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Global Comovement, Domestic Heterogeneity, and the Natural Rate of Interest: Evidence from the G20

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Abstract

How much of the variation in the natural rate of interest is attributable to global, regional, and domestic forces, and do these influences differ across advanced and emerging economies? This paper addresses this question using a Bayesian state-space model estimated for the 19 national members of the G20 over 2000Q1-2025Q4. The framework jointly estimates potential output, output gaps, ex ante real-rate gaps, and natural rates from real GDP, inflation, and policy-rate data. Natural rates are decomposed into global, regional, and domestic trend-growth and preference components within a unified system of country-specific IS curves and Phillips curves. The model accommodates cross-country heterogeneity through exchange-rate depreciation, global commodity-price inflation, an unbalanced-panel likelihood, and a pandemic-specific inflation-volatility state.

The results reveal substantial international comovement in natural rates. While global and regional factors contribute to common movements in equilibrium real rates, domestic factors account for the largest share of historical variation in every G20 economy. Posterior-median domestic variance shares range from 0.299 to 0.723, compared with global shares of approximately 0.06 to 0.18. Natural rates are generally higher in several emerging economies than in advanced economies, consistent with differences in growth prospects and structural conditions. These findings suggest that global forces influence the broad direction of natural-rate movements, whereas domestic fundamentals remain the primary source of persistent cross-country heterogeneity. Overall, the evidence points to a common global trend in equilibrium real rates operating alongside substantial national variation, implying that country-specific considerations remain central to the assessment of monetary-policy stance.

Keywords: Natural rate of interest; G20; Bayesian state-space model; global component; output gap

JEL classifications: C32; E43; E52; F44

1. Introduction

The natural rate of interest, r^*, occupies a central position in modern monetary policy because it provides a benchmark for assessing whether financial conditions are stimulative, neutral, or contractionary. Yet r^* is fundamentally unobservable and its measurement remains highly model dependent. Statistical estimates derived from trends in ex post real interest rates offer only a partial solution. Such measures are vulnerable to inflation surprises and are not explicitly linked to the underlying macroeconomic forces that define equilibrium in goods and credit markets. These challenges have become particularly salient following the global inflation surge of 2021-2023. The problem is even more pronounced in emerging market economies, where policy and money-market rates often embody sovereign risk, exchange-rate risk, liquidity premia, and other financial frictions that obscure the underlying equilibrium real rate.

A second challenge concerns the international dimension of natural-rate dynamics. Similar movements in estimated national natural rates may arise for very different reasons. They may reflect common global forces, such as slower productivity growth, demographic shifts, or changes in the supply and demand for safe assets. Alternatively, they may be driven by regional integration or by domestic structural developments that evolve independently across countries. Existing research documents a pronounced decline in global real interest rates over recent decades (Del Negro et al., 2019), while theories of safe-asset scarcity emphasize the role of global imbalances in savings and investment (Caballero et al., 2017). Demographic transitions and persistent shifts in desired saving and investment have also been identified as important determinants of long-run equilibrium rates (Carvalho et al., 2016; Rachel and Smith, 2017; Rachel and Summers, 2019; Eggertsson et al., 2019). Distinguishing between these channels is essential because each implies a different scope for national monetary policy and a different interpretation of observed interest-rate comovement. A credible empirical framework must therefore estimate natural rates jointly with the macroeconomic

relationships that give them economic meaning while disentangling global, regional, and domestic sources of variation.

This paper develops a unified framework to estimate and decompose natural rates of interest across the G20 over the period 2000Q1-2025Q4. We construct a Bayesian state-space model that jointly estimates potential output, output gaps, ex ante real-rate gaps, and country-specific natural rates. The natural rate in each economy is modeled as a function of latent global, regional, and domestic drivers operating through trend growth and preference-related components. To improve comparability across advanced and emerging economies, the model accommodates unbalanced data panels and augments the Phillips curve with exchange-rate depreciation, global commodity-price inflation, and a temporary pandemic-related volatility state. These features allow the framework to exploit available information without relying on artificial interpolation of missing observations.

This paper contributes to the literature in three principal ways. First, it provides the first unified decomposition of natural rates of interest for the full G20, encompassing both advanced and emerging economies within a common semi-structural framework. Existing cross-country studies focus primarily on advanced economies and, as a result, offer limited insight into how equilibrium real rates are determined in countries with different monetary regimes, financial structures, and exposures to external shocks. By bringing advanced and emerging economies into a single empirical framework, the analysis allows the sources of natural-rate variation to be compared on a globally consistent basis.

Second, the paper advances the measurement of r^* by identifying global, regional, and domestic components jointly within the state-space system rather than through a sequential decomposition of pre-estimated natural-rate series. This distinction is important because it propagates uncertainty from the estimation of latent macroeconomic states directly into the decomposition itself, avoiding the attenuation and generated-regressor problems that arise when estimated trends are treated as data. The framework therefore provides a structurally coherent assessment of how much of each country's natural rate is attributable to global forces, regional integration, and idiosyncratic domestic conditions.

Third, while a substantial global component underlies the broad decline in natural rates observed since the early 2000s, domestic factors remain the dominant source of variation across all G20 economies. This finding challenges the view that national equilibrium rates are primarily determined by global secular forces and points instead to the continuing importance of country-specific fundamentals even in an era of deep financial integration. By quantifying the relative importance of global, regional, and domestic drivers before and after the pandemic, the paper provides a new benchmark for evaluating monetary-policy constraints and the scope for national stabilization policies in an increasingly interconnected world.

The remainder of the paper proceeds as follows. Section 2 reviews the relevant literature and situates the paper's contribution. Section 3 describes the data and variable construction. Section 4 outlines the Bayesian state-space model and the global-regional-domestic decomposition of natural rates. Section 5 presents the empirical results, including national natural-rate estimates, variance decompositions, and cross-country comovement. Section 6 concludes with a discussion of the implications for monetary policy and future research.

2. Related Literature

2.1 Semi Structural Measurement of the Natural Rate

Laubach and Williams (2003) introduced a semi-structural approach that estimates the natural rate of interest jointly with potential output, trend growth, and the output gap. The framework assigns r^*a clear economic interpretation: when the ex ante real interest rate deviates from the natural rate, aggregate demand and inflation adjust through the IS and Phillips curves. Holston, Laubach, and Williams (2017) extend this approach to several advanced economies, demonstrating the importance of jointly modeling real activity, inflation, and equilibrium interest rates. Complementary macro-finance approaches extract low-frequency movements in equilibrium rates from the yield curve (Bauer and Rudebusch, 2020), while Obstfeld (2025) clarifies the distinction between natural and neutral rates in open economies. Unlike purely statistical filters, joint estimation identifies r^*within a coherent macroeconomic system and propagates uncertainty from latent output, inflation, and growth trends directly into estimates of the equilibrium real rate.

2.2 Global Regional and Domestic Components

A growing literature emphasizes the role of global forces in shaping equilibrium real interest rates and macroeconomic fluctuations. Del Negro et al. (2019) and Clarida (2019) document a global factor in real and neutral rates, while Kose, Otrok, and Whiteman (2003) identify world, regional, and national business-cycle components. Related work links cross-country comovement to global financial conditions and U.S. monetary policy (Jordà et al., 2019; Miranda-Agrippino and Rey, 2020). Goto (2023) incorporates a global-regional-domestic hierarchy into a Bayesian natural-rate model for the G7. We revisit this question for the broader G20, where differences in monetary regimes, inflation histories, and external exposures are more pronounced, and estimate component shares jointly within the state-space framework.

2.3 Emerging Markets and Open Economy Measurement

A growing literature highlights the importance of global forces in shaping equilibrium real interest rates and macroeconomic fluctuations. Del Negro et al. (2019) and Clarida (2019) document a common global component in real and neutral rates, while Kose, Otrok, and Whiteman (2003) decompose business-cycle fluctuations into world, regional, and country-specific factors. Related work links international comovement to global financial conditions and U.S. monetary policy spillovers (Jordà et al., 2019; Miranda-Agrippino and Rey, 2020). Most closely related, Goto (2023) incorporates a global-regional-domestic factor structure into a Bayesian natural-rate model for the G7. Whether these findings generalize beyond a relatively homogeneous group of advanced economies, however, remains an open question.

The broader G20 encompasses economies with markedly different inflation histories, monetary-policy frameworks, financial development, exchange-rate regimes, and exposures to global capital flows. These differences provide a more demanding test of the extent to which natural rates are determined by common international forces rather than domestic fundamentals. This paper addresses that question by estimating a unified natural-rate model for the G20 and jointly identifying global, regional, and domestic components within the state-space system. The central question is straightforward: how much of the variation in national natural rates reflects global and regional influences, and does this decomposition differ systematically between advanced and emerging economies?

3. Data

The dataset comprises a quarterly panel of the 19 national members of the G20 spanning 2000Q1-2025Q4. Real GDP is measured using seasonally adjusted constant-price output from the World Bank *Global Economic Monitor*. Inflation is defined as 400 times the quarterly log change in seasonally adjusted core consumer prices whenever core measures are available. For Australia, India, Argentina, and Saudi Arabia, headline CPI series are used because consistent core inflation measures are unavailable. Data availability varies across countries: Argentina's CPI series begins in 2016M12, while Saudi Arabia's quarterly GDP series starts in 2010Q1. Missing observations prior to these dates are retained as missing rather than imputed.

Monetary-policy rates are obtained from the BIS and measured at the end of each quarter. Following the introduction of the euro, Germany, France, and Italy are assigned the common euro-area policy rate and are therefore not treated as operating independent national monetary policies during the monetary-union period. Expected inflation is constructed as the average of the previous four annualized quarterly inflation rates, and the ex-ante real interest rate is calculated as the nominal policy rate minus this measure of expected inflation. Additional controls include exchange-rate depreciation, computed from the World Bank local-currency-per-U.S.-dollar exchange rate, and global commodity-price inflation, measured using the IMF all-commodity price index.

A key feature of the empirical design is that the estimation uses the unbalanced panel directly. The likelihood is evaluated using all available observations without truncating outliers, winsorizing the data, or introducing synthetic values to fill gaps. Although data availability differs across countries in the early part of the sample, all 19 G20 economies are observed simultaneously from 2018Q1 onward. Appendix Tables A1 and A2 provide detailed information on data sources, variable transformations, and the first available observation for each series included in the model.

4. Econometric Methodology

4.1 Measurement Equations

Let $\tilde{y}_{it} = y_{it} - y_{it}^{*}$ denote the output gap and $\tilde{r}_{it} = r_{it} - r_{it}^{*}$ the ex-ante real-rate gap. Aggregate demand follows:

$$\tilde{y}_{it} = \alpha_{y1,i}\tilde{y}_{i,t-1} + \alpha_{y2,i}\tilde{y}_{i,t-2} + \frac{\alpha_{r,i}}{2}\left(\tilde{r}_{i,t-1} + \tilde{r}_{i,t-2}\right) + \varepsilon_{it}^{y}, \qquad (1)$$

where the output gap is stationary and responds negatively to deviations of the real interest rate from its natural level. Inflation is described by an open-economy Phillips curve:

$$\pi_{it} = \beta_{\pi,i}\pi_{i,t-1} + \left(1 - \beta_{\pi,i}\right)\bar{\pi}_{i,t-2:t-4} + \beta_{y,i}\tilde{y}_{i,t-1} + \beta_{e,i}\Delta e_{it} + \beta_{c,i}\pi_{t}^{c} + \varepsilon_{it}^{\pi}, \qquad (2)$$

where Δe_{it} denotes exchange-rate depreciation against the U.S. dollar and π_t^c is global commodity-price inflation. To prevent the exceptional supply disruptions of 2020-2021 from being absorbed into estimates of r^*, the inflation equation incorporates a temporary pandemic volatility state that allows for a transitory increase in disturbance variance.

4.2 Natural-Rate Decomposition

The natural rate is modeled as the sum of global, regional, and domestic components:

$$r_{it}^* = (g_t^G + z_t^G) + \left(g_{h(i),t}^H + z_{h(i),t}^H\right) + (g_{it}^D + z_{it}^D), \quad (3)$$

where $h(i)$ assigns country i to one of five geographic regions. Each component consists of a trend-growth factor, g, and a preference-related factor, z. Potential output evolves according to

$$y_{it}^* = y_{i,t-1}^* + g_{t-1}^G + g_{h(i),t-1}^H + g_{i,t-1}^D + \varepsilon_{it}^{y^*}. \quad (4)$$

All latent trend-growth and preference factors follow random walks. This specification permits persistent movements in equilibrium real rates while decomposing them into common global forces, regional influences, and country-specific factors. A key feature of the framework is that the decomposition is estimated jointly with output gaps, inflation dynamics, and potential output. Consequently, the contributions of global, regional, and domestic factors are identified within the state-space system itself rather than through a subsequent factor-analysis step.

4.3 Bayesian Estimation

The model is estimated in a Bayesian state-space framework. Weakly informative priors are assigned to state-transition variances to regularize low-frequency components and mitigate the near-zero variance problem emphasized by Stock and Watson (1998). Estimation is conducted using variational Bayesian methods, and posterior inference is based on the resulting approximation to the joint posterior distribution. Throughout the paper, point estimates are reported as posterior medians and uncertainty is summarized by 10th-90th percentile credible intervals. Because the decomposition is embedded directly within the state-space model, uncertainty associated with latent output, trend

growth, and preference states is propagated naturally into estimates of the global, regional, and domestic components of the natural rate.

Table 1. Prior Distributions for the Joint G20 Natural-Rate Model

Parameter	Prior Distribution	Economic Interpretation
$\alpha_{y1,i}, \alpha_{y2,i}$	Stationary AR (2) parameterization via partial autocorrelations	Persistence of the output gap
$\alpha_{r,i}$	$-\text{Half-Normal}(0.10)$	Negative response of aggregate demand to the real-rate gap
$\beta_{\pi,i}$	$\text{Beta}(5, 2)$	Inflation persistence
$\beta_{y,i}$	$0.025 + \text{Half-Normal}(0.20)$	Positive Phillips-curve slope
$\beta_{e,i}$	$\text{Normal}(0, 0.08)$	Exchange-rate pass-through
$\beta_{c,i}$	$\text{Normal}(0, 0.05)$	Commodity-price pass-through
σ_g^G	$\text{Half-Normal}(0.03)$	Volatility of global trend-growth shocks
σ_g^H	$\text{Half-Normal}(0.03)$	Volatility of regional trend-growth shocks
σ_g^D	$\text{Half-Normal}(0.03)$	Volatility of domestic trend-growth shocks
σ_z^G	$\text{Half-Normal}(0.10)$	Volatility of global preference shocks
σ_z^H	$\text{Half-Normal}(0.10)$	Volatility of regional preference shocks
σ_z^D	$\text{Half-Normal}(0.10)$	Volatility of domestic preference shocks
κ_p	$\text{Half-Normal}(1.0)$	Pandemic inflation-volatility multiplier (2020-2021)

Note: G, H, and Ddenote global, regional, and domestic latent states. Trend-growth (g) and preference (z) components follow independent random walks. The output gap is restricted to have zero unconditional mean, which identifies the initial level of potential output. Common half-normal priors on state-innovation variances ensure that the global, regional, and domestic decomposition is driven by the data rather than by differential prior assumptions. The pandemic-volatility parameter $\kappa_p$captures the exceptional inflation disturbances of 2020-2021

Prior Rationale

The priors are weakly informative and primarily enforce economically motivated sign and stationarity restrictions. The IS curve is restricted to imply a negative effect of real-rate gaps on aggregate demand, while the Phillips curve imposes a positive relationship between inflation and economic slack. Common half-normal priors are used for the innovation variances of global, regional, and domestic latent states to avoid favoring any level of the decomposition a priori. Consequently, the relative importance of global, regional, and domestic factors is determined by the

data rather than by differences in prior support. The pandemic volatility parameter allows the temporary inflation disturbances of 2020-2021 to be absorbed through a transitory increase in inflation uncertainty rather than being attributed to persistent shifts in equilibrium real interest rates.

5. Result

5.1 National Natural Rates

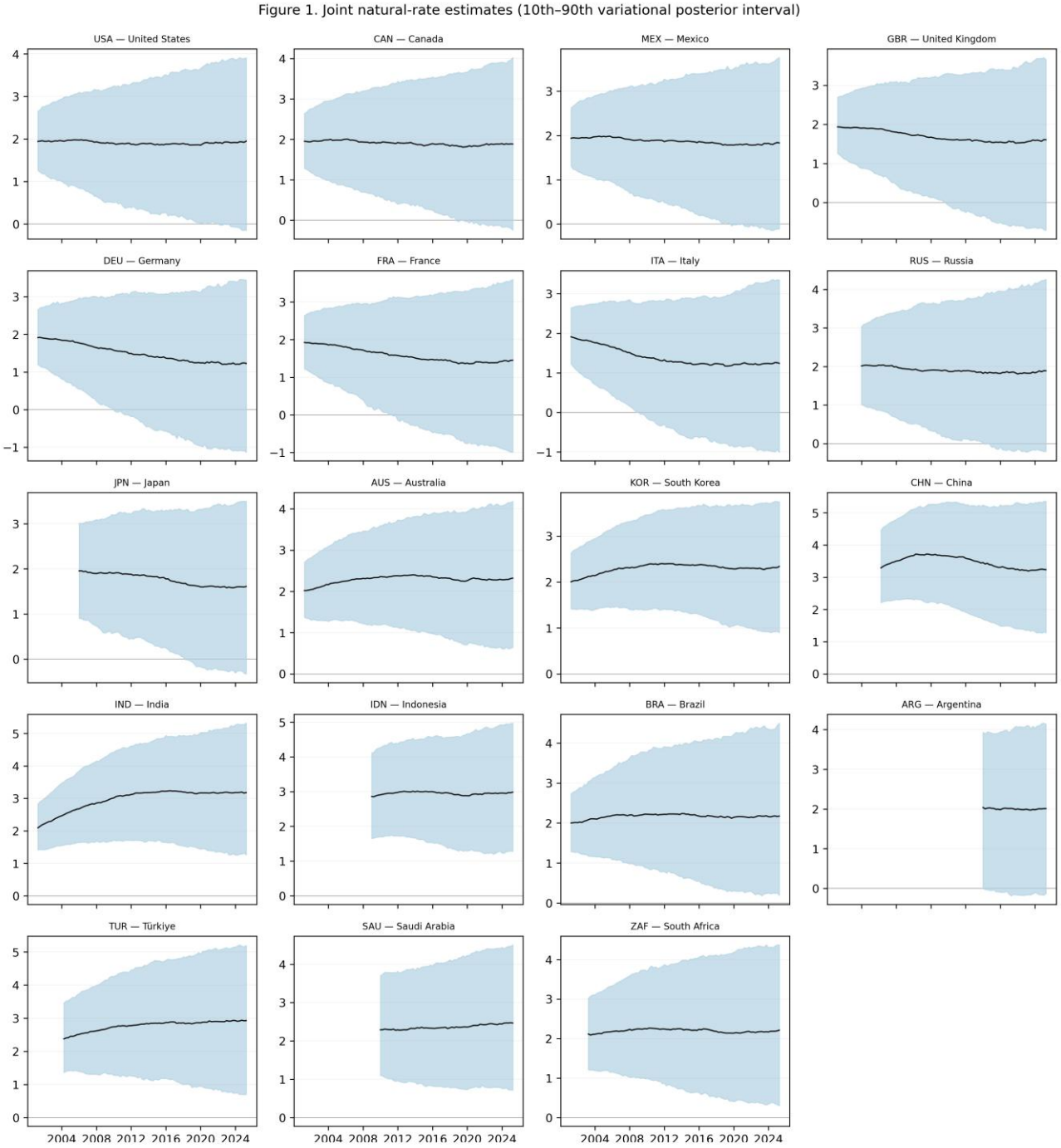
Figure 1 and Table 2 report the estimated natural rates of interest for the G20 economies. Substantial cross-country heterogeneity emerges. Over 2020-2025Q4, posterior median estimates range from 1.23 percent in Germany and 1.58 percent in Japan to 1.93 percent in the United States, compared with 2.91 percent in Türkiye, 2.94 percent in Indonesia, 3.17 percent in India, and 3.22 percent in China. These differences are economically meaningful because the natural rate summarizes the equilibrium balance between desired saving and investment. Lower natural rates are generally associated with slower trend growth, aging populations, and strong precautionary saving, while higher rates are consistent with faster productivity growth, greater investment demand, and ongoing structural transformation.

The estimates reveal a divide between most advanced and emerging economies. Natural rates remain relatively low in the major advanced economies, reflecting the secular forces emphasized by the recent literature on global real-rate decline. By contrast, several emerging economies exhibit persistently higher natural rates, suggesting that stronger growth opportunities and higher investment requirements continue to offset the downward pressures associated with global disinflation and financial integration. The results therefore indicate that, despite evidence of a common global trend, equilibrium real rates have not converged across the G20.

The magnitude of the differences should nevertheless be interpreted cautiously. Posterior intervals often overlap, indicating substantial uncertainty around country-level estimates. Moreover, policy rates in emerging markets may incorporate sovereign, currency, and liquidity risk premia that are not separately identified within the model. The contribution of the estimates lies less in establishing a precise ranking of countries than in characterizing broad differences in equilibrium financial conditions across economies.

A second notable finding is the coexistence of common long-run movements and persistent national heterogeneity. Most economies experienced a decline in estimated natural rates during the 2000s and 2010s, consistent with the influence of global forces such as demographic change, lower trend productivity growth, and shifts in the world saving-investment balance. However, the post-pandemic period is characterized by greater dispersion across countries, suggesting that domestic factors have become increasingly important in shaping equilibrium rates. This pattern motivates the decomposition analysis that follows. If national natural rates share a common downward trend yet remain widely dispersed in levels, an important question is whether the observed variation originates from global factors, regional influences, or country-specific determinants.

Figure 1. Natural Rate Estimates for the 19 National G20 Economies



Notes. Lines are posterior medians; shaded bands are 10th–90th percentiles from the variational posterior. Panels begin with the first jointly usable observation for each country.

Table 2. Period Average Natural Rate Estimates

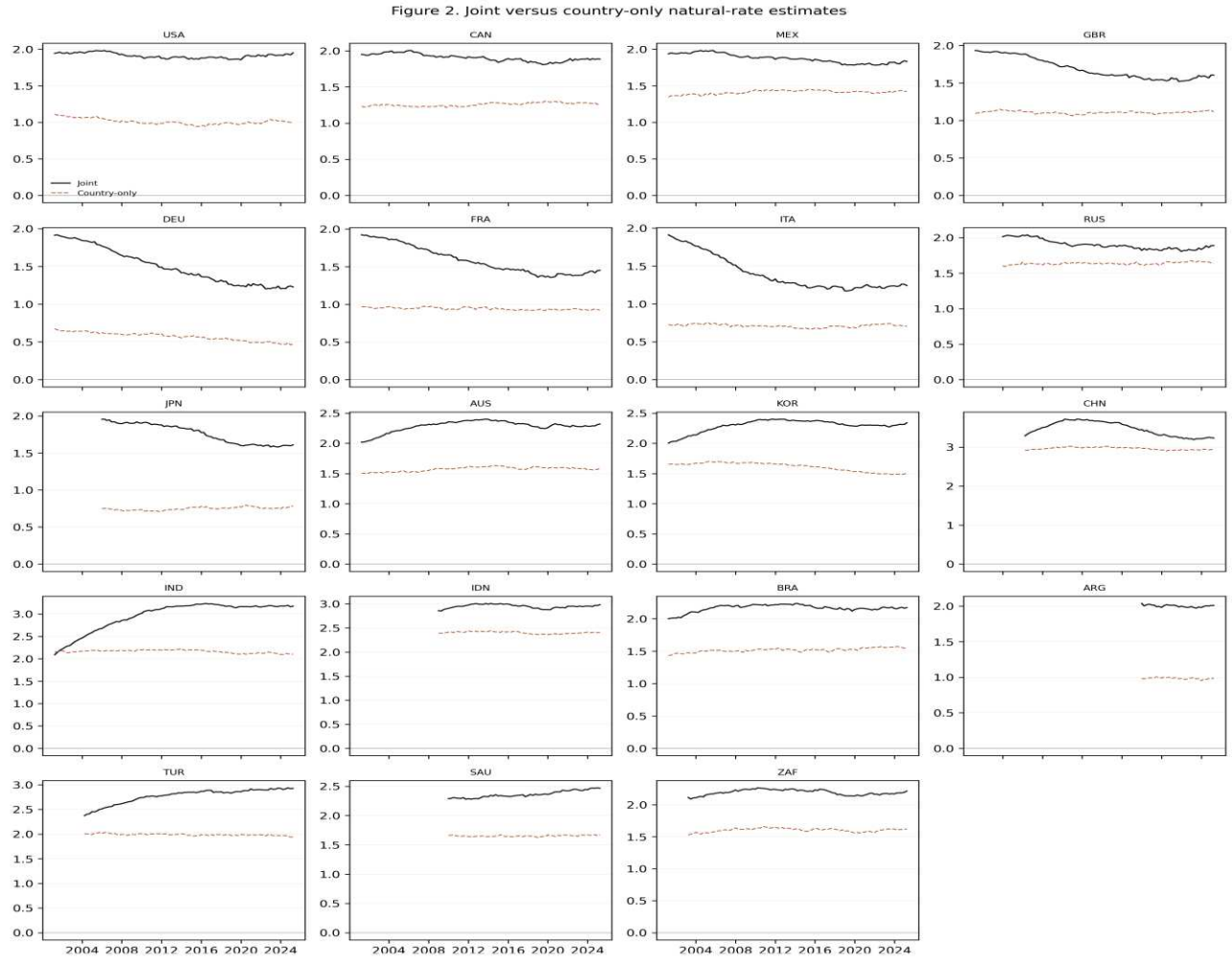
Country	2000s	2010s	2020–2025Q4
United States	1.95 [0.97, 2.94]	1.87 [0.32, 3.38]	1.93 [0.03, 3.77]
Canada	1.97 [0.96, 2.96]	1.86 [0.38, 3.43]	1.85 [-0.10, 3.75]
Mexico	1.93 [1.00, 2.88]	1.85 [0.39, 3.29]	1.80 [-0.02, 3.61]
United Kingdom	1.86 [0.86, 2.84]	1.61 [0.03, 3.19]	1.55 [-0.56, 3.48]
Germany	1.77 [0.71, 2.78]	1.41 [-0.47, 2.98]	1.23 [-1.01, 3.30]
France	1.81 [0.78, 2.79]	1.51 [-0.25, 3.12]	1.42 [-0.81, 3.39]
Italy	1.66 [0.63, 2.68]	1.25 [-0.49, 2.85]	1.22 [-0.90, 3.21]
Russia	2.00 [0.87, 3.27]	1.86 [0.23, 3.69]	1.84 [-0.17, 4.03]
Japan	1.92 [0.77, 3.04]	1.80 [0.33, 3.19]	1.58 [-0.21, 3.38]
Australia	2.21 [1.34, 3.15]	2.34 [1.06, 3.76]	2.28 [0.74, 4.06]
South Korea	2.21 [1.49, 3.02]	2.36 [1.35, 3.56]	2.29 [1.02, 3.67]
China	3.48 [2.34, 4.75]	3.59 [2.05, 5.17]	3.22 [1.42, 5.23]
India	2.59 [1.67, 3.61]	3.16 [1.73, 4.68]	3.17 [1.37, 5.12]
Indonesia	2.88 [1.67, 4.18]	2.95 [1.65, 4.43]	2.94 [1.29, 4.83]
Brazil	2.12 [1.22, 3.19]	2.20 [0.71, 3.94]	2.16 [0.26, 4.32]
Argentina	—	2.01 [-0.02, 3.90]	2.01 [-0.09, 4.03]
Türkiye	2.56 [1.41, 3.80]	2.84 [1.23, 4.57]	2.91 [0.81, 5.04]
Saudi Arabia	—	2.32 [0.96, 3.86]	2.45 [0.81, 4.32]
South Africa	2.18 [1.21, 3.29]	2.22 [0.75, 3.87]	2.15 [0.42, 4.25]

Notes. Entries are posterior medians with 10th and 90th percentiles in brackets, in percentage points. A dash indicates insufficient observations for the period.

5.2 Information from Joint Estimation

Figure 2 compares the joint G20 estimates with country-only models based on the same macroeconomic structure. Since the only difference is the inclusion of global and regional latent factors, any divergence reflects the contribution of cross-country information. The gains are largest for countries with limited data histories, where pooling helps identify low-frequency movements in r^*. The comparison therefore provides a direct test of whether international comovement improves the measurement of national natural rates.

Figure 2. Joint and Country Only Natural Rate Estimates



Note: The joint and country-only models use matched IS, Phillips-curve, and state specifications. Differences reflect cross-country pooling through the global and regional states.

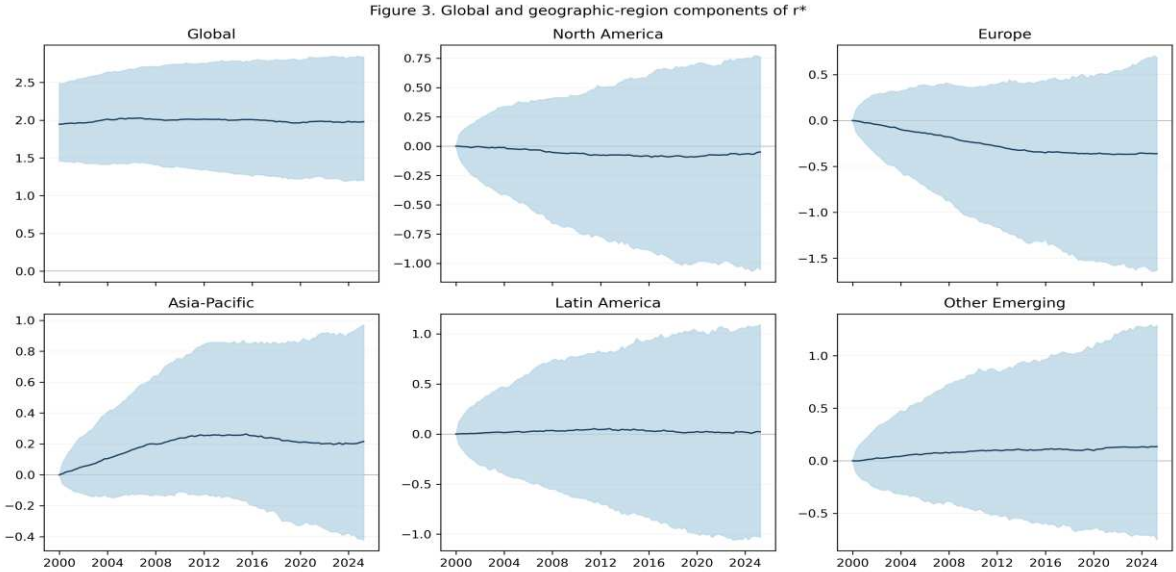
5.3 Global, Regional and Domestic Components

Figures 3 and 4 decompose national natural rates into global, regional, and domestic components, while Table 3 reports posterior historical variance shares. A consistent pattern emerges across the G20: domestic factors account for the largest share of natural-rate variation in every economy. Posterior-median domestic shares range from 0.299 in South Korea to 0.723 in China. Global factors contribute to cross-country comovement, but their quantitative importance is modest.

Posterior-median global shares range from 0.062 to 0.177 and are estimated with considerable uncertainty. Regional components are economically meaningful but remain smaller than domestic components in all countries.

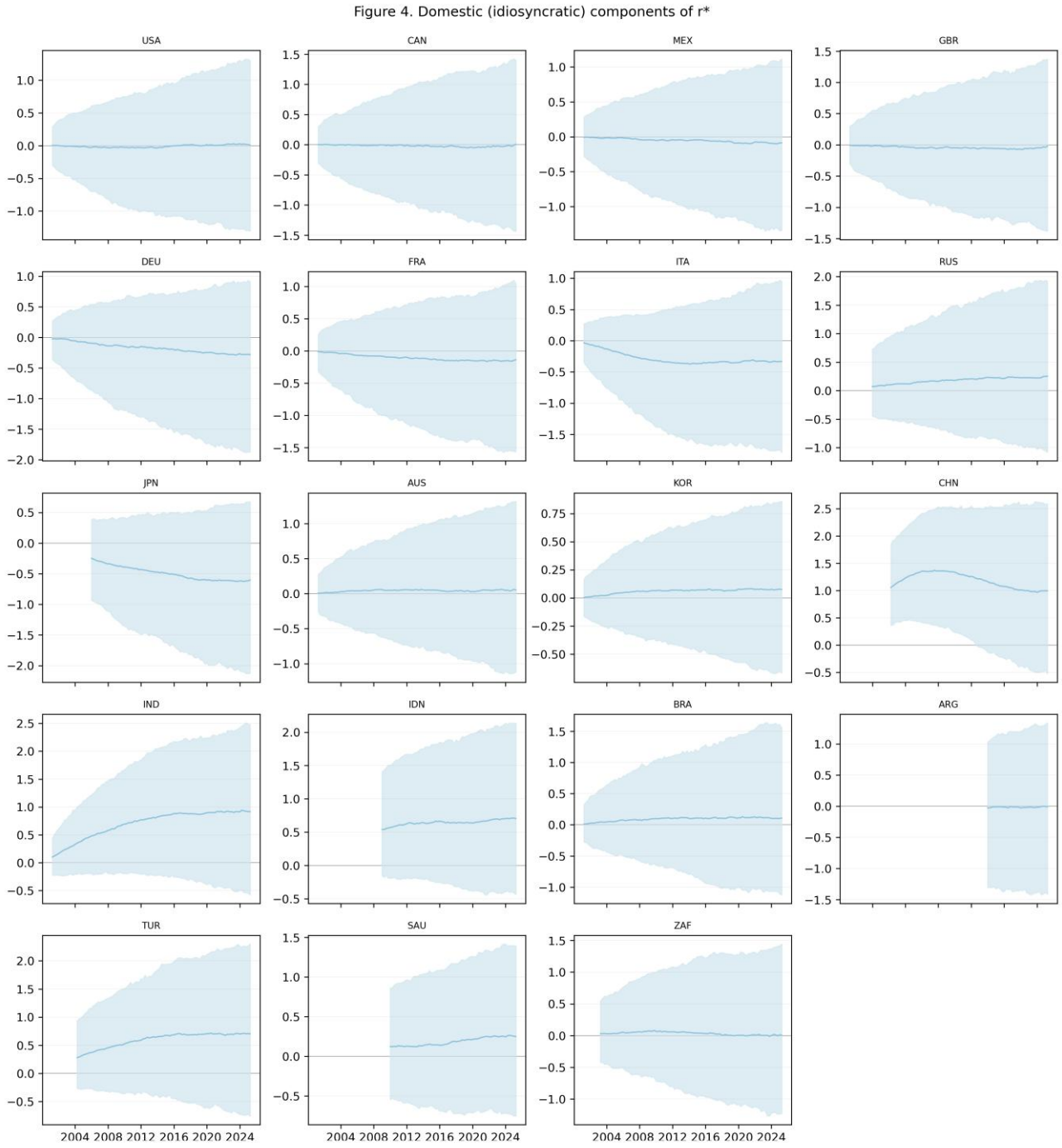
Overall, the results suggest that national natural rates are shaped by both common international forces and country-specific fundamentals. Global and regional factors generate comovement in aggregate $\boldsymbol{r}^*$, but domestic factors remain the dominant source of variation. Thus, the widespread decline in natural rates appears to reflect a common global trend operating alongside substantial and persistent national heterogeneity.

Figure 3. Global and Regional Components of the Natural Rate



Note: Components are measured in percentage points. The zero line has a level interpretation under the model normalization rather than the scale of a standardized factor.

Figure 4. Domestic Components of the Natural Rate



Note: Panels report country-specific domestic components in percentage points under the same normalization as Figure 3.

Table 3. Historical Variance Shares of Natural Rate Components

Country	Region	Global component	Regional component	Domestic component
United States	North America	0.079 [0.006, 0.560]	0.229	0.478
Canada	North America	0.080 [0.007, 0.552]	0.217	0.498
Mexico	North America	0.090 [0.008, 0.561]	0.244	0.461
United Kingdom	Europe	0.065 [0.005, 0.493]	0.306	0.420
Germany	Europe	0.064 [0.004, 0.480]	0.295	0.462
France	Europe	0.068 [0.005, 0.512]	0.326	0.391
Italy	Europe	0.062 [0.005, 0.459]	0.289	0.475
Russia	Europe	0.063 [0.005, 0.496]	0.291	0.465
Japan	Asia-Pacific	0.094 [0.007, 0.578]	0.129	0.619
Australia	Asia-Pacific	0.119 [0.010, 0.642]	0.180	0.472
South Korea	Asia-Pacific	0.177 [0.014, 0.734]	0.271	0.299
China	Asia-Pacific	0.072 [0.005, 0.455]	0.095	0.723
India	Asia-Pacific	0.068 [0.005, 0.452]	0.102	0.715
Indonesia	Asia-Pacific	0.109 [0.008, 0.581]	0.145	0.572
Brazil	Latin America	0.068 [0.005, 0.497]	0.280	0.438
Argentina	Latin America	0.067 [0.005, 0.503]	0.277	0.468
Türkiye	Other Emerging	0.062 [0.005, 0.466]	0.202	0.592
Saudi Arabia	Other Emerging	0.093 [0.008, 0.588]	0.292	0.379
South Africa	Other Emerging	0.075 [0.006, 0.531]	0.250	0.488

Note: Shares are calculated within each posterior draw over the full sample. The global component is reported as a median with 10th and 90th percentiles in brackets; regional and domestic columns report posterior medians. Medians need not sum to one because they are taken separately across draws.

5.4 Comovement and Dynamic Sensitivity

Table 4 compares posterior-median correlations of G7 natural rates with correlations computed from their domestic components. Aggregate natural rates exhibit substantial comovement, particularly within Europe. Once the common global and regional components are removed, however, cross-country correlations decline markedly, especially with respect to the United States. This pattern suggests that much of the observed synchronization in r^* reflects shared international influences rather than highly correlated domestic fundamentals.

Figure 5 provides complementary evidence using forecast-error variance decompositions from a G7 vector error-correction model for Germany, Japan, and the United States. Following Sims (1980), the decompositions are reported under both baseline and reverse recursive orderings, with the cointegration rank determined by the Johansen (1991) trace test. The results indicate that interconnectedness among national natural rates is sensitive to the common component embedded in the system, while remaining broadly robust to alternative orderings. Because identification relies on recursive restrictions, the exercise is informative about the propagation of comovement but should not be interpreted as identifying structural U.S. monetary-policy shocks.

Table 4. G7 Correlations of Natural Rates and Domestic Components

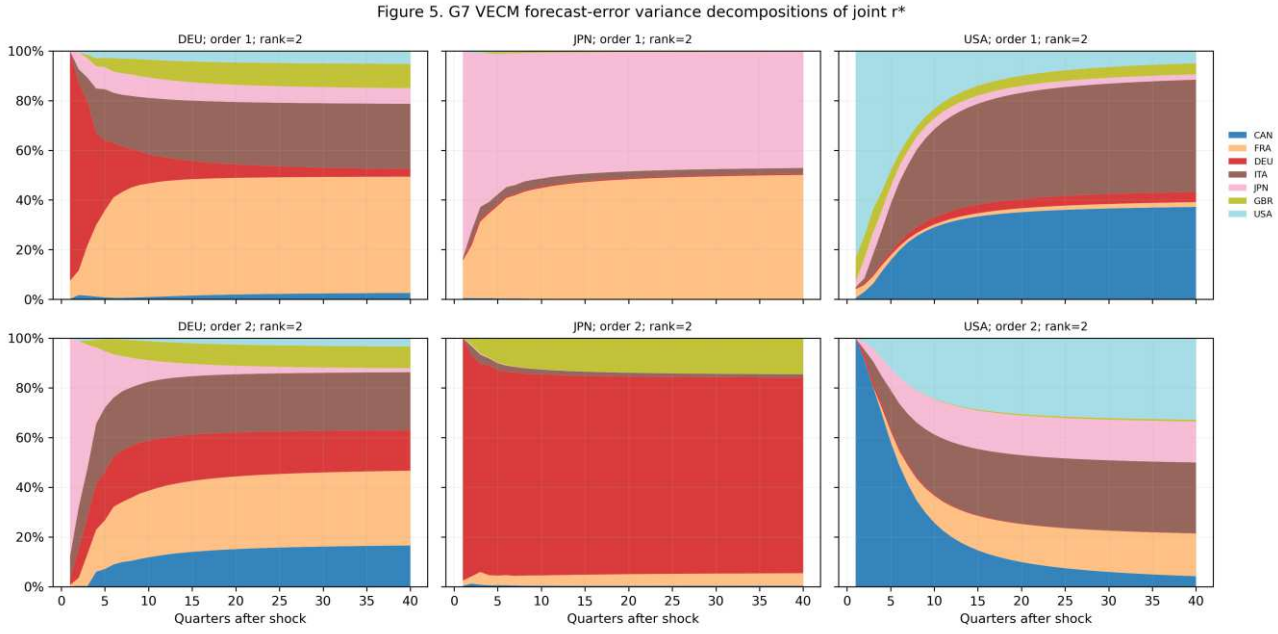
Panel A. National natural rates							
Country	**CAN**	**FRA**	**DEU**	**ITA**	**JPN**	**GBR**	**USA**
CAN	1.00	0.89	0.87	0.82	0.83	0.90	0.78
FRA	0.89	1.00	0.99	0.97	0.89	0.99	0.72
DEU	0.87	0.99	1.00	0.96	0.91	0.98	0.67
ITA	0.82	0.97	0.96	1.00	0.77	0.97	0.77
JPN	0.83	0.89	0.91	0.77	1.00	0.87	0.46
GBR	0.90	0.99	0.98	0.97	0.87	1.00	0.76
USA	0.78	0.72	0.67	0.77	0.46	0.76	1.00

Panel B. Domestic components

Country	CAN	FRA	DEU	ITA	JPN	GBR	USA
CAN	1.00	0.79	0.76	0.66	0.78	0.79	-0.37
FRA	0.79	1.00	0.97	0.90	0.99	0.90	-0.38
DEU	0.76	0.97	1.00	0.85	0.99	0.86	-0.46
ITA	0.66	0.90	0.85	1.00	0.91	0.85	0.02
JPN	0.78	0.99	0.99	0.91	1.00	0.90	-0.37
GBR	0.79	0.90	0.86	0.85	0.90	1.00	-0.23
USA	-0.37	-0.38	-0.46	0.02	-0.37	-0.23	1.00

Notes. Entries are posterior-median pairwise correlations. Panel A reports national natural rates; Panel B reports domestic components. Diagonal entries equal one. Complete 19 × 19 matrices are supplied with the replication materials.

Figure 5. G7 Forecast Error Variance Decompositions

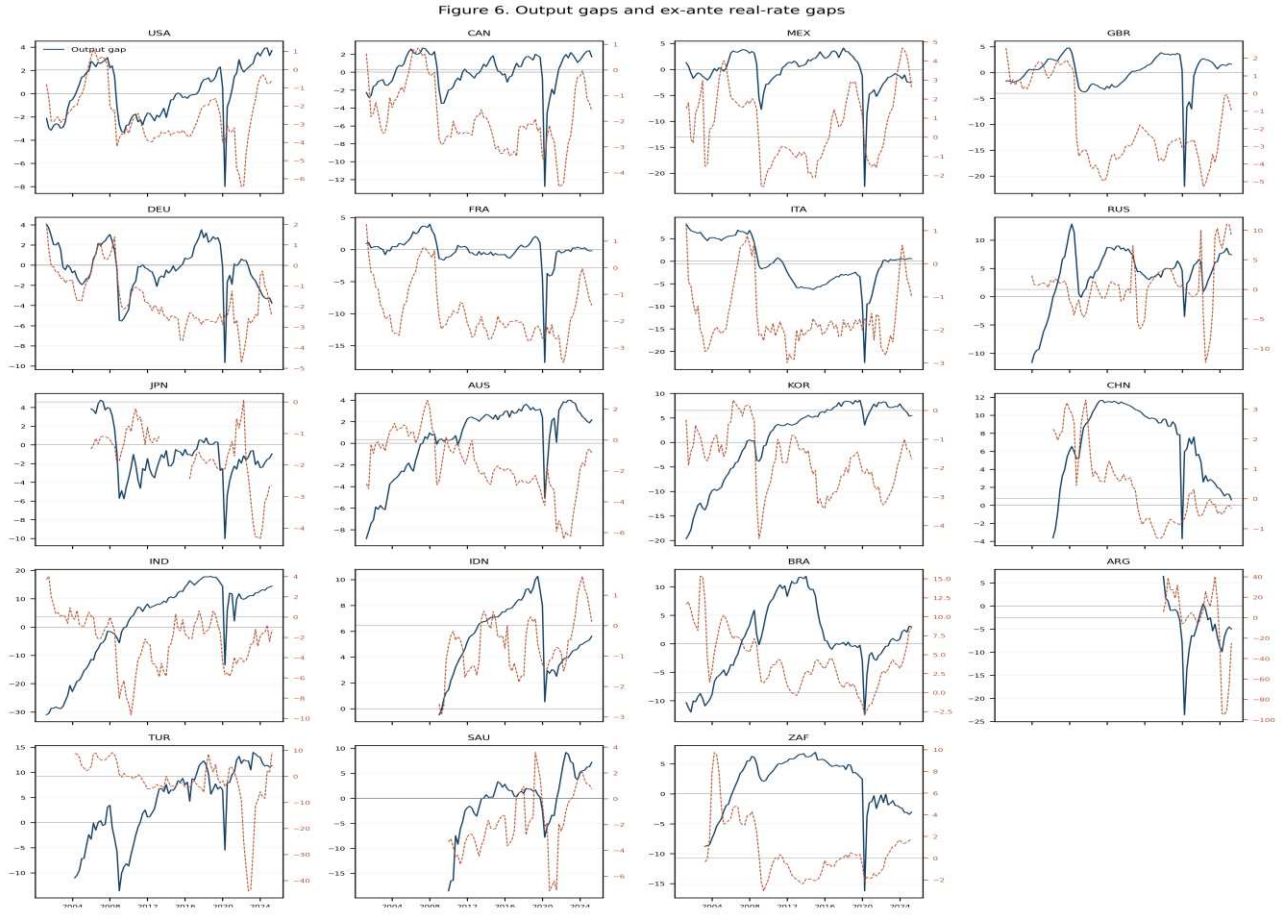


Note: Forecast-error variance shares are computed from a G7 VECM for Germany, Japan, and the United States under baseline and reverse recursive orderings. Panel titles report the cointegration rank selected by the Johansen trace test.

5.5 Output and Real Rate Gaps

Figure 6 shows the posterior-median output and ex-ante real-rate gaps. Their joint estimation supplies the central economic restriction on r*: lagged real-rate gaps enter the IS curve with a negative coefficient, and output gaps enter inflation dynamics. The resulting natural rate is therefore tied to demand and price adjustment rather than identified as a smooth trend in an inflation-adjusted policy rate.

Figure 6. Output Gaps and Ex Ante Real Rate Gaps

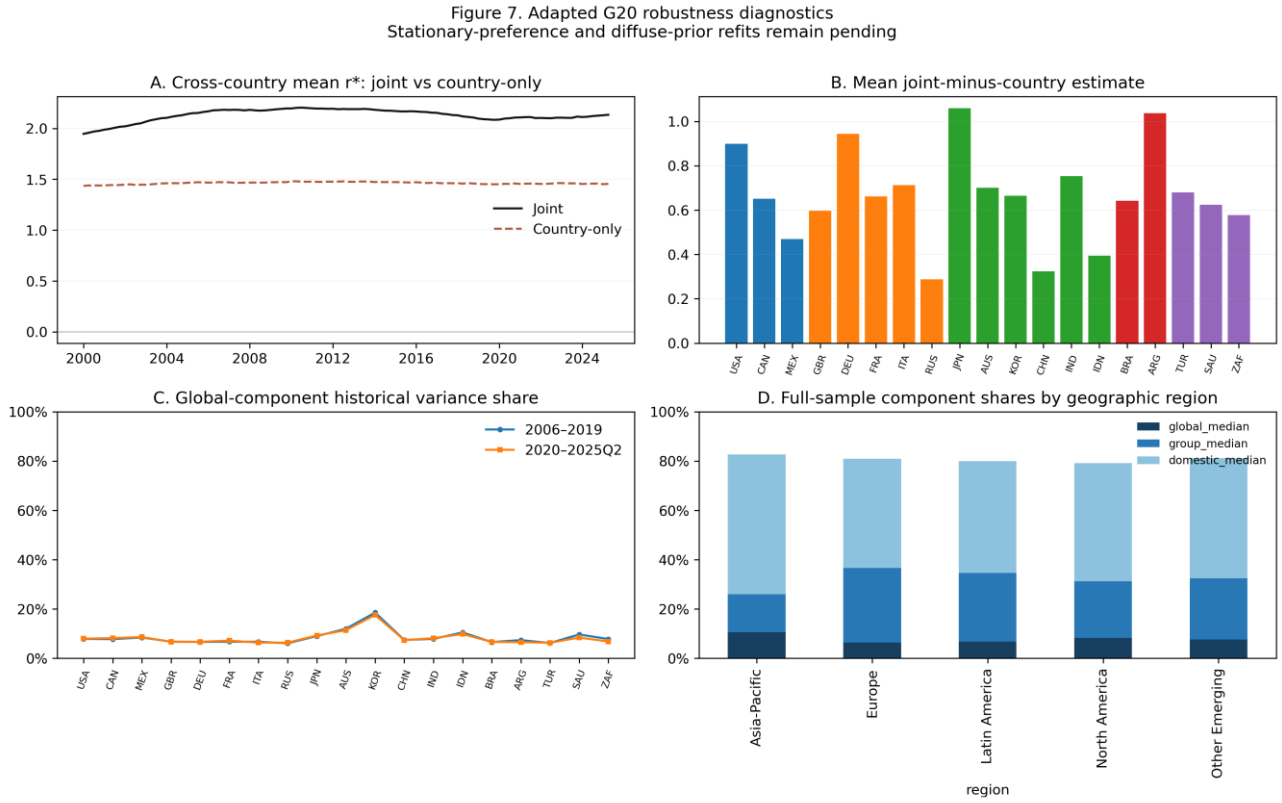


Note: Lines are posterior medians. The output gap is actual less potential output; the real-rate gap is the ex-ante real rate less r*.

6. Robustness and the Post Pandemic Period

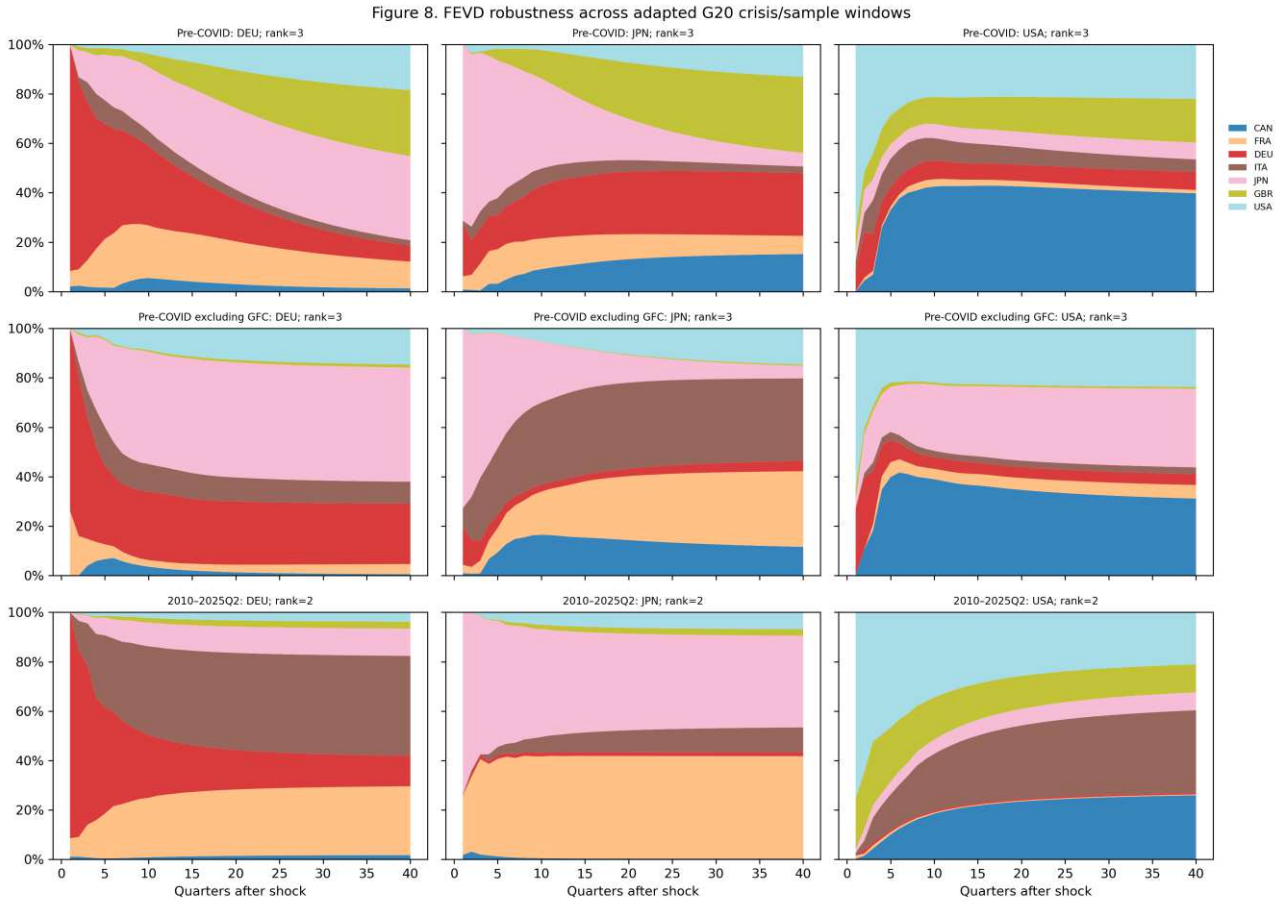
Figure 7 combines the joint-versus-country comparison with component shares calculated over pre- and post-2020 windows from the full-sample posterior. These are descriptive historical decompositions rather than estimates from a separate 24-observation model or a Chow test on generated regressors. The pandemic variance multiplier permits unusually large inflation disturbances during 2020–2021 without forcing them into permanent movements in r*. Figure 8 recomputes the VECM forecast-error variance decomposition across alternative crisis and sample windows.

Figure 7. Joint Estimation and Historical Window Diagnostics



Note: Pre- and post-2020 shares are calculated from the full-sample posterior. They are not separate subsample estimates or a formal structural-break test.

Figure 8. Forecast Error Variance Decomposition Across Sample Windows



Note: The G7 VECM forecast-error variance decomposition is recomputed across alternative crisis and sample windows using the definitions in Figure 5.

The short post-2020 window does not establish a permanent break in the global component. Formal evidence would require time-varying loadings, stochastic volatility in all state innovations, or a Bayesian change-point model with posterior regime probabilities. The reported evidence is therefore limited to shifts in historical component shares within the full-sample model.

6. Conclusion

This paper estimates natural rates of interest for the 19 national members of the G20 and decomposes them into global, regional, and domestic components within a unified Bayesian state-space framework. Extending the analysis beyond the G7 materially changes the interpretation of international natural rate comovement. While aggregate natural rates display substantial cross-country synchronization, particularly among advanced economies, domestic factors account for the largest share of historical variation in every G20 country. Global and regional forces therefore shape national equilibrium rates without eliminating meaningful country-specific heterogeneity. The results yield three main insights. First, a common global component contributes to the broad decline in natural rates observed since the early 2000s, supporting the view that international forces influence equilibrium real rates. Second, the dominance of domestic variance shares indicates that national structural factors remain the primary drivers of natural-rate fluctuations. Third, the balance between common and country-specific influences differs markedly across economies, suggesting that natural rates have not converged despite increasing financial integration.

The findings have distinct implications for advanced and emerging economies. In advanced economies, the importance of global and regional components suggests that long-run equilibrium rates are influenced by common forces such as demographic change, productivity trends, and global saving-investment imbalances, implying that shifts in $\boldsymbol{r}^*$ are often shared across countries. In emerging economies, however, the dominance of domestic variance shares indicates that structural factors, including productivity growth, financial development, and fiscal conditions, remain central to the evolution of equilibrium real rates despite increasing integration into global capital markets. More broadly, the results suggest that global factors help explain the common direction of natural-rate movements, while domestic factors account for much of the persistent cross-country variation. For policymakers, international estimates of $\boldsymbol{r}^*$ therefore provide useful benchmarks, but assessments of

monetary-policy stance ultimately require country-specific estimates that reflect domestic economic conditions and institutional characteristics.

More broadly, the results indicate that international comovement and domestic heterogeneity are complementary features of natural-rate dynamics. Global factors help explain the common downward trend in real interest rates, while domestic factors account for much of the persistent cross-country variation. For policymakers, this implies that international estimates of r^* can serve as useful benchmarks, but the calibration of monetary policy ultimately requires country-specific assessments of equilibrium rates and domestic macroeconomic conditions.

Several limitations remain. The model does not separately identify sovereign, currency, and liquidity risk premia in emerging-market interest rates, which may affect cross-country comparisons of r^*. Future work could combine the decomposition with externally identified global shocks to study international monetary spillovers and verify the results using full multi-chain MCMC estimation and posterior predictive checks.

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Data Availability: The study uses publicly available macroeconomic and financial data obtained from official sources. All datasets are accessible without restriction through the respective data providers' websites.

Declarations

Conflicts of Interest: The authors declare no conflicts of interest.

Declaration of Competing Interests and Funding

The authors declare that they have no known competing financial interests, personal relationships, academic affiliations, or other conflicts of interest that could have influenced the research, analysis, interpretation, or publication of this work.

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