Long-Run Inflation Expectations and Post-COVID Inflation Dynamics in Japan*

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Abstract

This paper estimates a New Keynesian model in which long-run inflation expectations vary endogenously over time and can deviate from steady-state inflation, using Japanese macroeconomic data and survey forecasts. A historical decomposition shows that cost-push shocks were the main driver of Japan's post-COVID inflation surge. Counterfactual simulations show that if long-run inflation expectations had been at the 2 percent target at the onset of the post-COVID inflation surge, inflation would have been 0.8 percentage points higher on average. With long-run inflation expectations five times as sticky, inflation would have been 0.4 percentage points lower on average. With monetary policy responding three times as strongly to inflation, inflation would have been 0.5 percentage points lower on average.

JEL: E31, E52, D84

Keywords: Inflation expectations, Bayesian estimation, Learning

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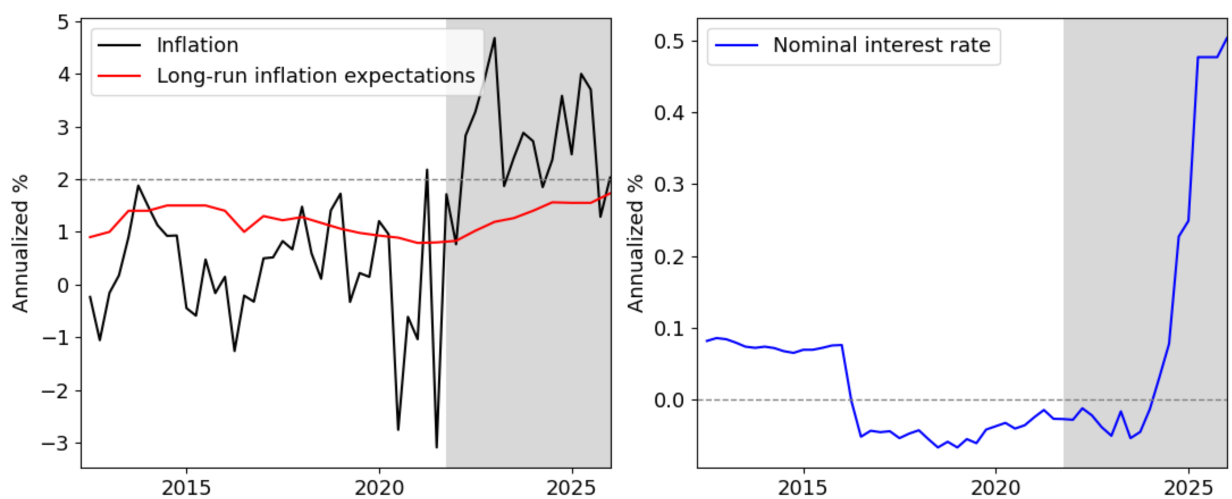
1 Introduction

Long-run inflation expectations can shape inflation dynamics and are therefore important for monetary policy. In a standard New Keynesian model with rational expectations (RE), long-run inflation expectations are pinned down by steady-state inflation, which is often assumed to coincide with the central bank's inflation target. In practice, however, long-run inflation expectations can deviate from that target for prolonged periods. Japan is one such case. As Figure 1 shows, long-run inflation expectations remained below the Bank of Japan's 2 percent target throughout the period shown. They increased during the post-COVID period, but remained below the target even as inflation rose above 2 percent. The persistent gap between long-run inflation expectations and the target calls for a framework in which long-run inflation expectations can evolve endogenously. At the same time, the nominal interest rate remained close to zero during much of the post-COVID period and increased toward the end of the sample, motivating an examination of the role of monetary policy in Japan's post-COVID inflation dynamics.

Figure 1: Inflation, long-run inflation expectations, and the nominal interest rate in Japan



Notes: Inflation is the quarter-on-quarter change in the tax-adjusted CPI excluding fresh food. Long-run inflation expectations are measured using the ESP Forecast Survey's average forecast of inflation 7 to 11 years ahead, and the nominal interest rate is the uncollateralized overnight call rate. The dashed line in the left panel marks the Bank of Japan's 2 percent inflation target, while that in the right panel marks zero. The shaded area denotes the post-COVID period beginning in 2021:Q4. Source: Author's calculations based on data from the Ministry of Internal Affairs and Communications, the Japan Center for Economic Research, "ESP Forecast Survey", and the Bank of Japan.

In this paper, I estimate a New Keynesian model in which long-run inflation expectations are endogenous and time-varying, using Japanese macroeconomic data and survey forecasts.

The model otherwise follows a standard New Keynesian framework but departs from rational expectations: agents form subjective expectations using a perceived law of motion and update the time-varying drifts in that law through constant-gain learning. This framework allows long-run inflation expectations to vary persistently rather than remain fixed at the steady-state inflation rate. I use the estimated model to conduct two quantitative exercises. First, I use a historical decomposition to identify the contributions of demand, cost-push, and monetary policy shocks to inflation dynamics in Japan during the post-COVID period. Second, I conduct counterfactual simulations that vary the initial level and stickiness of long-run inflation expectations and the strength of the monetary policy response to inflation. The main novelty of the paper is to use Japanese survey forecasts to discipline the evolution of time-varying long-run inflation expectations and to quantify their role in Japan's post-COVID inflation dynamics.

The first main finding is that cost-push shocks were the main driver of Japan's post-COVID inflation surge. Their contribution rose sharply at the onset of the post-COVID period, accounted for most of the increase around the inflation peak, and remained important in several subsequent quarters. Monetary policy shocks also contributed positively during much of this period. Demand shocks played a more mixed role, raising inflation in some quarters but exerting downward pressure in others.

Turning to the counterfactual results, if long-run inflation expectations had been at the 2 percent target at the onset of the post-COVID inflation surge, inflation would have been 0.8 percentage points higher on average. This result indicates that their below-target initial level dampened the rise in inflation. If long-run inflation expectations had instead been five times as sticky, inflation would have been 0.4 percentage points lower on average because their rise would have been more limited. These two counterfactuals therefore show that both the initial level and the stickiness of long-run inflation expectations shaped the post-COVID inflation path. Finally, if the monetary policy response to inflation had been three times as strong, inflation would have been 0.5 percentage points lower on average. The stronger response would also have lowered the output gap and left long-run inflation expectations further below the target.

This paper is related to the literature on New Keynesian and other structural models with time-varying long-run inflation expectations. One mechanism generating such time variation is imperfect credibility about the central bank's inflation objective. Erceg and Levin (2003) show that limited information about changes in the inflation target can generate inflation persistence, while Ireland (2007) estimates a New Keynesian model with an unobserved time-varying inflation target. A separate literature studies macroeconomic dynamics and monetary policy under learning and imperfect knowledge, in which agents form expectations using econometric forecasting models and revise their beliefs as new data arrive (Evans and Honkapohja, 2001; Preston, 2005; Orphanides and Williams, 2007; Gaspar, Smets, and Vestin, 2010). Related learning mechanisms have been incorporated into estimated structural New Keynesian models by Milani (2007), Milani (2014), and Eusepi and Preston (2018). Carvalho, Eusepi, Moench, and Preston (2023) and Gáti (2023) focus specifically on the dynamics and anchoring of long-run inflation expectations within learning frameworks. This paper contributes to this strand of the literature by estimating a New Keynesian model with time-varying long-run inflation expectations using Japanese macroeconomic data and survey forecasts and by applying the estimated model to Japan's post-COVID inflation dynamics.

This paper is also related to empirical work on the anchoring of inflation expectations, particularly in Japan. Ehrmann (2015) shows that inflation expectations become less well anchored during prolonged periods of below-target inflation. For Japan, Hattori and Yetman (2017), Fukuda and Soma (2019), and Hogen and Okuma (2025) examine the evolution and anchoring of inflation expectations. Relatedly, Kaihatsu and Nakajima (2018) estimate trend inflation in Japan and document its time variation. This paper differs from these studies by embedding time-varying long-run inflation expectations in an estimated New Keynesian model and by quantifying their role in Japan's post-COVID inflation dynamics through a historical decomposition and counterfactual simulations.

This paper is also related to studies of post-COVID inflation dynamics. Bernanke and Blanchard (2025) quantify the roles of product-market shocks, labor-market tightness, and inflation expectations in the post-COVID inflation surge in the United States. Bullard, Grimaud, Salle, and Vermandel (2026) study how the timing and strength of the monetary policy response affected inflation dynamics and the anchoring of long-run inflation expectations. For Japan, Nakamura, Nakano, Osada, and Yamamoto (2024) and Sunakawa (2026) quantify the shocks driving post-COVID inflation. Hagio, Ikeda, Takahashi, and Yoshida (2026) examine the consequences of exiting a prolonged low-interest-rate regime under learning, while Hasui and Teranishi (2026) study the roles of monetary policy commitment and cost-push shocks in the Bank of Japan's exit from the liquidity trap. Relative to these studies, this paper combines a historical decomposition of inflation with counterfactual simulations that vary the initial level and stickiness of long-run inflation expectations and the strength of the monetary policy response.

The remainder of the paper is organized as follows. Section 2 describes the model. Section 3 presents the data and estimation strategy. Section 4 reports the estimation results, historical decomposition, and counterfactual simulations. Section 5 concludes.

2 The Model

The model builds on the standard New Keynesian framework of Woodford (2003) and incorporates habit formation and price indexation to lagged inflation. It departs from RE by assuming that the private sector forms subjective expectations.

2.1 Aggregate dynamics

The aggregate dynamics are characterized by the following system of equations:

$$x_t - hx_{t-1} = \widehat{E}_t x_{t+1} - hx_t - \sigma(1-h)\left(i_t - \widehat{E}_t \pi_{t+1} - r_t^n\right), \tag{1}$$

$$\pi_t - \gamma\pi_{t-1} = \kappa x_t + \beta\left(\widehat{E}_t \pi_{t+1} - \gamma\pi_t\right) + u_t, \tag{2}$$

$$i_t = (1-\rho_i)\left(\phi_\pi \pi_t + \phi_x x_t\right) + \rho_i i_{t-1} + m_t. \tag{3}$$

Here, x_t, π_t, and i_t denote the output gap, the inflation rate, and the nominal interest rate, respectively, expressed as deviations from their steady-state values. The operator $\widehat{E}_t$ denotes subjective expectations. The parameter h captures habit persistence, σ is the intertemporal elasticity parameter, κ is the slope of the New Keynesian Phillips curve, and γ captures the degree of indexation to past inflation. The monetary policy rule features interest-rate smoothing, governed by ρ_i, and policy responses to inflation and the output gap, governed by ϕ_π and ϕ_x, respectively.

The variables r_t^n, u_t, and m_t denote a demand shock, a cost-push shock, and a monetary policy shock. A positive value of m_t represents a contractionary monetary policy shock, while a negative value represents an expansionary monetary policy shock. These shocks follow AR(1) processes:

$$r_t^n = \rho_r r_{t-1}^n + \varepsilon_t^r, \tag{4}$$

$$u_t = \rho_u u_{t-1} + \varepsilon_t^u, \tag{5}$$

$$m_t = \rho_m m_{t-1} + \varepsilon_t^m, \tag{6}$$

where ε_t^r, ε_t^u, and ε_t^m are mean-zero innovations with standard deviations σ_r, σ_u, and σ_m, respectively.

The equations above describe the aggregate equilibrium conditions. Unlike under RE, private-sector expectations need not be model-consistent and are instead formed using the perceived law of motion specified in the next subsection.

2.2 Expectations formation

To allow long-run inflation expectations to vary over time and to deviate persistently from steady-state inflation, I follow the drift-learning approach of Eusepi and Preston (2018). Private-sector agents form subjective expectations using a linear model with time-varying perceived drifts.

Let

$$\boldsymbol{y}_t = \begin{pmatrix} \pi_t & x_t & i_t \end{pmatrix}', \qquad \boldsymbol{q}_t = \begin{pmatrix} r_t^n & u_t & m_t \end{pmatrix}'.$$

Agents are assumed to know the AR(1) processes for the exogenous shocks specified in equations (4)–(6). They therefore update beliefs only about the perceived drifts of the endogenous variables. Subjective one-period-ahead expectations are given by

$$\widehat{E}_t \boldsymbol{y}_{t+1} = \boldsymbol{a}_t + B\boldsymbol{y}_t + C\boldsymbol{q}_t, \tag{7}$$

where

$$\boldsymbol{a}_t = \begin{pmatrix} a_{\pi,t} & a_{x,t} & a_{i,t} \end{pmatrix}'.$$

The matrices B and C contain the slope coefficients implied by the stationary RE solution. The vector $\boldsymbol{a}_t$ captures perceived drifts in inflation, the output gap, and the nominal interest rate. When $\boldsymbol{a}_t = \boldsymbol{0}$, equation (7) coincides with the one-period-ahead expectations implied by the stationary RE solution.

The perceived drifts are updated according to

$$\boldsymbol{a}_t = \boldsymbol{a}_{t-1} + K\left(\boldsymbol{y}_t - \widehat{E}_{t-1}\boldsymbol{y}_t\right). \tag{8}$$

Here, $K > 0$ is a constant scalar gain that is common across the three perceived drifts. Under this updating rule, each perceived drift is revised in response to the corresponding one-period-ahead forecast error.

2.3 Long-run inflation expectations

Long-run inflation expectations are obtained by recursively applying equation (7). Under the anticipated-utility approach, agents hold the time-t perceived-drift vector $\boldsymbol{a}_t$ fixed over the forecast horizon when forming multi-period expectations.

Let

$$P = \begin{pmatrix} \rho_r & 0 & 0 \\ 0 & \rho_u & 0 \\ 0 & 0 & \rho_m \end{pmatrix}$$

denote the transition matrix associated with the AR(1) processes in equations (4)–(6). The subjective expectation of the vector of exogenous shocks j periods ahead is therefore

$$\widehat{E}_t \boldsymbol{q}_{t+j} = P^j \boldsymbol{q}_t. \tag{9}$$

Iterating equation (7), the k-period-ahead subjective expectation of the endogenous variables is given by

$$\widehat{E}_t \boldsymbol{y}_{t+k} = \sum_{j=0}^{k-1} B^j \boldsymbol{a}_t + B^k \boldsymbol{y}_t + \sum_{j=0}^{k-1} B^{k-1-j} C P^j \boldsymbol{q}_t. \tag{10}$$

The first term captures the cumulative effect of the perceived drifts. The second term captures the effect of the current endogenous variables, while the third term captures the effect of the current exogenous shocks.

For the stationary RE solution used to construct B, all eigenvalues of B lie strictly inside the unit circle. The stationarity of the exogenous-shock processes similarly implies that all eigenvalues of P lie strictly inside the unit circle. It follows that

$$\sum_{j=0}^{k-1} B^j = (I_3 - B)^{-1} \left(I_3 - B^k\right) \longrightarrow (I_3 - B)^{-1},$$

since $B^k \longrightarrow 0$. The same stability conditions imply that

$$B^k \boldsymbol{y}_t \longrightarrow \mathbf{0}$$

and

$$\sum_{j=0}^{k-1} B^{k-1-j} C P^j \boldsymbol{q}_t \longrightarrow \mathbf{0}.$$

Taking the limit of equation (10) therefore gives

$$\lim_{k \to \infty} \widehat{E}_t \boldsymbol{y}_{t+k} = (I_3 - B)^{-1} \boldsymbol{a}_t, \tag{11}$$

where I_3 denotes the 3×3 identity matrix.

Because inflation is the first component of $\boldsymbol{y}_t$, I define the first component of the limiting vector on the right-hand side of equation (11) as the model-implied long-run inflation expectation. The effects of the current endogenous variables and exogenous shocks vanish as the forecast horizon tends to infinity. Consequently, the long-run inflation expectation is determined solely by the perceived drifts $\boldsymbol{a}_t$. Under RE, $\boldsymbol{a}_t = \mathbf{0}$, so the long-run expectation of inflation expressed as a deviation from its steady-state value is zero. Equation (11), together with equation (8), implies that K governs the speed at which long-run inflation expectations are revised in response to forecast errors.

3 Estimation

3.1 Data

The model is estimated using quarterly Japanese data over the period from 2012:Q2 to 2025:Q4. The starting date is determined by the availability of survey measures of long-run inflation expectations.

The estimation uses five observable variables: the output gap, inflation, the nominal interest rate, short-run inflation expectations, and long-run inflation expectations. To account for the effective lower bound, the nominal interest-rate observable combines the uncollateralized overnight call rate with a shadow rate, following Sunakawa (2026). The short-run measure is the one-quarter-ahead inflation forecast, while the long-run measure is the forecast for inflation 7 to 11 years ahead. Detailed information on the data sources and construction of the observable series is provided in Appendix A.

Let π_t^{obs}, i_t^{obs}, x_t^{obs}, $\pi_t^{SR,obs}$, and $\pi_t^{LR,obs}$ denote observed inflation, the observed nominal interest rate, the observed output gap, short-run inflation expectations, and long-run inflation expectations, respectively. These observed variables are linked to the model variables through the following measurement equations:

$$
\begin{aligned}
x_t^{obs} &= x^* + x_t, && (12)\\
\pi_t^{obs} &= \pi^* + \pi_t, && (13)\\
i_t^{obs} &= r^* + \pi^* + i_t, && (14)\\
\pi_t^{SR,obs} &= \pi^* + \widehat{E}_t \pi_{t+1} + \eta_t^{SR}, && (15)\\
\pi_t^{LR,obs} &= \pi^* + \lim_{k\to\infty} \widehat{E}_t \pi_{t+k} + \eta_t^{LR}. && (16)
\end{aligned}
$$

Here, x^* denotes the steady-state output gap, π^* denotes steady-state inflation, and r^* denotes the steady-state real interest rate. The terms η_t^{SR} and η_t^{LR} are measurement errors for short-run and long-run inflation expectations, respectively. Their standard deviations are denoted by $\sigma_{\pi,1}^m$ and $\sigma_{\bar{\pi}}^m$, respectively.

Although the survey measure refers to inflation 7 to 11 years ahead, I map it to the model-implied long-run inflation expectation defined by the limiting expression in Subsection 2.3. To assess this approximation, I construct the model-implied counterpart to the survey measure by averaging the model's inflation forecasts at each quarterly horizon from 7 to 11 years ahead. The resulting series has a sample correlation of 0.993 with the model-implied long-run inflation expectation, and the RMSE between the two series is 0.045 percentage points. These values indicate that the model-implied long-run inflation expectation closely approximates the corresponding finite-horizon expectation over the estimation sample.

3.2 Prior distributions

The model is estimated using Bayesian methods. The discount factor β is fixed at 0.999 and is not estimated. This subsection describes the prior distributions assigned to the estimated structural parameters, the learning gain, the shock processes, and the measurement errors. The prior distributions are summarized in Table 1.

Table 1: Prior distributions for the estimated parameters

			Prior	
Param.	Description	Type	Mean	Std.
σ	Intertemporal elasticity of substitution	G	0.670	0.375
κ	Slope of the New Keynesian Phillips curve	G	0.030	0.020
γ	Degree of indexation to past inflation	B	0.500	0.150
h	Habit persistence	B	0.500	0.100
ρ_i	Interest-rate smoothing	B	0.750	0.150
ϕ_π	Policy response to inflation	N	2.000	0.100
ϕ_x	Policy response to output gap	N	0.250	0.100
K	Learning gain	G	0.080	0.070
ρ_r	AR coefficient of demand shock	B	0.500	0.150
ρ_u	AR coefficient of cost-push shock	B	0.500	0.150
ρ_m	AR coefficient of monetary policy shock	B	0.500	0.150
σ_r	Std. dev. of demand shock	IG	0.100	2.000
σ_u	Std. dev. of cost-push shock	IG	0.100	2.000
σ_m	Std. dev. of monetary policy shock	IG	0.100	2.000
$\sigma^m_{\pi,1}$	Std. dev. of measurement error for one-quarter-ahead inflation expectations	IG	0.100	2.000
$\sigma^m_{\bar{\pi}}$	Std. dev. of measurement error for long-run inflation expectations	IG	0.100	2.000
x^*	Steady-state output gap	N	0.385	0.050
π^*	Steady-state inflation	G	0.257	0.050

Notes: Type indicates the prior distribution: N = Normal, B = Beta, G = Gamma, IG = Inverse-Gamma.

The prior specifications draw on Eusepi and Preston (2018), Hirose (2020), and Sunakawa (2026). Following the learning literature, I assign a gamma prior to K, which restricts the gain to be positive. The prior is chosen to be relatively diffuse so that the data can discipline the degree of updating in perceived drifts.[1]

The monetary policy parameters are estimated with priors centered around standard values. The prior mean for the response to inflation is set above one, reflecting the Taylor-principle benchmark, while the response to the output gap is centered at a smaller positive value. The interest-rate smoothing parameter is assigned a beta prior, reflecting the persistence typically observed in short-term nominal interest rates.

Measurement errors are included only for the survey measures of short-run and long-run inflation expectations, and their standard deviations are assigned inverse-gamma priors.

3.3 Posterior computation

The model and the measurement equations are written in state-space form, and the likelihood is evaluated using the Kalman filter.

The posterior mode is first obtained by numerically maximizing the posterior density. Posterior inference is then based on a random-walk Metropolis–Hastings algorithm. The proposal covariance matrix is initialized using the inverse Hessian evaluated at the posterior mode and is scaled to obtain an acceptance rate in a conventional range. I run two Markov chains with 100,000 draws each and discard the first 50,000 draws of each chain as burn-in, leaving 100,000 retained posterior draws in total. Convergence is assessed using potential scale reduction factors. Across the estimated parameters, their median is 1.00 and their maximum is 1.01. These values indicate that the chains have converged.

The reported parameter estimates are posterior means. Uncertainty is summarized using 90 percent credible intervals computed from the retained posterior draws. The historical decompositions and counterfactual simulations reported below are computed using the posterior mean estimates.

4 Results

This section presents the quantitative results of the estimated model. I first summarize the posterior estimates of the parameters. I then use the model to decompose Japan's post-COVID inflation dynamics into the contributions of structural shocks. Finally, I conduct counterfactual experiments to quantify how long-run inflation expectations and the monetary policy response shaped Japan's post-COVID inflation dynamics.

[1]For comparison, Milani (2007) assigns a gamma prior to the constant gain with mean 0.031 and standard deviation 0.022. Eusepi and Preston (2018), following Slobodyan and Wouters (2012), assign a gamma prior with mean 0.035 and standard deviation 0.03.

4.1 Estimated parameters

Table 2 reports the posterior modes, posterior means, and 90 percent credible intervals of the estimated parameters. The posterior means of the habit persistence and inflation indexation parameters are 0.318 and 0.189, respectively. The posterior mean of the slope of the New Keynesian Phillips curve is 0.026, suggesting that inflation is only weakly sensitive to movements in the output gap.

Table 2: Posterior estimates of the parameters

		Posterior			
Param.	Description	Mode	Mean	5%	95%
σ	Intertemporal elasticity of substitution	0.184	0.297	0.124	0.532
κ	Slope of the New Keynesian Phillips curve	0.007	0.026	0.010	0.049
γ	Degree of indexation to past inflation	0.175	0.189	0.064	0.344
h	Habit persistence	0.281	0.318	0.208	0.442
ρ_i	Interest-rate smoothing	0.926	0.884	0.840	0.921
ϕ_π	Policy response to inflation	1.961	1.955	1.796	2.119
ϕ_x	Policy response to output gap	0.249	0.297	0.126	0.456
K	Learning gain	0.049	0.050	0.040	0.063
ρ_r	AR coefficient of demand shock	0.983	0.929	0.879	0.971
ρ_u	AR coefficient of cost-push shock	0.166	0.223	0.082	0.371
ρ_m	AR coefficient of monetary policy shock	0.411	0.504	0.357	0.638
σ_r	Std. dev. of demand shock	0.256	0.422	0.265	0.719
σ_u	Std. dev. of cost-push shock	0.256	0.258	0.200	0.326
σ_m	Std. dev. of monetary policy shock	0.121	0.138	0.114	0.168
$\sigma^m_{\pi,1}$	Std. dev. of measurement error for one-quarter-ahead inflation expectations	0.139	0.154	0.129	0.184
$\sigma^m_{\bar{\pi}}$	Std. dev. of measurement error for long-run inflation expectations	0.032	0.035	0.029	0.041
x^*	Steady-state output gap	0.386	0.387	0.304	0.469
π^*	Steady-state inflation	0.255	0.271	0.193	0.361

Notes: The posterior mean is computed from the retained draws after discarding the first half of each chain as burn-in. The 5th and 95th percentiles form a 90 percent credible interval.

The monetary policy rule features substantial interest-rate smoothing and a strong response to inflation. The posterior means of ρ_i and ϕ_π are 0.884 and 1.955, respectively, indicating a high degree of policy-rate persistence and a strong response to inflation.

The key parameter for the expectation-formation block is the gain parameter K. Its posterior mean is 0.050, which is larger than the estimates reported in previous studies using

U.S. data.[2] Under the updating rule in equation (8), this estimate means that 5 percent of each one-period-ahead forecast error is incorporated into the corresponding perceived drift.

The posterior mean of steady-state inflation π^* is 0.271 percent per quarter, or about 1.1 percent at an annual rate, which is below the 2 percent target. The posterior mean of the steady-state output gap x^* is 0.387.

The natural-rate shock is highly persistent, with a posterior mean of $\rho_r = 0.929$. In contrast, the cost-push and monetary policy shocks are less persistent, with posterior means of $\rho_u = 0.223$ and $\rho_m = 0.504$, respectively.

The posterior means of the measurement-error standard deviations are 0.154 for one-quarter-ahead inflation expectations and 0.035 for long-run inflation expectations. Thus, the model attributes more unexplained variation to the short-run survey measure.

4.2 Historical decomposition

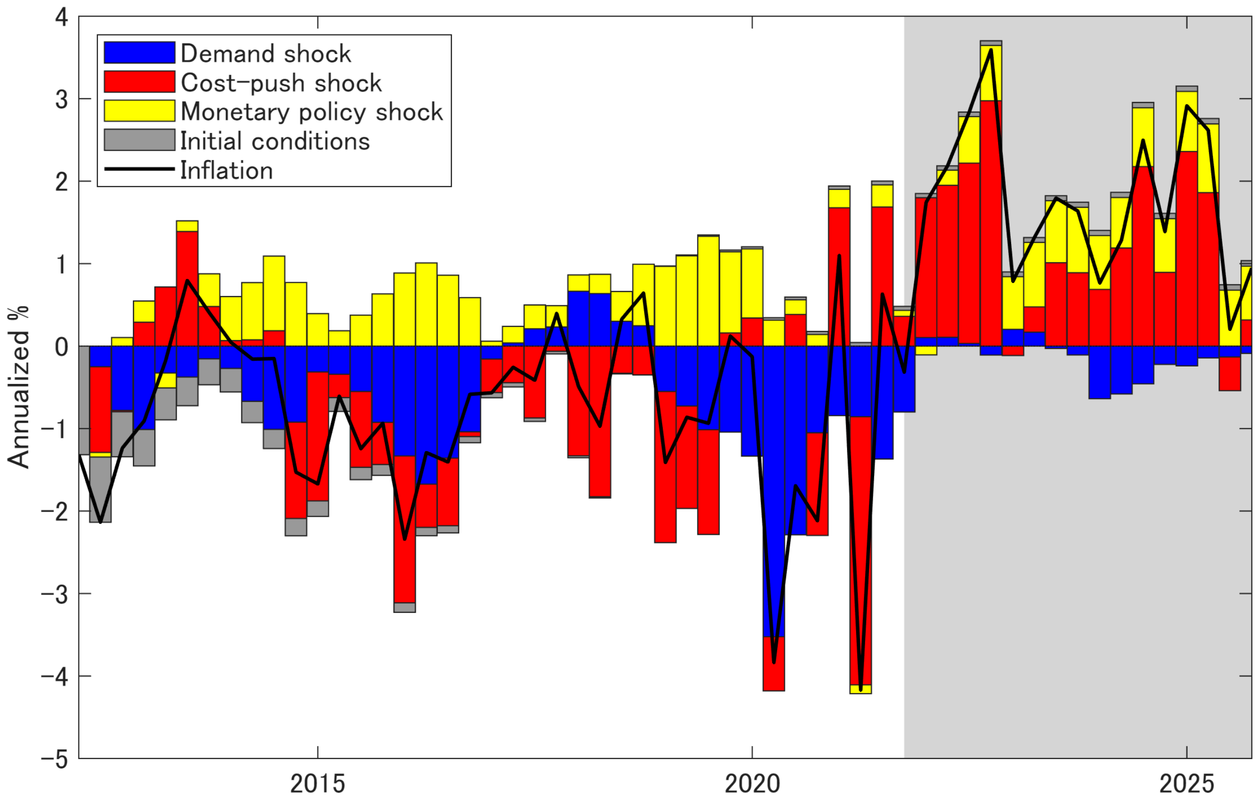
Figure 2 shows the historical decomposition of inflation. The black line denotes inflation, while the stacked bars show the contributions of demand shocks, cost-push shocks, monetary policy shocks, and initial conditions. The shaded area marks the post-COVID period, which is the main focus of the analysis below. The corresponding decomposition for the output gap is reported in Appendix B.

The decomposition shows that cost-push shocks are the main source of the post-COVID rise in inflation. Their contribution increases sharply from the beginning of the shaded period and accounts for most of the rise around the peak of inflation. Cost-push shocks also remain an important source of inflation in several later quarters. Monetary policy shocks generally make positive contributions during the post-COVID period. Demand shocks play a more mixed role, contributing positively in some quarters but exerting downward pressure on inflation in several later quarters.

The dominant role of cost-push shocks is broadly consistent with recent evidence that Japan's post-pandemic inflation was driven largely by supply-side disturbances. Nakamura, Nakano, Osada, and Yamamoto (2024) show that energy and food price shocks, rather than labor-market tightness, account for much of the increase in inflation. Similarly, Sunakawa (2026) finds that the recent rise in inflation is largely explained by supply-side disturbances, including price markup shocks.

[2] Using U.S. data, Milani (2007) estimates K at 0.0183, while Eusepi and Preston (2018) report estimates between 0.034 and 0.045.

Figure 2: Historical decomposition of inflation



Note: The black line shows inflation as a deviation from its steady-state value, and the stacked bars show the contribution of each component to that deviation.

4.3 Counterfactual analysis

This subsection conducts counterfactual simulations to assess how long-run inflation expectations and the monetary policy response shaped Japan's post-COVID inflation dynamics. The simulations keep the sequence of estimated structural shocks fixed and change one component of the model environment at a time: the level of long-run inflation expectations, the stickiness of long-run inflation expectations, or the strength of the monetary policy response to inflation.

The first counterfactual changes the initial level of long-run inflation expectations. The simulation begins in 2021:Q4, which marks the beginning of the post-COVID inflation period considered in this analysis. At that time, long-run inflation expectations were 1 percent.

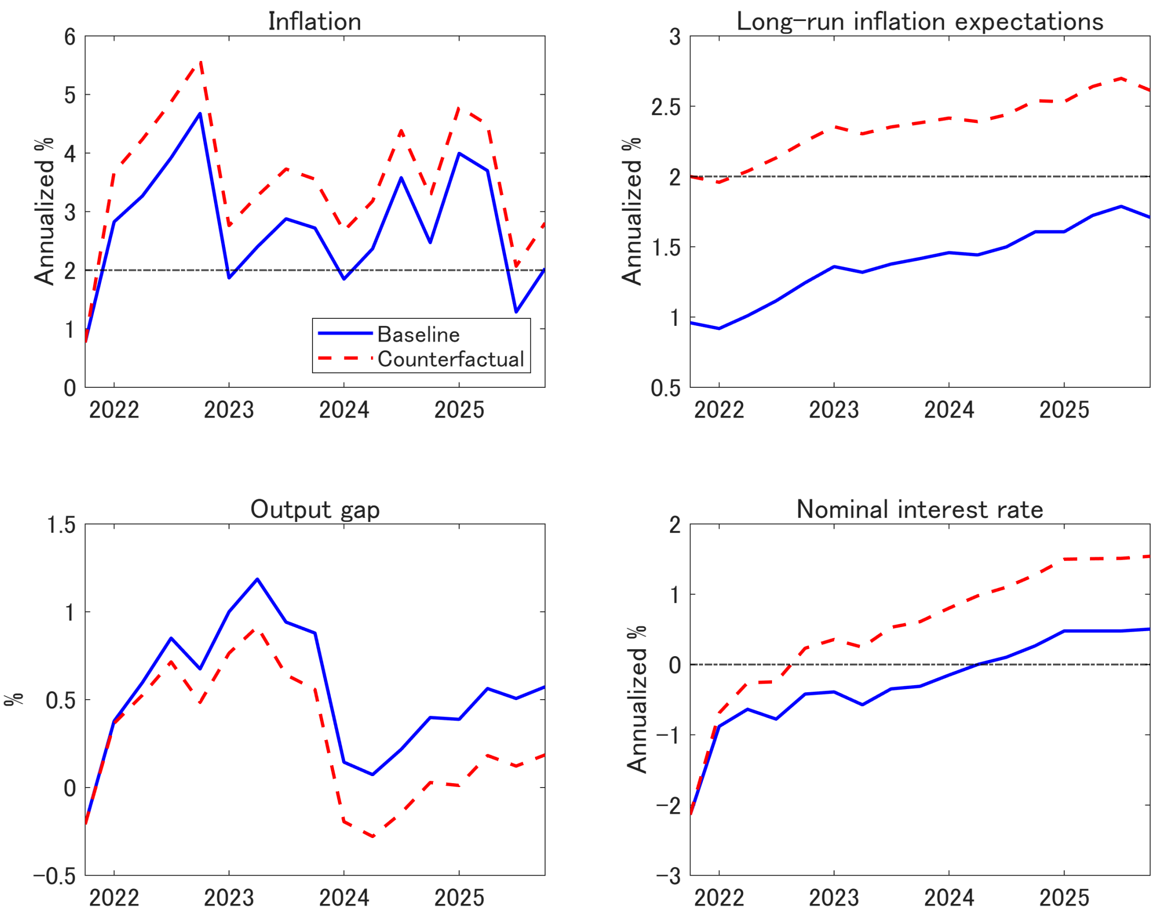
The counterfactual instead sets long-run inflation expectations in 2021:Q4 to the Bank of Japan's 2 percent target. I implement this counterfactual by adjusting the inflation component of the initial perceived-drift vector by the amount required for model-implied long-run inflation expectations to equal 2 percent, while holding the output-gap and nominal-interest-rate components at their baseline values. This intervention directly changes the intercept of the one-period-ahead inflation forecasting rule without directly changing the corresponding intercepts for the output gap or the nominal interest rate.

Figure 3 shows that long-run inflation expectations remain above the baseline path throughout the simulation. Inflation is also higher under the counterfactual, by 0.8 percentage points on average. The higher initial level of long-run inflation expectations raises one-period-ahead expected inflation, which in turn raises current inflation. The nominal interest rate is also higher as monetary policy responds to higher inflation. The output gap is lower than in the baseline path for most of the simulation. It is negative initially and turns negative again around 2024.

The counterfactual shows that the initial level of long-run inflation expectations has persistent effects on subsequent inflation dynamics. Because long-run inflation expectations were below the 2 percent target at the onset of the post-COVID inflation episode, their low initial level dampened the rise in inflation generated by the subsequent shocks.

The second counterfactual examines the role of the stickiness of long-run inflation expectations. The gain parameter K scales the revision of each perceived drift in response to its corresponding one-period-ahead forecast error. Through equation (11), these revisions determine how quickly model-implied long-run inflation expectations adjust. Because a lower gain implies slower adjustment, I measure stickiness by the inverse gain, $1/K$. The counterfactual reduces K from its posterior mean of 0.050 to 0.010, so that agents incorporate 1 percent rather than 5 percent of each forecast error into the corresponding perceived drift.

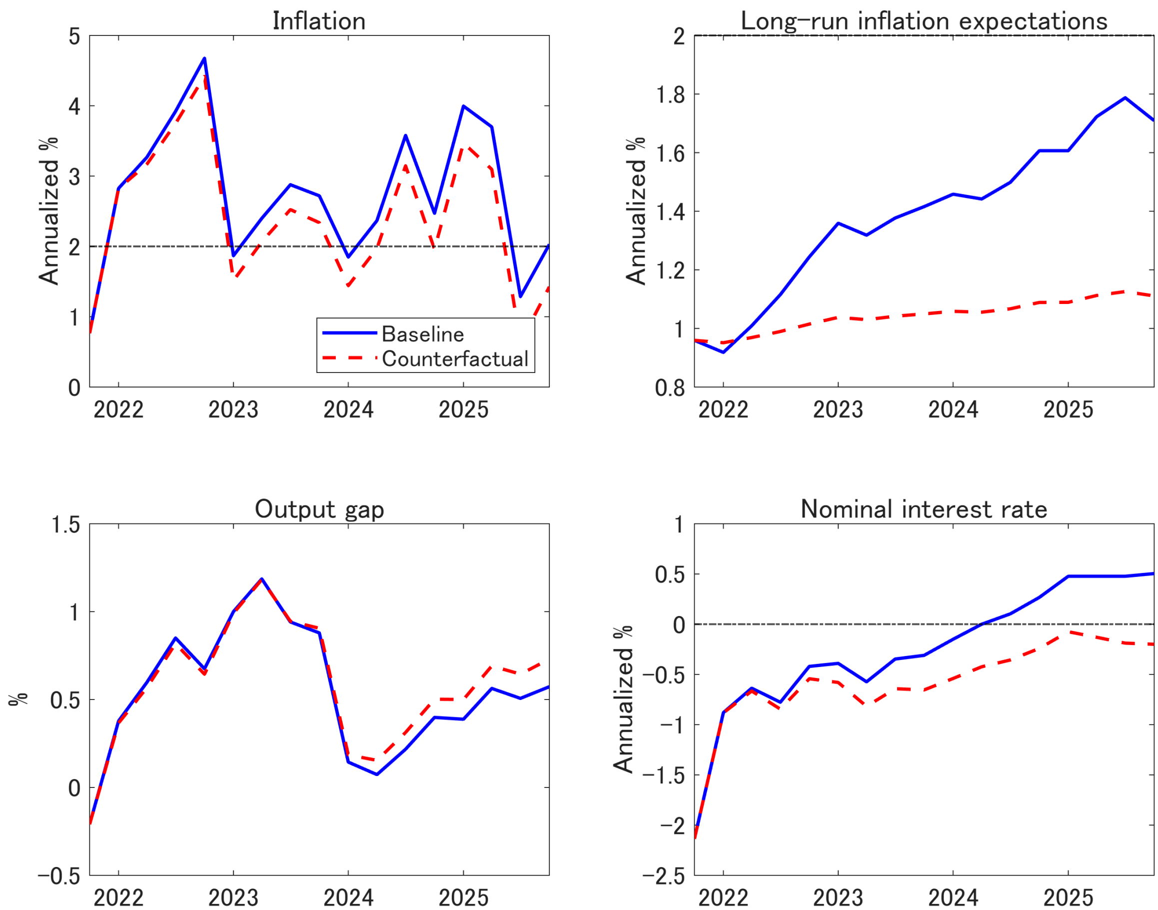
Figure 3: Counterfactual: Long-run inflation expectations reset to 2 percent



Note: “Baseline” denotes the model-implied path under the posterior mean estimates.

Under the inverse-gain measure, this represents a fivefold increase in stickiness.

Figure 4: Counterfactual: Greater stickiness of long-run inflation expectations



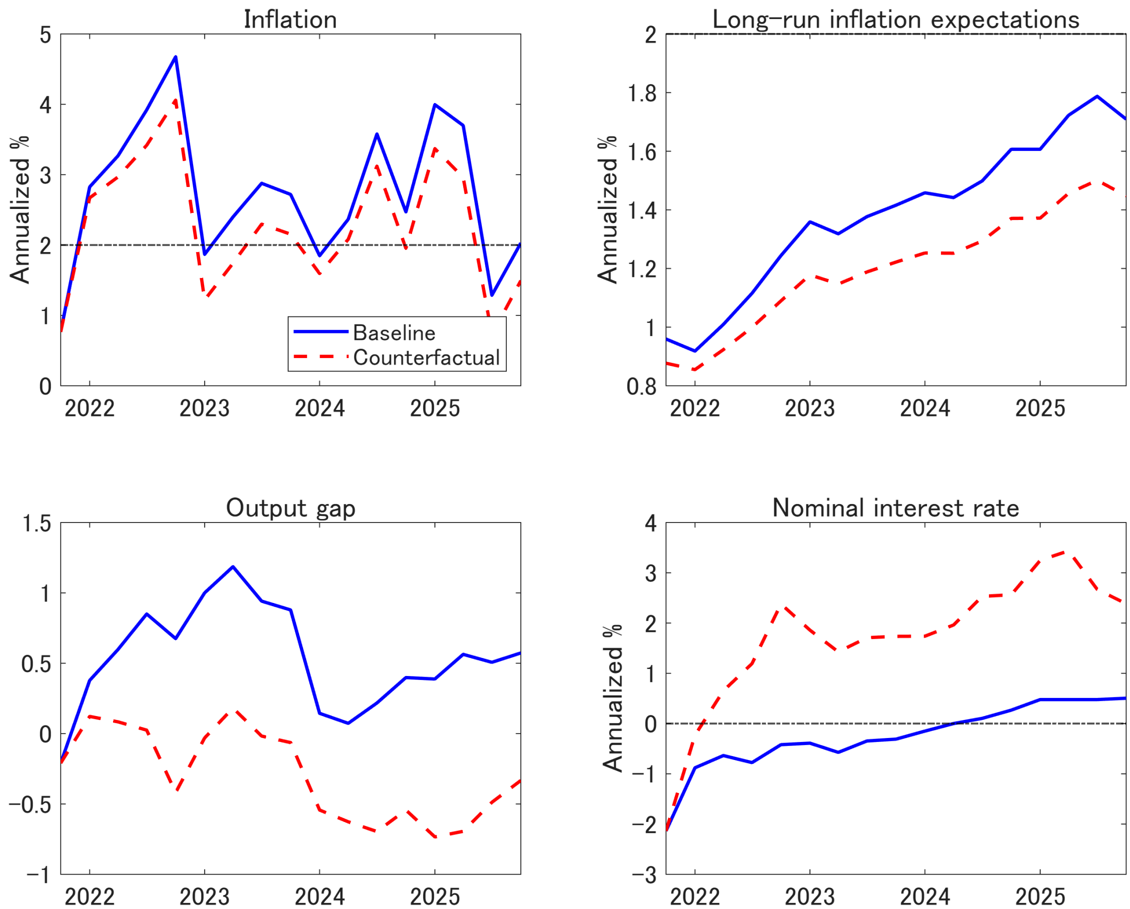
Note: "Baseline" denotes the model-implied path under the posterior mean estimates.

Figure 4 shows that long-run inflation expectations respond much more slowly under the counterfactual. After briefly exceeding the baseline path at the beginning of the simulation, they remain below it from mid-2022 onward. Because stickier long-run inflation expectations limit the rise in one-period-ahead expected inflation, they also lower current inflation through the New Keynesian Phillips curve. Inflation is 0.4 percentage points lower on average under the counterfactual. The nominal interest rate is also lower, as monetary policy responds to the lower inflation rate. The output gap remains close to the baseline path through 2023 and is higher from around 2024 onward, partially offsetting the effect of lower inflation on the policy rate.

These results show that the stickiness of long-run inflation expectations is an important determinant of inflation dynamics. Greater stickiness would have limited the rise in long-run inflation expectations and resulted in a lower path of inflation during the post-COVID period.

The third counterfactual examines the effect of a stronger monetary policy response to inflation. The counterfactual sets the inflation-response coefficient ϕ_π to three times its estimated value. Because changing ϕ_π also changes the stationary RE solution used to construct the coefficients B and C in equation (7), I recompute these coefficients under the counterfactual value of ϕ_π. This ensures that subjective expectations in the counterfactual are consistent with the stronger monetary policy response.

Figure 5: Counterfactual: Stronger monetary policy response to inflation



Note: "Baseline" denotes the model-implied path under the posterior mean estimates.

Figure 5 shows that the nominal interest rate rises substantially above its baseline path under the counterfactual, reflecting the stronger policy response to inflation. The higher interest rate reduces the output gap, which remains below its baseline path for most of the simulation and turns negative around 2024. The resulting decline in inflation also leads to a lower path of long-run inflation expectations. The lower output gap and lower one-period-ahead expected inflation both reduce current inflation through the New Keynesian Phillips curve. Inflation is 0.5 percentage points lower on average under the counterfactual.

Thus, the counterfactual implies that the Bank of Japan could have contained the post-COVID inflation surge more effectively by responding more strongly to inflation. Such a response would, however, have lowered the output gap and kept long-run inflation expectations slightly further below the 2 percent target.

5 Conclusion

This paper estimates a New Keynesian model in which long-run inflation expectations vary endogenously over time, using Japanese macroeconomic data and survey forecasts. Their time variation arises from constant-gain learning of perceived drifts, whose estimated paths are disciplined by survey measures of short-run and long-run inflation expectations. The analysis focuses on Japan's post-COVID inflation surge and quantifies how structural shocks, long-run inflation expectations, and monetary policy contributed to inflation dynamics.

The historical decomposition shows that cost-push shocks were the main driver of the post-COVID rise in inflation. Monetary policy shocks also contributed positively during this period. Demand shocks played a more mixed role, contributing positively at some points but exerting downward pressure later in the period.

Counterfactual simulations highlight the quantitative importance of long-run inflation expectations. If long-run inflation expectations had been at the 2 percent target at the onset of the post-COVID inflationary episode, inflation would have been about 0.8 percentage points higher on average. Increasing the stickiness of long-run inflation expectations fivefold would have lowered inflation by about 0.4 percentage points on average. Finally, tripling the policy response to inflation would have lowered inflation by about 0.5 percentage points on average, while also lowering the output gap and long-run inflation expectations.

Taken together, these findings show that both the level and the stickiness of long-run inflation expectations are important determinants of inflation dynamics in Japan. Below-target long-run inflation expectations initially dampened the inflationary effects of the post-COVID shocks. Greater stickiness in long-run inflation expectations would have resulted in a lower path of inflation. The monetary policy counterfactual further suggests that a stronger response to inflation could have contained the inflation surge more effectively, but at the cost of a lower output gap and a larger shortfall of long-run inflation expectations from the 2 percent target.

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Appendix A Data sources and construction

This appendix reports the sources and construction of the five observable variables used in the estimation. The estimation sample runs from 2012:Q2 to 2025:Q4. Table 3 summarizes the data series and construction methods.

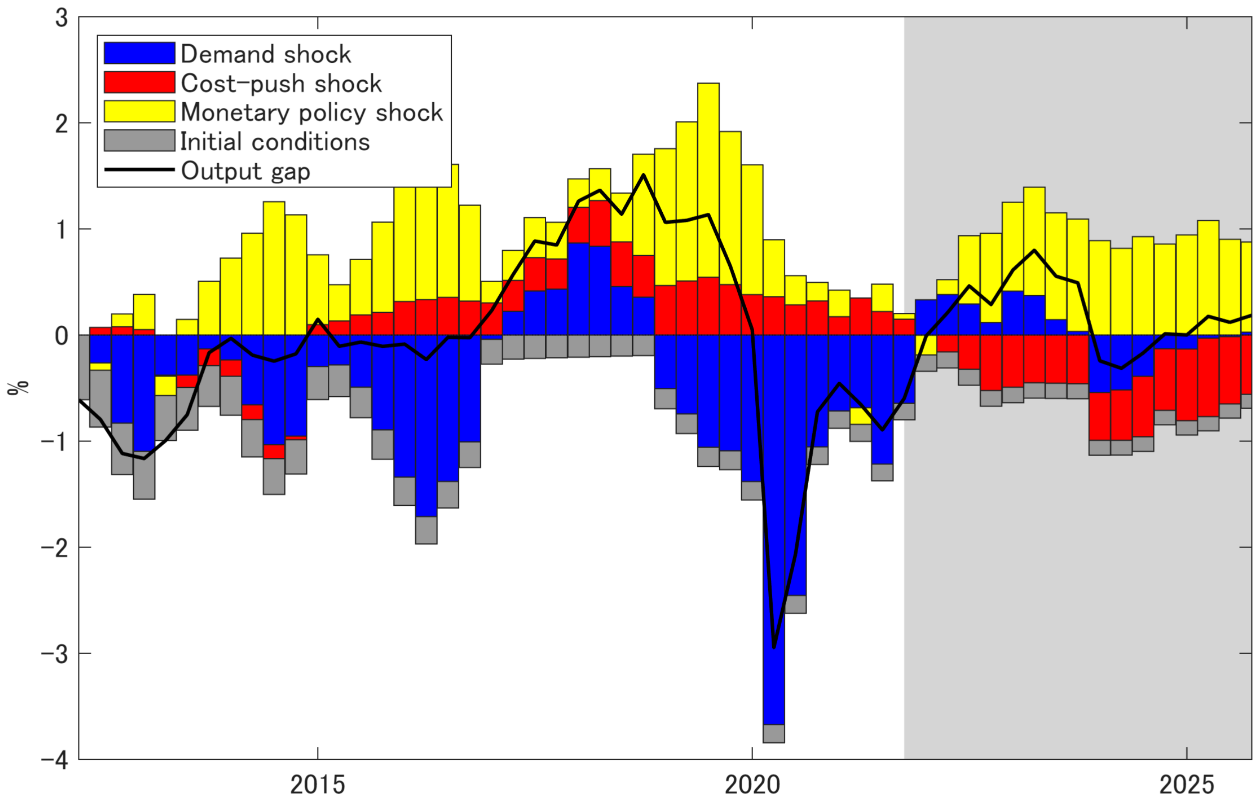
Table 3: Data used in the estimation

Observable	Source and series	Construction
Output gap	Bank of Japan, output gap estimate	Used as published.
Inflation	Ministry of Internal Affairs and Communications, tax-adjusted consumer price index excluding fresh food	Inflation is measured by the quarter-on-quarter percentage change in the corresponding quarterly consumer price index.
Nominal interest rate	Bank of Japan, uncollateralized overnight call rate; LJK Macro Finance Analysis, shadow short rate	Following Sunakawa (2026), the shadow rate is used when the uncollateralized overnight call rate is below 0.25 percent or below the shadow rate; otherwise, the call rate is used. The quarterly series is constructed by averaging the resulting monthly observations.
Short-run inflation expectations	Japan Center for Economic Research, "ESP Forecast Survey", one-quarter-ahead inflation forecast excluding the effects of consumption tax increases	The quarterly series is constructed by averaging the monthly observations within each quarter.
Long-run inflation expectations	Japan Center for Economic Research, "ESP Forecast Survey", average inflation forecast 7 to 11 years ahead excluding the effects of consumption tax increases	The long-run inflation forecast is available twice a year, in June and December. The June and December observations are assigned to Q2 and Q4, respectively, and the intervening Q1 and Q3 values are obtained by linear interpolation.

Appendix B Historical decomposition of the output gap

Figure 6 reports the historical decomposition of the output gap, which is the counterpart to the inflation decomposition in Figure 2. The black line denotes the output gap, while the stacked bars show the model-implied contributions of demand shocks, cost-push shocks, monetary policy shocks, and initial conditions. The shaded area marks the post-COVID period.

Figure 6: Historical decomposition of output gap



Note: The black line shows the output gap as a deviation from its steady-state value, and the stacked bars show the contribution of each component to that deviation.