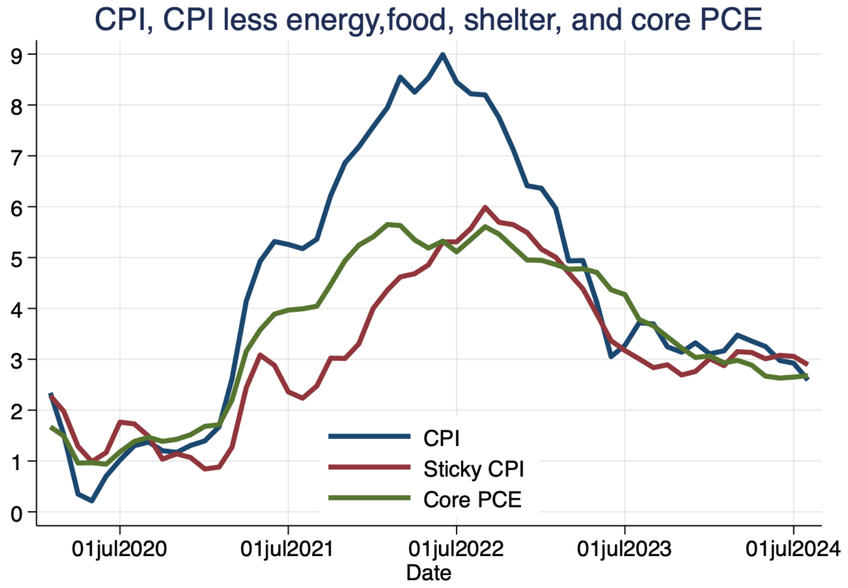
Bank of Canada Annual conference

Why did inflation explode?







The consensus narrative: Powell at Jackson Hole

- Early 2021 "pent-up demand, stimulative policies, pandemic changes in work and leisure practices, and the additional savings associated with constrained services spending all contributed to a historic surge in consumer spending on goods."
- Late 2021: "New supply shocks appeared. Russia's invasion of Ukraine led to a sharp increase in energy and commodity prices."
- 2022: "We raised our policy rate by 425 basis points in 2022 and another 100 basis points in 2023. "The summer of 2022 proved to be the peak of inflation"
- Causes: "Pandemic-related distortions to supply and demand, as well as severe shocks to energy and commodity markets, were important drivers of high inflation, and their reversal has been a key part of the story of its decline."
- *Expectations? "anchored inflation expectations, reinforced by vigorous central bank actions, can facilitate disinflation without the need for slack."*

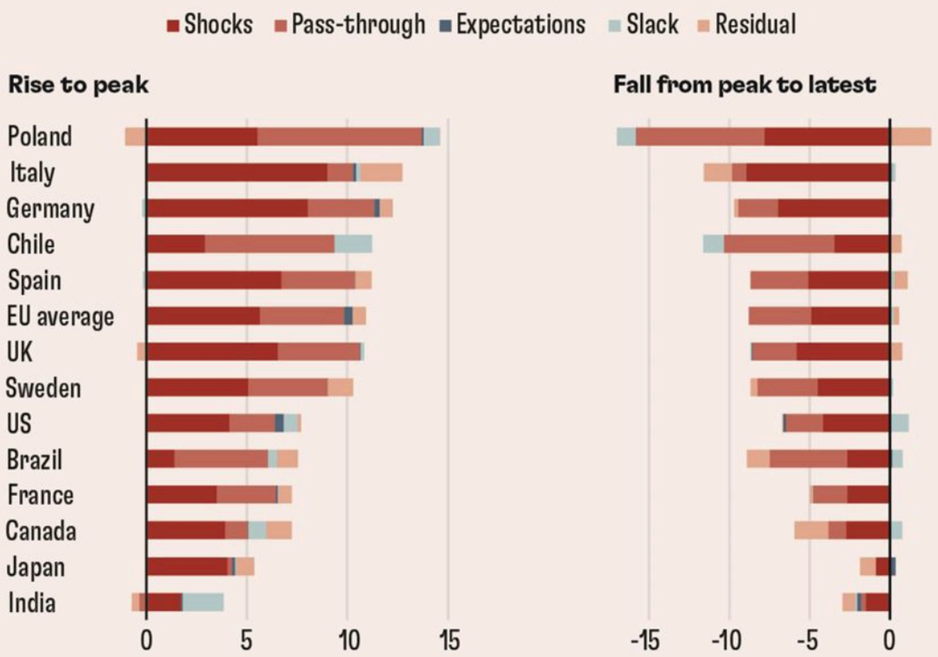
A more extreme statement: F&D magazine

CHART 2

Shocks and effects

Inflation's rise and fall reflected mainly shocks to prices in particular industries and their pass-through rather than macroeconomic slack.

(percentage points; 12-month rate)



SOURCES: Haver Analytics; and authors' calculations.

NOTE: Chart decomposes rise in headline inflation from December 2020 to the country-specific peak (left panel) and change from the peak to the latest observation included in the study (March 2024).

CHART 1

Stable expectations

Long-term inflation expectations held steady despite a surge in energy prices and headline inflation.

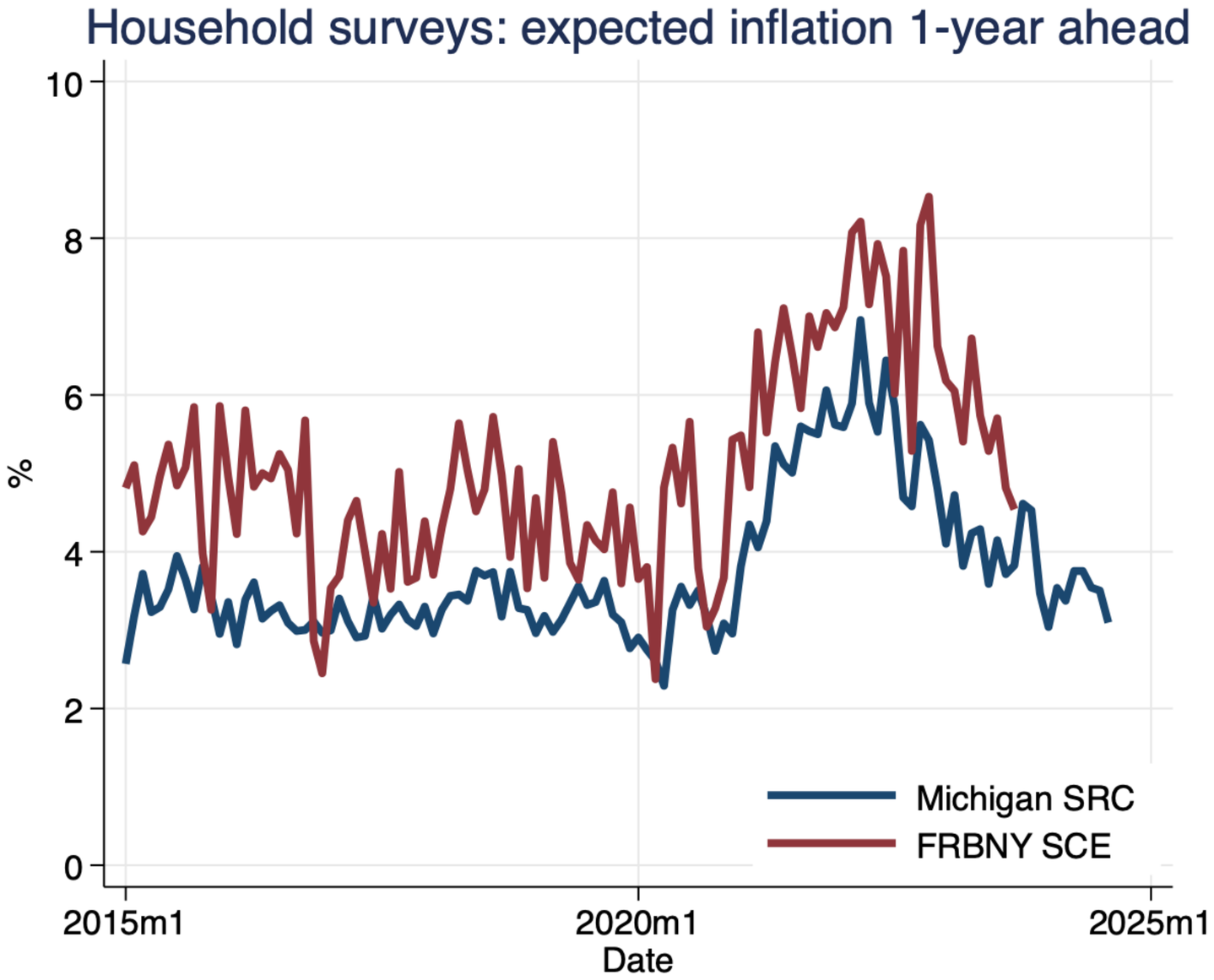
(percent; median across countries)

SOURCES: Haver Analytics; and authors' calculations.

NOTE: Energy price inflation is based on consumer price index for energy; long-term expectations are based on assessments of professional forecasters.

BUT IS THAT RIGHT?
DIG DEEPER...

But were inflation expectations so anchored?

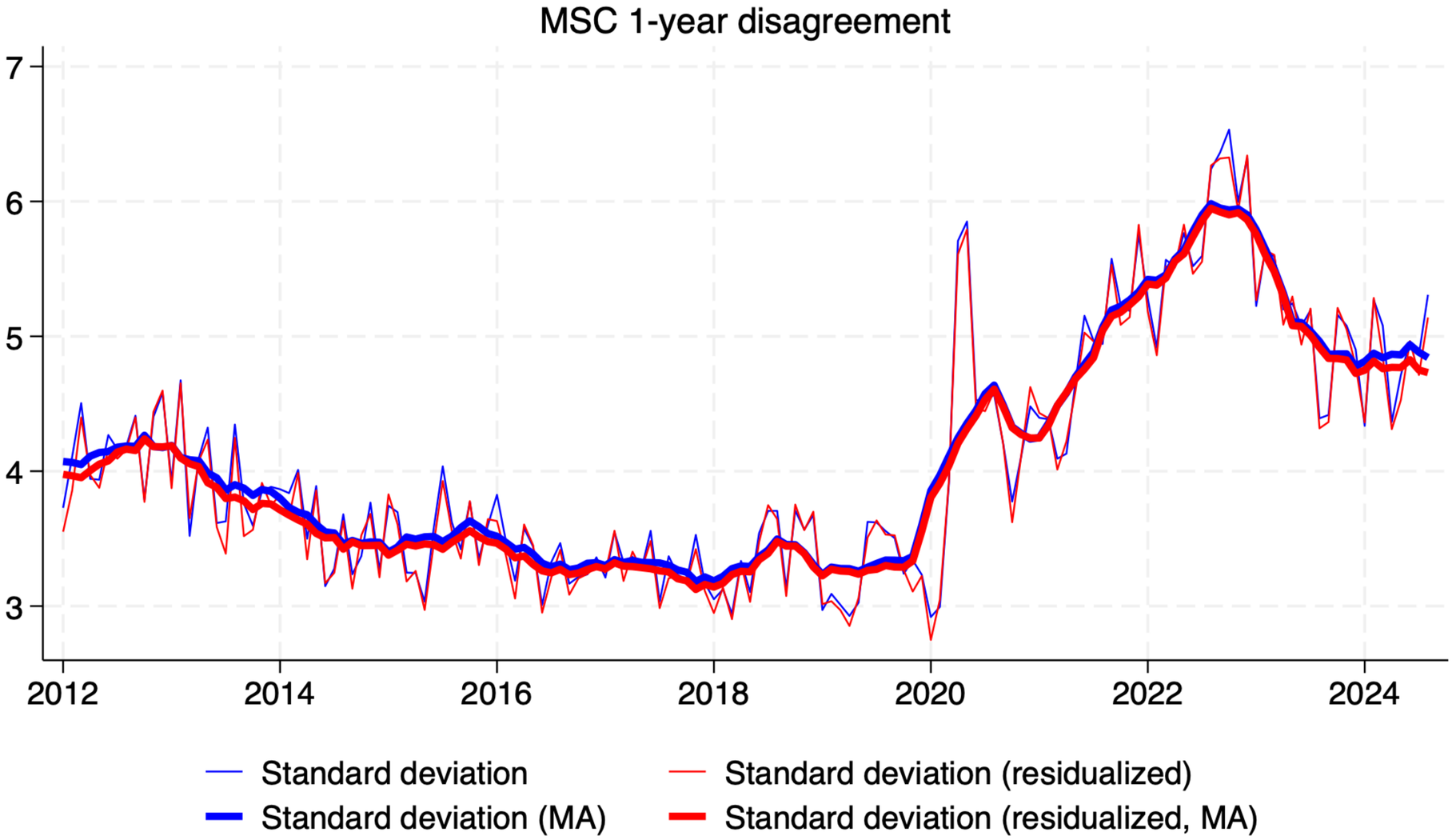


Between start of 2021 and end of 2022, yes.

But in between that 2-year (or 18-month) period, there was a clear up and down.

It was quantitatively large

But were inflation expectations so anchored?



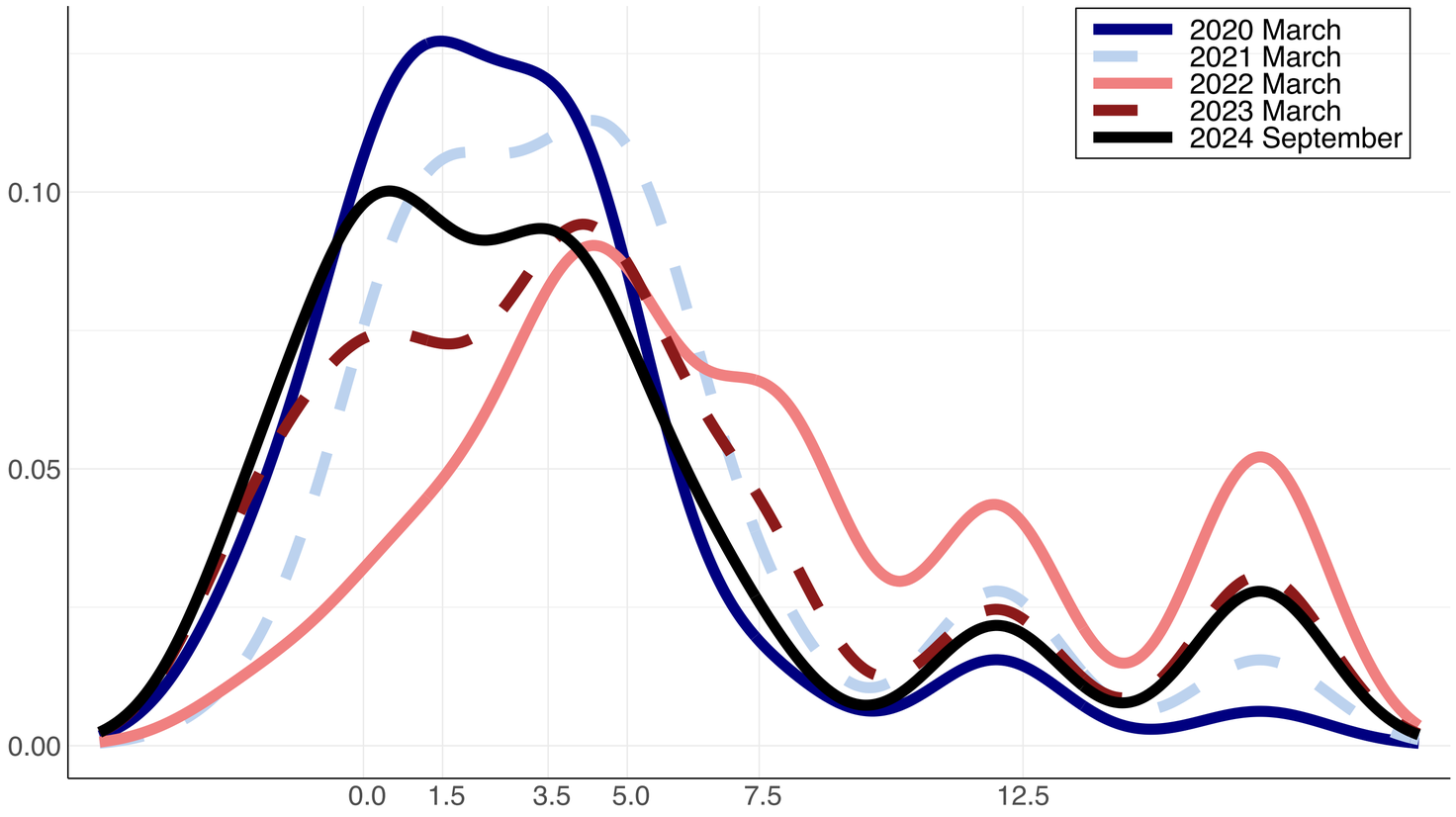
Anchoring is as much about the second moment

Unanchoring starts earlier, already in 2020.

It has only partially reversed

Source: Fofana, Patzelt, Reis (2024) "Household disagreement about expected inflation" in *The Research Handbook of Inflation*

But were inflation expectations so anchored?



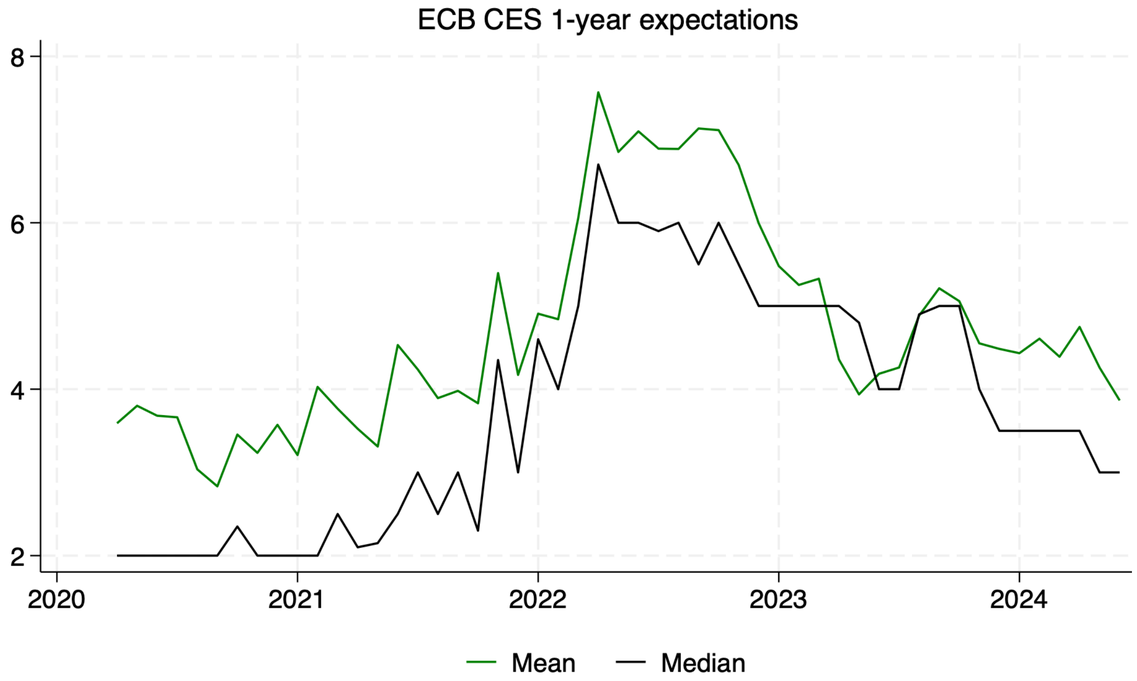
Fattening of right tail and flattening of top in 2021-22. Converge back, not fully.

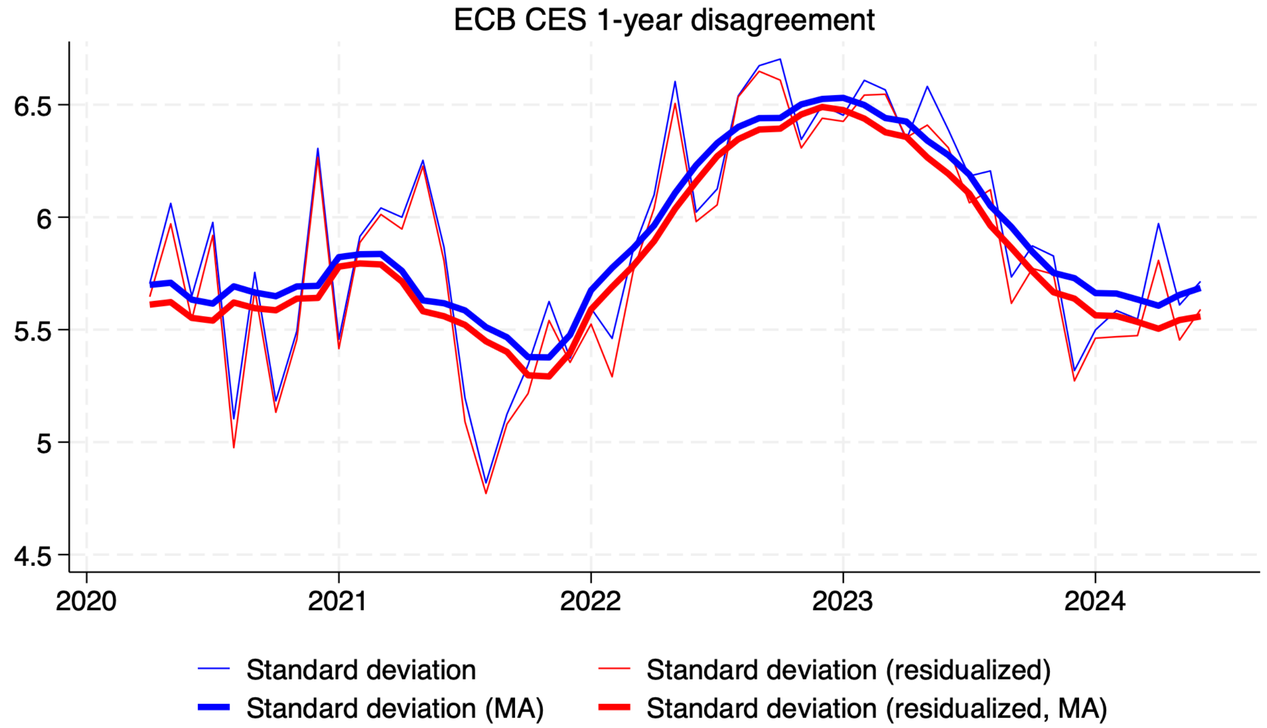
<u>Common pattern around large shocks</u>: first skewness moves, then variance, only then mean. Inspired theories of inattention or sticky information: some respond to big shocks, most do not.

Source: Reis (2023) "The Burst of High Inflation in 2021-22: How and Why Did We Get Here?" in *How Monetary Policy Got Behind the Curve* (updated)

But were inflation expectations so anchored?

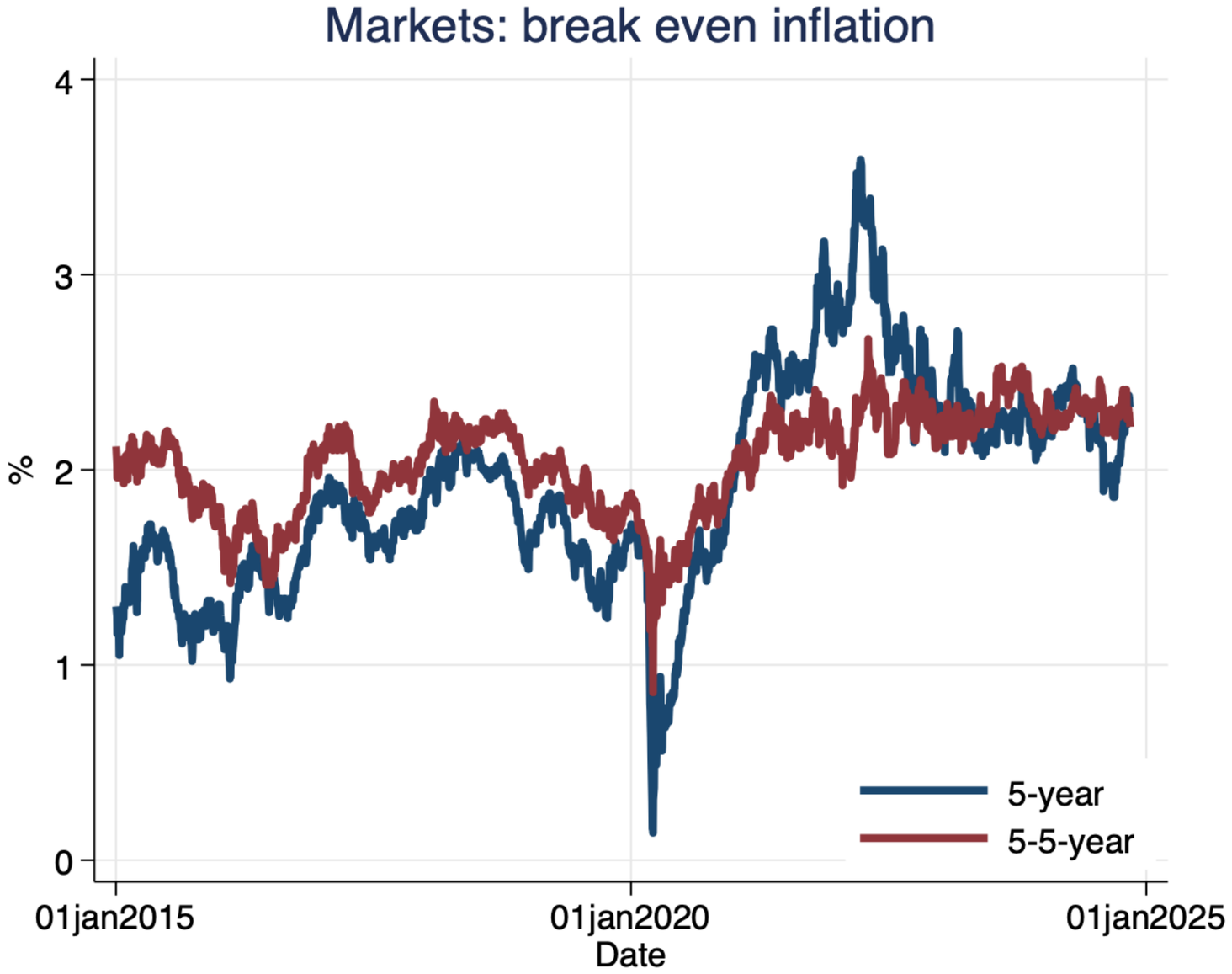
Similar story across the Atlantic: later, and maybe less persistent





Source: Fofana, Patzelt, Reis (2024) "Household disagreement about expected inflation" in *The Research Handbook of Inflation*

But were inflation expectations so anchored?



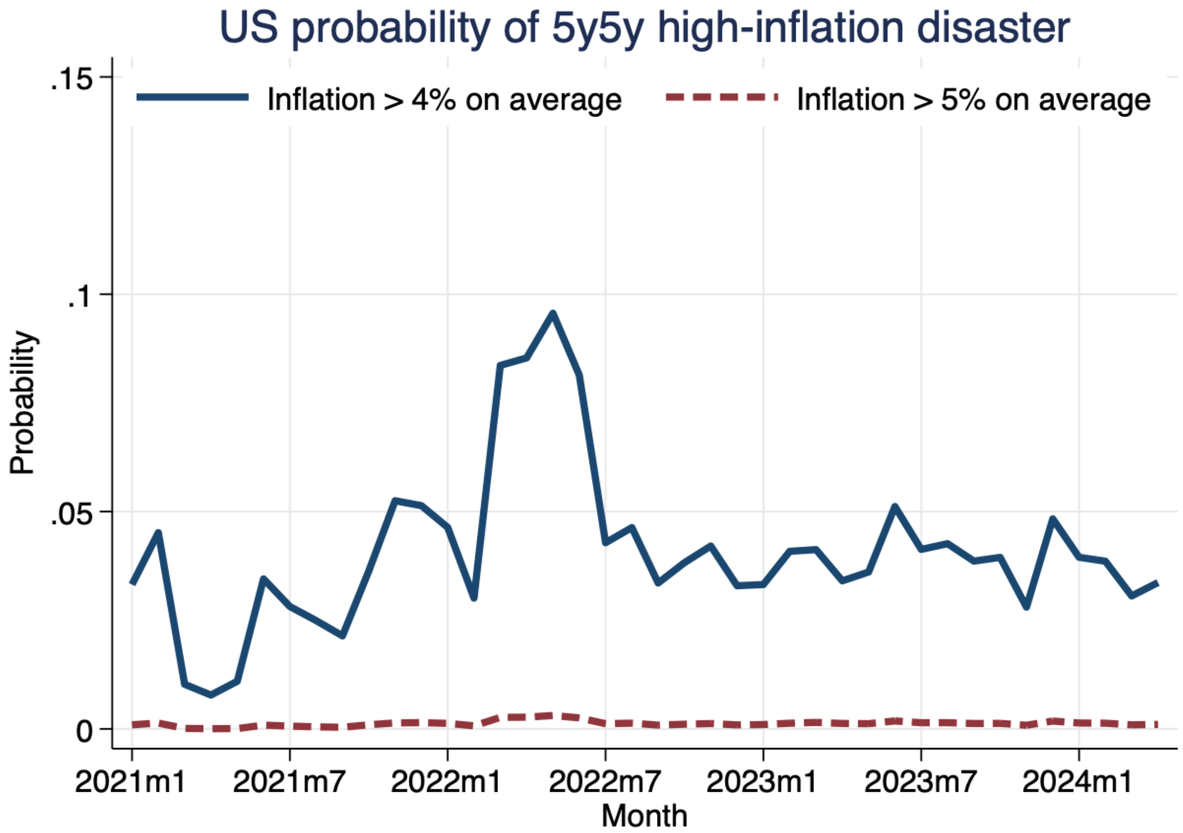
Longer horizon, must turn to markets

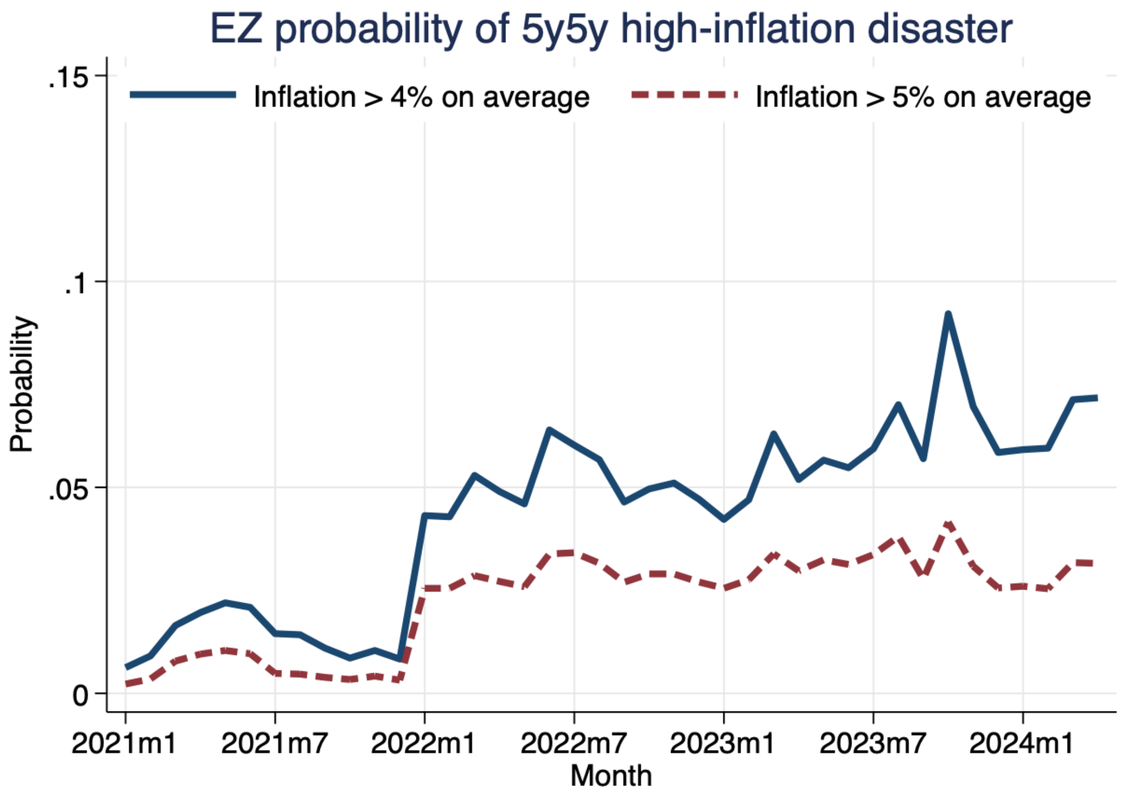
Clear rise by full 100bps from second half of 2020 until now

Persistently higher by 20-30bps than in the pre-pandemic decade

But were inflation expectations so anchored?

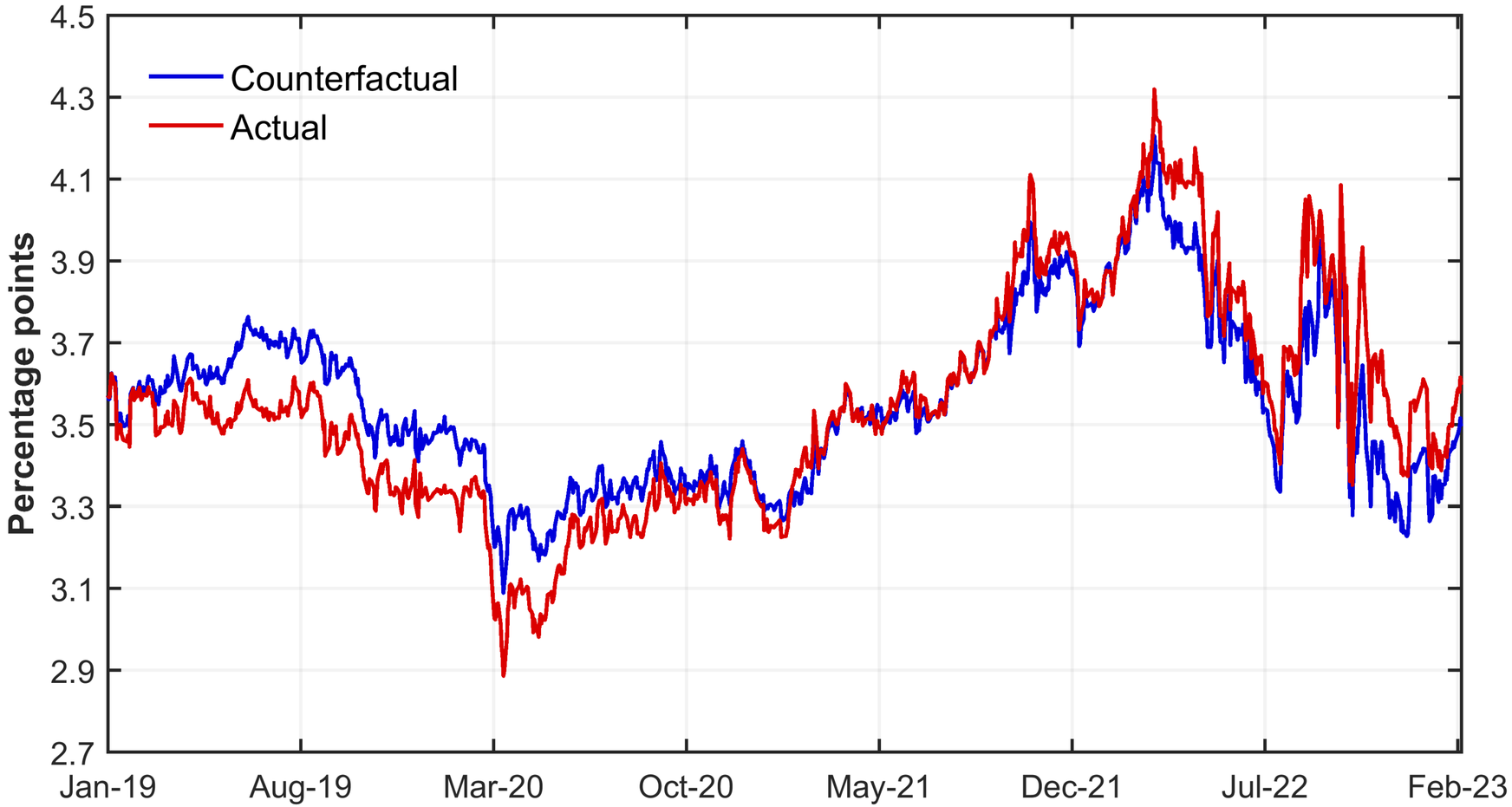
Tails went up and down in US in 2021-22. Still persists in the EA.





Source: Hilscher, Raviv, Reis (2022) "How Likely Is an Inflation Disaster?" *CEPR Discussion Paper 17224*

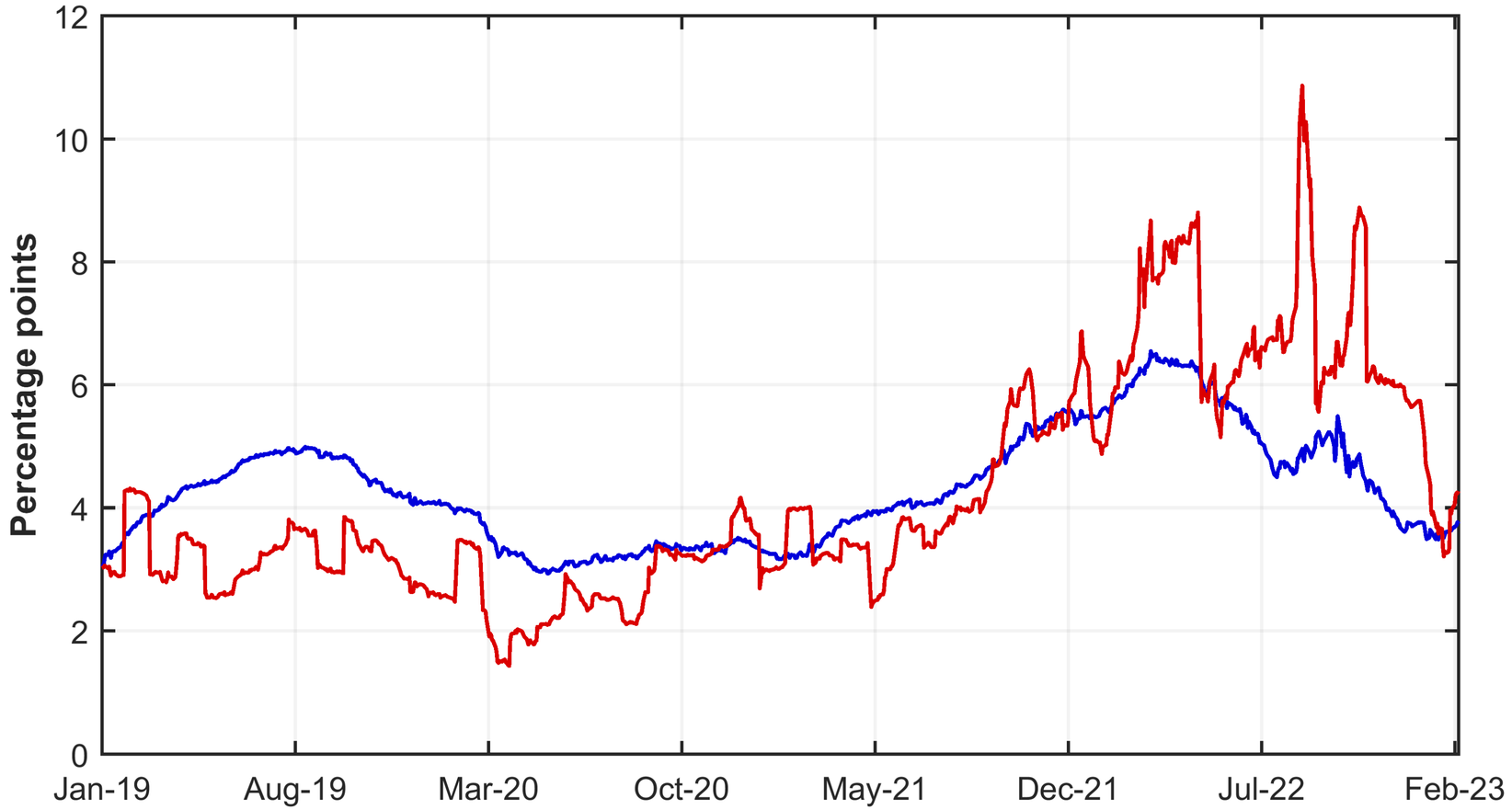
But were inflation expectations so anchored?



UK at long-horizons, cleaned using data on quantities: cannot blame liquidity premia

Source: Bahaj, Czech, Ding Reis (2023) "The Market for Inflation Risk?" *Bank of England working paper*

But were inflation expectations so anchored?



UK, short-horizon: liquidity premia matter for high frequency, but the trends are still there.

Source: Bahaj, Czech, Ding Reis (2023) "The Market for Inflation Risk?" *Bank of England working paper*

Conclusions from the raw data

- **Long-horizon professional inflation forecasts moved little**. So….

- **Household expectation at the 1-year horizon moved significantly, up in 2021, down in 2002**. Anchored at biennial frequency. Un-anchored and then re-anchored is a more accurate description.

- **Judging by household disagreement, long-run market prices, and option prices for disasters, effects persist**. Anchored but not as deeply in the holding ground.

- **Beyond measurement, economists proceed to ask (quasi-)causal questions**:

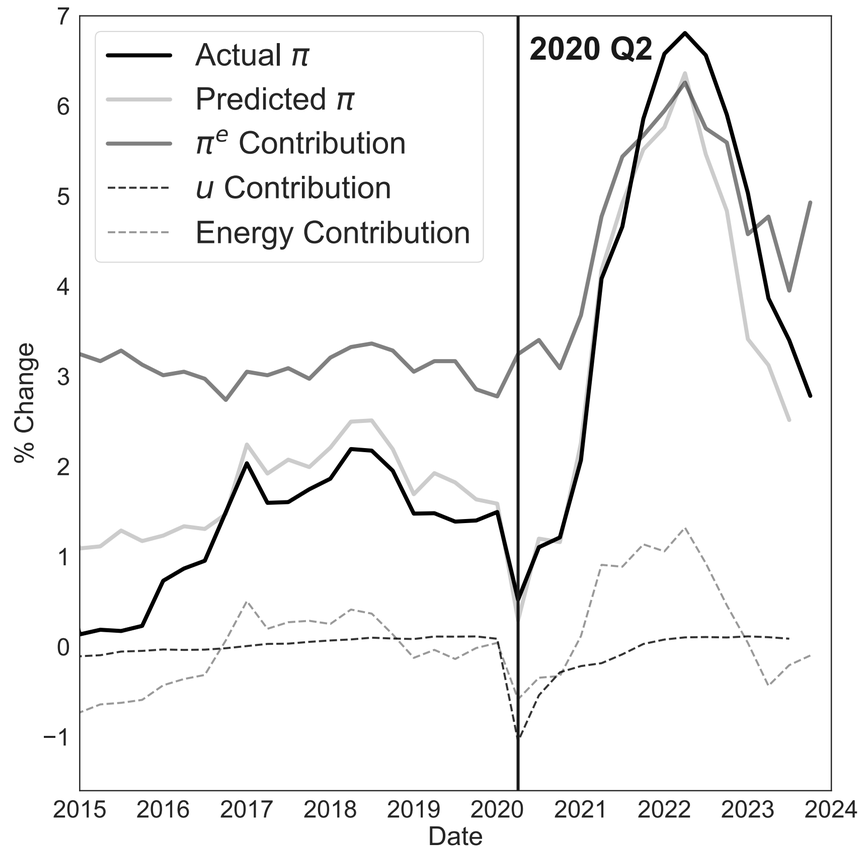
  (1) Did the energy shocks drive all of the unanchoring of expectations?

  (2) Did monetary policy shocks contribute to the reanchoring of expectations?

DID THE ENERGY SHOCKS DRIVE ALL OF THE UNANCHORING OF EXPECTATIONS?

A simple decomposition

Figure 3: Predicting Post-2020 Inflation using Pre-2020 Phillips Curve



Notes: the figure uses estimated regression coefficients from estimating equation (2)—the relationship between inflation, inflation expectations, the unemployment gap and energy price growth—using data up to 2020Q2. The figure then uses the realized path of inflation expectations, the unemployment gap and energy price growth after 2020, combined with the pre 2020 regression coefficients, in order to predict inflation after 2020. The figure also plots the contribution associated with each regressor to predicting overall inflation.

Estimate by OLS:

$$\pi_t = \beta \pi^e_{t,t+4} - \kappa \tilde{u}_t + \gamma e_t + \varepsilon_t$$

- π_t: PCE headline inflation
- $\pi^e_{t,t+4}$: 1 year expectations (Michigan)
- $\tilde{u}_t$: Unemployment gap (CBO)
- e_t: PCE energy inflation
- Sample: 1984Q1-2020Q1

In a reduced-form Phillips curve sense, expected inflation accounts for most of inflation, energy does little

Source: Hazell (2024) "Comment on "The Dominant Role of Expectations and Broad-Based Supply Shocks Driving inflation" *NBER Macroeconomics Annual 2025*

State of the art in 2021

- **Three influential facts:**

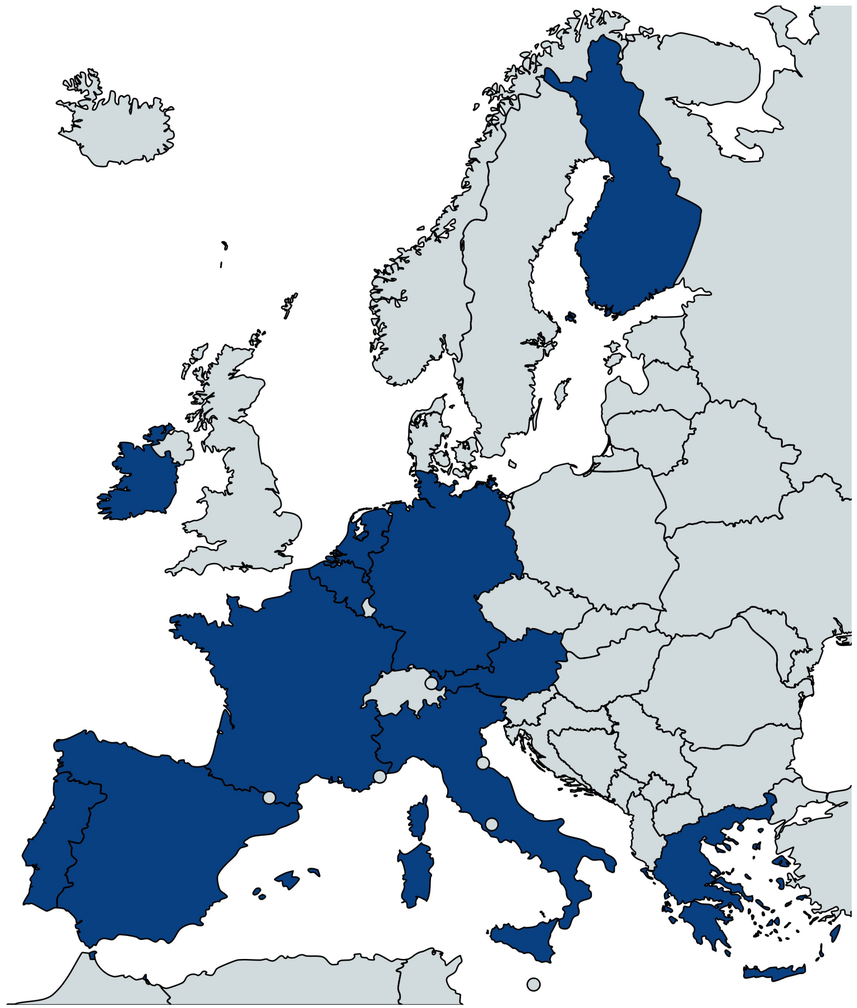
  (1) Correlation (average expected inflation , real oil prices) is 0.54 since 2000.

  (2) Energy prices (gas) are one of the top two determinants of people's information and expectations of inflation. (D'Acunto Weber, 2024)

  (3) Coibion and Gorodnichenko (2015): 1% higher wholesale oil prices raise expected inflation by 1.6bp.

- **Popular statement in the 2021 debates**: energy prices are a major driver of expected inflation, people over-react to them, policy should see through the rise in expected inflation in 2021

Patzelt-Reis: use cross-regional variability



- Consumer expectations survey: 9,000-22,000 respondents, 2020:4-2023:12, 11 countries, expected inflation 12 months ahead

- $\pi^{e}_{i,c,g,t}$ expected inflation person *i*, country *c*, group *g*, month *t*

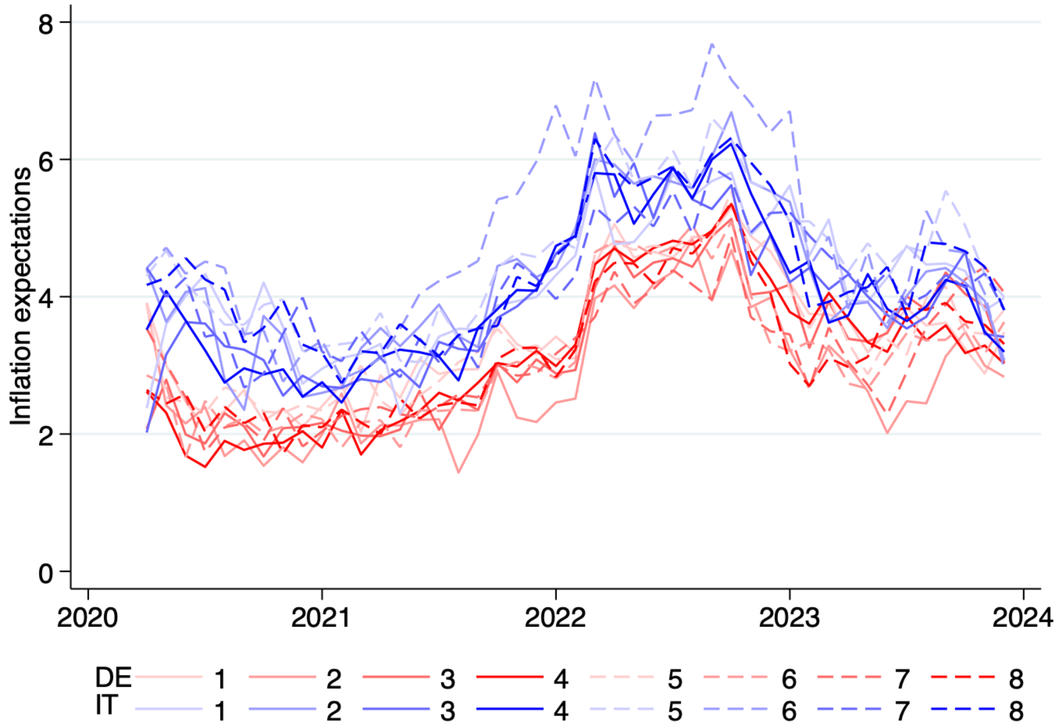
Eight demographic groups *g* crossing

- gender (male/female)
- income bracket (above/below 60th percentile)
- education (college/below)

Source: Patzelt and Reis (2024) "Estimating the Rise in Expected Inflation from Higher Energy Prices" in *CEPR Discussion Paper 18907*

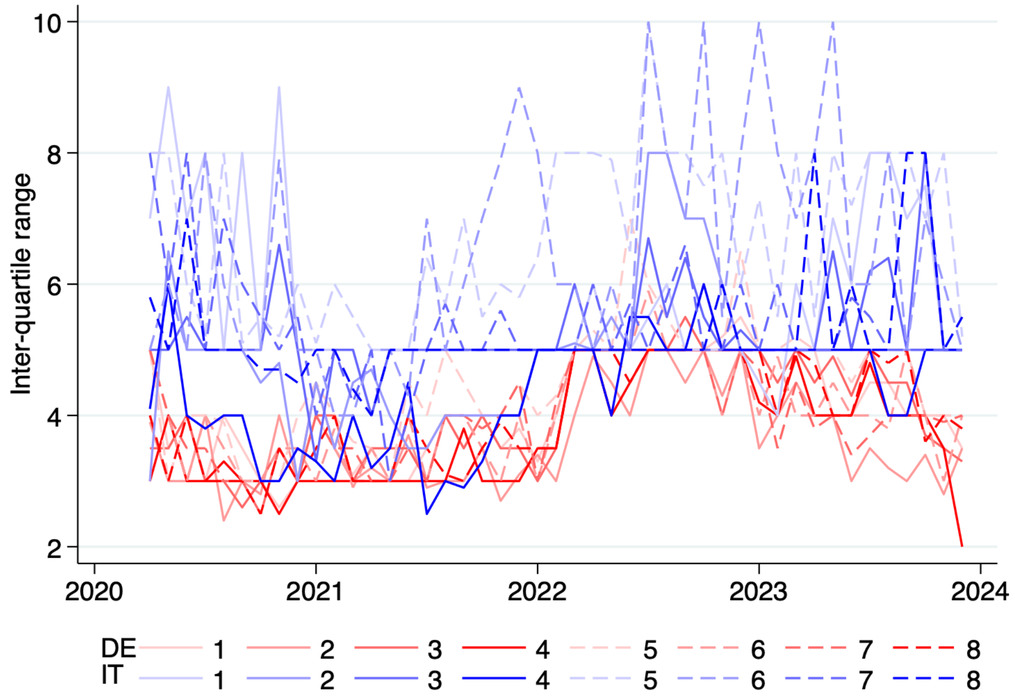
Variation in expected inflation in the data

(a) Expected inflation: Germans and Italians



- Lots of variation
- Large country and group fixed effects

(b) Anchored expectations: Germans and Italians

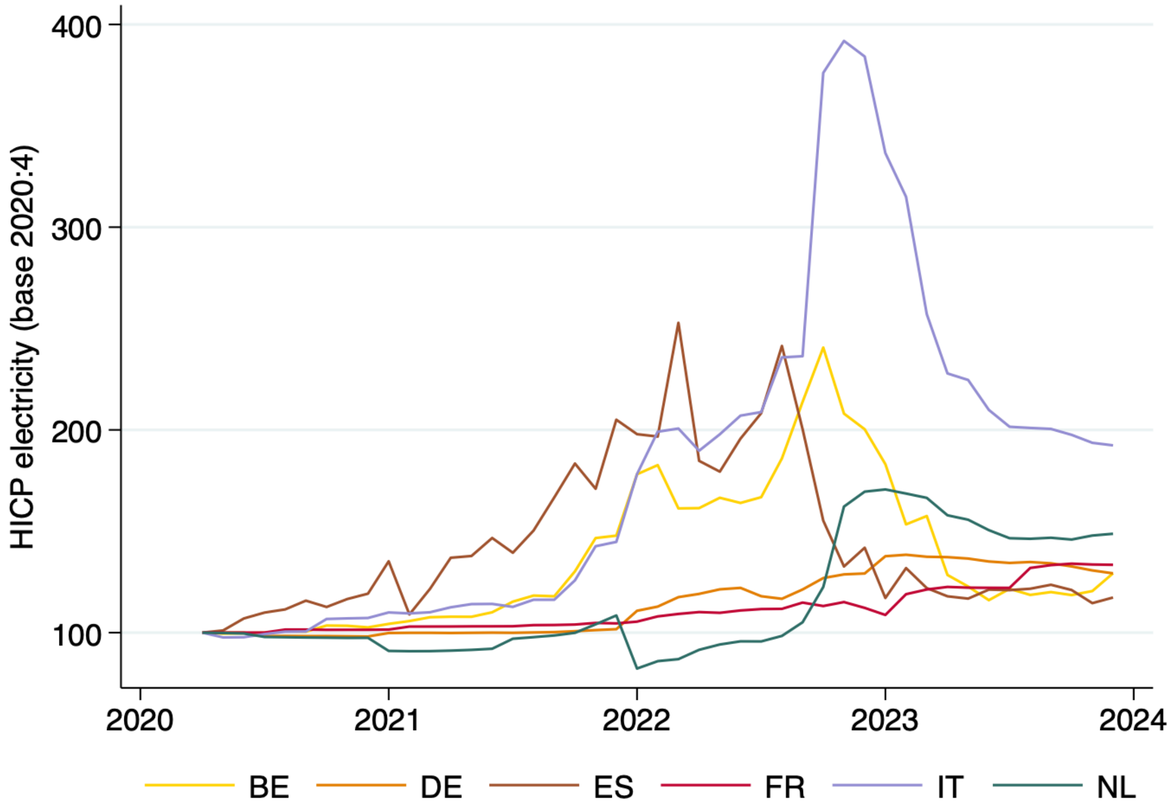


- Higher-order moments (IQR) of the distribution of long-term inflation expectation (3-year) within country-group

Source: Patzelt and Reis (2024) "Estimating the Rise in Expected Inflation from Higher Energy Prices" in *CEPR Discussion Paper 18907*

Electricity prices across countries and time

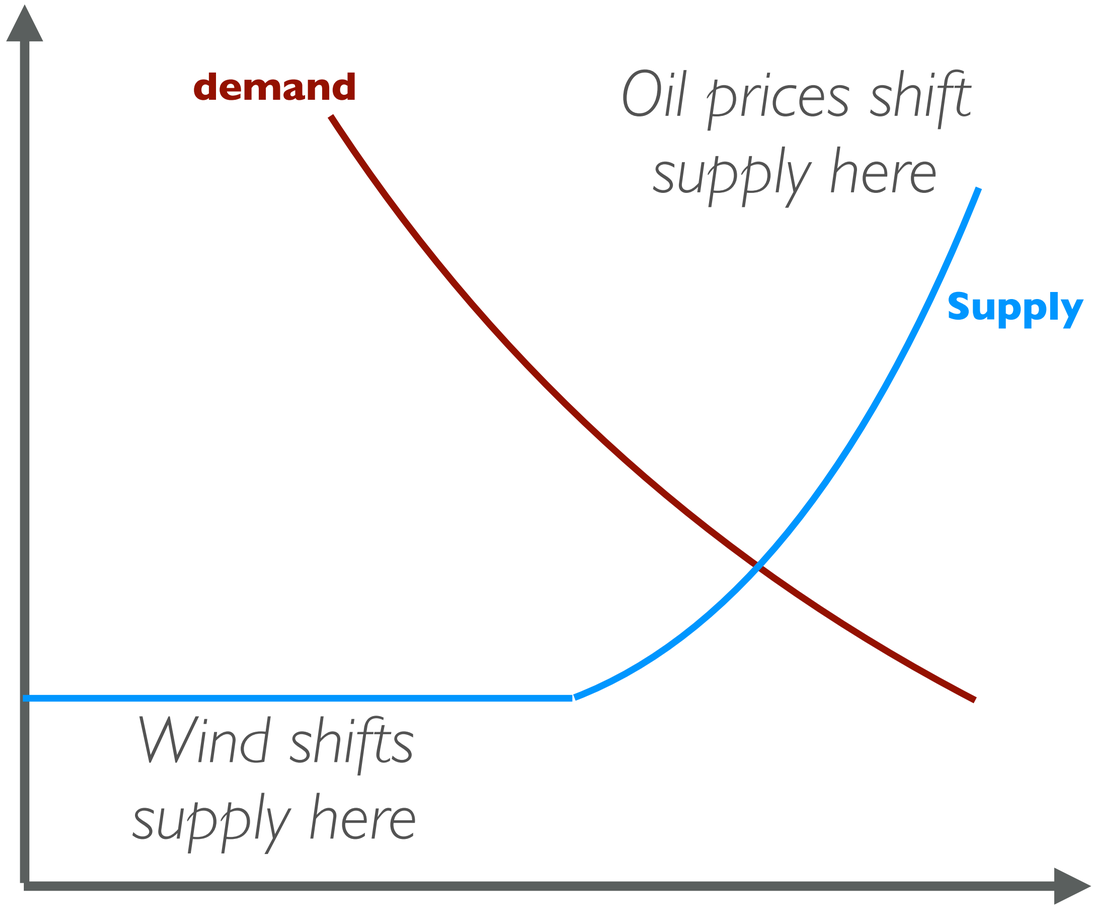
(a) Electricity prices across countries



- $e_{c,t}$ log electricity prices per country, Segmented markets suggest a shift-share strategy
- $z_{c,t} = e_t s_c$: cross-country differences in expenditure shares affect expected inflation, but not energy prices.
- $z_{c,t} = k_t s_c$: High-frequency shifts in oil futures prices following OPEC production announcements.

Source: Patzelt and Reis (2024) "Estimating the Rise in Expected Inflation from Higher Energy Prices" in *CEPR Discussion Paper 18907*

Wind supply shocks



Source: Patzelt Reis (2024)

Table 1: The impact of electricity prices on expected inflation

Revision of expectation	(1)	(2)	(3)	(4)	(5)	(6)
Change in electricity prices	1.404***	1.167***	1.222***	1.531***	1.397***	0.372**
	(0.296)	(0.103)	(0.229)	(0.329)	(0.294)	(0.181)
Change in electricity prices	0.596***	0.199***	2.609***	1.499***	0.617***	0.146
× Unanchoring	(0.171)	(0.061)	(0.466)	(0.374)	(0.173)	(0.089)
Average past inflation	0.004	-0.025***	-0.001	0.009	0.005	0.004
	(0.028)	(0.009)	(0.025)	(0.027)	(0.028)	(0.079)
ECB deposit rate change	-0.436***	-0.449***	-0.442***	-0.438***	-0.437***	
	(0.119)	(0.031)	(0.113)	(0.118)	(0.119)	
Observations	362756	2472	362756	362756	362756	362756
R^2	0.016	0.343	0.018	0.016	0.016	0.032
Country & group fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	No	No	No	No	No	Yes
Country-group fixed effects	No	No	No	No	Yes	No

Note: This table presents estimates of the regression in equation (1): $\Delta^6 \pi^e_{i,c,g,t} = \beta \Delta^6 e_{c,t} + \gamma \Delta^6 e_{c,t} \times \Delta^6 a_{c,g,t} + \alpha_c + \eta_g + \theta \bar{\pi}_{c,t-6} + \psi \Delta^6 r_t + \varepsilon_{i,c,g,t}$. Column (1) has the baseline estimates, (2) uses the average $\pi^e_{c,g,t}$ as the dependent variable, (3) uses as measure of unanchoring the deviation of long-run expected inflation from target, (4) uses anchoring at the country level only $a_{c,t}$, (5) includes country-group fixed effects, and (6) includes time fixed effects. In parentheses are standard errors clustered by month for the regressions using individual expectations.

Source: Patzelt Reis (2024)

Energy shocks

Table 3: The impact of energy shocks on expected inflation

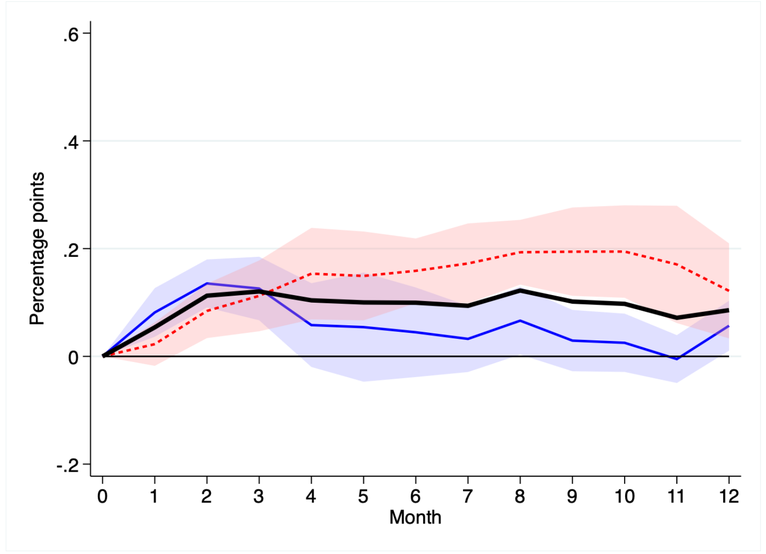
Revision of expectation	(1)	(2)	(3)	(4)	(5)
Energy price shock	0.185***	0.613***	0.339***	0.044	0.603**
	(0.060)	(0.061)	(0.102)	(0.100)	(0.265)
Energy price shock	0.244***	0.138***	-0.002	-0.042	0.146***
× Unanchoring	(0.031)	(0.029)	(0.062)	(0.076)	(0.050)
Average past inflation	-0.025	0.081***	-0.079	-0.051*	0.213
	(0.025)	(0.021)	(0.086)	(0.027)	(0.144)
ECB deposit rate change	-0.352***	-0.423***	-0.103	-0.370**	-0.708**
	(0.117)	(0.061)	(0.228)	(0.142)	(0.267)
Observations	362756	362756	305037	362224	197950
R^2	0.018	0.027	0.015	0.012	0.029

Note: This table presents estimates of the regression equation $\Delta^h \pi^e_{i,c,g,t} = \beta \Delta^h z_{c,t} + \gamma \Delta^h z_{c,t} \times \Delta^h a_{c,g,t} + \alpha_c + \eta_g + \theta \bar{\pi}_{c,t-6} + \rho \Delta^h r_t + \varepsilon_{i,c,g,t}$ where the first four columns use different measures of $z_{c,t}$. The energy shocks are, in order: (1) the h-month change in HICP electricity prices by country, (2) the h-month change in EA-wide HICP electricity times country-specific electricity expenditure weights in 2019, (3) OPEC supply shocks to oil prices cumulated over h months times country-specific expenditure weights in 2019, and (4) the h-month change in wind-source electricity generation, all standardised to increase electricity prices. The first four columns set $h = 6$, while the fifth column uses the oil shocks with $h = 12$. In parentheses are standard errors clustered by month.

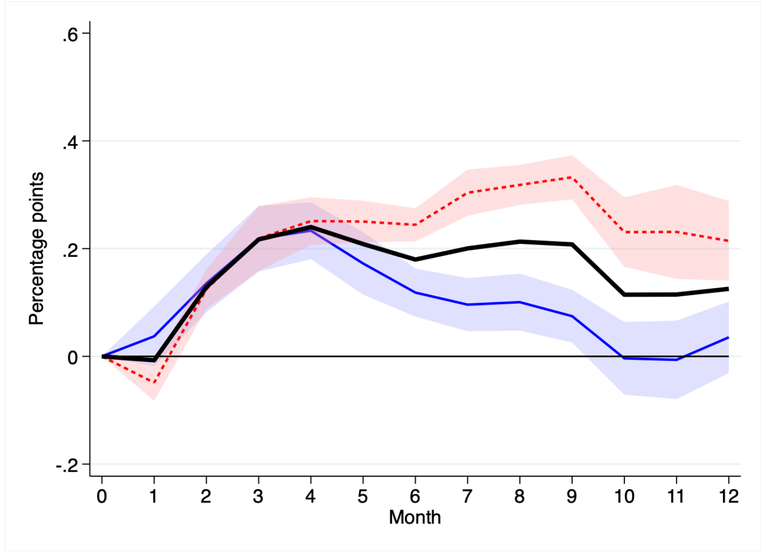
Source: Patzelt Reis (2024)

Figure 3: Impulse response of expected inflation to a shock in energy prices

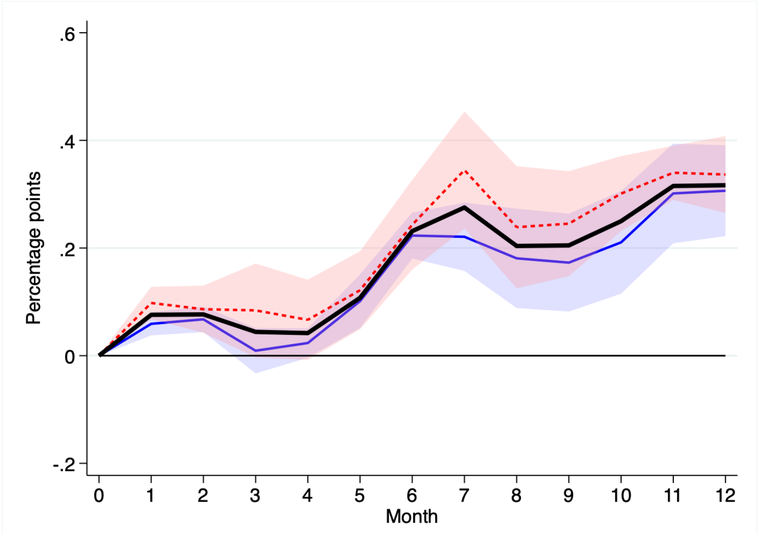
(a) Country electricity prices



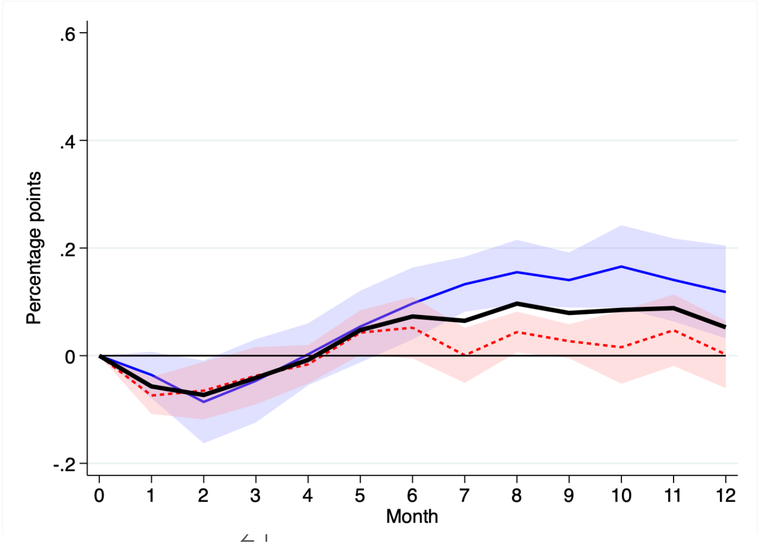
(b) EA electricity prices with country shares



(c) Oil shifts and energy shares



(d) Wind



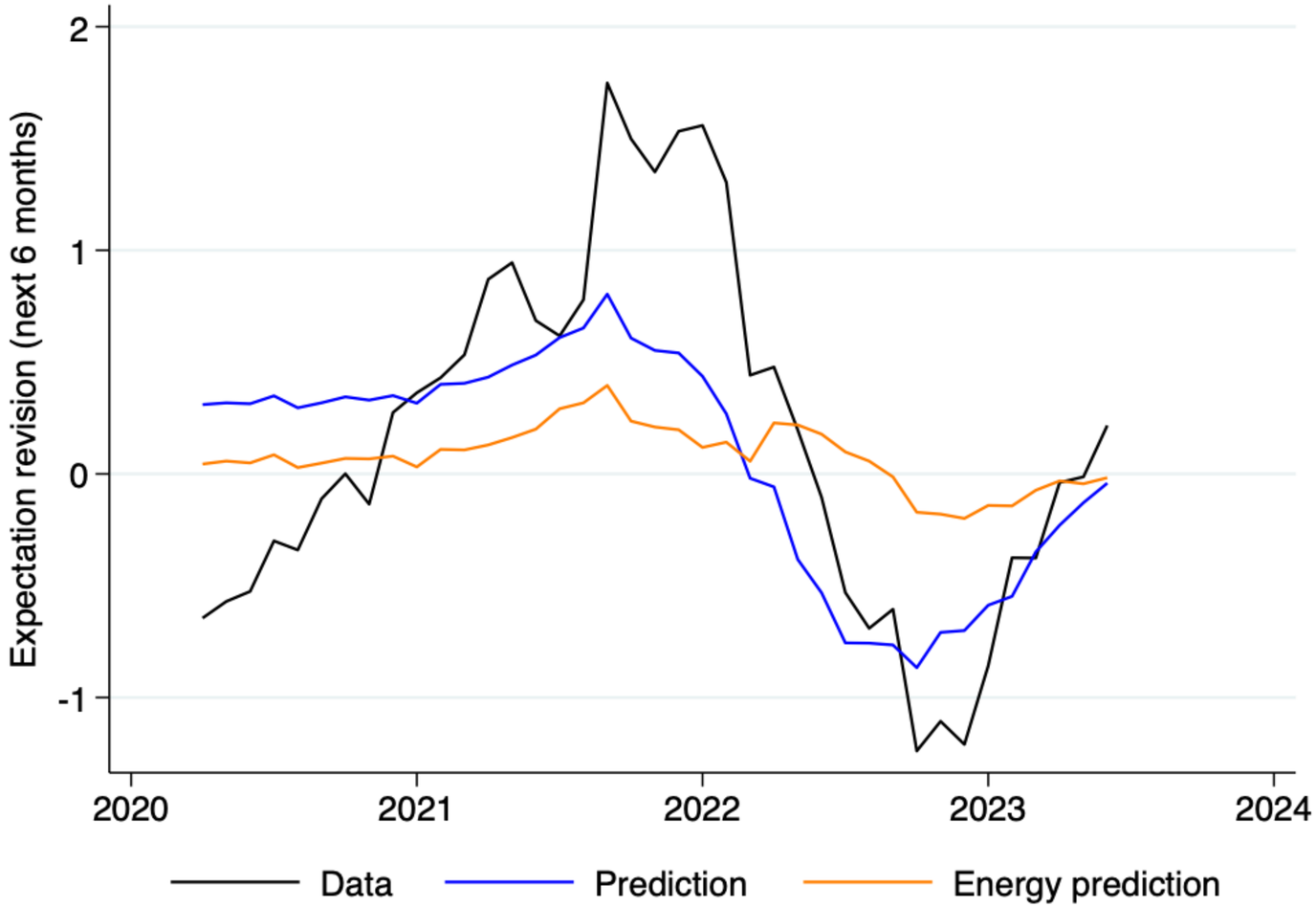
Much more sluggish than what "over-attention" stories suggest

But also small quantitatively.

Source: Patzelt Reis (2024)

Counterfactuals

Figure 4: The contribution of electricity prices to expectation revisions

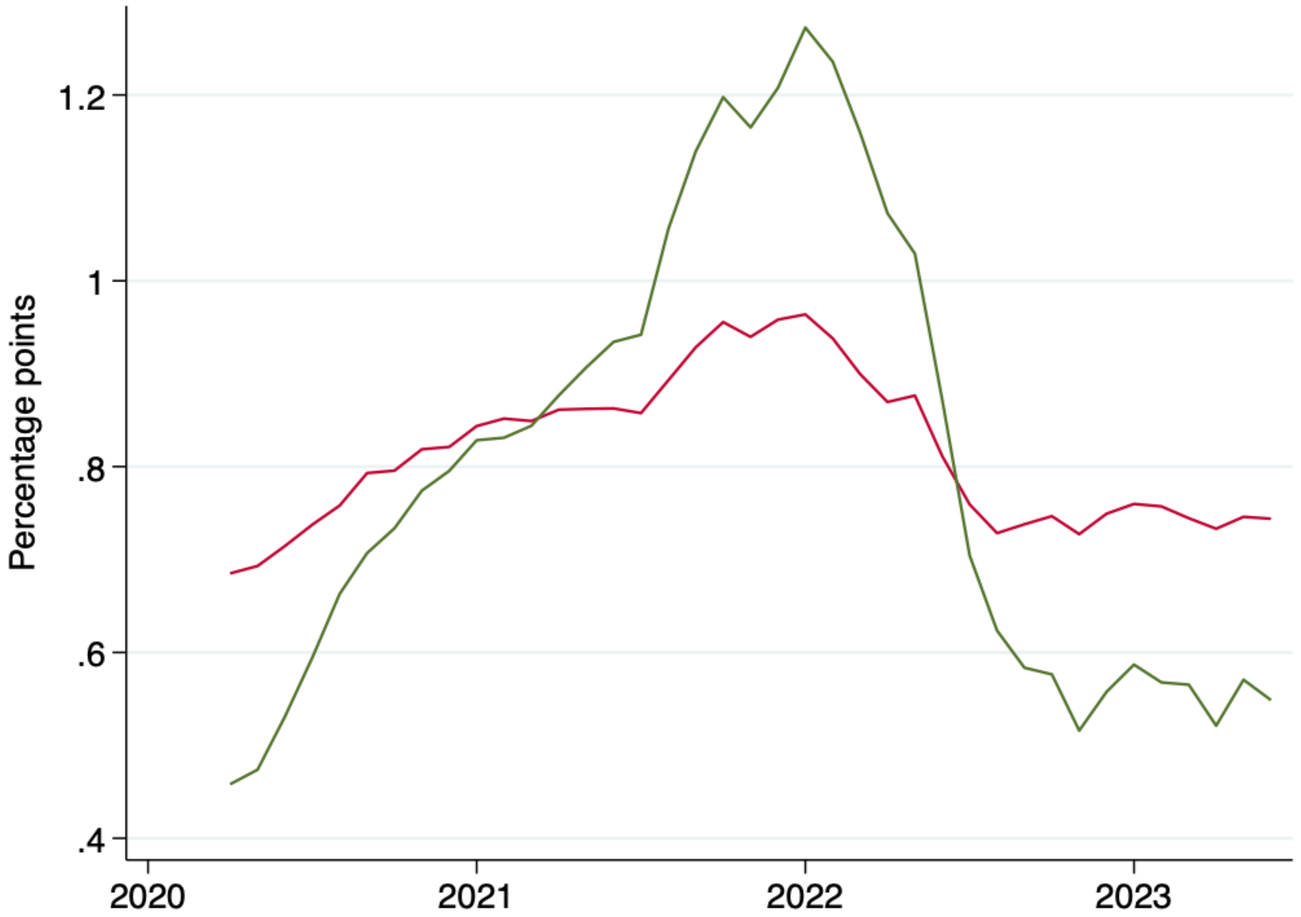


Predictive equation explains little, and what it does comes mainly from dynamics

Source: Patzelt Reis (2024)

Counterfactuals

Figure 5: The time-varying impact of electricity prices on expected inflation



Anchoring matters, so can become more relevant going forward.

But still small.

Source: Patzelt Reis (2024)

DID MONETARY POLICY SHOCKS CONTRIBUTE TO THE RE-ANCHORING OF EXPECTATIONS?

Errors-on-revisions panel regressions

$$Error_{i,t} = \kappa AvRevision_t - \chi \left(Revision_{i,t} - AvRevision_t \right) + u_{i,t}$$

Time-series consensus version:

- If average both sides of the regression, χ drops out, have a regression of average forecast errors on average forecast revisions over time
- $\kappa > 0$: when a shock raises inflation, people, on average, increase forecasts by less than the new reality. **Under-reaction**. Serial correlation of forecast errors

Individual cross-section version

- If only cross-sectional data, include time fixed effects, then κ drops out.
- $\chi < 0$: those that revise forecasts more, over-do it, end up making forecast errors in the opposite direction. **Over-reaction**. Maybe over-confidence

Source: Angeletos, Sastry, Zhu (2021), Reis (2021)

Panel regressions' estimates

Table 2: Error-on-revision Regression Coefficients

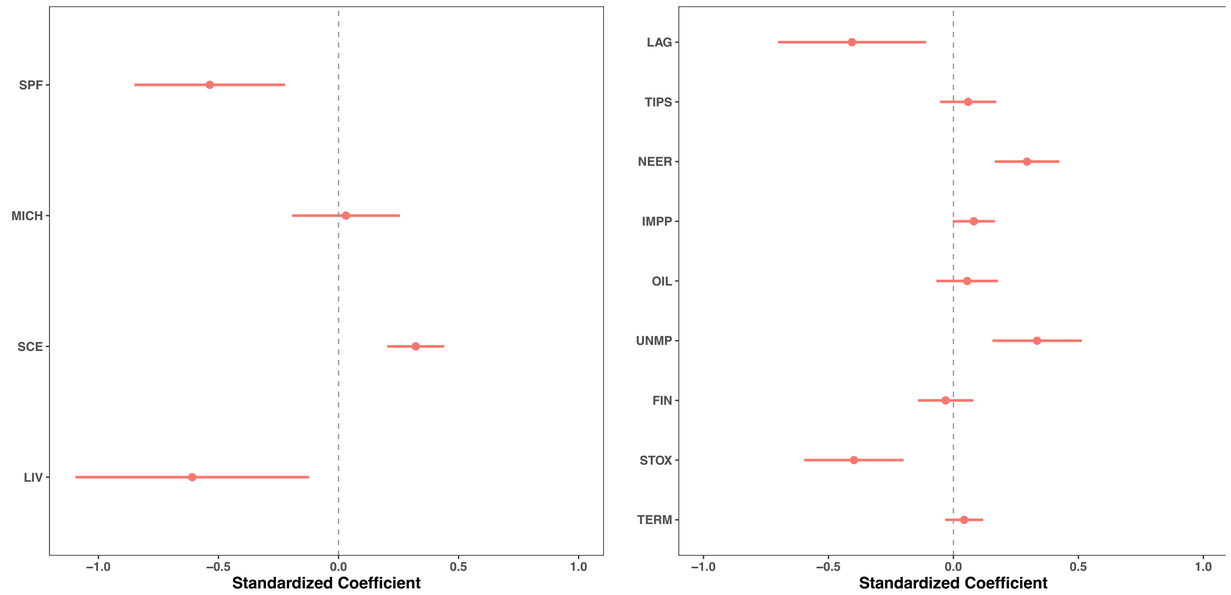
	$\hat{\beta}^C$			$\hat{\beta}^I$		
	Point Estimate	SE	p-value	Point Estimate	SE	p-value
RGDP	0.11	0.31	0.73	-0.28	0.12	0.02
GDP Price Index	1.26	0.41	0.00	-0.15	0.07	0.04
NGDP	0.14	0.25	0.56	-0.32	0.12	0.01
CPI	1.04	0.76	0.17	-0.38	0.09	0.00
Tbill	0.69	0.11	0.00	0.21	0.09	0.03
AAA	-0.02	0.16	0.92	-0.27	0.07	0.00
Tbond	-0.06	0.09	0.46	-0.23	0.02	0.00

Notes: This table reports the Error-on-revision regression results at both the consensus and individual level. For consensus time-series regressions, standard errors are calculated using the Newey-West method, with the automatic bandwidth selection procedure as proposed by Newey & West (1994). For individual-level panel regressions, standard errors are clustered by both the forecaster and time. The time coverage for each variable is as in Table 1.

Source: Liao (2024) "Over/Underreaction to New Information and Noise in Expectations Formation" *Essex manuscript*

Response to shocks

Figure 2: Inflation Forecast Errors and Different Public Signals



Note: The figure depicts estimates of δ in (2.3) (horizontal axis) for various public signals (vertical axis). The left-hand side panel shows the coefficient estimates for previous period's consensus estimate of one-year ahead inflation ($h = 4$) from the Survey of Professional Forecasters (SPF), the Michigan Survey of Consumers (MICH), the Survey of Consumer Expectations (SCE), and the Livingston Survey (LIV). The right-hand side panel shows estimates of δ using one-period lagged inflation outcomes (LAG), 10-year inflation expectations from the TIPS market (TIPS), the year-over-year change in the nominal effective exchange rate (NEER), the year-over-year change in import prices (IMP), the year-over-year change in the WTI oil price (OIL), the unemployment rate (U), the Cleveland Fed's Financial Market-based measure of future inflation (FIN), the log-linear detrended level of the SP500 (STOX), and the 10-year-2-year term spread (TERM). All variables have been standardized, and have been signed such that an increase predicts higher inflation one year out. All variables and growth rates have also been derived using the latest available data at the time of the inflation forecast. Whisker-intervals correspond to 95 percent robust doubled-clustered confidence bounds. Online Appendix Table B.1 provides further details on the estimates.

$$Error_{i,t} = \alpha_i + \delta y_t + u_{i,t}$$

Regress forecast errors of individual on known public information

- Over-reaction to average forecasts (left panel, negative), but under-reaction to data (right panel, positive)

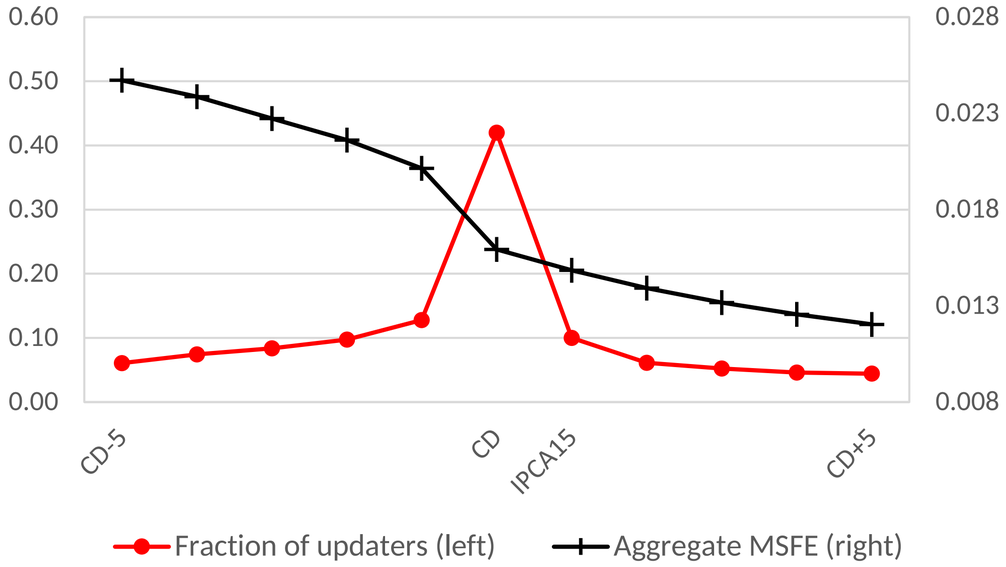
Lesson:

- Beauty contest, looking at each other, responding too much to what others are doing

Source: Broer and Kohlhas (2024) "Forecaster Mis-Behavior" in *Review of Economics and Statistics*

High frequency studies

Figure 1. Contest versus Information Release



Notes: The figure shows the fraction of forecasters in the *Focus Survey* who update their nowcast of inflation on a five-day window around the contest (CD) and the information release (IPCA15) days, averaged over all months in the dataset. It also shows the aggregate MSFE, which is the average across forecasters of the individual Mean Squared Forecast Errors. The individual MSFE is the squared difference between the nowcast associated with each forecaster on that day and the realization of inflation for that month, averaged over all months. Accuracy is the negative of the MSFE.

Source: Gaglianone, Giacomini, Issler, and Skreta (2022) "Incentive-Driven Inattention" in *Journal of Econometrics*

Focus survey in Brasil

- Daily
- Incentivized.

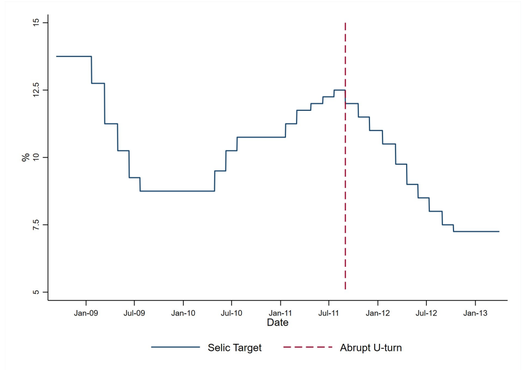
Attention shows up when others update, not when new gets released

- Again beauty contest
- But <u>timing</u> of attention suggests fundamentals can work as public signals

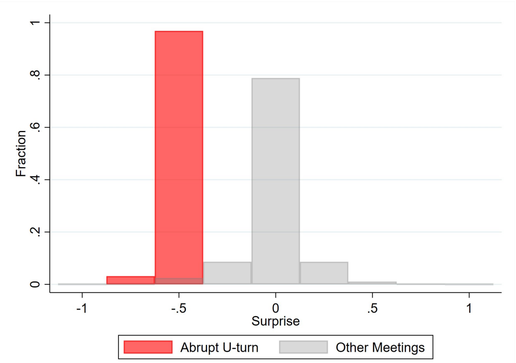
High frequency after large policy shocks

Figure 2: **Abrupt U-turn in monetary policy**

(a) Policy rate



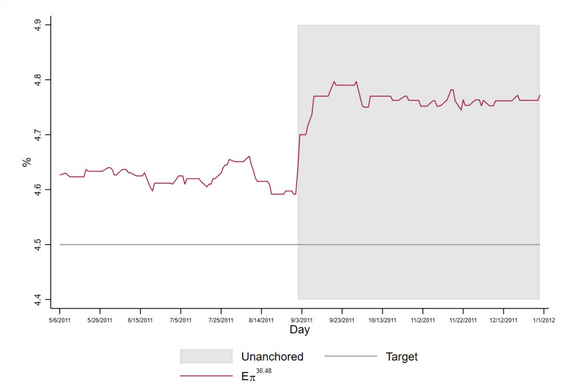
(b) Distribution of individual interest rate surprises



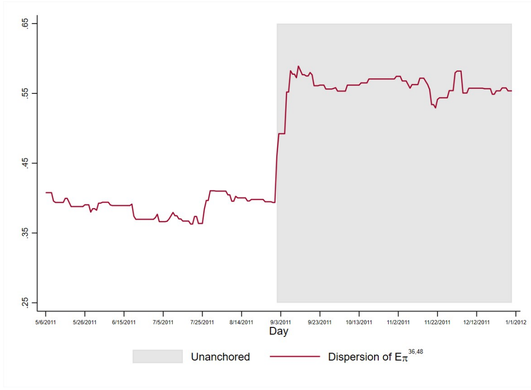
Note: Left panel shows the Selic policy rate (solid line) from 2008 to 2013. The vertical dashed line indicates the August 31, 2011 monetary policy meeting, which marked the abrupt policy U-turn. Right panel shows the distribution of individual forecasters' interest rate surprises (in percentage points) for all monetary policy meetings from July 2008 to December 2019. Surprise is the difference between the announced interest rate and the individual's forecast for the rate decision. Dark (red) histogram corresponds to the abrupt U-turn meeting (August 31, 2011). Light (grey) histogram covers all other policy meetings in our sample.

Figure 5: **High-frequency evidence unanchoring was caused by the abrupt U-turn**

(a) Daily mean inflation forecasts for 36-48 months ahead



(b) Daily cross-sectional dispersion for 36-48 months ahead



Note: Left panel: Daily cross-sectional mean of inflation expectations for 36-48 months ahead (solid red line) and the inflation target (horizontal light grey line). Right panel: Daily cross-sectional dispersion of 36-48 month ahead inflation forecasts. Shaded region indicates unanchored regime.

Brazil sudden U-turn in monetary policy in 2011 surprised

- Big unexpected shock
- Daily reaction

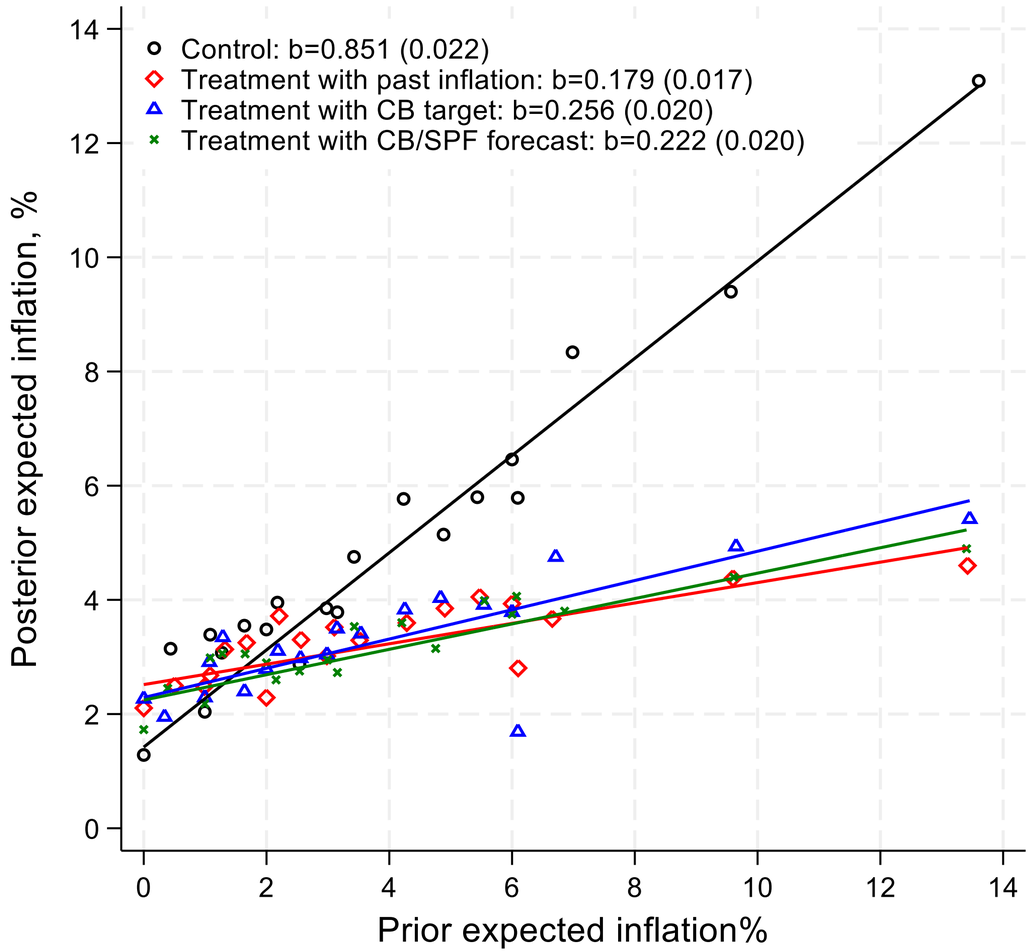
Response to fundamentals

- Beauty contest may mean usual sluggishness
- But complementarities it comes with, then big amplifier of shocks.

Source: Bonomo, Carvalho, Eusepi, Perrupato, Abib, Ayres, Matos (2024) "Abrupt Monetary Policy Change and Unanchoring of Inflation Expectations" in *Journal of Monetary Economics*

Randomized control trials

$$posterior_i = \alpha + \beta \times prior_i + \delta \times T_i + \gamma \times (T_i \times prior_i) + error_i$$



Control group, $T_i = 0$ so if $posterior_i = prior_i$ should find $\alpha = 0, \beta = 1$. Not exactly but close.

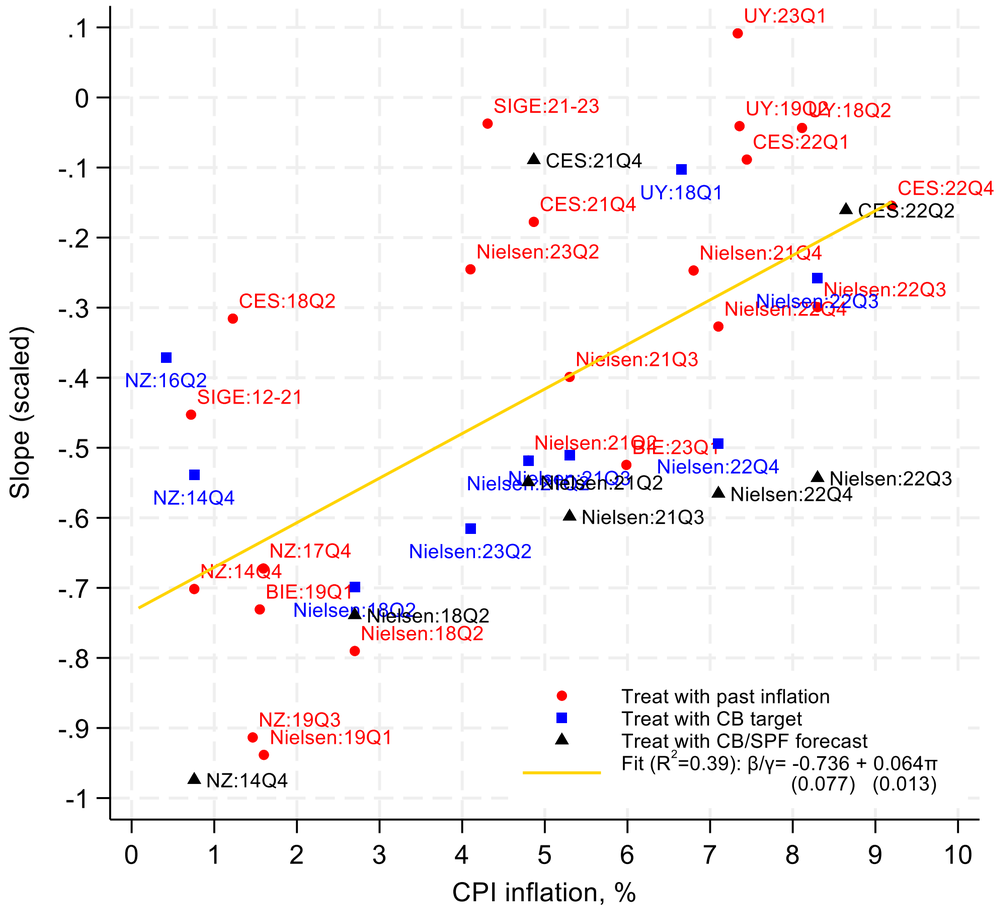
δ - impact of treatment on update

γ - impact on perceived reliability of signal. Flatter after treatment that gives information about inflation posterior is not as close to your prior.

Source: Afrouzi, Candia, Coibion, Frache, Georgarakos, Gorodnichenko, et al (2024) "Tell Me Something I Don't Already Know: Learning in Low and High-Inflation Settings" in *Econometrica*

Lucas critique: not so if high inflation

$$posterior_i = (\alpha + \delta) + (\beta + \gamma) \times prior_i + error_i$$



Plot $\gamma/\beta = -0.75$ strength of treatment

Policy matters: across experiments, see the higher is inflation, weaker treatment, less value of information.

Rational inattention, better informed in the first place, more precise prior.

Source: Afrouzi, Candia, Coibion, Frache, Georgarakos, Gorodnichenko, et al (2024) "Tell Me Something I Don't Already Know: Learning in Low and High-Inflation Settings" in *Econometrica*

Lessons from micro data identification

- **Micro data on inflation expectations showed**
  - Panel regressions: under-reaction of the average as inattentive, overreaction of attentive agents
  - Identified shocks: beauty contest, under react to fundamentals
  - High-frequency diff-in-diff: if large common fundamental, get over-reaction
  - Randomized control trials: information matters but mediated through policy

- **Application to 2021-22**
  - Monetary policy speeches and actions do matter
  - Especially after large shocks, when attention is high and coordinated

CONCLUSION

The credibility revolution

- **Use micro data and econometrics to focus on signal in spite of noise**
  - Expectations survey data is not noisier than expectations survey data.
  - Large disagreement that varies over time, to be exploited
  - Who answers matters, the horizon matters, market prices measure marginal bot average belief
- **Identification strategies to ascertain links from drivers to their effect**
  - Cross-regional variation for time-series inference
  - Panel data regressions
  - Identified shocks
  - High-frequency diff-in-diffs
  - Randomized control trials
  - Throughout thinking hard about variation that identifies effects and the importance of the question

Inflation expectations during the inflation disaster

- **Were inflation expectations anchored throughout?**
  - Yes, at biennial frequency, but between mid 2021 and mid 2022 at least, unanchored and re-anchored, and not as deep and steady as before.
- **Were the movements in expected inflation solely driven by energy prices?**
  - Households may pay disproportionate attention to them among the fundamentals, but still clearly under react. qualitatively explain little.
- **Should monetary policy see through inflation expectations, can it affect them?**
  - Some will over-react others under-react, careful with sample selection. Beauty contest means usual move little, but worry when they move a lot. Monetary policy regime and credibility reduce the risks, make the job easier.