Managing Expectations: Inflation and Monetary Policy

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WEO OUTREACH

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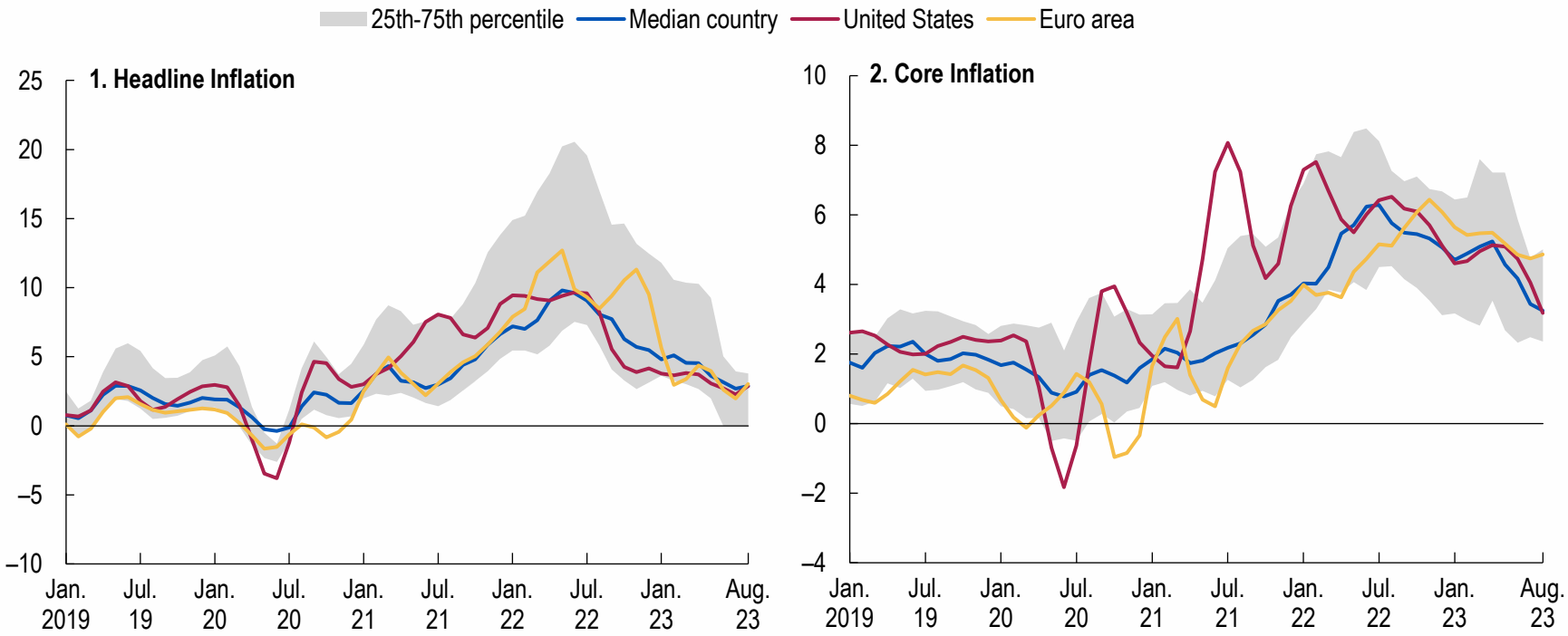
Headline Inflation receding but core stickier

Recent Inflation Dynamics

(Percent change, 3-month annualized, seasonal adjusted)



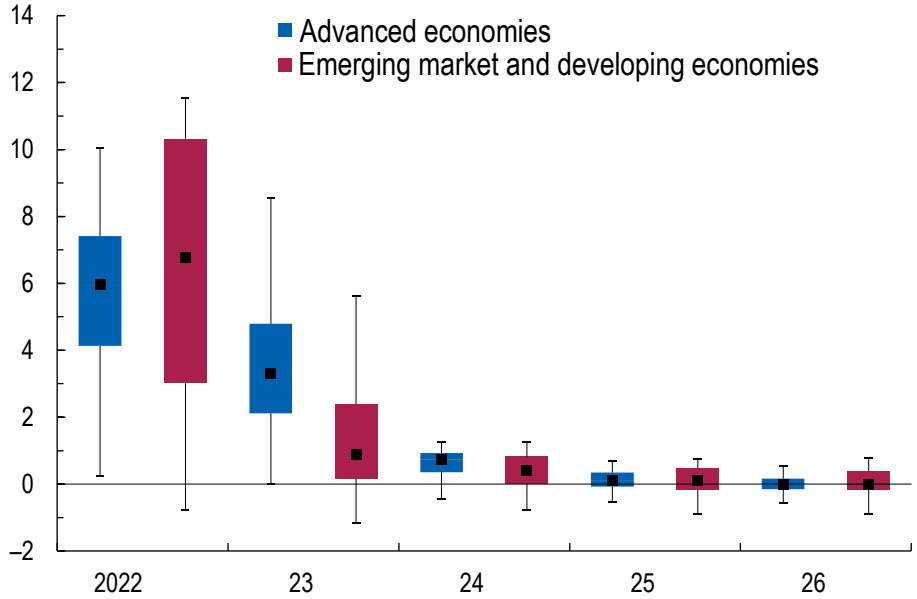
- Global inflation halved since 2022:Q2
- Core inflation is stickier than headline inflation

Sources: Haver Analytics; and IMF staff calculations.
Note: The figure shows the development in headline and core inflation across 17 emerging markets and developing economies and 18 advanced economies. Core inflation is the change in prices for goods and services, but excluding those for food and energy (or the closest available measure). For the euro area (and other European countries for which the data are available), energy, food, alcohol, and tobacco are excluded. The grey band depicts the 25th to 75th percentile of inflation across countries. 35 sample countries account for approximately 81 percent of 2022 world output.

Prolonged High-Inflation Environment

Cross-Economy Deviations of Inflation Expectations from Targets
(Percentage points)

Inflation rates are expected to revert to targets, but only gradually over the next two years.



Sources: Consensus Economics; and IMF staff calculations.
Note: Inflation expectations in the figure are from professional forecasters, in order to maximize economy coverage. For each economy group, the boxes denote the upper quartile, median, and lower quartile of the distribution, while the whiskers show the maximum and minimum within the boundary of 1.5 times the interquartile range.

- Only slow decline in inflation anticipated.
  - Professional forecasters expect inflation rates to be fully back at targets only by 2026.
  - Role of expectations: further inflation if expectations de-anchor or a channel to bring inflation faster and easily?

Key questions

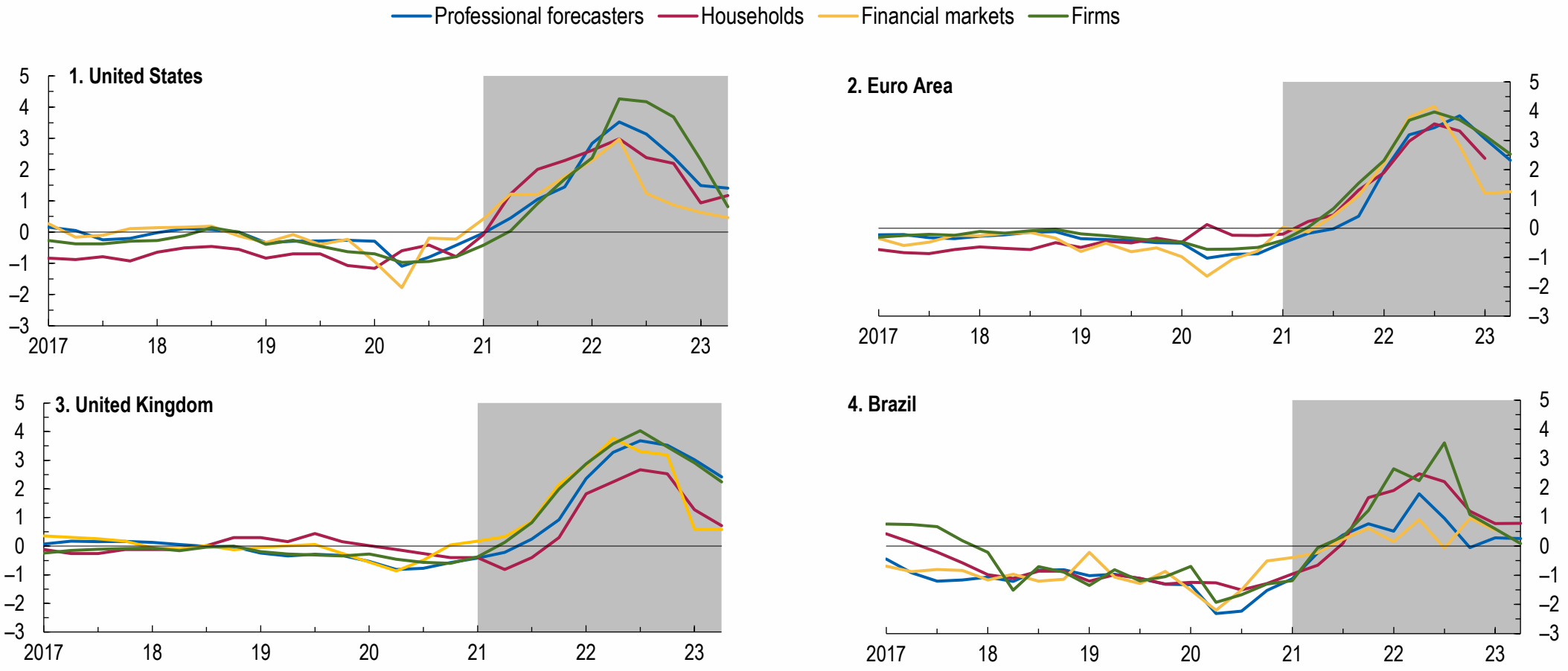
- **How have inflation expectations across different agents and at alternative horizons behaved pre- and post-pandemic across economies?**
  - Are there signs of inflation expectations deanchoring since 2021? Or do the rapid interest rate hikes over 2022 appear to have contained risks?
- **How important are expectations in explaining inflation dynamics, particularly since the COVID-19 shock?**
  - Does the prevailing level of inflation (high/low) affect the explanatory power of inflation expectations?
- **How do expectations affect monetary policy effectiveness and how does policy affect expectations?**
  - How does the expectations formation process affect the trade-offs that monetary policymakers face to bring inflation rates back to their targets?

How have inflation expectations behaved pre- and post-pandemic across economies?

- Dynamics of inflation expectations across different agents
  - Professional forecasters
  - Households
  - Financial markets
  - Firms: novel contribution based on firms' earnings calls
- Recent mean inflation expectations behavior by forecast horizon
- Comparison of recent inflation and expectations dynamics with historical episodes of sustained rises in expectations

Agents' inflation expectations largely agree on dynamics.

Next-12-Months Mean Inflation Expectations by Economic Agent
(Z-score, standard deviations from the mean)

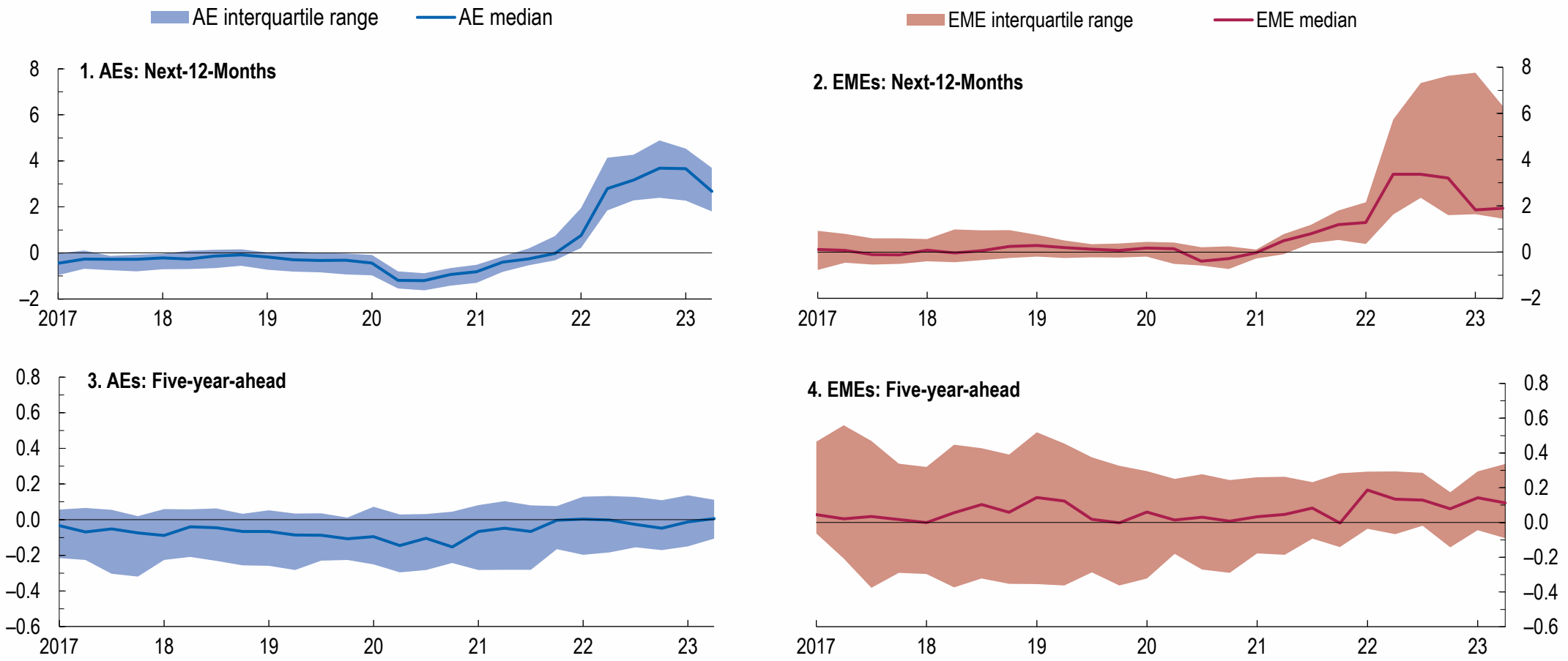


Sources: Consensus Economics; European Commission; Haver Analytics; NL Analytics; S&P Capital IQ; and IMF staff calculations.
Note: The figure shows z-scores (variable minus its mean, all divided by its standard deviation) calculated over the period 2004:Q1 to 2023:Q2 at quarterly frequency. Shaded areas in each panel highlight the period from 2021 onward, when realized inflation began notably rising.

Near-term expectations rose, while long-term are broadly stable.

Cross-Economy Distribution of Mean Inflation Expectations Over Time

(Percentage point deviation from target)

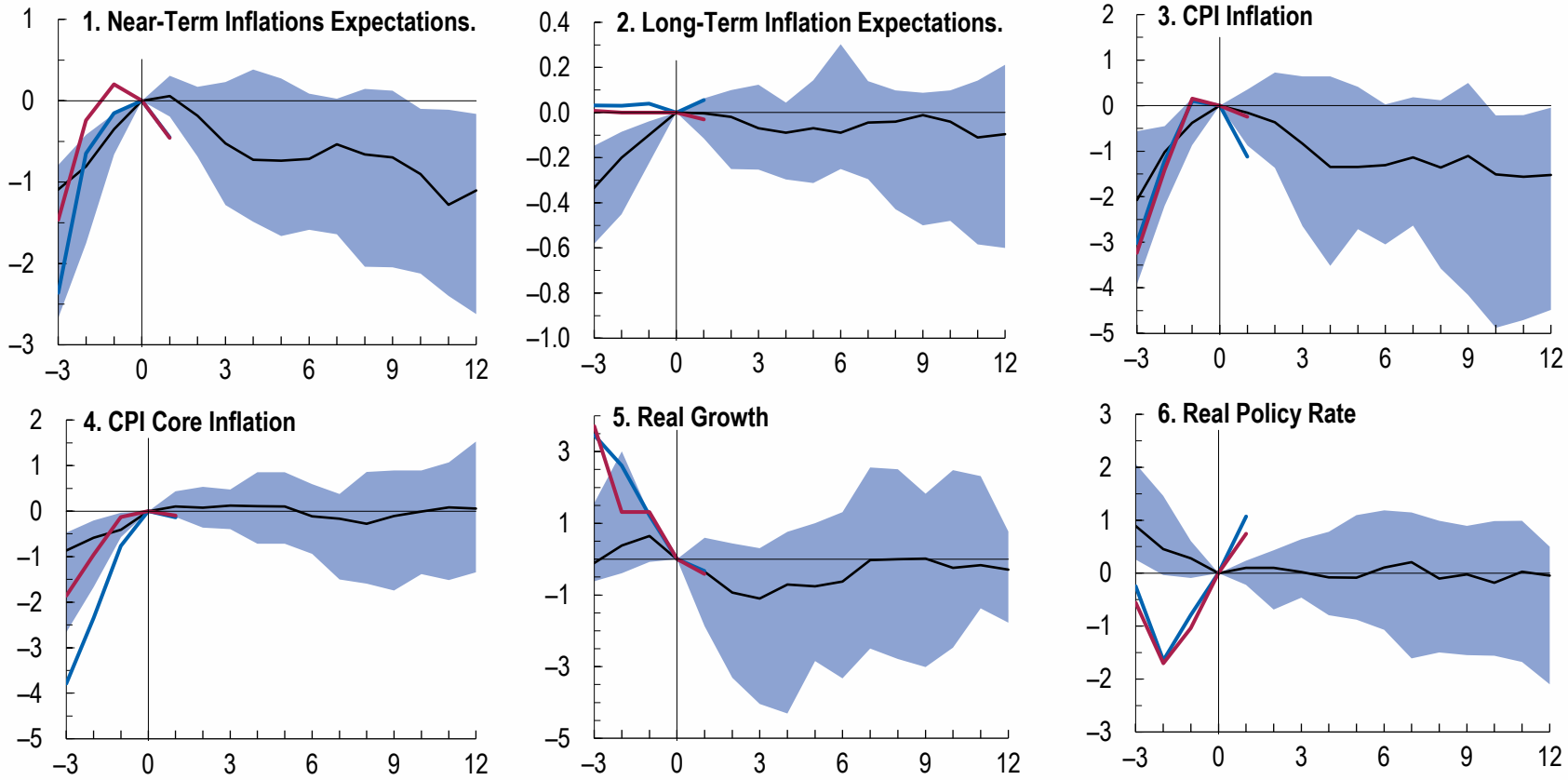


Sources: Central bank websites; Consensus Economics; Haver Analytics; and IMF staff calculations.
Note: Mean inflation expectations in the figure are from professional forecasters. Economies are included in the sample based on data availability. See Online Annex 2.1 for details. AEs = advanced economies; EMEs = emerging market economies.

After sustained rises, expectations can get stuck at higher level, but variability large.

Historical Episodes with Persistently Rising Near- and Long-Term Inflation Expectations

(Percentage points relative to level at end of episode)



- **Historical episodes**: 4 quarters of rising 1-year- and 5-year-ahead inflation expectations.
- Sample covers 1989:Q4 to 2023:Q1, with exact coverage varying by economy.
- 32 past episodes identified (16 AEs and 16 EMDEs).

Sources: Consensus Economics: and IMF staff calculations.

Note: Horizontal axes show quarters after the end of the historical episode. All rates are expressed in annual terms. Near-term inflation expectations (panel 1) are expected inflation rates over the subsequent year on a rolling basis. Long-term inflation expectations (panel 2) are expected inflation rates in five years' time. Real policy rates are interest rates based on expected inflation. Inclusion as a historical episode requires four quarters in which both near- and long-term inflation expectations are rising. The sample spans 1989:Q4 to 2023:Q1, with exact time coverage varying by economy. A total of 32 historical episodes are identified, with 16 from AEs and 16 from EMEs. See Online Annex 2.3 for further details. AEs = advanced economies; CPI = consumer price index; EMEs = emerging market economies; Exp. = expectations; Infl. = inflation; Med. = median.

How important are inflation expectations in explaining inflation dynamics?

- Economy-specific hybrid Phillips curve (WEO 2018, 2021, 2022)

$$\pi_{i,t} = \beta_i \pi_{i,t-1} + \gamma_i E_{i,t} \pi_{i,t+h} + \theta_i y_{i,t} + \delta_i X_{i,t} + \alpha_i + \tau_t + \varepsilon_{i,t}$$

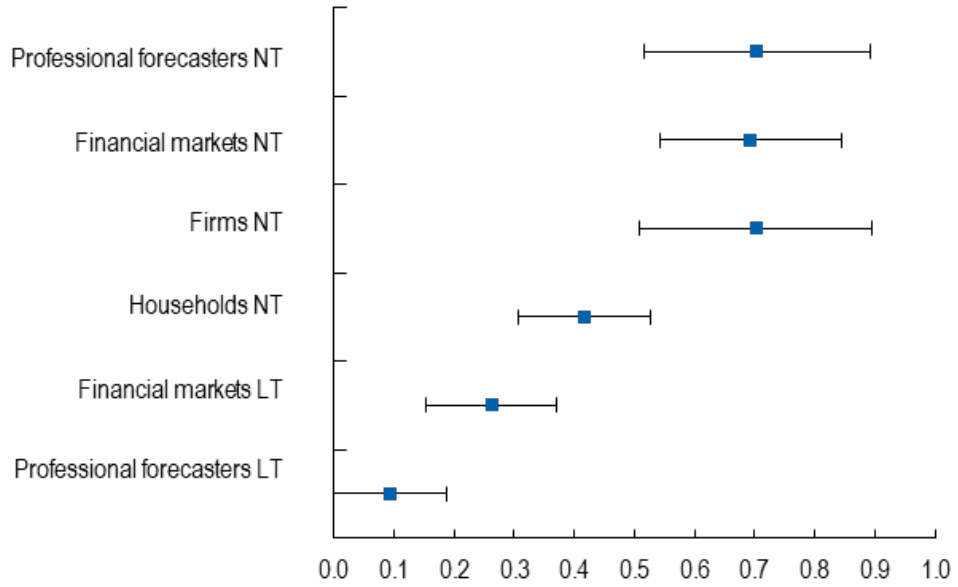
  - Relates current headline inflation to past inflation, inflation expectations (near- and medium/long-term), output gap, commodity prices (energy), nominal effective exchange rate growth, economy and time fixed effects. 53 countries (32 AEs, 21 EMs), quarterly data, starting from 1990 through 2023

- Analysis considers:

  - Relative explanatory power of near-term versus medium/long-term inflation expectations, across economic agents
  - Attempt to identify causality between inflation expectations and inflation
  - Historical decomposition of inflation dynamics: role of inflation expectations in recent quarters
  - State dependence: above versus below median inflation regimes

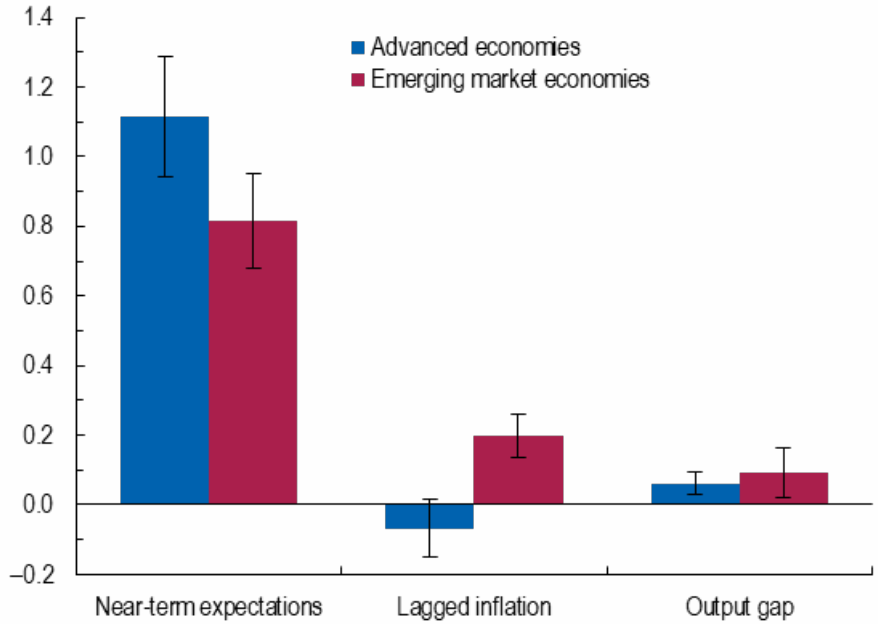
Near-term inflation expectations play a larger role in explaining current inflation, especially in advanced economies.

Estimated Effects of Alternative Inflation Expectations Measures on Current Inflation
(Standardized regression coefficients)



Source: IMF staff calculations.
Note: The figure shows standardized coefficients from linear regressions estimated by pooled times series for the euro area, United Kingdom, and United States using quarterly data from 1991:Q2 through 2023:Q1. The dependent variable is quarterly headline inflation, seasonally adjusted at an annualized rate. Horizontal lines show 90 percent confidence intervals with heteroskedasticity-robust standard errors. LT = long-term (five-year-ahead; for financial markets is next-5-years) inflation expectations; NT = near-term (next-12-months) inflation expectations.

Key Coefficients of the Hybrid Phillips Curve
(Regression coefficients)



Source: IMF staff calculations.
Note: The figure shows coefficients from linear regressions estimated by pooled times series using quarterly data from 1991:Q2 through 2023:Q1. The dependent variable is quarterly headline inflation, seasonally adjusted at an annualized rate. Whiskers show the 90 percent confidence intervals with Driscoll-Kraay standard errors.

A new instrumental variables approach to estimate the price Phillips curve.

- Two sources of variation drive measured expectations (Coibion and Gorodnichenko 2015, Coibion, Gorodnichenko and Kamdar 2018, D'Acunto, Malmendier and Weber 2022, Alvarez and Dizioli 2023)
  - Current realized inflation $\pi_{i,t}$
  - Persistent component which arises from adaptive learning

$$E_{i,t}\pi_{i,t+h} = \gamma_{i,1}\pi_{i,t} + \gamma_{i,2}E_{i,t-1}\pi_{i,t+h} + e_{i,t}$$

- Key identifying assumption:
  - Lagged inflation expectations affect current inflation *only* through their impact on current expectations

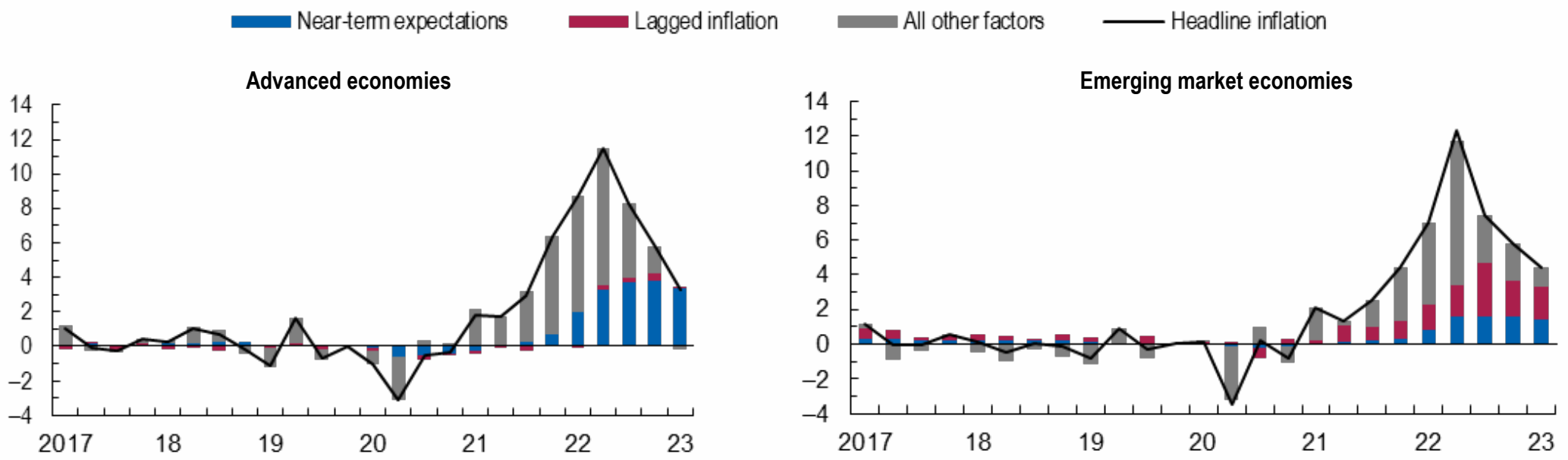
OLS estimates of the effect of expectations in the Phillips curve are upward biased.

	AE Mean groups OLS	AE Common OLS	AE Common IV	EME Mean groups OLS	EME Common OLS	EME Common IV
Near-term expectations	1.14***	1.24***	0.82***	0.66***	0.89***	0.42***
	(0.10)	(0.10)	(0.08)	(0.11)	(0.09)	(0.10)
Output gap	0.06***	0.06***	0.12***	0.13***	0.09**	0.14**
	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)	(0.06)
Lagged inflation	-0.09*	-0.10**	-0.01	0.26***	0.18***	0.35***
	(0.05)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
R-squared	0.70	0.72	0.48	0.67	0.68	0.56
Countries	31	31	31	17	17	17
Observations	3379	3379	3379	1757	1757	1757
First stage F-stat Expectations			1745			250
First stage F-stat Output gap			478			92
Overidentification (p-value)			0.94			0.21

Coefficients estimated by pooled time series using quarterly data from 1991Q2 through 2023Q1. All regressions also include country and time fixed effects, and changes in global energy prices and nominal effective exchange rate depreciation interacted with country fixed effects. Excluded instruments for the IV models are: lagged 12-month ahead expecations for inflation and GDP growth, lagged output gap and policy interest rates. Driscoll-Kraay standard errors in parentheses. First stage F-stat report values from the Sanderson-Windmeijer test for weak identification. Overidentification reports for the p-value of the Hansen J-statistic for the joint null hypothesis of instrument validity. * p<0.10, **p<0.05, ***p<0.01.

Recent inflation dynamics reveal growing importance of near-term inflation expectations, especially in advanced economies.

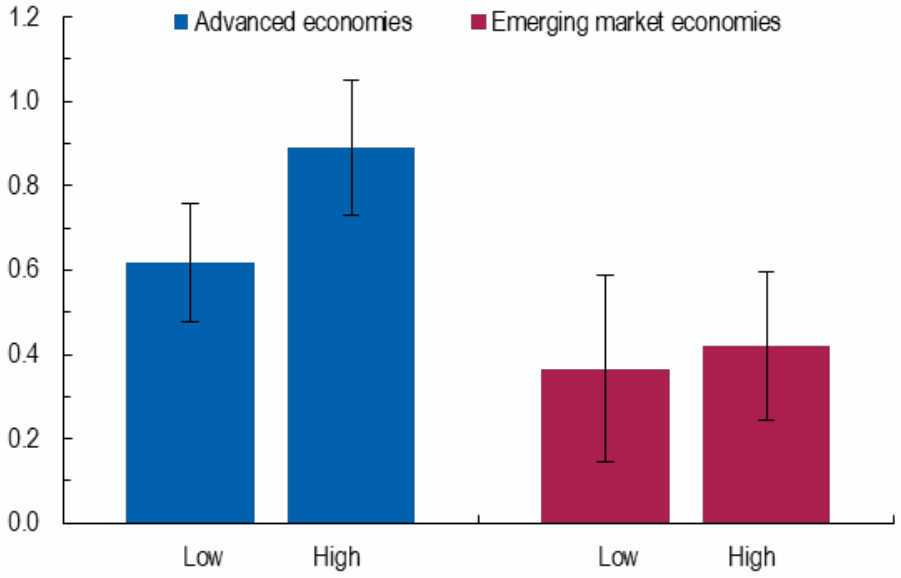
Contributors to Recent Inflation Dynamics
(Percentage point deviation from 2019:Q4)



Source: IMF staff calculations.
Note: Bars in the figure show the contributions to average headline inflation by economy group relative to the contributions observed in 2019:Q4. Contributions are calculated using coefficients estimated by instrumental variables pooled time series with quarterly data over 1991:Q2–2023:Q1. The black lines in each panel show the average seasonally adjusted annualized quarter-on-quarter headline consumer price index inflation observed relative to 2019:Q4. The "All other factors" category includes the contributions from time fixed effects (common global factors), all other explanatory variables, and the regression residual.

The passthrough of expectations to current inflation increases when inflation is already elevated.

State-Dependent Pass-Through from Expectations to Inflation
(Regression coefficients)



Source: IMF staff calculations.
Note: Bars in the figure show the average estimated coefficients from regressions of headline inflation on inflation expectations by economy group, interacted with an indicator for whether lagged headline inflation was above an economy's median inflation level over the sample period. Estimation is via instrumental variables using quarterly data over 1991:Q2–2023:Q1. The whiskers show the 90 percent confidence interval using heteroskedasticity-robust standard errors.

- The estimated impact of inflation expectations is higher when inflation is above a country's median level of inflation.
- The difference in pass-through by prevailing level of inflation is larger for advanced economies, and statistically significant.

How do expectations affect monetary policy effectiveness and how does policy affect expectations?

- How does the share of backward-looking learners in the economy affect the cost of disinflation (the sacrifice ratio)?
- How structural and cyclical policies affect inflation outcomes when part of the agents have backward-looking expectations?
- How long would it take to bring inflation back to target under different scenarios?

A learning model

- **Model-based analysis:** tractable estimated DSGE model (Alvarez and Dizioli 2023)
  - *Key elements*
    - Output gap related to past and expected output gap and ex ante real interest rate (IS curve)
    - Price inflation related to past and expected inflation and real wage gap (Price Phillips curve)
    - Wage inflation related to past real wage, expected inflation, and output gap (Wage Phillips curve)
    - Monetary policy reaction function (nominal interest rate)
  - *New features affecting expectations formation*
    - Two kinds of agents → forward-looking (full-information) agents and backward-looking learners
    - Inflation expectations at two horizons → near and long term (similar to Bernanke and Blanchard 2023)
  - *Model estimation/calibration*
    - Bayesian methods for two representative economies (an AE and an EME)

Expectations formation in the model

Two kinds of agents.

- *Backward-looking learners*
  - Expectations formed with backward-looking statistical models with limited information set X_j:

$$E_t(y_{t+1}) = X_j^T \beta_j^T$$

$$E_t(\pi_{t+1}) = X_j^T \beta_j^T$$

- *Forward-looking (full information) learners*
  - Forward-looking expectations taking into account share and behavior of backward-looking learners in the economy:

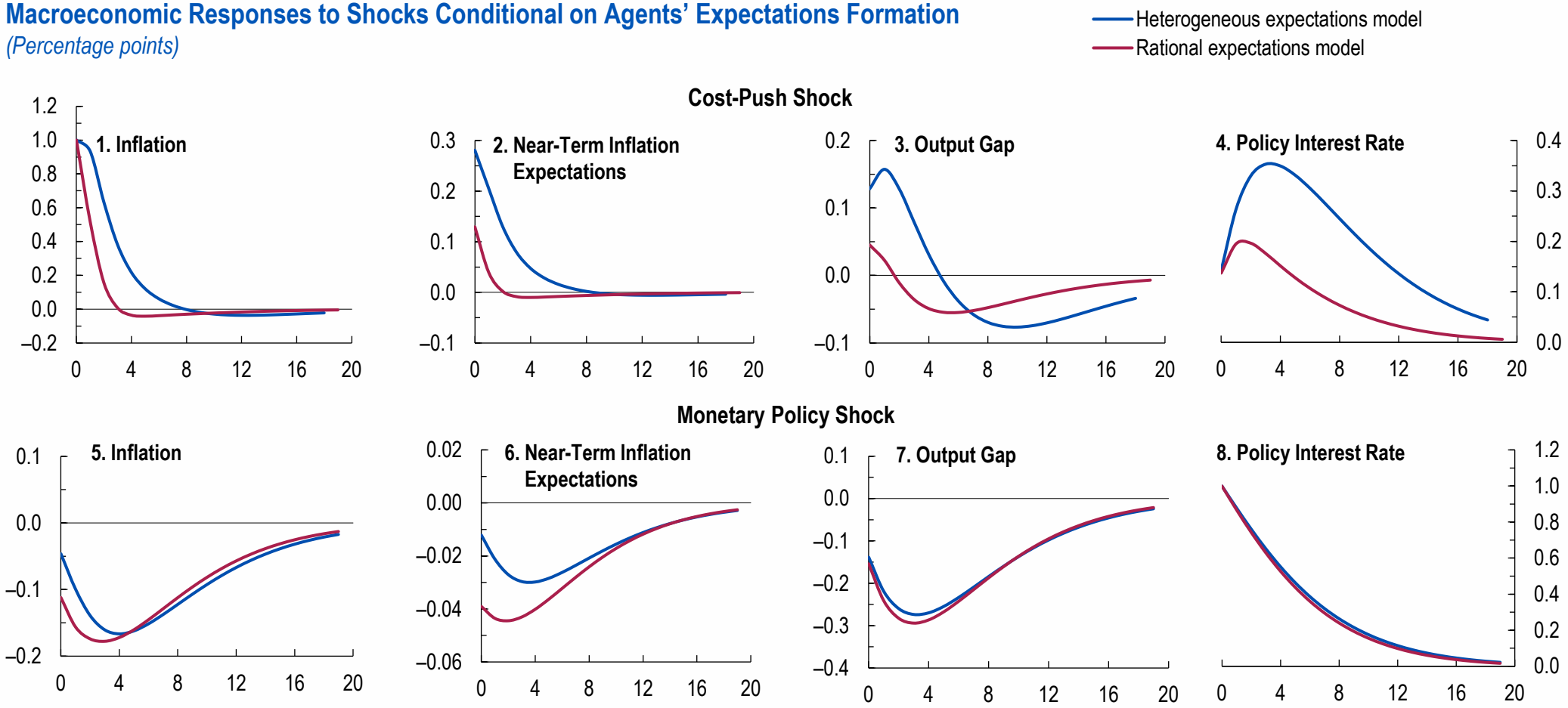
$$E_t(\pi_{t+1}) = \pi_{t+1}$$

Baseline model with heterogenous agents uses the estimated share of backward-looking and forward-looking learners in the economy.

Cost-push shocks are more persistent and policy less potent with higher share of backward-looking learners.

Macroeconomic Responses to Shocks Conditional on Agents' Expectations Formation

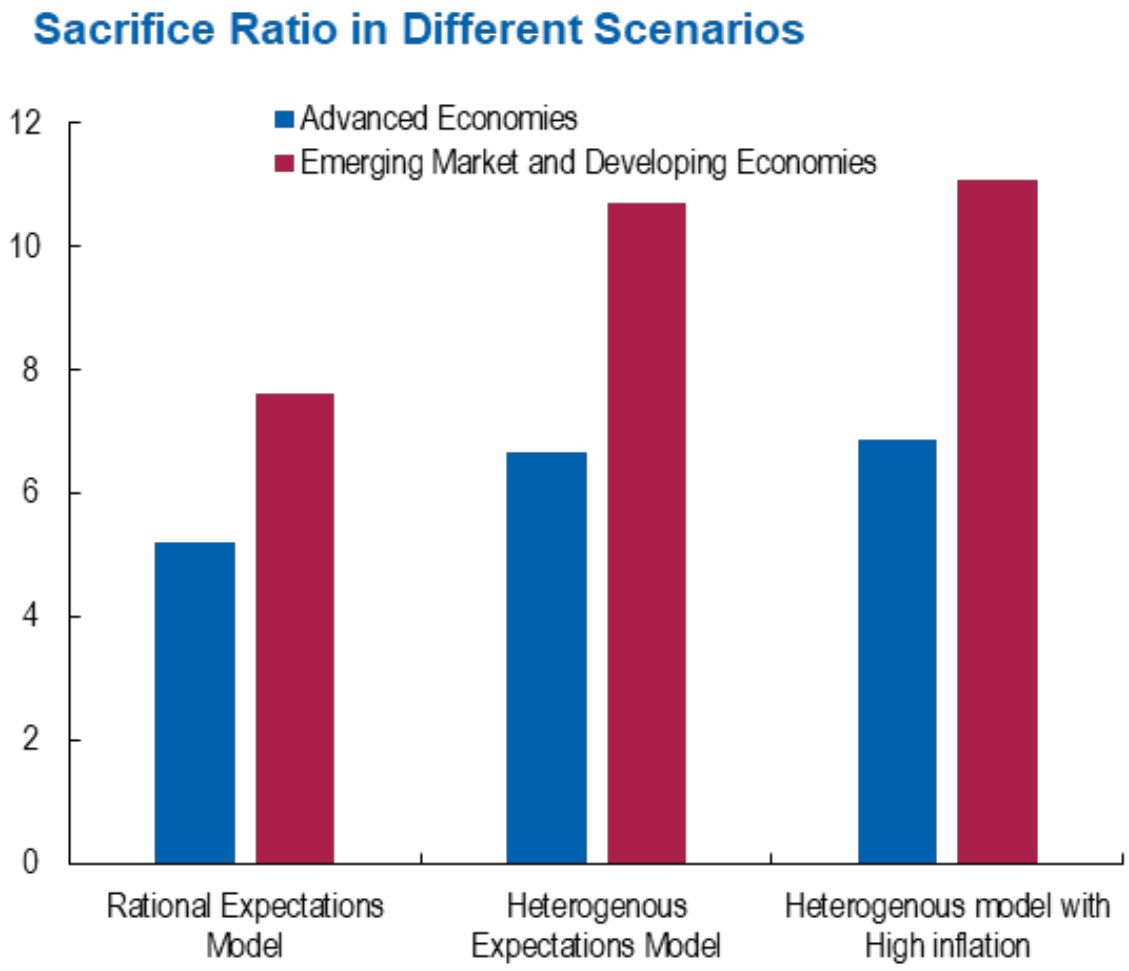
(Percentage points)



Source: IMF staff calculations.

Note: Numbers on the horizontal axes in the panels represent quarters after the shock at time 0. Panels 1–4 show the impulse responses to a cost-push shock that increases inflation by 1 percentage point. Note that the output gap increases after this shock, because potential output falls by more than real GDP. Panels 5–8 show the impulse responses to a temporary monetary policy shock that increases the policy rate by 100 basis points. Note that the monetary policy shock's impact on inflation peaks after five quarters in the heterogenous-expectations model and after three quarters in the rational-expectations model.

The sacrifice ratio is higher when there are more backward-looking learners in the economy.

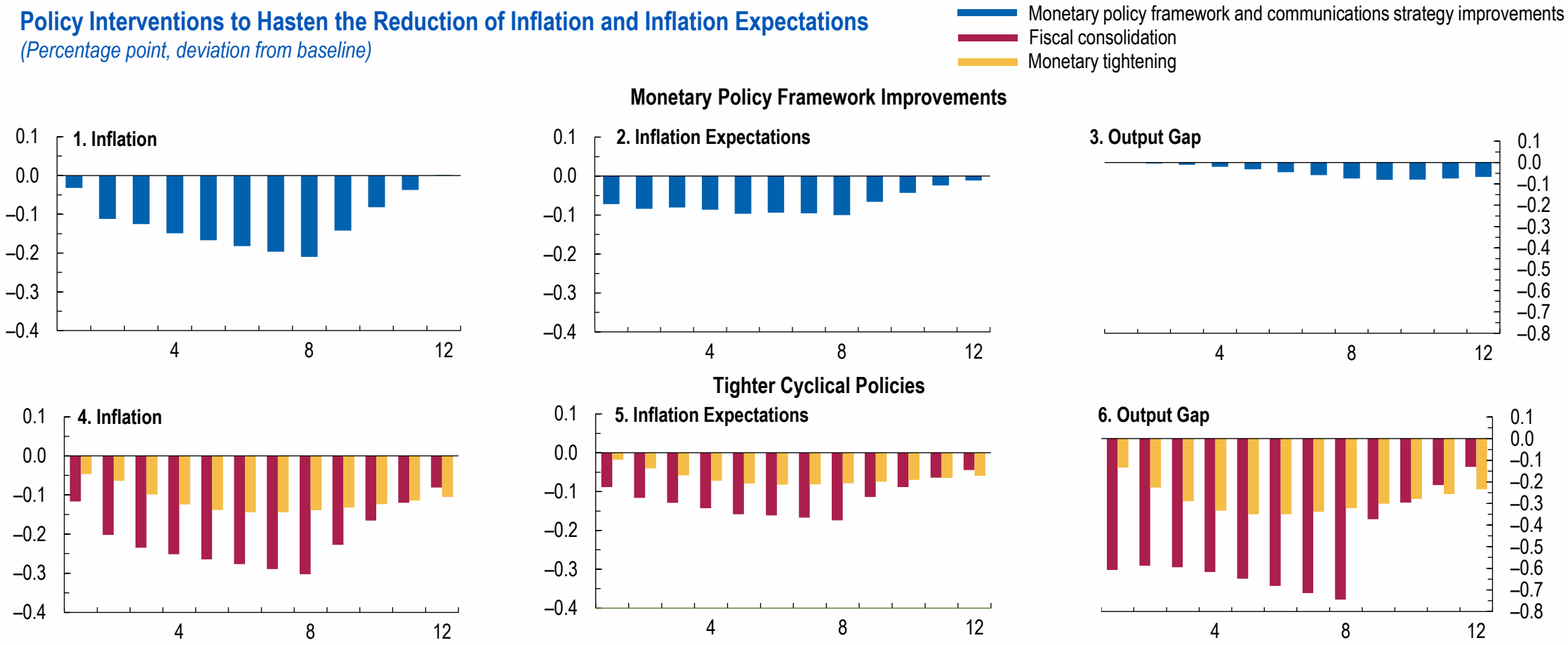


Source: IMF staff calculations.
Notes: Sacrifice ratio is defined to be the percent reduction in output induced by a monetary policy tightening to bring inflation down by one percentage point after three years.

- Higher sacrifice ratio is driven by backward-looking learners. These agents do not fully incorporate the anticipated impact of monetary policy going forward.
- The effect is higher in emerging market economies since they typically have a higher share of backward-looking learners.

Improved monetary policy communications also helps and at low cost, complementing cyclical policies.

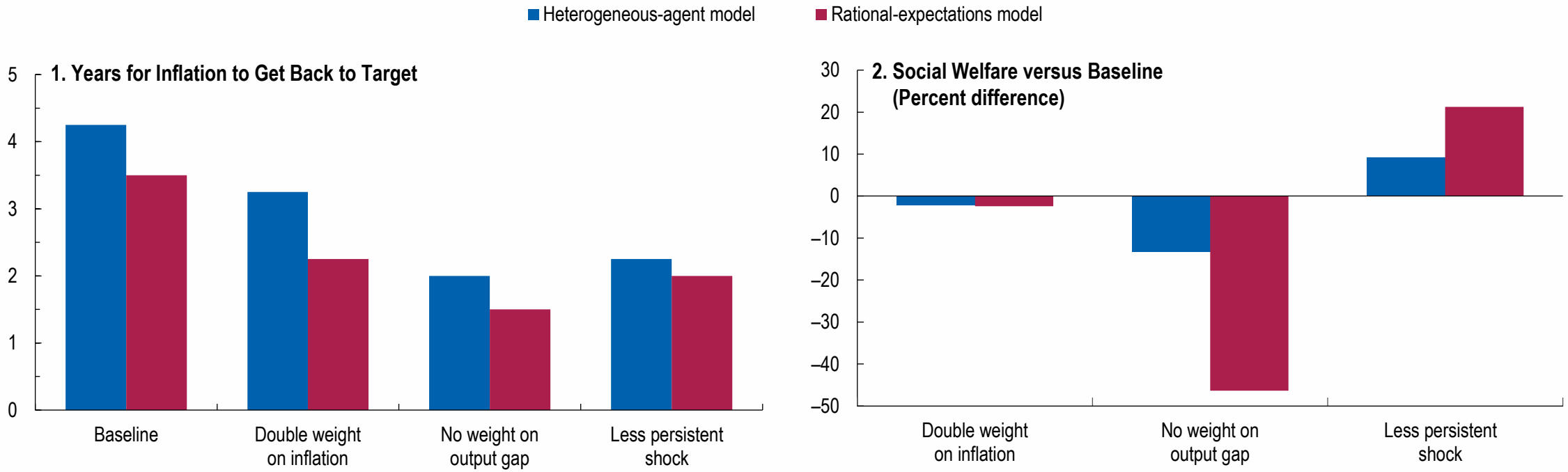
Policy Interventions to Hasten the Reduction of Inflation and Inflation Expectations
(Percentage point, deviation from baseline)



Source: IMF staff calculations.
Note: Improvements in communication strategies is calibrated as the difference of the forward-looking share between the representative advanced and emerging market economies. Fiscal consolidation shock is assumed to be a 1% consolidation maintained for 2 years. The monetary policy tightening exercise uses a standard 100bps tightening.

Optimal monetary policy implies a slow path to get inflation back to target with heterogenous agents.

Policy Objectives, Social Welfare, and Expectations Formation



Source: IMF staff calculations.

Key conclusions and findings

- **How have inflation expectations behaved pre- and post-pandemic?**
  - Near-term inflation expectations rose sharply (up to 4 standard deviation rise).
  - Long-term expectations do not show signs of de-anchoring on average.
  - Inflation is so far roughly in line with the median from historical episodes. On average, it took 3 years to revert to pre-episode inflation rates.

- **How important are expectations for inflation dynamics?**
  - Near-term inflation expectations play a more important role for inflation than long-term measures, with raising explanatory power in the recent period.
  - In emerging markets, past inflation still play a predominant role.
  - The passthrough tends to be higher when inflation is already elevated.

Policy implications

- Monitoring changes in agents' expectations formation process is key to understand the trade-off (speed of inflation convergence to target vs economy slowdown) and calibrate monetary policy actions

- A smoother transition toward inflation targets might be needed to minimize welfare losses, especially when expectations are more backward-looking and the shock is persistent.

- Improved monetary policy frameworks and communications can help achieving a softer landing, since are better informs agents’ expectations.

World Economic Outlook
October 2023

Chapter 2

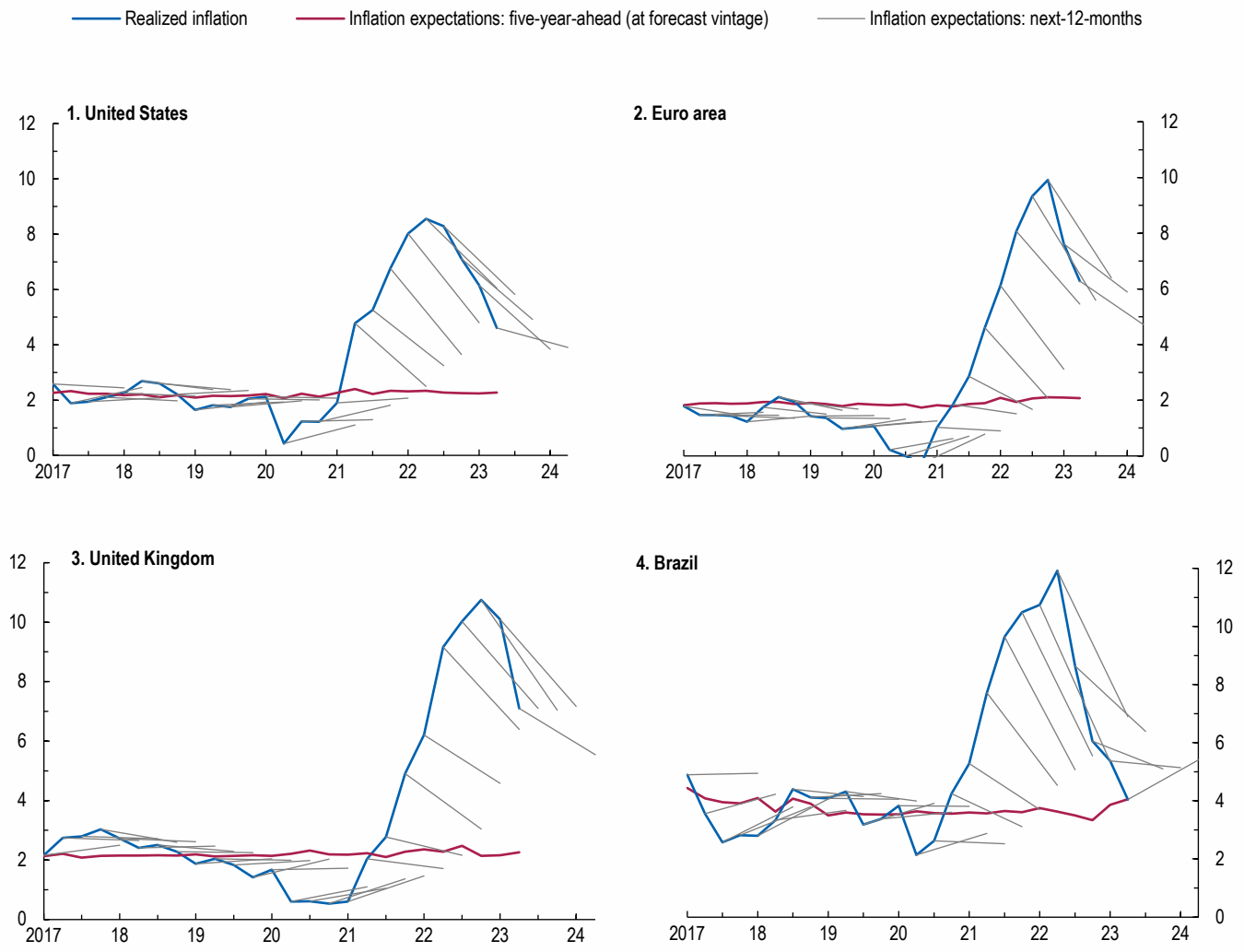
“Managing Expectations: Inflation and Monetary Policy”

THANK YOU!

EXTRA SLIDES

Near-term inflation expectations are stickier.

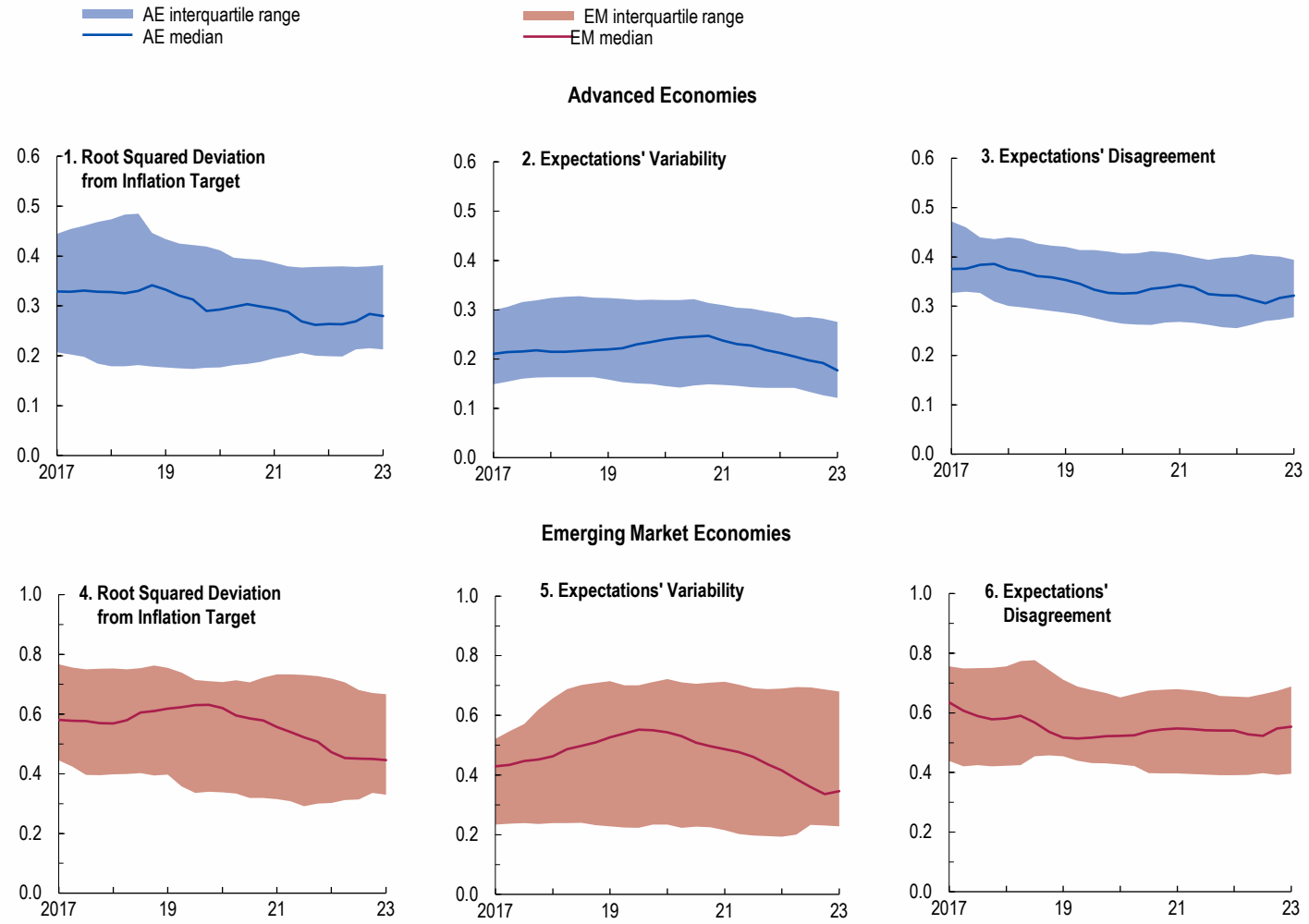
Realized Inflation and Next-12-Months and Five-Year-Ahead Inflation Expectations by Professional Forecasters
(Percent)



Sources: Consensus Economics; World Economic Outlook; and IMF staff calculations.

Long-term expectations remain anchored.

Metrics of Inflation Expectation Anchoring
(Percentage points)



Source: Consensus Economics, central bank websites, Haver Analytics, and IMF staff calculations.
Note: Root Squared Deviation from Target, Expectations' Variability, and Expectations' Disagreement in percentage points. The plots are smoothed with a trailing average of six years, but quarterly figures show similar trends in all three metrics. See October 2018 WEO Chapter 3 Annex, page 12-13 for details. AE = Advanced Economies; EM = Emerging Market Economies.

The augmented Phillips curve in a system of simultaneous equations

- Adaptive expectations

$$F_{i,t}x_{i,t+h} = \gamma_{i,1}^{x}x_{i,t} + \gamma_{i,2}^{x}F_{i,t-1}x_{i,t+h} + e_{i,t}^{x}, \qquad x_{i,t} = \{\pi_{i,t}, y_{i,t}\}$$

- Augmented Phillips curve

$$\pi_{i,t} = \beta_{i,1}\pi_{i,t-1} + \beta_{i,2}F_{i,t}\pi_{i,t+h} + \beta_{i,3}y_{i,t} + \beta_{i,4}X_{i,t} + v_{i,t}$$

- IS curve

$$y_{i,t} = \alpha_{i,1}y_{i,t-1} + \alpha_{i,2}F_{i,t}y_{i,t+h} + \alpha_{i,3}\left(F_{i,t}\pi_{i,t+h} - r_{i,t}\right) + \alpha_{i,4}X_{i,t} + u_{i,t}$$

First stage equations

$$\mathbb{E}[x_{i,t}] = \eta_{i,1}^{x}\pi_{i,t-1} + \eta_{i,2}^{x}F_{i,t-1}\pi_{i,t+h} + \eta_{i,3}^{x}y_{i,t-1} + \eta_{i,4}^{x}F_{i,t-1}y_{i,t+h} + \eta_{i,5}^{x}r_{i,t} + \eta_{i,6}^{x}X_{i,t}$$

Model-based Analysis: Estimation and Empirical Strategy

- The model described earlier is estimated with standard Bayesian techniques.
- In particular, the share of forward-looking agents is estimated.
- We use quarterly data from the USA from 2000Q1 to 2019Q4, and from 2011Q1 to 2019Q4 for Brazil.
- We use a simple HP filter to calculate potential output; inflation target, and the natural rate are constants.

Heterogenous expectations' DSGM model: main equations

$$y_t = \alpha_{yL} y_{t-1} + \alpha_{yF} y_{t+1} + \gamma(\pi_{t+1} - r_t) + s_{yt} \quad \text{(IS curve)}$$

$$s_{yt} = \rho_{\varepsilon} s_{y_{t-1}} + \varepsilon_{y_t} \quad \text{(AR1 shock to IS curve)}$$

$$\pi_t = \alpha_{\pi L} \pi_{t-1} + \alpha_{\pi F} \pi_{t+1} + k_{\pi} \bar{w}_t + \varepsilon_{\pi t} \quad \text{(Phillips curve depends on real wage gap)}$$

$$\pi_{wt} = \bar{w}_t - \bar{w}_{t-1} + \pi_t \quad \text{(nominal wage inflation gap definition)}$$

$$\pi_{wt} = -\alpha_{wL} w_{t-1} + \alpha_{wF} \pi_{wt+1} + K_w y_t + \varepsilon_{wt} \quad \text{(nominal wage depends on output gap)}$$

$$r_t = \rho r_{t-1} + (1-\rho)(\rho_{\pi} \pi_{t+1} + \rho_y y_t) + \varepsilon_{rt}$$

Heterogenous expectations' DSGM model: new model equations on expectations

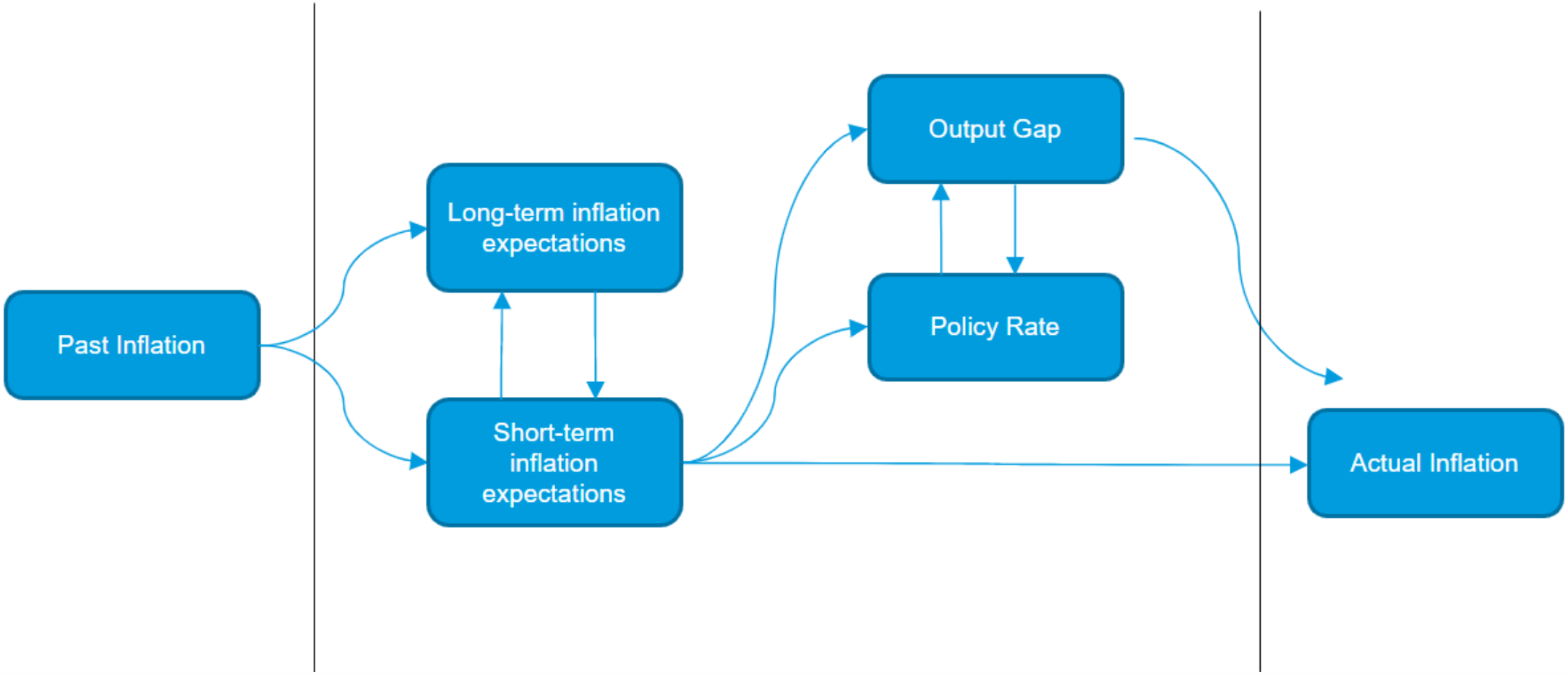
$$\pi_{t+1} = \alpha_{1\pi L}\pi_{t-1} + \alpha_{2\pi F}\pi^{*}_{t+1} + \varepsilon_{\pi t} \quad \text{(expectation equation)}$$

$$\pi^{*}_{t} = \alpha^{*}_{1\pi L}\pi_{t-1} + \alpha^{*}_{2F}\pi^{*}_{t-1} + \varepsilon^{*}_{\pi_t} \quad \text{(long run expectation equation)}$$

$$\pi_{t+1} = \pi^{obs}_{t+1} + \varepsilon^{obs}_{t+1} \quad \text{(measurement equations)}$$

$$\pi^{*}_{t+1} = \pi^{* obs}_{t+1} + \varepsilon^{* obs}_{t+1} \quad \text{(measurement equations)}$$

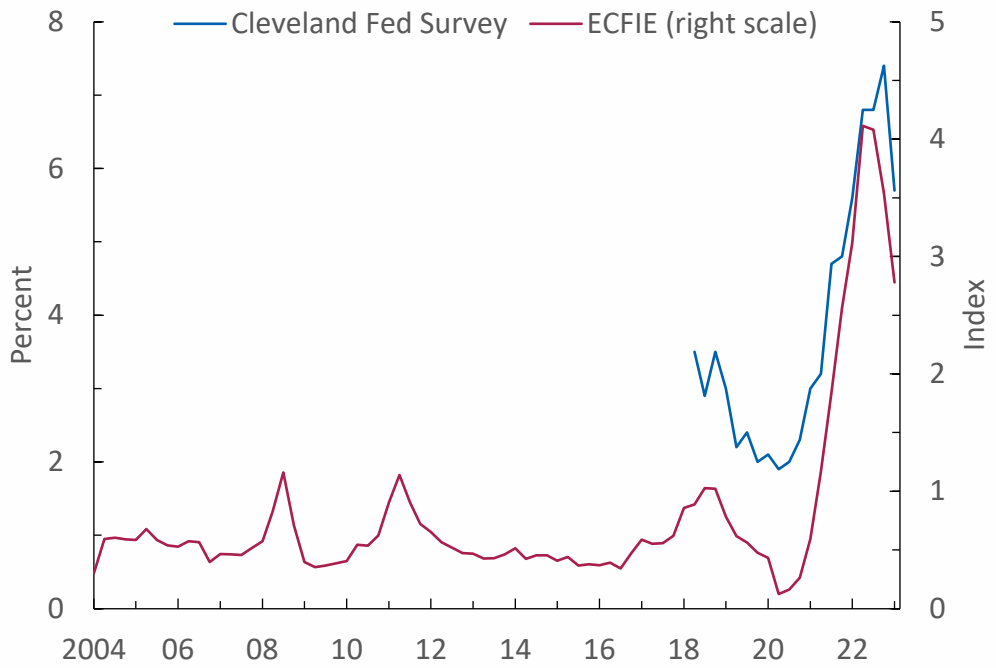
Model structure and connections



ECFIE: Earning-Calls-based Firm Inflation Expectations

- New measure of firms' inflation expectations based on text analysis of firms' earnings calls to capture firms' intensity of discussion of near-term inflation expectations.
  - Human judgment and ChatGPT to identify two set of key words: **inflation** and **expectations** at the sentence level, Then Bag-of-words" (NL Analytis).
  - $ECFIE\ Index_{t,i} = \frac{\Sigma\ Inflation\ Expectation\ Sentences_{t,i}}{Total\ Sentences_{t,i}}$

US ECFIE Index and Survey-based Firms' Inflation Expectations

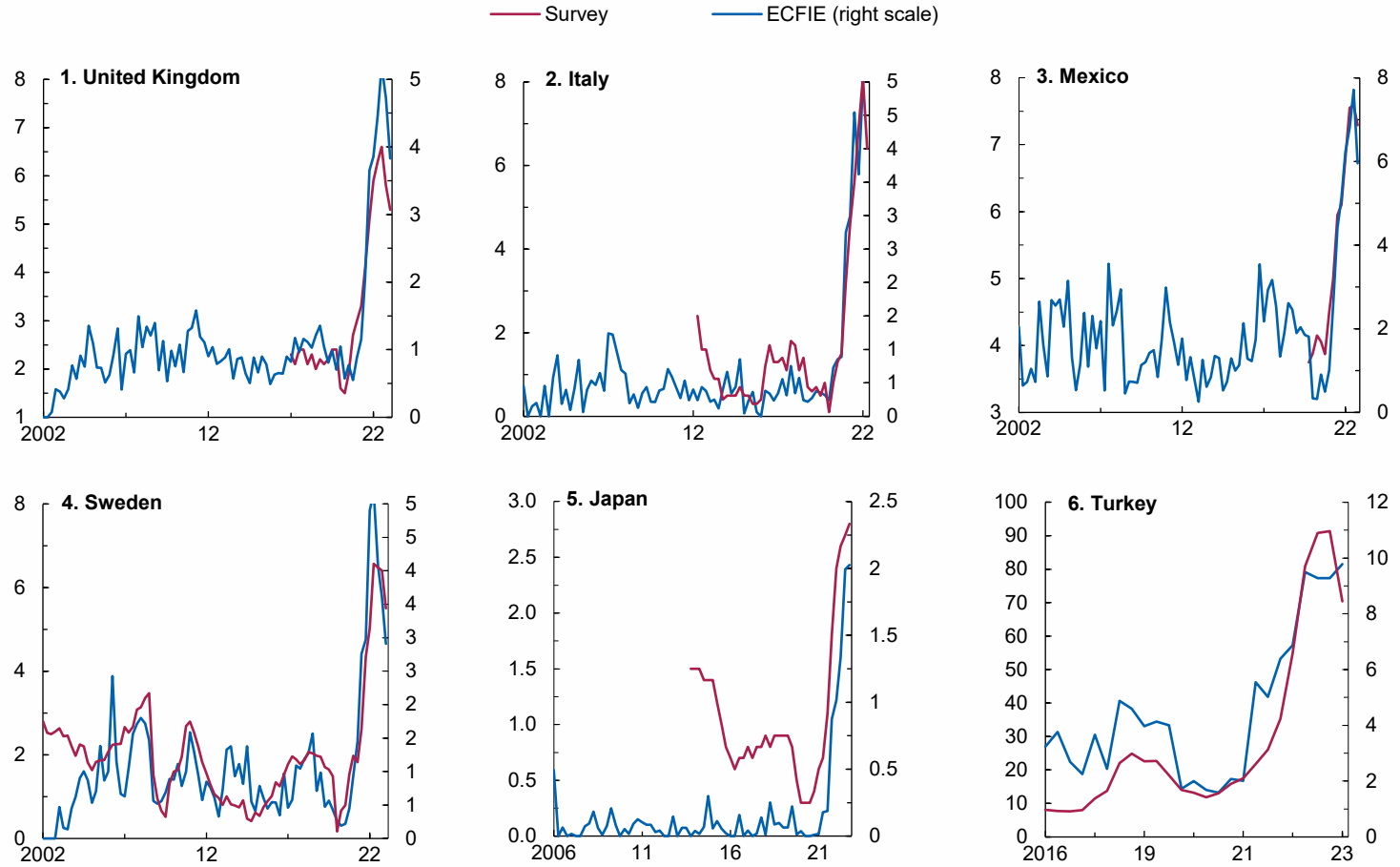


Source: Federal Reserve Bank of Cleveland; NL Analytics; S&P Capital IQ; and IMF staff calculations

Note:The figure shows ECFIE Index according to the information content extracted from the earnings call (right scale) and the US firms' survey is conducted by the Cleveland Fed (left scale) for US. The ECFIE is calculated from a text analysis using transcripts of US based companies. ECFIE = earnings call firm inflation expectations

ECFIE highly correlated with existing surveys

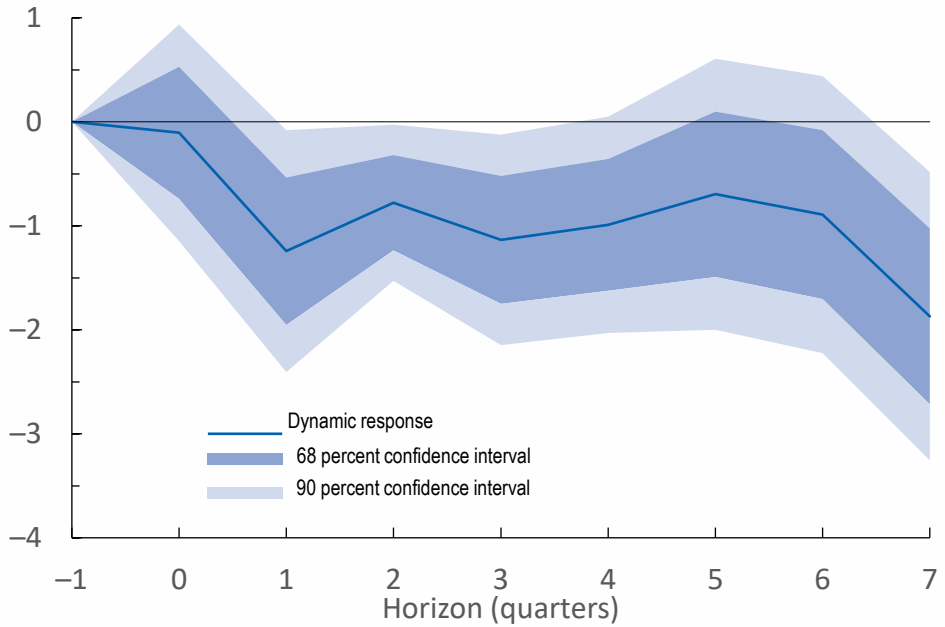
ECFIE Cross-Country Validation with Survey-based Next-12-Months Inflation Expectations by Firms
(Percent; index on right scale)



Sources: Bank of England; Italy Central Bank; Japan Central Bank; Mexico Central Bank; NL Analytic; S&P Capital IQ; Sweden Central Bank; Turkey Central Bank; and IMF staff calculations.
Note: Next-12-months inflation expectations by firms come from existing survey-based measures, available for selected economies, shown in annualized percent. The ECFIE measure is an index, with a higher number indicating higher inflation. See the discussion and Dizioli, Simon, and Albrizio (forthcoming) for further details.

Monetary policy effectiveness is boosted when firms pay attention to the Fed

Role of Attention in Monetary Policy Effectiveness
(Percent of ECFIE standard deviation)

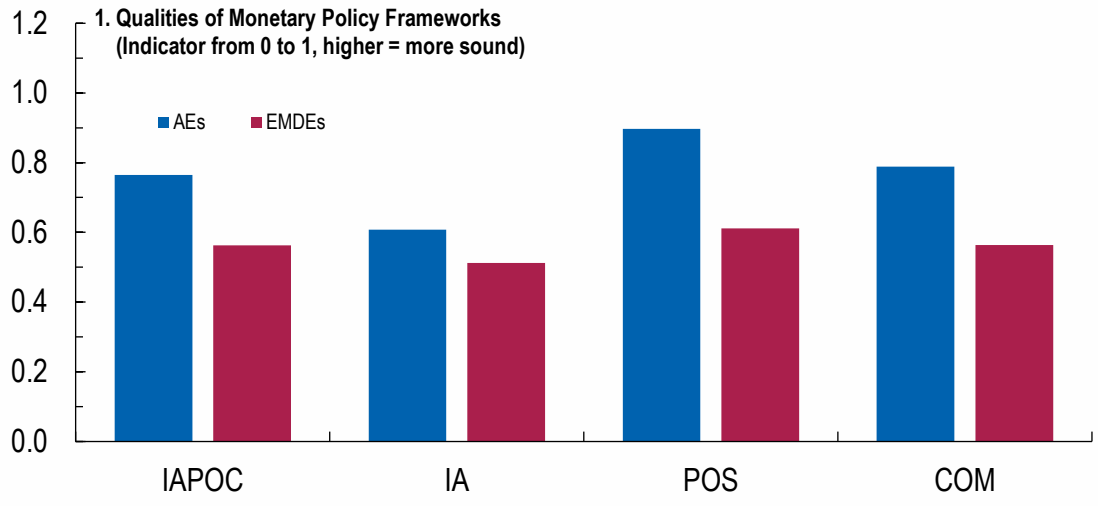


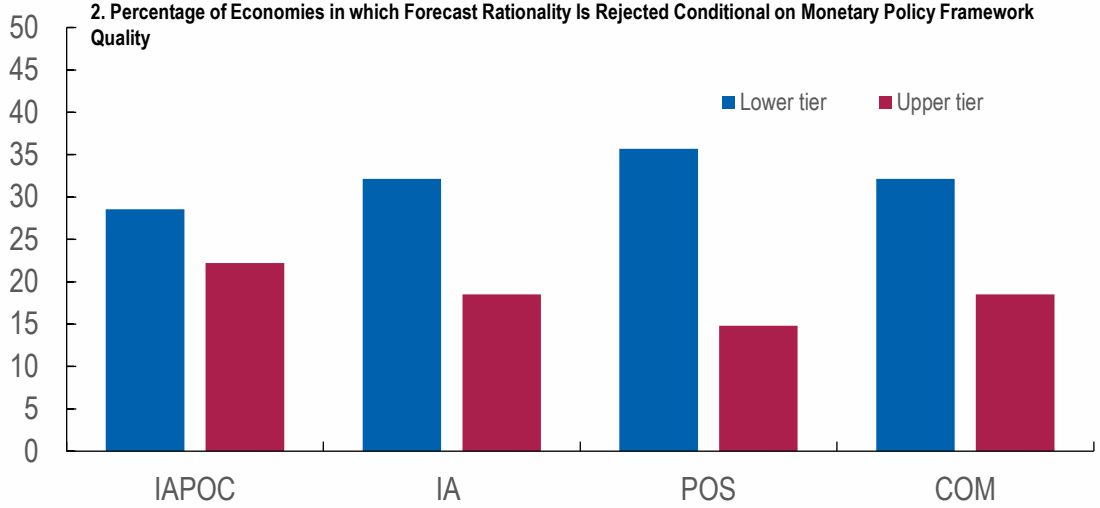
Sources: Haver Analytics; NL Analytics; S&P Capital IQ; S&P Compustat; and IMF staff calculations.
Note: The line in the figure is the estimated cumulative impulse response to a one-standard-deviation contractionary monetary policy shock for a firm that is one standard deviation above the average firm attentiveness in its sector. Shaded areas represent 68 (outer) and 90 percent (inner) confidence intervals. ECFIE = Earnings-Calls-based Firm Inflation Expectations index.

- Attention to the Central Bank index based on text analysis of firms' earnings call.
- Firms more attentive to the Fed's actions decrease their inflation expectation relative more following a monetary policy shock
- This corresponds to an amplification of about one-fourth by sector.

Better central bank framework is associated with more forward-looking expectations.

Soundness of Monetary Policy Frameworks and Forecast Rationality Tests across Economies

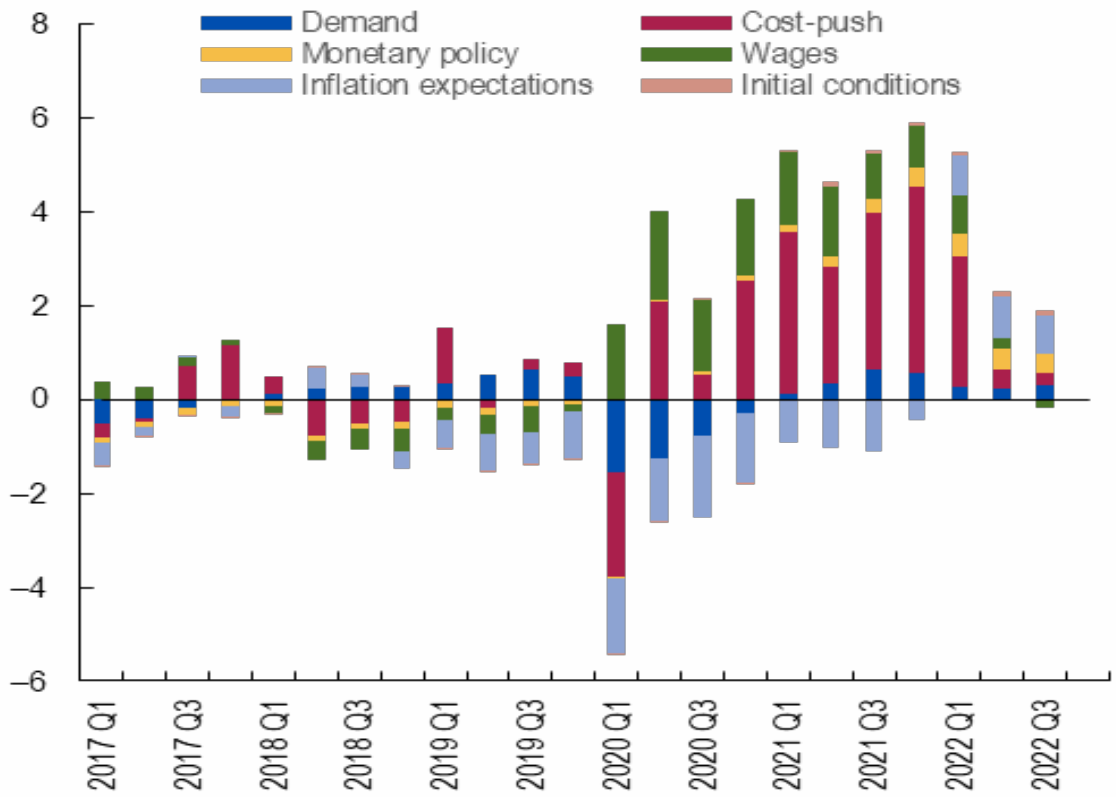




Sources: Unsal, Papageorgiou, and Garbers (2022); and IMF staff calculations.
Note: Panel 1 shows the mean of the indicator by economy group for which data is available (2007–21). Panel 2 of the figure shows the share of economies (among those with expectations from professional forecasters) for which a simple forecast rationality test (Lovell 1986) rejects the hypothesis of rational expectations. See Online Annex 2.7 for further details. AEs = advanced economies; EMDEs = emerging market and developing economies; IAPOC = Overall Monetary Policy Framework index, which is composed of three pillars: Independence and Accountability (IA), Policy and Operational Strategy (POS), and Communications (COM).

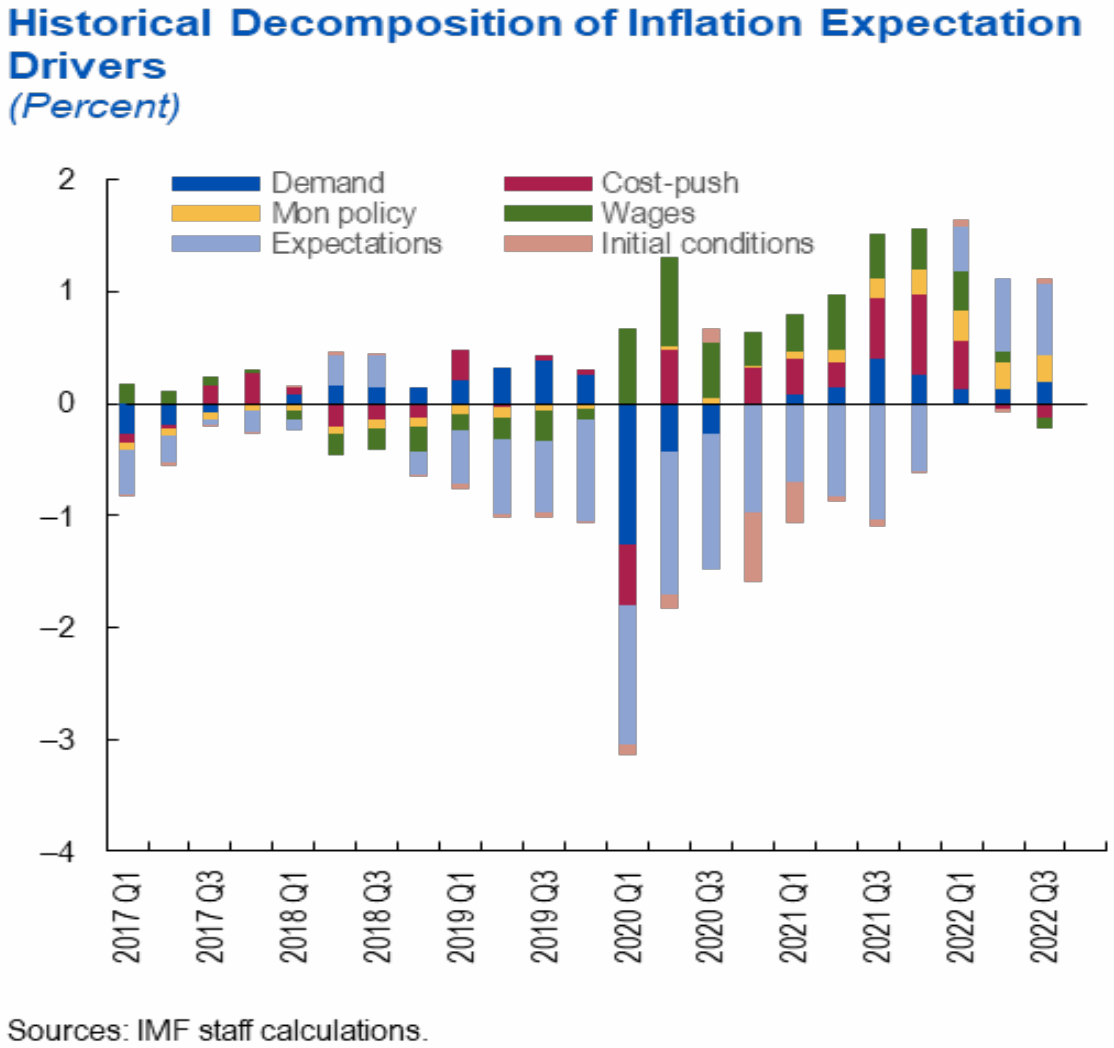
Structural decomposition indicates supply shocks were important after pandemic shock, while inflation expectations are more important recently.

Historical Decomposition of Inflation Drivers
(Percent)



Sources: IMF staff calculations.

Structural decomposition for inflation expectations indicates similar drivers.



Sources: IMF staff calculations.