Good Luck or Not: Bank of Japan's Monetary Policy*

Kohei Hasui† Yuki Teranishi‡

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Abstract

This paper evaluates whether the Bank of Japan (BOJ)'s "Inflation-Overshooting Commitment" can work to raise inflation rates by over 2 percent to end the zero interest rate policy or whether cost-push shocks luckily give a chance of high inflation rates for the BOJ to escape a liquidity trap.

We show that the Taylor-type rule can not replicate inflation overshooting, even though the zero interest rate policy continues as the BOJ's monetary policy. However, the Taylor-type rule achieves about a 2 percent target in the end, and the cost-push shocks work as good luck to induce high inflation data and justify the escape from a liquidity trap. In the case of the price-level targeting policy, inflation rates increase by more than 2 percent, and the zero interest rate policy continues even after inflation rates sufficiently exceed 2 percent. Under the price-level targeting policy, the cost-push shocks give little good luck in terminating the zero-interest rate policy earlier. Our simulation results imply that the BOJ successfully excludes the effect of positive cost-push shocks to implement the exit policy and conducts the history-dependent policy under inflation-overshooting commitment.

Our results do not change for a variety of Japanese parameters for the anchored level of inflation rate, elasticity of demand to real interest rate, and inflation persistence. Moreover, the augmented Taylor-type rule with a strong history dependence can work as a price-level targeting policy.

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†Aichi University. E-mail: khasui@vega.aichi-u.ac.jp

‡Keio University. E-mail: yukitera@fbc.keio.ac.jp

1 Introduction

Our aim in this paper is to investigate whether the Bank of Japan (BOJ)'s "Inflation-Overshooting Commitment" can work to raise inflation rates by over 2 percent to end the zero interest rate or whether other elements, such as cost-push shocks, luckily provide a chance of high inflation rates for the BOJ to escape a liquidity trap. To reveal it, we assume the conventional monetary policy rules that are often interpreted as a guideline for the conduct of monetary policy to map our analysis to actual monetary policy.

Under the inflation-overshooting commitment, the BOJ promised to continue monetary easing by maintaining the zero interest rate policy until the year-on-year CPI inflation rate stably exceeded the 2 percent target.[1] This commitment policy can work to simulate the Japanese economy by reducing the real interest rate. In July 2024, the BOJ confirms inflation sufficiently overshooting the 2 percent target due to aggressive monetary easing and terminates the zero interest rate policy.

Several papers evaluate the BOJ's monetary policy in a liquidity trap. Kawamoto et al. (2025) analyze the BOJ's inflation-overshooting commitment as an implementation of the "makeup strategy" using an estimated model for the Japanese economy. They assume the Taylor-type rules and show that a prolonged zero interest rate policy with inflation overshooting can work as the makeup strategy from the perspective of early achievement of the inflation target. On the other hand, Ikeda et al. (2022) analyze the inflation behavior before and after the pandemic. They argue that cost-push pressures, such as commodity price hikes and yen depreciation, temporarily raise the inflation rate after the pandemic. Its effect, however, would not continue. Their analysis suggests that cost-push shocks affect the BOJ's monetary policy and give some good luck to induce high inflation data in escaping a liquidity trap.

Given these backgrounds, we quantitatively evaluate whether a prolonged low interest rate policy can achieve inflation overshooting as well as whether cost-push shocks can

[1] Kawamoto et al. (2025) explain that BOJ's "Quantitative and Qualitative Monetary Easing with Yield Curve Control" consists of the two elements, "Yield Curve Control (YCC)" and "Inflation-Overshooting Commitment." Our paper focuses on "Inflation-Overshooting Commitment."

work to make the BOJ seemingly perform well in the exit from the zero interest rate policy. In detail, we use the conventional New Keynesian model with inflation persistence and the conventional simple monetary policy rules, such as the Taylor-type rule and the price-level targeting rule. We apply our analysis to the case of the BOJ's exit from the zero interest rate policy after the pandemic.

Our paper is closely related to Kawamoto et al. (2025) and Ikeda et al. (2022). All papers, including our paper, try to evaluate the effectiveness of the BOJ's inflation-overshooting commitment. A sharp difference from these two papers is that we apply the analysis to the actual exit policy from the zero interest rate after the pandemic. We compare the simulation of the model with the data for the ongoing exit policy. Hasui and Teranishi (2025) is also related to our paper. They show that the Bank of Japan's monetary policy shares several similarities with optimal monetary policy in a liquidity trap to large negative shocks caused by the recent pandemic. Optimal monetary policy lasts the zero interest rate policy until the second quarter of 2024, as the Bank of Japan does. They evaluate that recent high inflation rates can be explained by a prolonged zero interest rate policy under optimal monetary policy. Against the paper, we assume the conventional simple monetary policy rules in this paper.

From the outside of the BOJ, it is impossible to clarify which monetary policy rule is the best to explain the BOJ's monetary policy. Even inside the BOJ, it could be difficult to identify the monetary policy rule since not all BOJ's board members may necessarily assume such a simple monetary policy rule. Therefore, we can only showcase under some conventional monetary policy rules. The BOJ, however, gives some suggestions to identify the monetary policy rules. Ueda (2023) explains that the BOJ maintains the stance that the BOJ will continue expanding the monetary base until the year-on-year rate of increase in the observed CPI (all items less fresh food) exceeds 2 percent and stays above the target in a stable manner. This induces the prolonged zero and low interest rate policy. One way to describe such history-dependent policy by the simple rule is to include lagged variables. As the former studies, Bank of Japan (2021) examines the inflation-overshooting commitment using the BOJ's macroeconomic model. In the analysis, they similarly assume the simple monetary policy rule including lagged inflation rates. Kawamoto et al. (2025) also show that BOJ's inflation-overshooting commitment policy can be described by the monetary policy rules that prolong the zero interest rate policy. In our paper, we assume the Taylor-type rule and the price-level targeting rule.

The remainder of the paper proceeds as follows. Section 2 presents a model with inflation persistence. In Section 3, we calibrate the model. Sections 4 and 5 show experiments under the Taylor-type rule and the price-level targeting rule, respectively. Section 6 shows comprehensive and robust analyses of monetary policy in Japan. Section 7 gives discussions. Section 8 concludes.

2 The Model

2.1 Economy

We use a new Keynesian model following Woodford (2003) and Eggertsson and Woodford (2006) and omit detailed explanations for the model. The macroeconomic structure is expressed by the two equations:

$$x_t = \mathrm{E}_t x_{t+1} - \chi \left(i_t - \mathrm{E}_t \pi_{t+1} - r_t^n \right), \tag{1}$$

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

where χ is the intertemporal elasticity of substitution of expenditure, β is a discount factor, γ $(0 \leq \gamma \leq 1)$ is the degree of inflation persistence, and

$$\kappa = \frac{(1-\alpha)(1-\beta\alpha)}{\alpha} \frac{\omega + \chi^{-1}}{1 + \omega\theta},$$

where ω is the elasticity of firm's real marginal cost and θ is an elasticity of substitution across goods. It should be noted that a slope of the Phillips curve κ depends on price stickiness α. x_t, i_t and π_t denote the output gap, the nominal interest rate (or policy rate), and the rate of inflation in period t, respectively. The expectations operator E_t covers information available in period t. r_t^n is the natural rate of interest and works as the shock. μ_t is the cost-push shock.

Equation (1) is the forward-looking IS curve as shown in Clarida et al. (1999) and Woodford (2003). The IS curve states that the current output gap is determined by the expected value of the output gap and the deviation of the current real interest rate, defined as $i_t - \mathrm{E}_t\pi_{t+1}$, from the natural interest rate.

Equation (2) is the hybrid Phillips curve. When $\gamma = 0$, the hybrid Phillips curve turns into a purely forward-looking Phillips curve, where current inflation is dependent on expected inflation and the current output gap. When $0 < \gamma \leq 1$, the Phillips curve is both forward-looking and backward-looking, and the current inflation rate depends on the lagged inflation rate, as well as the expected inflation and the current output gap. When γ is closer to 1, the coefficient on the lagged inflation rate is closer to 0.5. Following the indexation rule in Woodford (2003), some firms that can not reoptimize their own goods prices adjust current prices based on the past inflation rate.

Finally, we give a nonnegativity constraint on the nominal interest rate:

$$i_t \geq 0. \tag{3}$$

2.2 Monetary Policy Rules

In this paper, to describe a prolonged zero interest rate policy with inflation overshooting, we assume the Taylor rule with an interest rate lag and the price-level targeting rule.

2.2.1 Taylor Rule with Inertia

We assume the Taylor-type rule with an interest rate lag as follows:

$$i_t = \max\left[0, (1-\rho_i)\left\{i^* + \phi_\pi(\pi_t - \bar{\pi})\right\} + \rho_i i_{t-1}\right], \tag{4}$$

where ϕ_π and ρ_i are positive parameters. This rule includes history dependence by gradually changing an interest rate.

2.2.2 Price-level Targeting Rule

$$i_t = \max\left[0, i^* + \phi_p p_t + \phi_x x_t\right], \tag{5}$$

where we set ϕ_p and ϕ_x are positive parameters. Here, we define $\pi_t - \bar{\pi} = p_t - p_{t-1}$ to simplify the rule. This price level is evaluated from an inflation deviation from the steady state. However, an important feature of price-level targeting, which continues the zero-interest rate policy until the initial price level is recovered, remains. It makes strong history dependence in a liquidity trap.

3 Calibration for Japanese Economy

Table 1 shows the parameter values. These parameters come from papers for the Japanese economy. Sugo and Ueda (2008) estimate a DSGE model for Japanese economy and show that $\alpha = 0.875$, $\omega = 2.149$, and $\theta = 6$.[2] Then, we can calculate $\kappa = 0.0048$, and $\lambda_x = 0.0008$. Following Iiboshi et al. (2022), we set $\chi = \frac{1}{1.548} = 0.646$.

For inflation persistence, the recent BOJ's paper Kawamoto et al. (2025) use a coefficient on the lagged inflation rate as 0.85 to evaluate the BOJ's inflation-overshooting commitment policy in the BOJ's small-size projection model. Moreover, to evaluate the quantitative and qualitative monetary easing policy, Kawamoto et al. (2023) use the BOJ's macroeconomic model where a coefficient on the lagged inflation rate in the Phillips curve is estimated as 0.69. These papers show high inflation persistence in Japan.[3] Thus, we use $\gamma = 1$.[4] It notes that the model eventually does not change when we set $\gamma = 1$ even for a non-zero inflation target due to $\pi_t - \gamma\pi_{t-1}$ terms in the model as shown in Woodford (2004).

For simulation, we need to set the natural rate of interest and an anchored inflation expectation in the steady-state. Osada and Nakazawa (2024) show that the principal component-based composite index of inflation expectations for different forecast horizons is about 1.5 percent at the end of 2023. Moreover, Bank of Japan (2024) shows that the break-even inflation rate is about 1.5 percent in April 2024. Thus, we set the anchored

[2]Mukoyama et al. (2021) also estimate high price stickiness as $\alpha = 0.82$.

[3]Sugo and Ueda (2008) also estimates γ as high as 0.862.

[4]These papers imply that $\gamma = 1$ is still conservative in describing inflation persistence since $\gamma = 1$ implies about 0.5 for a coefficient on the lagged inflation rate as shown in equation (2).

inflation expectation, as the steady-state and target inflation rates, at 1.5.

Regarding the natural interest rate in the steady-state, Bank of Japan (2024) shows several estimates because of difficulties to calculate an exact natural interest rate. The latest estimates of the natural interest rates are distributed around -0.5 in 2023. We set a nominal interest rate at 1.0 percent annually in the steady-state, and a discount factor, i.e., an inverse of the nominal interest rate, is given by $\beta = 0.9975$.

In our model, the long-run nominal interest rate is given by a sum of an anchored inflation expectation and the natural rate of interest. Therefore, the nominal interest rate in the steady-state is given by 1.0 percent annually.

Regarding the monetary policy rules, we arbitrarily set parameters for the monetary policy rules to replicate BOJ's monetary policy. We set $\phi_\pi = 5$, $\rho_i = 0.842$, $\phi_p = 1.5$, and $\phi_x = 0.5$.[5]

In simulations, we interpret the second quarter of 2020 as the starting point since we observe the largest negative shocks for the output gap and the inflation rate due to the pandemic. The output gap is -6.3 and the inflation rate is -2.8 annually in the second quarter of 2020.[6] Regarding shocks for the simulation, we give one-time negative natural rate shock and one-time negative cost-push shock without shock persistence as Eggertsson and Woodford (2003) to match models to the data for an inflation rate and the output gap at the second quarter of 2020, as shown in figures.[7] The simulations are perfect foresight and we use Dynare to run simulations.[8]

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[5]For example, Fujiwara et al. (2013) assume $\phi_\pi = 5$ and Sugo and Ueda (2008) set $\rho_i = 0.842$.

[6]We use the Real Gross Domestic Product (Expenditure), Quarterly, Seasonally Adjusted Annual Rate for the output gap. We make a trend series of one-year moving averages and calculate a gap from the trend series to real GDP. We use the Consumer Price Index for all items, less fresh food, seasonally adjusted for inflation rates. We calculate an annual inflation rate by the growth rate from a previous period. For the BOJ's policy rate, we use the call rate, uncollateralized overnight, average, annually.

[7]In simulations, we use the inflation rate data at the first quarter of 2020 to an inflation lag in the model in a period of 0. Before shocks occur, other variables are set to zero.

[8]We extend a code by Johannes Pfeifer for optimal monetary policy in a liquidity trap, JohannesPfeifer/DSGE_mod/blob/master/Gali_2015/Gali_2015_chapter_5_commitment_ZLB.mod. Our code is available upon your request.

4 Experiments under Taylor-type Rule

Figure 1 shows inflation rates, the output gap, and policy rates under the Taylor rule with an interest rate lag from the second quarter of 2020 to the fourth quarter of 2025, as well as these Japanese data.[9] It notes that the Taylor-type rule holds a high history dependence with a coefficient $\rho_i = 0.842$ for an interest rate lag.

We observe that the Taylor-type rule can not replicate inflation overshooting even though the zero interest rate policy continues as the BOJ's monetary policy. The Taylor-type rule, however, raises the inflation rates toward the end of the simulation and achieves about a 2 percent target.[10]

As discussed in Ikeda et al. (2022), cost-push pressures, such as commodity price hikes and yen depreciation, temporarily raise the inflation rate after the pandemic. It suggests that inflation overshooting itself is brought about by these cost-push shocks and the BOJ's role is to continue the zero interest rate policy under high inflation rates. Thus, inflation overshooting promised by the BOJ is given by good luck and not by the BOJ's monetary policy. If there were no cost-push shocks, the BOJ would not be able to achieve inflation overshooting.

It notes that the BOJ follows the conventional Taylor-type rule, but it excludes responses to cost-push shocks. This is the implementation of the inflation-overshooting commitment. Figure 2 shows the case where we give cost-push shocks to match an average inflation rate for 2021Q1–2022Q4 between the data and the model simulation.[11] The result shows that the zero interest rate policy ends at a very early timing and the output gap largely decreases. It contradicts the data.

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[9] We assume -8.65 percent of the natural rate shock and -0.86 percent of cost-push shock at time zero on a quarterly basis.

[10] Hasui and Teranishi (2025) show a similar result using the Taylor-type rule without a policy rate lag. We show this case in the Appendix.

[11] We assume -4.14 percent of the natural rate shock and -0.98 percent of cost-push shock at time zero, and an additional cost-push shock of 0.42 percent at time 6 on a quarterly basis.

5 Experiments under Price-level Targeting Rule

We often discuss whether the Taylor rule is a guideline for monetary policy or not. The price-level targeting rule is not the first candidate to describe the actual monetary policy. However, in a liquidity trap, as shown in Eggertsson and Woodford (2003), the price-level targeting rule can be a proxy of optimal monetary policy with history dependence.

Figure 3 shows inflation rates, the output gap, and policy rates under the price-level targeting rule.[12] We observe that inflation rates rise by more than 2 percent and the zero interest rate policy continues even after inflation rates sufficiently exceed 2 percent. This is consistent with the BOJ's inflation-overshooting commitment that allows inflation rates to stably exceed the 2 percent target. The model simulation well replicates inflation rates and the output gap.

When we include cost-push shocks to match an average inflation rate for 2021Q1–2022Q4 between the data and the model simulation as shown in Figure 4, the timing to terminate the zero interest rate policy becomes earlier and a model's fit to inflation rates, the output gap, and policy rates improves.[13] It suggests that the BOJ can cause inflation overshooting by a prolonged zero interest rate policy, and the cost-push shocks give little good luck to escape the zero interest rate policy earlier.

6 Comprehensive Robust Analysis

6.1 Anchored Two Percent Inflation Target

We change the inflation rate and the natural interest rate in the steady-state. As the BOJ's official target of the inflation rates, we set the inflation rate in the steady-state, i.e., the target rate of inflation $\bar{\pi}$, at 2 percent. This number is not supported by the data as shown in Osada and Nakazawa (2024) and Bank of Japan (2024). However, the

[12] We assume -15.45 percent of the natural rate shock and -0.99 percent of cost-push shock at time zero on a quarterly basis.

[13] We assume -14.33 percent of the natural rate shock and -1.03 percent of cost-push shock at time zero, and an additional cost-push shock of 0.15 percent at time 6 on a quarterly basis.

BOJ can consider it for the exit policy from the zero interest rate. At the same time, we set the natural interest rate in the steady-state at -1 percent, which is the lowest case in the estimation as shown in Bank of Japan (2024). Then, the steady-state nominal interest rate is the same and is given by 1 percent.

Figure 5 shows the case of the Taylor-type rule.[14] We observe a similar result as shown in Figure 1. The Taylor-type rule can not make inflation overshooting even though the zero interest rate policy continues longer. The Taylor-type rule, however, raises the inflation rates toward the end of the simulation and achieves about a 2 percent target, which gives good luck for the BOJ to terminate the zero interest rate policy after high inflation rates. Figure 6 shows the case of the price-level targeting policy.[15] We observe that inflation rates increase by more than 2 percent and the zero interest rate policy continues even after inflation rates sufficiently exceed 2 percent, as shown in Figure 3.

As another calibration, we set the natural interest rate in the steady-state at -0.5 percent, which is the baseline calibration as listed in Table 1. Then, the steady state of the nominal interest rate is set to 1.5 percent and the inflation target remains at 2 percent. Figure 7 shows the case of the Taylor-type rule. Compared to the results in Figure 5, inflation approaches 2 percent earlier, but does not result in significant overshooting, and the zero interest rate policy ends earlier. Figure 8 shows the case of the price-level targeting policy.[16] Compared to the results in Figure 6, the zero interest rate policy ends earlier but continues even after inflation rates sufficiently exceed 2 percent.

These results suggest that even when the inflation target is set at 2 percent, the findings presented in Sections 4 and 5 remain unchanged.

[14] We assume -7.50 percent of the natural rate shock and -0.85 percent of cost-push shock at time zero on a quarterly basis.

[15] We assume -15.6 percent of the natural rate shock and -1.01 percent of cost-push shock at time zero on a quarterly basis.

[16] We assume -17.57 percent of the natural rate shock and -1.03 percent of cost-push shock at time zero on a quarterly basis.

6.2 Augmented Taylor-type Rule

The analysis of the price-level targeting rule demonstrated that a rule with strong history dependence can generate inflation overshooting and earlier termination of the zero interest rate policy with a small luck of cost-push shocks.

In this section, we conduct a simulation under the augmented Taylor-type rule with strong history dependence as proposed by Reifschneider and Williams (2000) as follows:

$$\begin{aligned} i_t &= \max\left[0, \tilde{\imath}_t - \phi_z z_t\right], \\ \tilde{\imath}_t &= (1-\rho_i)\left\{i^* + \phi_\pi(\pi_t - \bar{\pi}) + \phi_x x_t\right\} + \rho_i \tilde{\imath}_{t-1}, \\ z_t &= z_{t-1} + (i_t - \tilde{\imath}_t), \end{aligned} \tag{6}$$

where $\tilde{\imath}_t$ denotes the nominal shadow rate and z_t denotes the cumulative past deviation of the nominal interest rate from the nominal shadow rate. Reifschneider and Williams (2000)'s monetary policy rule is used to compare its performance with optimal commitment policy as in Nakov (2008).[17] We set ϕ_z to 0.5 following Nakov (2008), and set ϕ_x to 0 with other parameters as given in Table 1.

Figures 9a–c show inflation rates, the output gap, and policy rates under the augmented Taylor rule from the second quarter of 2020 to the fourth quarter of 2025, as well as these Japanese data.[18] Unlike the previous simulation results based on the Taylor-type rule, we observe that inflation rates rise by more than 2 percent, and the zero interest rate policy continues even after inflation rates sufficiently exceed 2 percent. Interestingly, this result is highly similar to the simulation results of the price-level targeting rule in Figure 3.

Figures 9d–f show the result when we include cost-push shocks to match an average inflation rate for 2021Q1–2022Q4 between the data and the model simulation. This result is also highly similar to the simulation results of the price-level targeting rule in

[17] Nakata and Tanaka (2016) use Reifschneider and Williams (2000)'s monetary policy rule to analyze the effects of forward guidance.

[18] We assume −14.85 percent of the natural rate shock and −0.98 percent of cost-push shock at time zero on a quarterly basis.

Figure 4: The timing to terminate the zero interest rate policy becomes earlier, and the model's fit to inflation rates, the output gap, and policy rates is better.[19]

As Nakov (2008) mentions, the augmented Taylor-type rule has influenced US monetary policy from 2003 to 2005. Figure 9 suggests that a monetary policy rule that incorporates cumulative past information on the interest rate can be important in explaining Japan's macroeconomic behavior in the post-pandemic period. Together with the result in Section 5, we can conclude that a monetary policy with a prolonged zero interest rate policy replicates inflation overshooting and escapes a liquidity trap. It implies that the BOJ can achieve these outcomes by implementing a prolonged zero interest rate policy.

6.3 Low Elasticity of Demand to Real Interest Rate

In this section, we assume a low intertemporal elasticity of substitution of expenditure, i.e., a low elasticity of the output gap to the real interest rate. One of the reasons for the prolonged low growth in Japan is the weak demand. Following the estimate by Cashin and Unayama (2016), we set $\chi = 0.21$ for simulation.[20]

Figures 10a–c show the simulation result under the Taylor-type rule.[21] We observe a similar result as shown in Figure 1. The Taylor-type rule can not replicate overshooting even though the zero interest rate policy continues long enough. Figures 10d–f show the case where we give cost-push shocks to match an average inflation rate for 2021Q1–2022Q4 between the data and the model simulation.[22] The result contradicts the data as shown in Figure 2. The zero interest rate policy ends at a very early time, and the output gap largely decreases.

[19]We assume −13.50 percent of the natural rate shock and −1.03 percent of cost-push shock at time zero, and an additional cost-push shock of 0.18 percent at time 6 on a quarterly basis.

[20]For parameters other than χ, we use the values shown in Table 1.

[21]We assume −28.30 percent of the natural rate shock and −0.82 percent of cost-push shock at time zero on a quarterly basis.

[22]We assume −23.50 percent of the natural rate shock and −0.96 percent of cost-push shock at time zero, and an additional cost-push shock of 0.38 percent at time 6 on a quarterly basis.

Figures 11a–c show the result under the price-level targeting rule.[23] As in Figure 3, we observe that inflation rates rise by more than 2 percent, and the zero interest rate policy continues for a prolonged period. A model's fit to inflation rates, the output gap, and the nominal interest rates improves compared to Figure 3. Figures 11d–f show the case under the price-level targeting rule when we include cost-push shocks to match an average inflation rate for 2021Q1–2022Q4 between the data and the model simulation.[24] We observe that the timing to terminate the zero interest rate policy becomes earlier compared to the case of no cost-push shock.

6.4 Inflation Persistence

In this section, we analyze how the simulation results change by different inflation persistence, such as γ to 0 (purely forward-looking), 0.358 (Hirose, 2020), 0.631 (Hirose and Kurozumi, 2012), and 0.862 (Sugo and Ueda, 2008).[25] For these simulations, we replace π_t by $\pi_t - \bar{\pi}$ in the Phillips curve (2), where $\bar{\pi}$ is exogenously given anchored inflation rate and $\pi_t = \bar{\pi}$ in the steady-state.

Figures 12a–c show the result under the Taylor-type rule.[26] We observe that the rise in the inflation rate is later and the zero interest rate policy lasts longer as γ becomes larger. This indicates that higher inflation persistence leads to a longer period of deflation, requiring a longer zero interest rate policy under the Taylor-type rule. However, in all cases of γ, there is no overshooting of the inflation rate above 2 percent, and the zero interest rate policy ends earlier in the simulations than in the data.

Figures 12d–f show the case where we give cost-push shocks to match an average

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[23] We assume −28.3 percent of the natural rate shock and −0.82 percent of cost-push shock at time zero on a quarterly basis.

[24] We assume −34.11 percent of the natural rate shock and −0.99 percent of cost-push shock at time zero, and an additional cost-push shock of 0.20 percent at time 6 on a quarterly basis.

[25] For parameters other than γ, we use the values shown in Table 1.

[26] We assume −10.99, −11.11, −10.92, and −10.20 percent of the natural rate shock and −1.06, −0.97, −0.91, and −0.87 percent of cost-push shock at time zero on a quarterly basis for case of $\gamma = 0$, 0.358, 0.631, and 0.862, respectively.

inflation rate for 2021Q1–2022Q4 between the data and the model simulation.[27] We observe that, as γ becomes larger, it takes longer for inflation to exceed 2 percent, even in the presence of a positive cost-push shock. Therefore, the zero interest rate policy lasts longer as γ increases. However, similar to the result in Figure 2, the zero interest rate policy ends much earlier in the simulation than in the data, indicating that the simulation result contradicts the data.

Figures 13a–c show the result under the price-level targeting rule.[28] We observe overshooting of the inflation rate above 2 percent for all values of γ. When γ is lower, inflation overshooting occurs earlier. As γ is higher, greater inflation overshooting occurs later. The zero interest rate policy lasts longer as γ is larger, but for all values of γ, the simulation results for the nominal interest rate closely resemble the data.

Figures 13d–f show the case where we give cost-push shocks to match an average inflation rate for 2021Q1–2022Q4 between the data and the model simulation.[29] We observe that the simulation results for $\gamma = 0.862$ are consistent with the data even when including a positive cost-push shock.[30] While $\gamma = 0.358$, the zero interest rate policy ends earlier than in the data, the simulation results for the output gap and inflation rates are more consistent with the data compared to the Taylor-type rule results shown in Figures 12d–f.

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[27] We assume −5.05, −6.92, −7.18, and −5.85 percent of the natural rate shock, −1.30, −1.10, −1.01, and −0.97 percent of cost-push shock at time zero, and 0.42, 0.27, 0.24, and 0.31 percent of additional cost-push shock at time 6 on a quarterly basis for case of $\gamma = 0$, 0.358, 0.631, and 0.862, respectively.

[28] We assume −15.62, −15.62, −15.55, and −15.44 percent of the natural rate shock and −1.20, −1.11, −1.04, and −1.00 percent of cost-push shock at time zero on a quarterly basis for case of $\gamma = 0$, 0.358, 0.631, and 0.862, respectively.

[29] We assume −13.88 and −15.14 percent of the natural rate shock, −1.14 and −1.01 percent of cost-push shock at time zero, and 0.13 and 0.04 percent of additional cost-push shock at time 6 on a quarterly basis for case of 0.358 and 0.862, respectively.

[30] Due to technical constraints of the simulation, we present only the cases of γ being 0.358 and 0.862.

7 Discussion

Through our analysis, it is apparent that the BOJ successfully excludes the effect of positive cost-push shocks in implementing the exit policy. Moreover, the BOJ conducts the history-dependent policy under an inflation-overshooting commitment. A remaining question is which monetary policy rule describes the BOJ's monetary policy.

The rules shown in this paper are history dependent thanks to lagged variables. The degree of history dependence is different among the rules. In particular, the Taylor-type rule describes less history dependence than the price-level targeting rule does. The Taylor-type rule includes one lag of the policy interest rate and becomes less history dependent in a liquidity trap. This is because the nominal interest rate can not be fully below zero and loses information about past inflation rates, as shown in Sugo and Teranishi (2005). The price-level rule follows past inflation rates regardless of the zero lower bound on the nominal interest rate and can compensate for the lack of a past monetary easing policy, depending on the price level. For example, the past large negative inflation rate demands prolonged monetary easing until the price level recovers to an initial (a target) level.

Under inflation-overshooting commitment, the BOJ promises to continue monetary easing until the year-on-year CPI inflation rate stably exceeds the 2 percent target. It implies that the BOJ focuses on consecutive inflation rates, such as the average inflation rate over the past, rather than a one-time inflation rate, such as the present inflation rate. In this aspect, the BOJ's monetary policy shares a feature with the price-level targeting rule, particularly even in a liquidity trap. Then, we recognize that the BOJ continues to implement monetary easing by focusing on consecutive inflation rates, even after preceding high inflation rates, the commitment starts to work, and our inflationary expectations and actual inflation rates can rise.

8 Concluding Remarks

The Taylor-type rule and the price-level targeting rule are conventional monetary policy rules and are often interpreted as guidelines for conducting monetary policy. Using these interest rate rules, we evaluated whether an inflation-overshooting commitment can raise inflation over 2 percent to end the zero interest rate policy, or whether factors, such as cost-push shocks, luckily lead to high inflation rates, providing an opportunity to escape the liquidity trap.

Through our analyses, we show that the BOJ excludes the effect of positive cost-push shocks to implement the exit policy from the zero interest rate. Moreover, the BOJ conducts the history-dependent policy under an inflation-overshooting commitment. These two successful actions change our inflationary expectations and actual inflation rates.

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Table 1: Calibration for Japan

Parameters	Values	Explanation
β	0.9975	Discount Factor
χ	0.646	Intertemporal Elasticity of Substitution of Expenditure
ω	2.149	Elasticity of Firm's Real Marginal Cost
θ	6	Elasticity of Substitution across Goods
κ	0.0048	Elasticity of Inflation to Output Gap
α	0.875	Price Stickiness
γ	1	Degree of Inflation Persistence
ϕ_π	5	Coefficient of Inflation in Taylor Rule
ρ_i	0.842	Coefficient of Interest rate Lag in Taylor Rule
ϕ_x	0.5	Coefficient of the Output Gap in Price-level Rule
ϕ_p	1.5	Coefficient of Price in Price-level Rule
i^*	1	Steady-state Nominal Interest Rate (Annual)

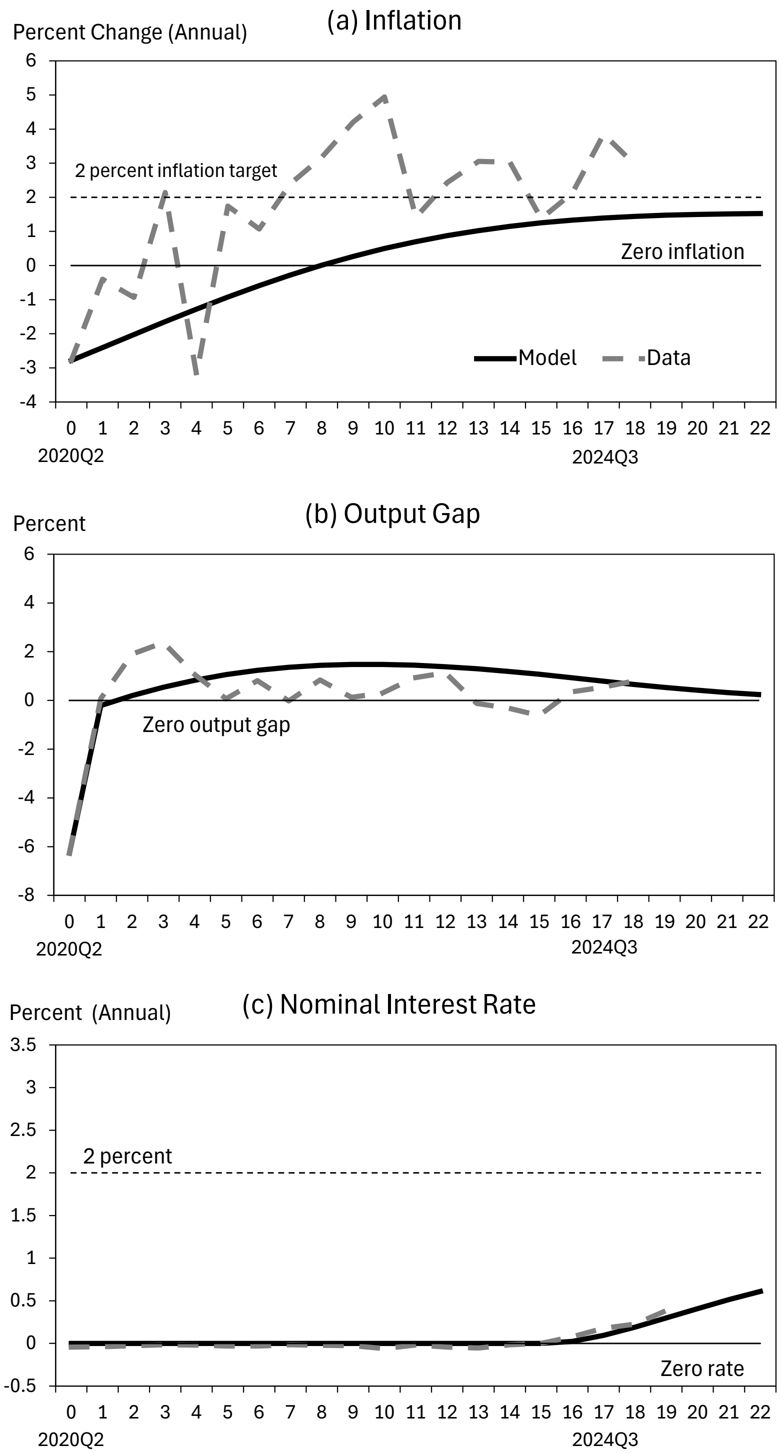

Figure 1: Taylor-type Rule

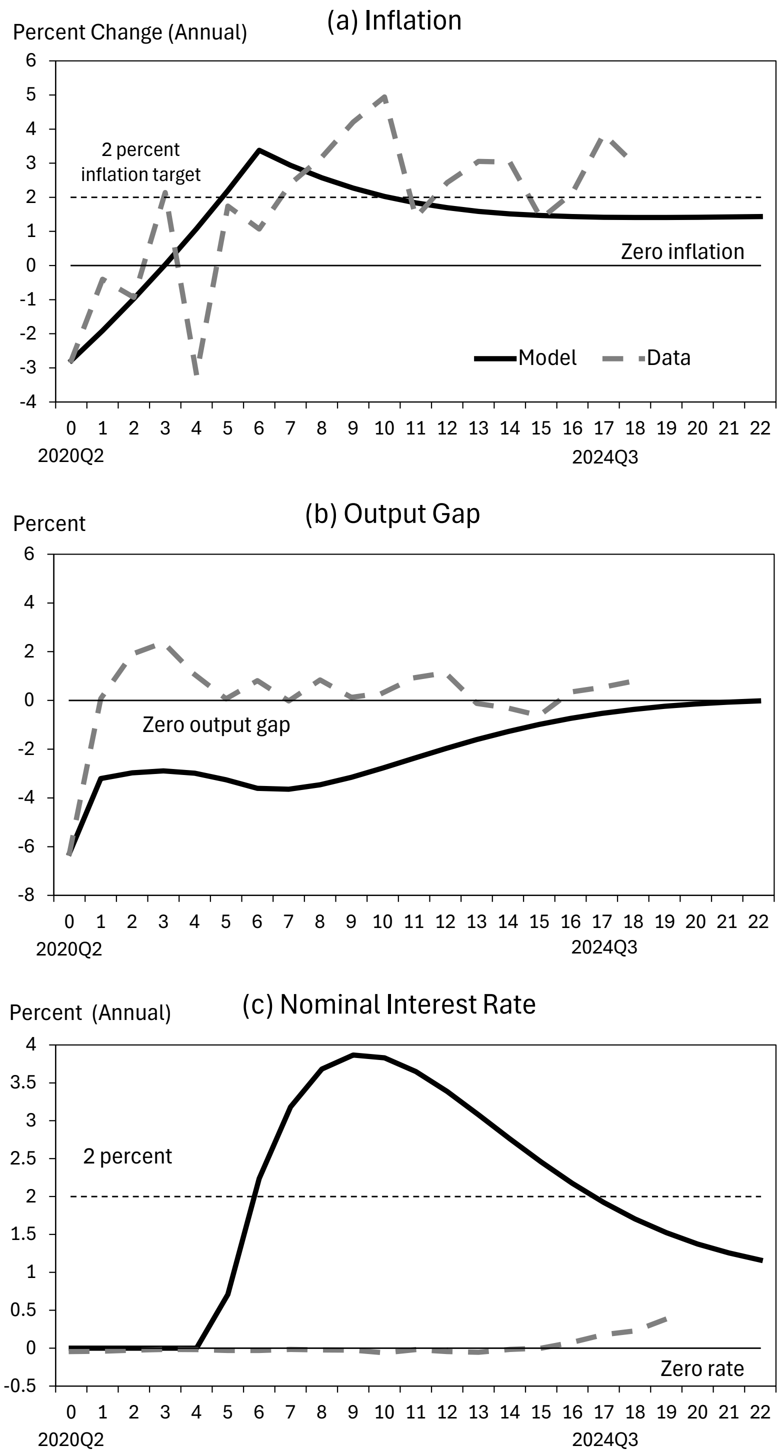

Figure 2: Taylor-type Rule with Cost-push Shock

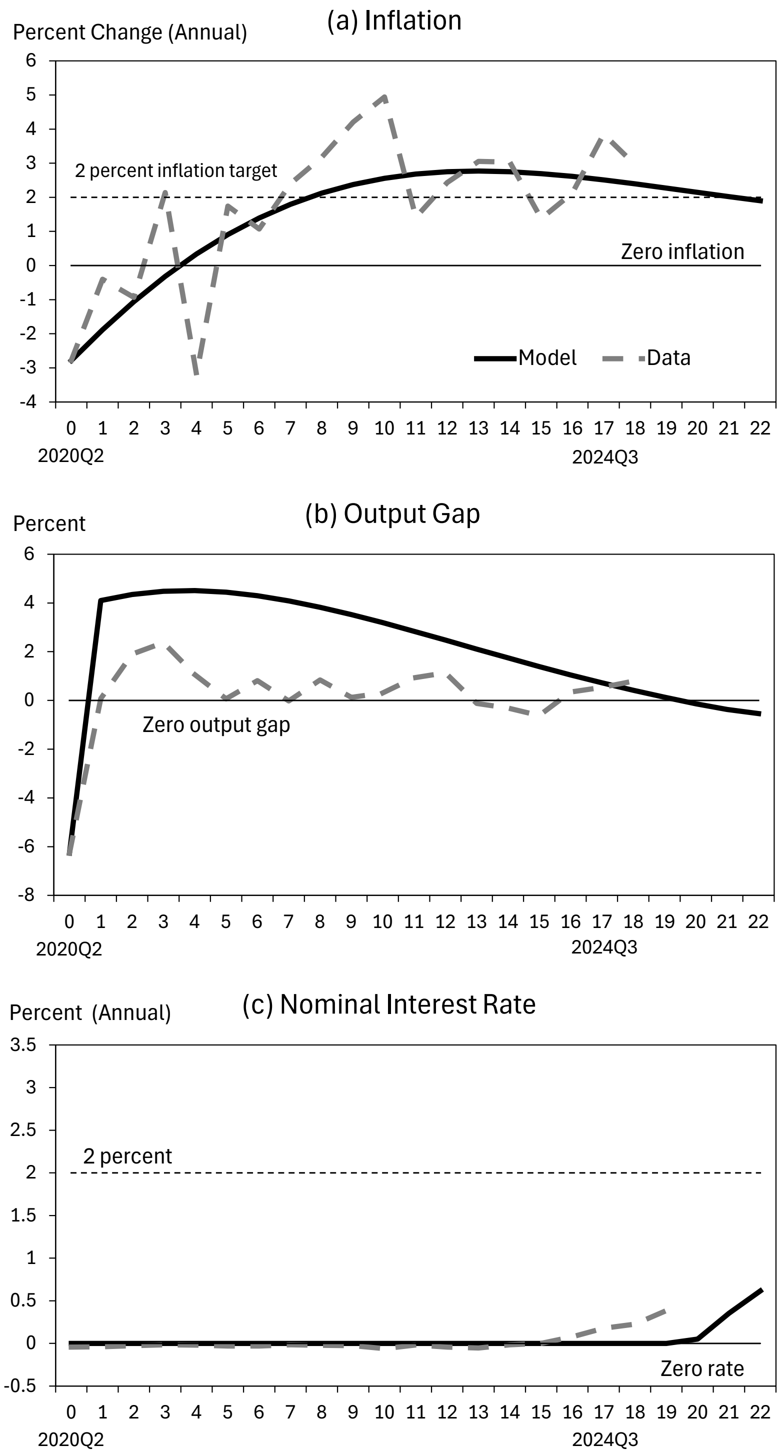

Figure 3: Price-level Targeting Rule

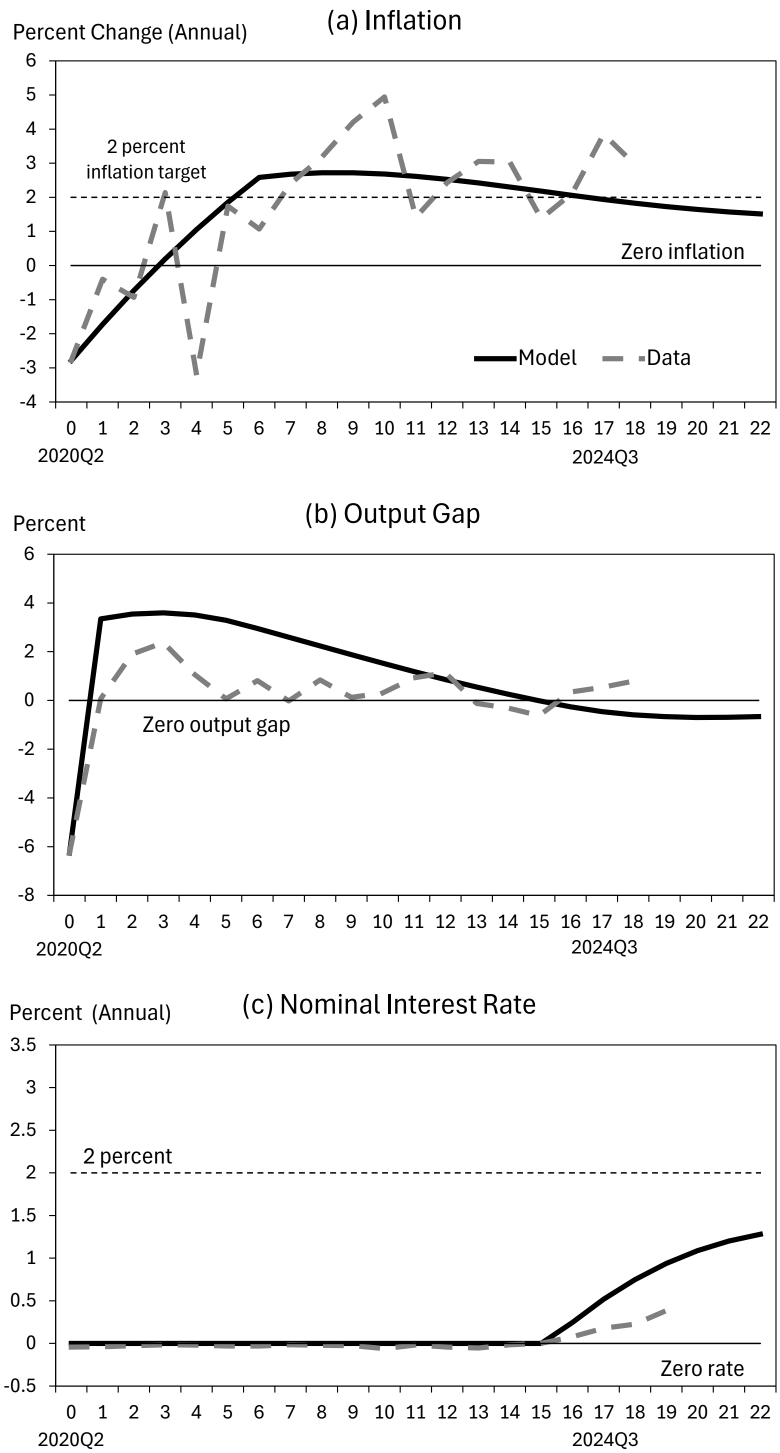

Figure 4: Price-level Targeting Rule with Cost-push Shock

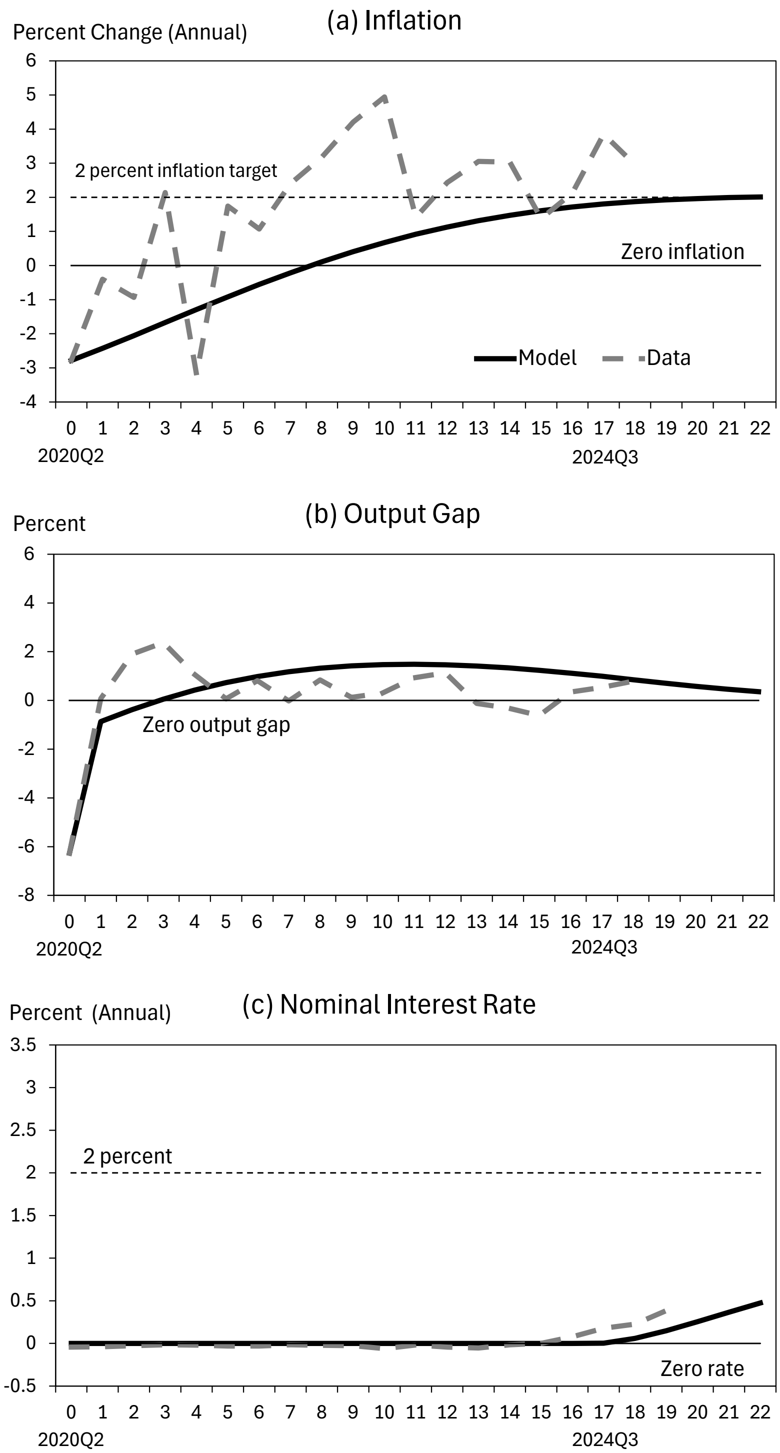

Figure 5: Taylor-type Rule under 2 Percent Target

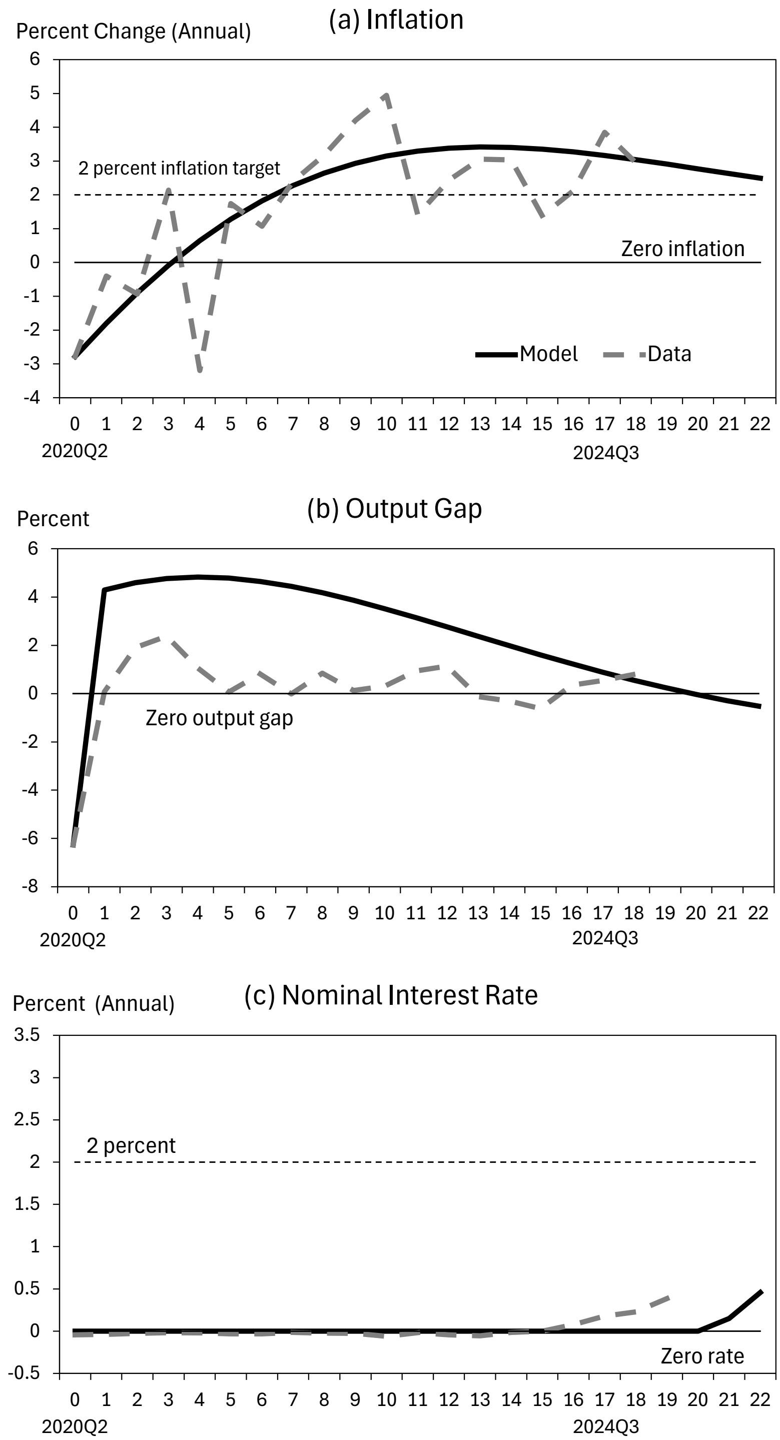

Figure 6: Price-level Targeting Rule under 2 Percent Target

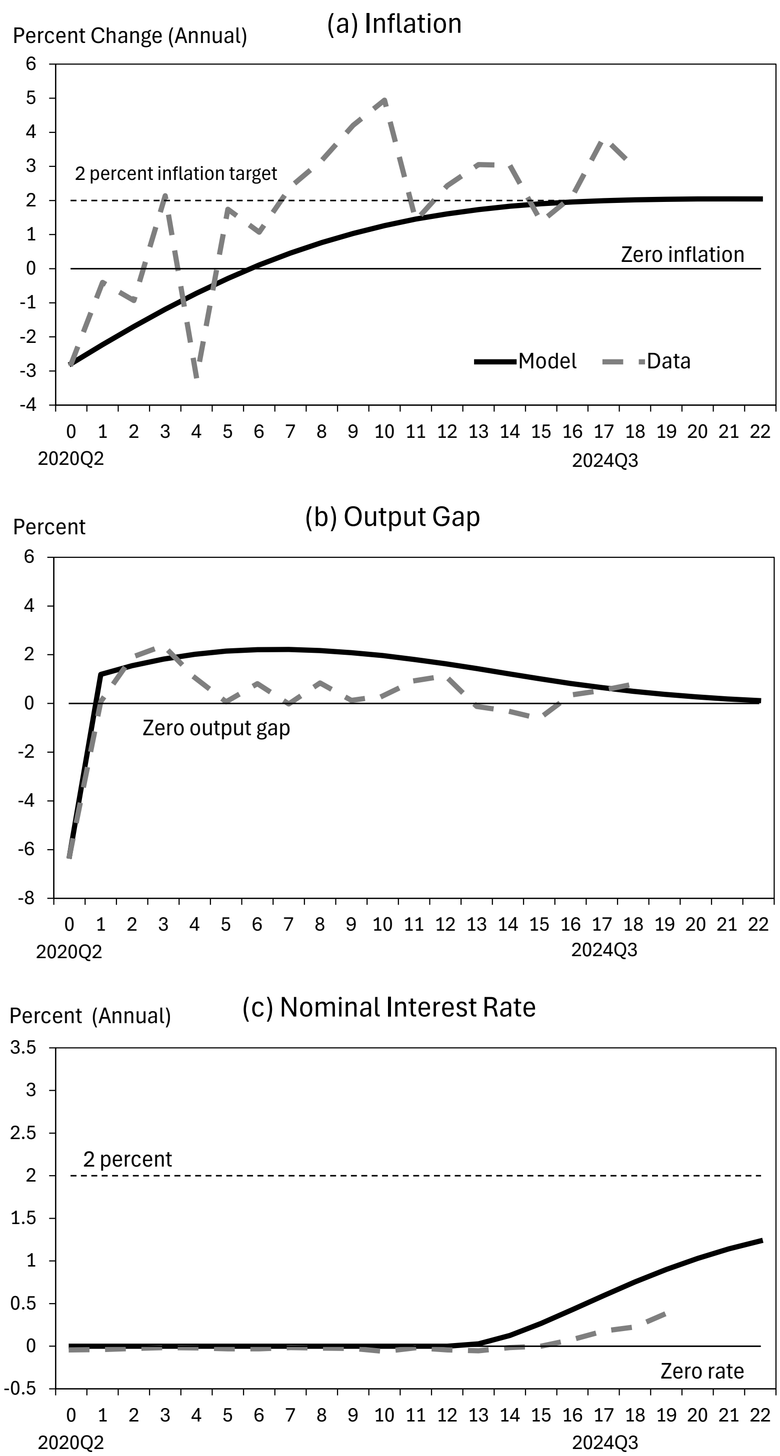

Figure 7: Taylor-type Rule under 2 Percent Target, −0.5 Percent Natural Rate, and 1.5 Percent Nominal Interest Rate

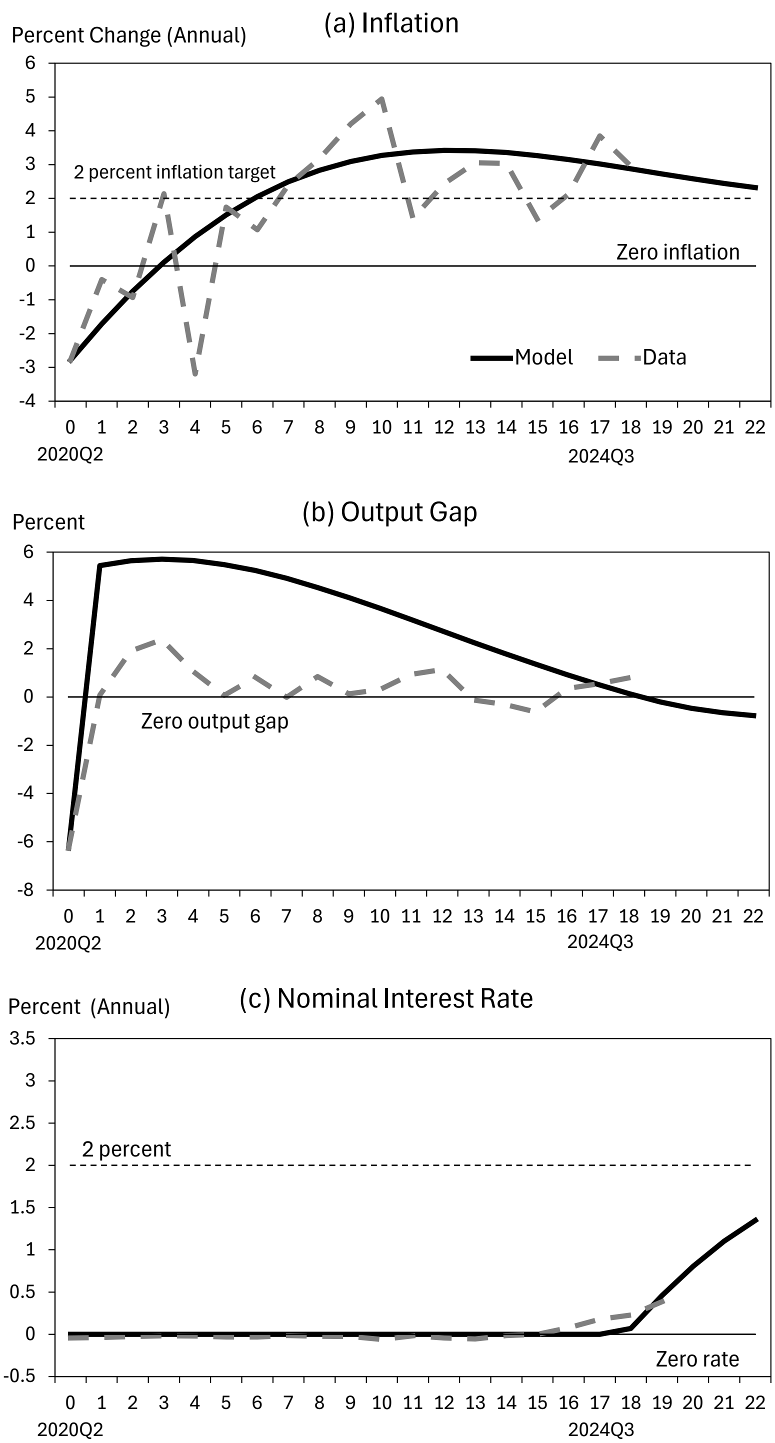

Figure 8: Price-level Targeting Rule under 2 Percent Target, −0.5 Percent Natural Rate, and 1.5 Percent Nominal Interest Rate

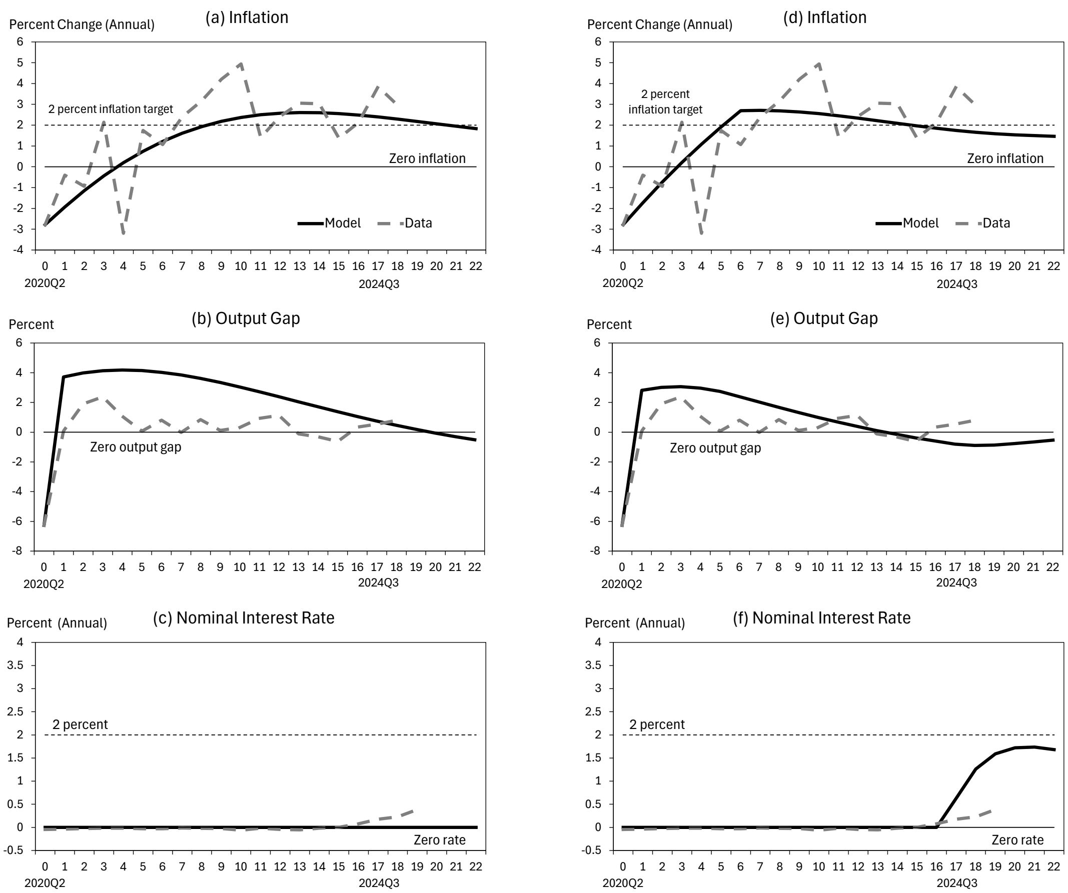

Figure 9: Augmented Taylor Rule

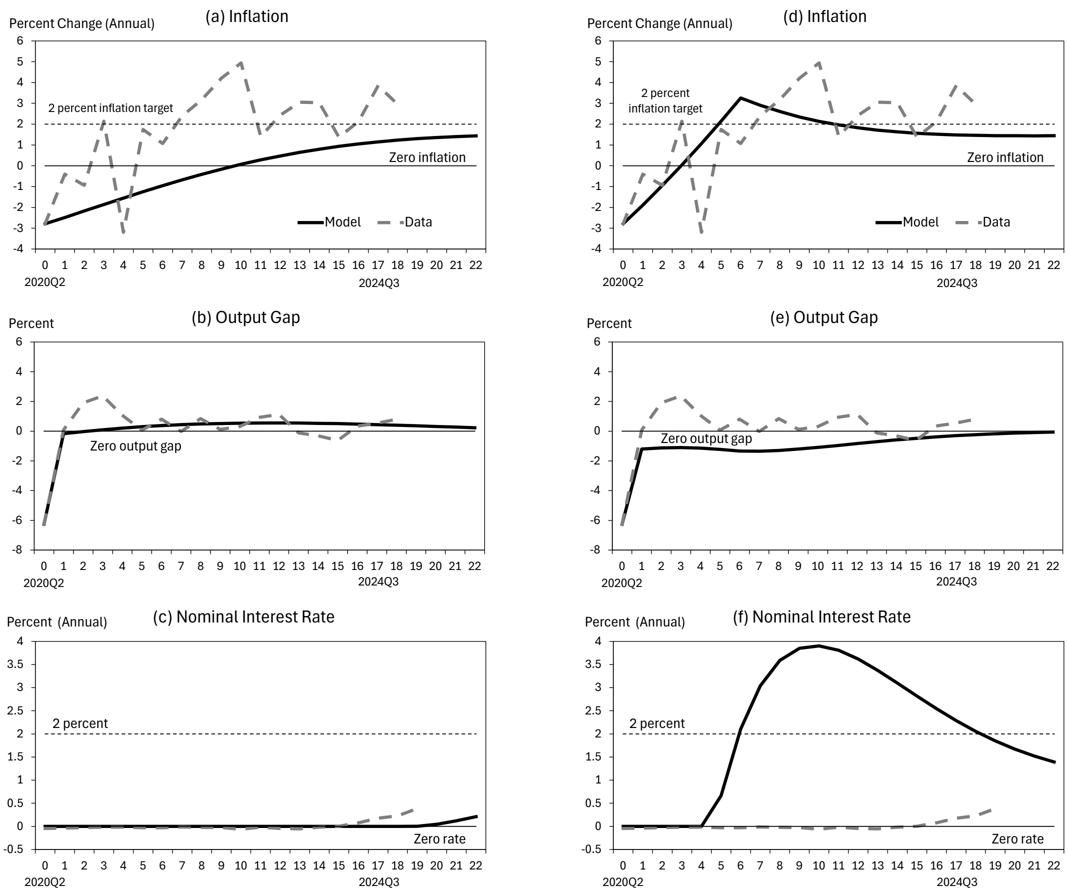

Figure 10: Taylor-type Rule: Low Elasticity of Demand to Real Interest Rate

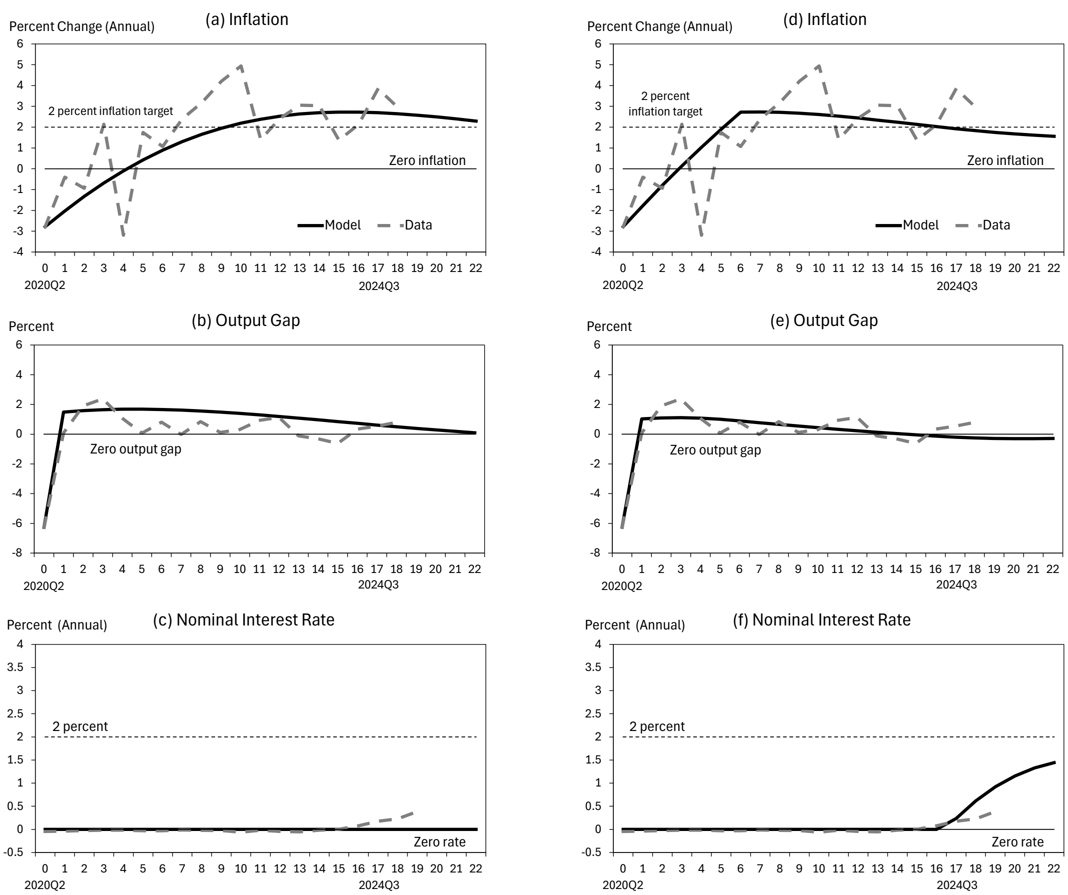

Figure 11: Price-level Targeting Rule: Low Elasticity of Demand to Real Interest Rate

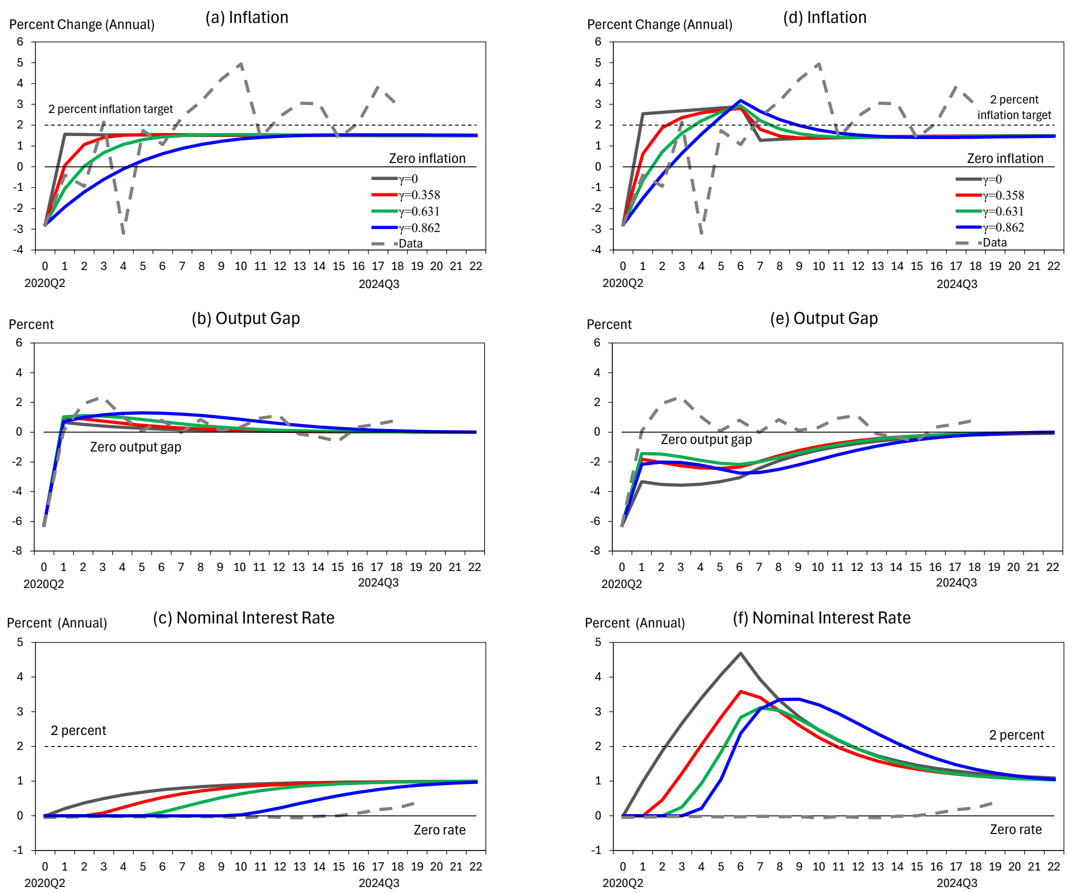

Figure 12: Taylor-type Rule: Inflation Persistence

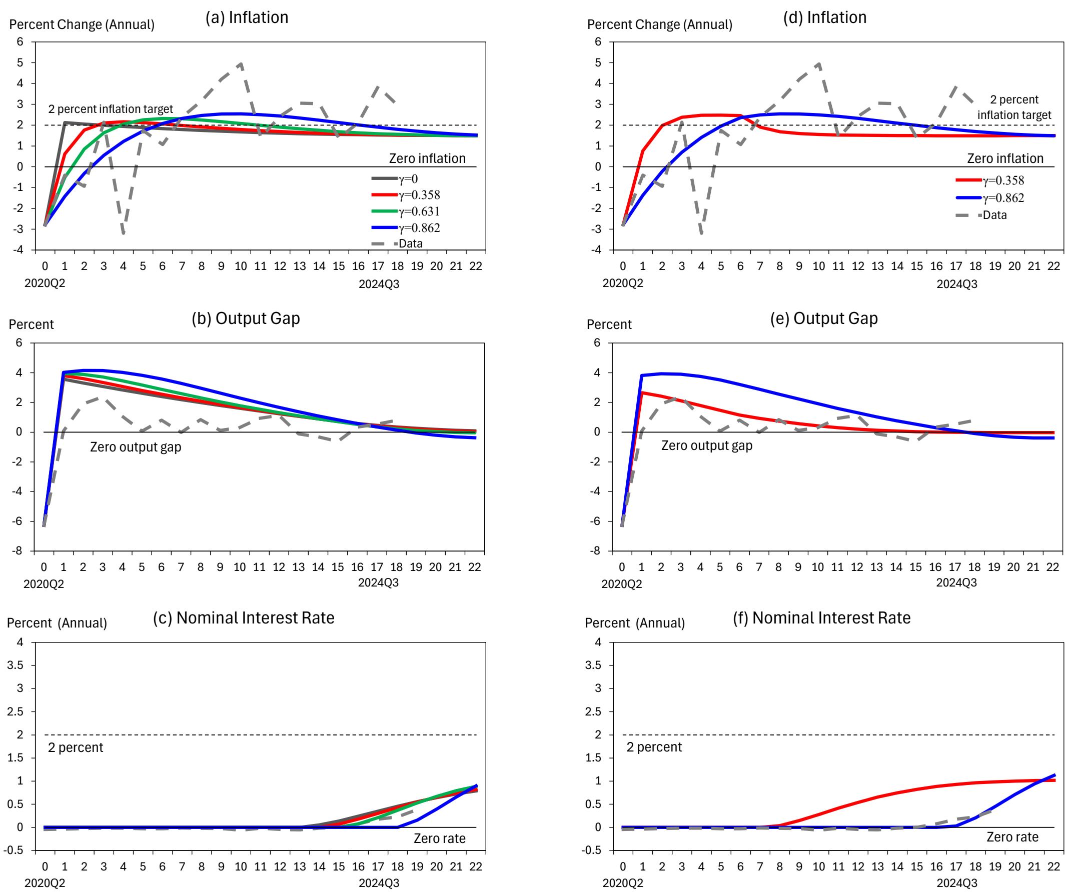

Figure 13: Price-level Targeting Rule: Inflation Persistence

Appendix

A.1 Experiments with Simple Taylor Rule

We assume a simple interest rate rule as follows to investigate whether inflation overshooting occurs:

$$i_t = \max\left[0, i^* + \phi_\pi(\pi_t - \bar{\pi})\right], \tag{A.1}$$

where we set $\phi_\pi = 5$ following Fujiwara et al. (2013) with other parameters as given in Table 1. This rule does not incorporate the commitment policy by history dependence.

Figures Aa–c show inflation rates, the output gap, and policy rates under the Taylor rule with an interest rate lag from the second quarter of 2020 to the fourth quarter of 2025, as well as these Japanese data.[31]

We observe that the Taylor rule can not replicate inflation overshooting even though the zero interest rate policy continues as the BOJ's monetary policy. Figures Ad–f show the case where we give cost-push shocks to match an average inflation rate for 2021Q1-2022Q4 between the data and the model simulation.[32] In this case, the zero interest rate policy ends in a very earlier timing and the output gap largely decreases.

[31]We assume -7.66 percent of the natural rate shock and -0.84 percent of cost-push shock at a time zero as a quarterly base. It notes that Hasui and Teranishi (2025) show a similar figure with a shorter data for Figures Aa–c.

[32]We assume 0.62 percent of the natural rate shock and 0.95 percent of cost-push shock at a time zero, and an additional cost-push shock of 0.47 percent at a time 6 as a quarterly base.

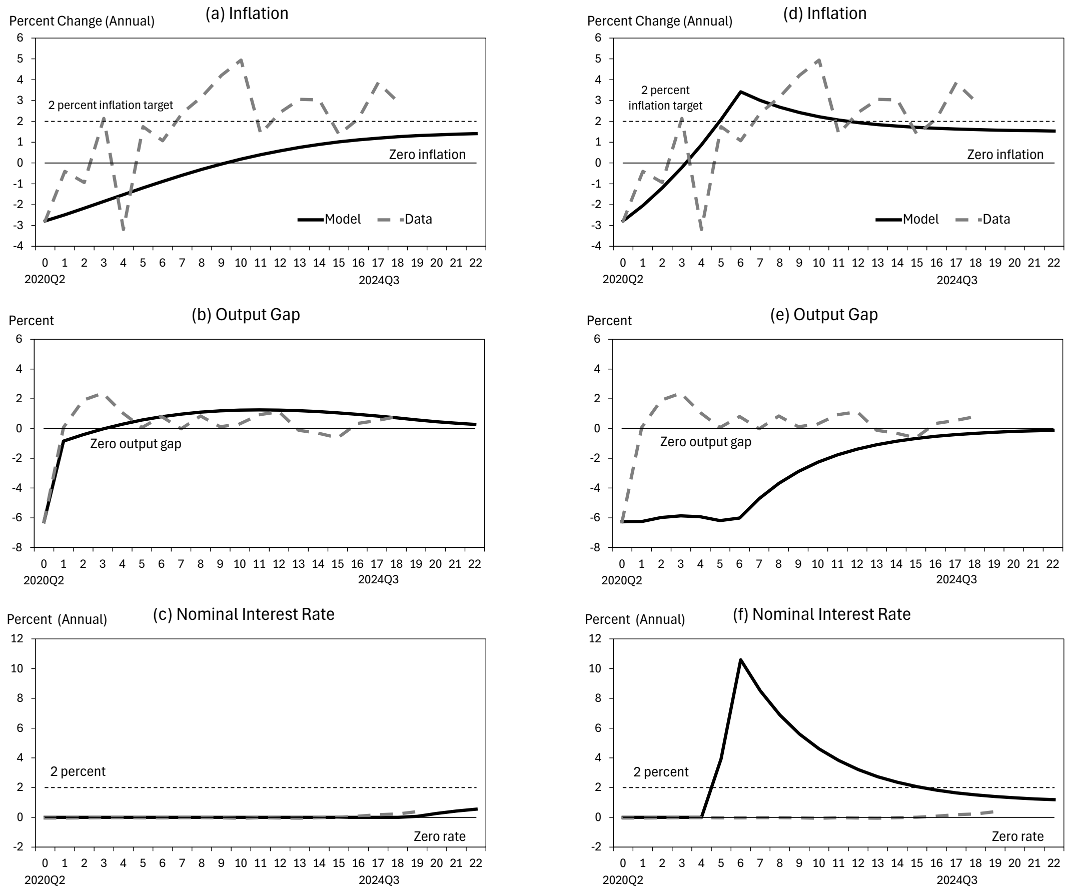

Figure A1: Taylor Rule