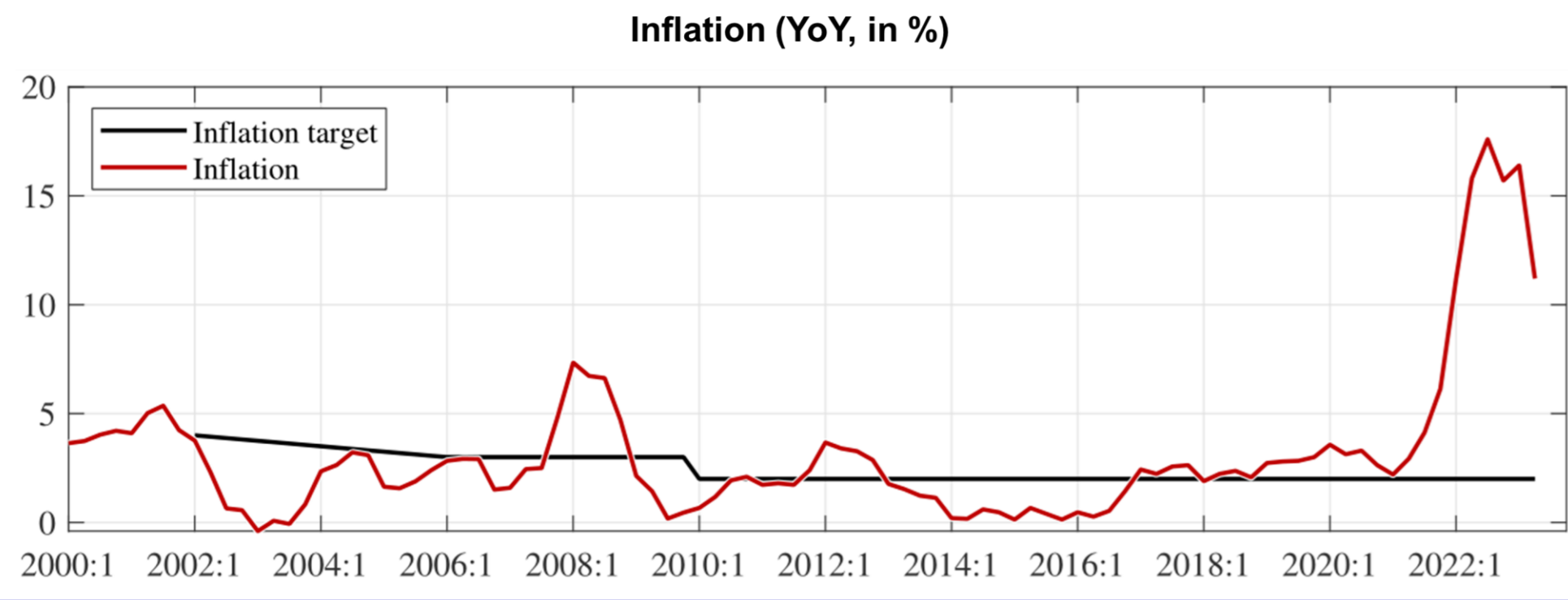


Understanding Inflation Expectations: Data, Drivers and Policy Implications

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Disclaimer: The views expressed here are those of the authors and do not necessarily reflect the position of the CNB.

Introduction



In mid 2021, inflation has started to rise up and peaked in 2022 at unprecedented levels due mainly to:

- high domestic demand (supported also by COVID-delayed savings),
- high inflation pressures from abroad (mainly prices of energy commodities),...

- What are inflation expectations (IE) properties and their role in the inflation upsurge?
- Any implications for monetary policy should the formation of expectations have changed?

Objectives

Collect and explore data regarding inflation expectations

- study formation of inflation expectations

Construct hands-on indices to enrich our analytical toolbox

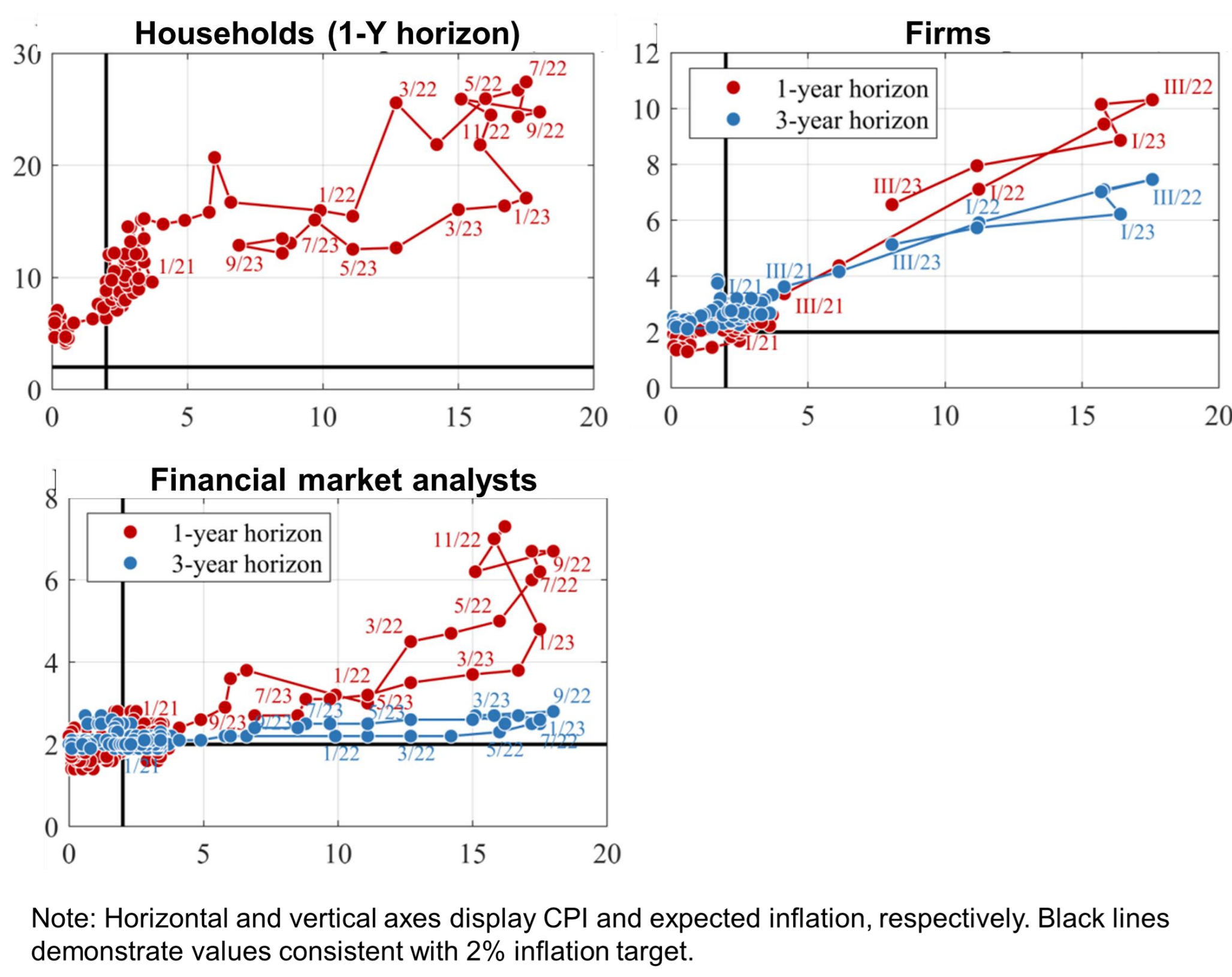
- assess the degree of anchoring
- assess the economy-wide inflation expectations, summarize

Monetary policy implications

- modify the core projection model g3+ to address the elevated inflation expectations
- create scenarios and draw policy recommendations

Results

Inflation expectations started to rise in mid 2021

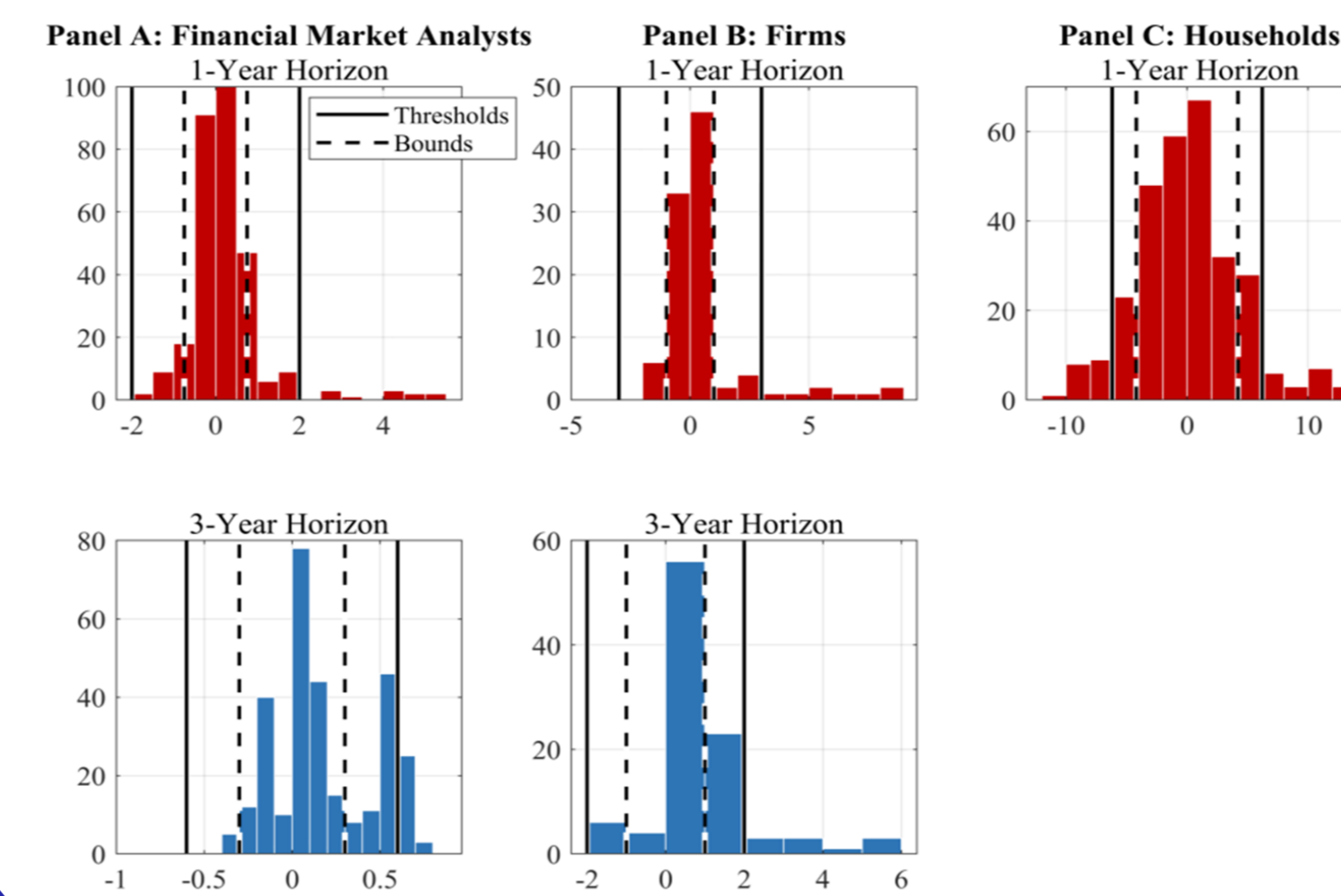


- Inflation expectations retrieved from surveys:
 - households (only 1-Y), new data source
 - firms (1-Y and 3-Y),
 - financial market analysts (1-Y and 3-Y; in our view the most relevant group of respondents).
- Inflation expectations have moved into new territories since mid 2021. Since late 2022:
 - Inflation expectations in the 1-Y horizon have been returning back to pre-2021 levels.
 - 3-Y IE remained well above its previous level.

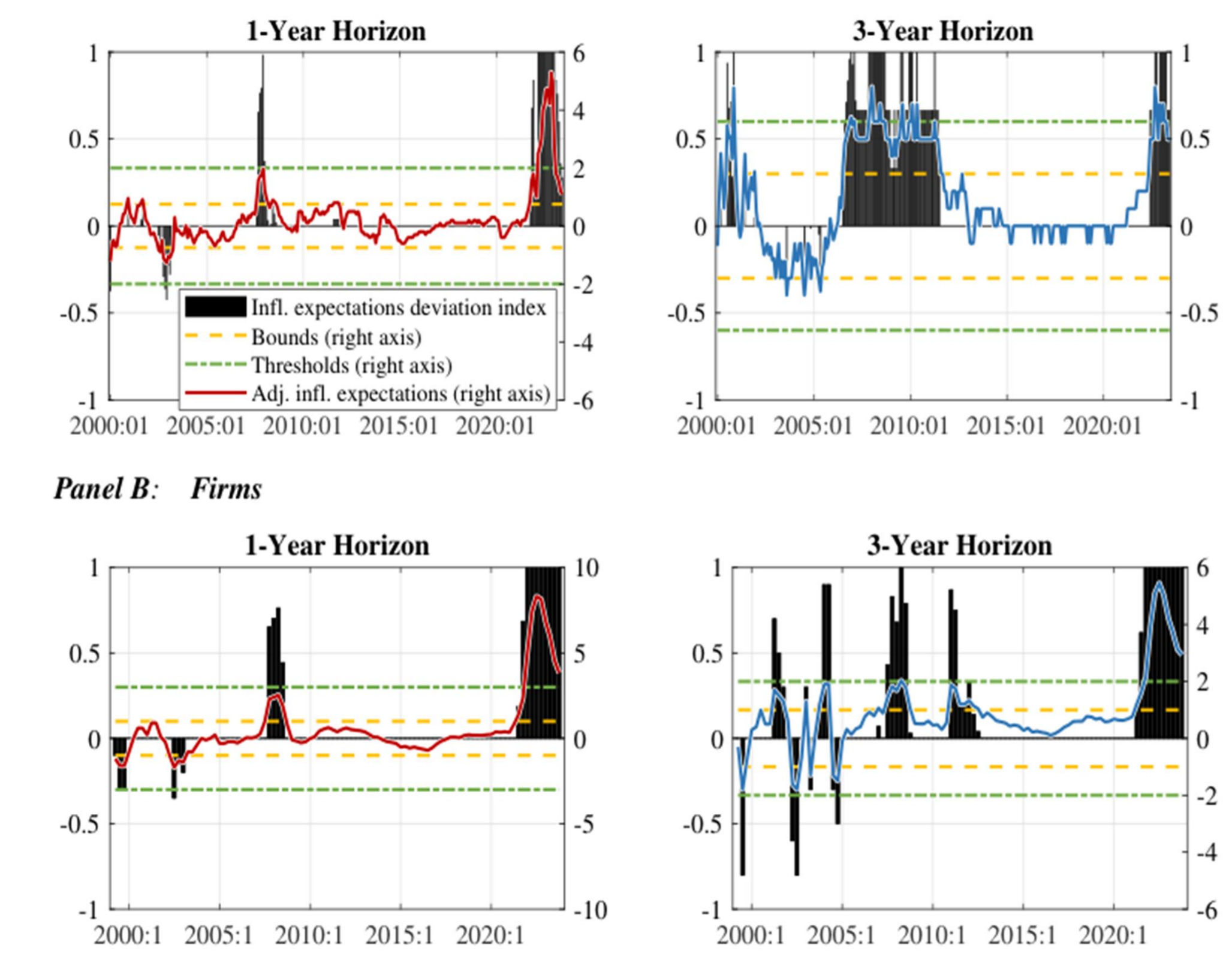
Measuring "too much" of Deviation

$$Dev_{it} = \begin{cases} 0 & \text{if } \pi^{T-} < E_t[\pi_{t+s}] < \pi^{T+}; \\ 1 \text{ or } -1 & \text{if } E_t[\pi_{t+s}] > \pi^{max} \text{ or } E_t[\pi_{t+s}] < \pi^{min}; \\ \frac{E_t[\pi_{t+s}] - \pi^{T+}}{\pi^{max} - \pi^{T+}} & \text{if } \pi^{T+} \leq E_t[\pi_{t+s}] \leq \pi^{max}; \\ \frac{E_t[\pi_{t+s}] - \pi^{T-}}{\pi^{T-} - \pi^{min}} & \text{if } \pi^{T-} \geq E_t[\pi_{t+s}] \geq \pi^{min}; \end{cases}$$

- Aim to design an inflation deviation signal accounting for deviations in both directions.
- Indicator: Cecchetti and Krause (2002), Abib et al. (2022) and Carvalho and Nechio (2023) motivates us.
- However, we create symmetric index
- Country specific issues:
 - Data are adjusted for inflation target changes
 - Thresholds are determined by the distribution of adjusted inflation expectation responses over several economic cycles.

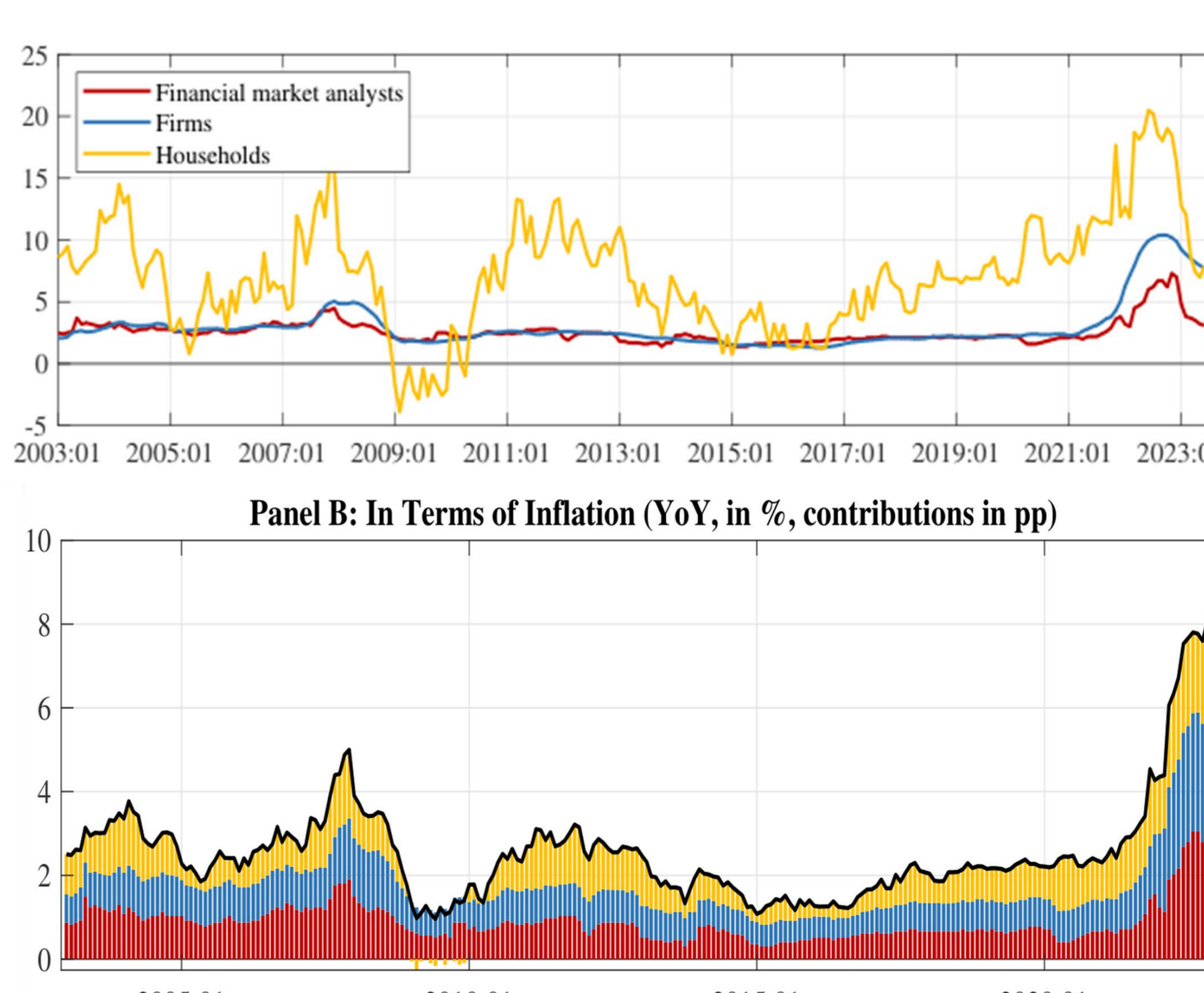


Inflation Expectations Deviation Index



- Low degree of anchoring of inflation expectations at the one-year horizon in 2022, possible de-anchoring over 2022–2023, regardless of time horizon.
- MP implication:
 - Over past two years: the inflation expectations deviation indices convey a generally low degree of inflation expectations anchoring.
 - Over the medium term, inflation expectations exhibit persistence in deviation and have not been fully anchored to the central bank's target

Inflation Expectations Measures: Economy Wide Index



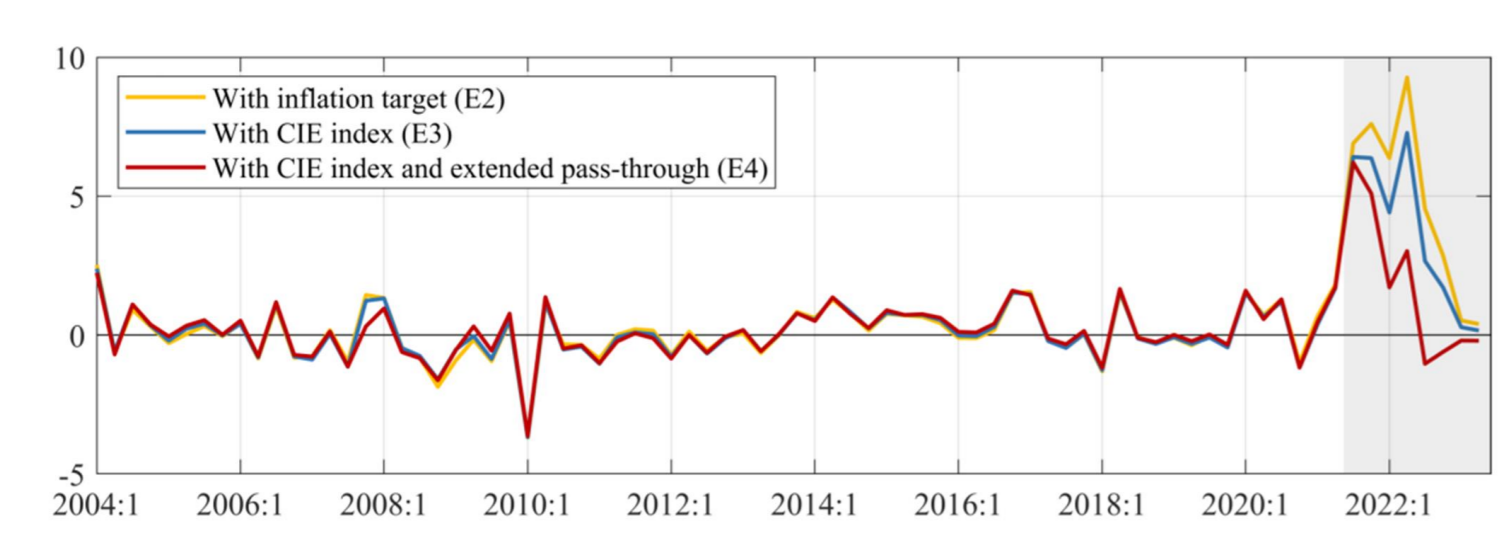
- Multiple sources of inflation expectations measures
- Motivation stems from Ahn and Fulton (2020): common component of movements in inflation expectations across the economy
- PCA approach: The first principal component, explaining the highest share of common volatility (over 80%)
- PCA-CIE index:
 - expressed in standard deviations, with zero representing the sample-wide average.
 - De-standardization: takes some period close to target and rescale

Core Inflation Dynamics

$$\pi_t^{core, QoQ} = \beta_1 \pi_{t-1}^{core, QoQ} + \beta_2 LUCI_t + \beta_3 \pi_t^{impEx, QoQ} + \beta_4 X_t + \varepsilon_t$$

Variable	(E1)		(E2)		(E3)		(E4)	
	Pre 21Q3	21Q3+	Pre 21Q3	21Q3+	Pre 21Q3	21Q3+	Pre 21Q3	21Q3+
π_t^{core}	0.64 (0.11)	0.94 (0.08)	0.47 (0.13)	0.92 (0.09)	0.51 (0.12)	0.76 (0.10)	0.52 (0.12)	0.64 (0.13)
$LUCI_t$	0.44 (0.19)	0.25 (0.22)	0.58 (0.19)	0.25 (0.23)	0.53 (0.18)	0.33 (0.21)	0.49 (0.19)	0.48 (0.24)
π_t^{impEx}	0.01 (0.02)	0.07 (0.03)	0.01 (0.02)	0.07 (0.03)	0.01 (0.02)	0.05 (0.03)	0.01 (0.02)	0.05 (0.03)
π_t^{imp}			0.16 (0.06)	0.07 (0.10)				
CIE_t					0.15 (0.06)	0.24 (0.09)	0.13 (0.06)	0.21 (0.09)
$CIE_t \times Dev_{it}^{imp}$					0.35 (0.26)	0.36 (0.21)		
No. of windows	11	8	11	8	11	8	11	8
Obs./window	60	60	60	60	60	60	60	60
Average R^2	0.67	0.85	0.71	0.86	0.71	0.88	0.72	0.88

Figure A11: Residuals from Estimated Phillips Curves (QoQ annualized growth rate, in %)



Note: Residuals are retrieved from PCs with fixed coefficients; the shaded area highlights the period starting mid-2021.

- Rolling window regression (15 years, starting in 2004Q1). Core inflation, measure of labor slack LUCI, import price inflation w/o food and energy, various measures of expectations, X:
 - E1- no inflation expectations
 - E2- IE proxied by the inflation target
 - E3- IE proxied by the CIE index
 - E4- IE proxied by the CIE index with extended pass-through – use of the deviation index
- To assess the explanatory power of the Phillips curve specifications we take average value of coefficients. Residuals suggest:
 - fits the data reasonably well, except for the upsurge in core inflation after mid-2021.
 - Integrating the CIE index demonstrates a more accurate fit to the data compared to the original PC specification.
 - Heightened inflation expectations played a significant role in the recent surge in inflation

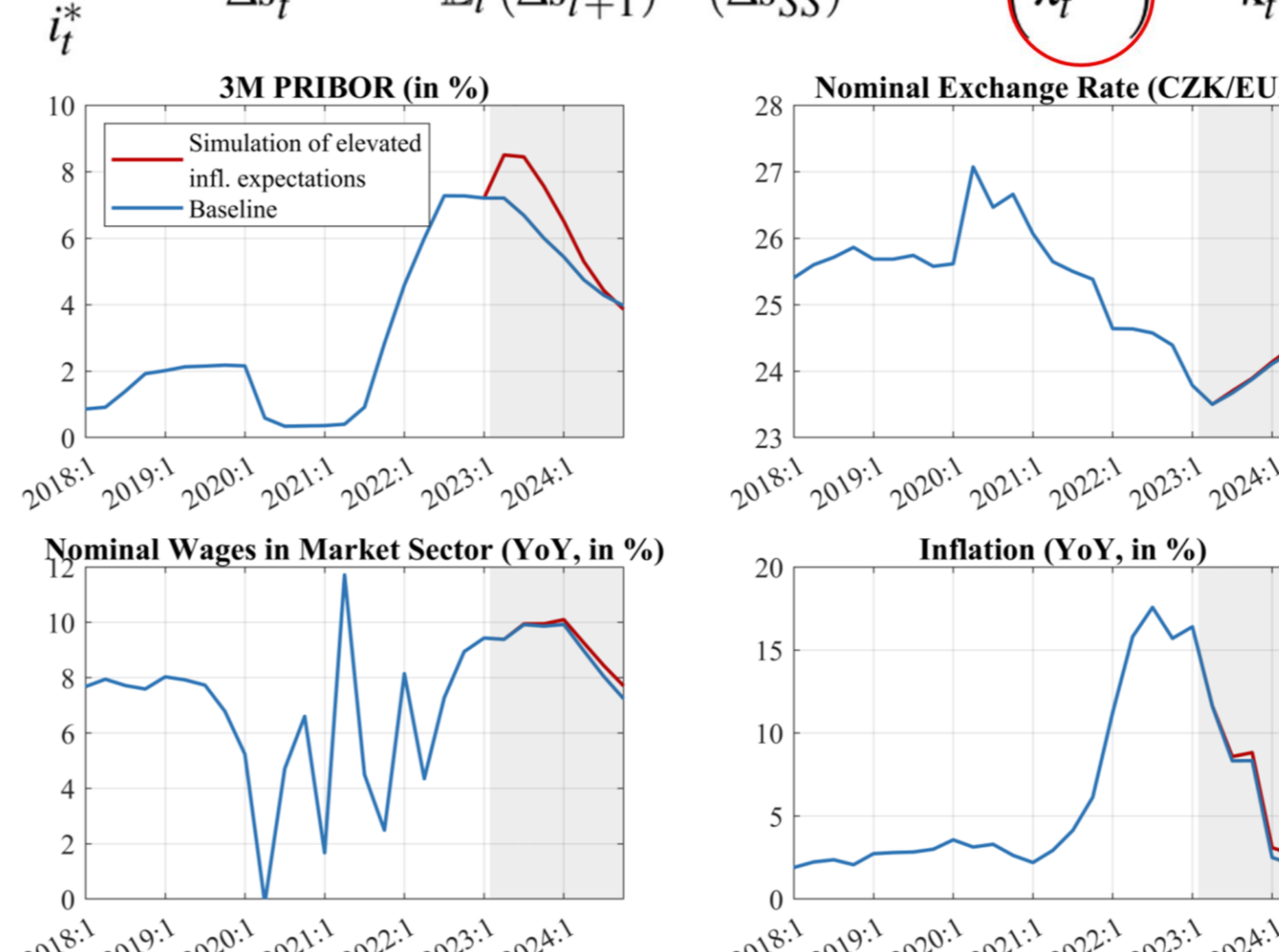
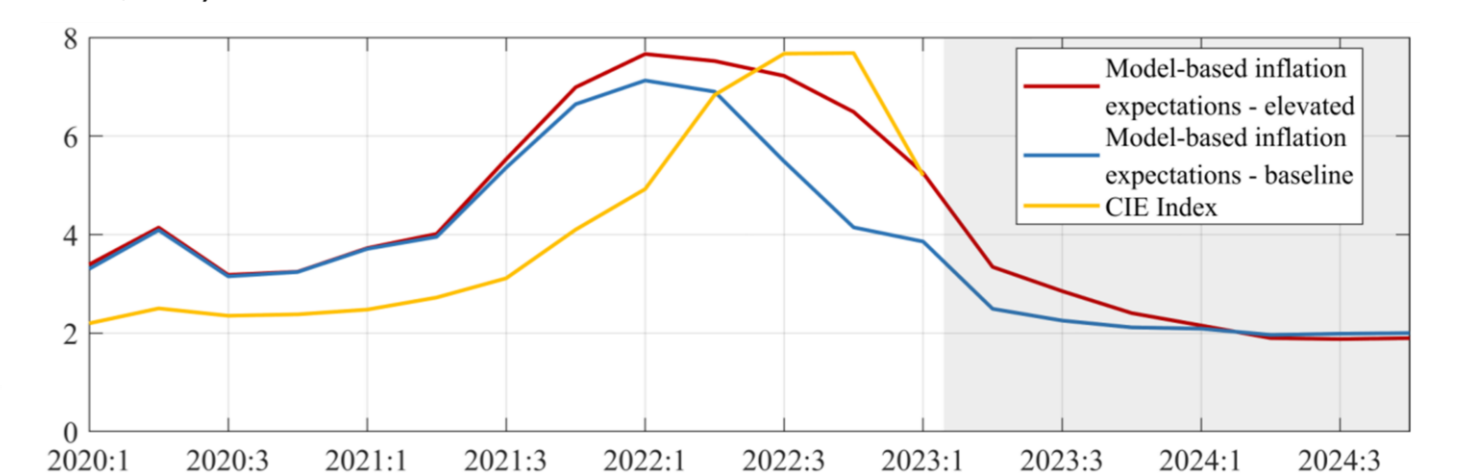
Core Forecasting Model Extension

$$\pi_t^N = \beta \mathbb{E}_t(\pi_{t+1}^N) + \frac{(1-\beta\xi_C)(1-\xi_C)}{\xi_C} \mu_C mc_{C,t} + \varepsilon_t^C$$

$$\pi_t^{dev} = \left(\pi_{t-1}^{dev} \right)^{\rho_{dev}} \left(\frac{\pi_{t-1}^A}{\pi_{t-1}^{tar}} \right)^{\frac{1}{4} \rho_{dev} (1-\rho_{dev})} \exp \left\{ \varepsilon_t^{dev} \right\}$$

$$\frac{i_t}{i_t^e} = \Delta s_t^{-(1-\rho_s)} \mathbb{E}_t(\Delta s_{t+1})^{\rho_s} (\Delta s_{SS})^{2(1-\rho_s)} \pi_t^{dev} \kappa_t^{uip} \kappa_t^{uip}$$

Model-based inflation expectations and the CIE index (expected inflation in 1-year horizon, YoY, in %)



- The g3+ core prediction model is modified to capture developments of elevated inflation expectations on top of „standard model mechanisms“.
- We use newly-constructed composite inflation expectations index CIE to calibrate the model.
- We modify one main mechanism and two complementary areas:
 - impact on the pricing of firms through a modified Phillips curve,
 - additional exchange rate risk premium in the UIP condition.

Our research shows....

- **signals** of high inflation period with a **low degree of inflation expectations anchoring**;
- an economy **wide indicator of inflation expectations** for the Czech Republic;
- an evidence of **adaptive formation of inflation expectations in a short horizon** with more aggressive pass-through in high-inflation periods;
- **“a weaker gravity“ of the central bank’s target in a short horizon** in high-inflation periods;
- **short-term inflation expectations as one of the main drivers of the recent inflation upsurge** in the Czech economy;
- **no substantial change in formation of inflation expectations in a longer-horizon**;
- **a modified version of the core forecasting model g3+** capturing elevated inflation expectations and policy-relevant simulations.

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