Fiscal Inflation in Japan: The Role of Unfunded Fiscal Shocks[*]

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Abstract

We investigate the extent to which fiscal factors have contributed to inflation in Japan over the past four decades. Despite sustained fiscal expansion and rising debt since the 1990s, inflation remained low until recent years. Using the medium-scale DSGE model developed by Bianchi et al. (2023), we estimate the model with Japanese data and find that, in contrast to the U.S. case, unfunded fiscal shocks are not the main drivers of inflation in Japan. Instead, real demand and supply shocks, along with accommodative monetary policy, have played more significant roles in shaping inflation dynamics.

Keywords: Inflation; Fiscal Theory of Price Level; Japan.

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1 Introduction

We investigate the extent to which fiscal factors have contributed to inflation in Japan over the past four decades, encompassing the bubble economy and the so-called "lost three decades." Figure 1 plots the inflation rate and the debt-to-GDP ratio for Japan and the United States. In Japan, a prolonged period of low inflation has persisted since the bursting of the asset price bubble in the early 1990s, despite the Bank of Japan's implementation of large-scale monetary easing. More recently, after the COVID-19 pandemic crisis in 2020, signs of rising inflation have emerged amid global inflationary pressures; however, it remains uncertain whether this trend will be sustained.

Throughout this period, Japan's government debt has steadily increased, accompanied by repeated large-scale fiscal stimulus measures. Concerns about the sustainability of public finances may give rise to inflation, as suggested by the Fiscal Theory of the Price Level (FTPL) (among many others, Sargent and Wallace, 1981; Leeper, 1991; Sims, 1994; Woodford, 1994; Cochrane, 1999). Thus, analyzing fiscal determinants of inflation is essential not only for understanding the current inflationary environment, but also for explaining the persistently low inflation observed in the past.

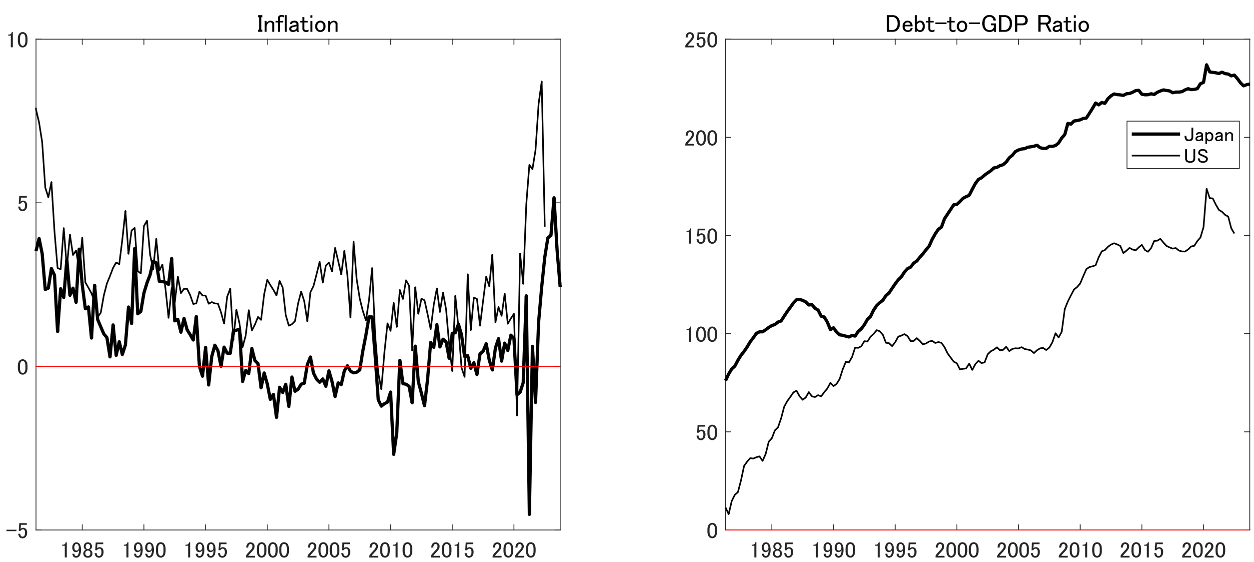


Figure 1. Inflation and Debt-to-GDP ratio: Japan vs. US.

We employ a new general equilibrium model to examine the fiscal origins of inflation in Japan. The model demonstrates that inflation can be driven by shocks to government transfers that lack future repayment guarantees, under which the Ricardian equivalence does not hold. We refer to such shocks as *unfunded fiscal shocks*.

Using the estimated model based on Japanese data, we find that the historical dynamics of inflation can be summarized as follows. Excluding the bubble period, unfunded fiscal shocks have exerted upward pressure on inflation. However, the inflation rate remained low, primarily due to demand and supply shocks in the real economy. These non-policy shocks account for much of the recent increase in inflation in the post-pandemic period. Other policy shocks, including monetary policy shocks—especially after the Bank of Japan launched its Quantitative and Qualitative Monetary Easing (QQE) policy in 2013—have also contributed to maintaining inflation.

A closely related study, Bianchi et al. (2023) (hereafter BFM), estimates a medium-scale New Keynesian model using U.S. data and find that unfunded fiscal shocks play a central role in explaining U.S. inflation dynamics. In contrast, we estimate the same model using Japanese data and find that such shocks are not the primary drivers of inflation in Japan.

Why do shocks to government transfers without repayment guarantees potentially lead to higher inflation? Suppose there is an unexpected increase in government transfers without a corresponding future tax increase. In this case, the Ricardian equivalence fails to hold, and households perceive a rise in their permanent income.[1]

If monetary policy does not respond by tightening, household consumption and the price level increase. As a result, inflation rises, thereby stabilizing the real value of government debt. When monetary policy does not respond to inflation, it is regarded as passive (Leeper, 1991). In contrast, fiscal policy that is not accompanied by future tax hikes may generate inflation and is therefore considered active. When monetary policy is passive and fiscal policy is active, inflation is determined by fiscal policy.[2]

Our finding—that fiscal factors play a limited role in explaining inflation in Japan—relates closely to the extent to which the Ricardian equivalence holds in the Japanese context. If the Ricardian equivalence holds, households do not increase consumption in response to government transfer spending, and consequently, the price level remains unaffected. In other words, fiscal factors have a limited impact on inflation precisely because households believe that current government spending will inevitably be financed by future taxation and that government debt will not become unsustainable. However, if this belief were to erode for any reason, the Ricardian equivalence would no longer hold, and fiscal factors could begin

[1] According to the Ricardian equivalence, government spending is offset by future taxation, leaving households' permanent income—and thus their behavior—unchanged.

[2] In the standard New Keynesian framework, monetary policy is responsible for controlling inflation through adjustments in the nominal interest rate, while fiscal policy ensures debt sustainability by adjusting taxes or transfers. Under this regime, monetary policy is considered active and fiscal policy passive. In the case of funded fiscal shocks—those accompanied by credible future repayments—the central bank stabilizes inflation, and the fiscal authority maintains debt sustainability. By contrast, unfunded fiscal shocks, which lack such repayment guarantees, lead the central bank to accommodate persistent inflation in order to stabilize the real value of government debt.

to influence inflation dynamics.

Related Literature The causes of post-pandemic inflation in the United States have been widely discussed in recent literature, which can be broadly categorized into three strands: the price-wage spiral, supply chain disruptions, and fiscal policy.

Price-Wage Spiral: Blanchard and Bernanke (2023) argue that the post-pandemic inflation resulted from a sharp increase in aggregate demand driven by fiscal stimulus combined with supply constraints. In particular, tight labor market conditions led to rising wages, which subsequently pushed up service prices. Although signs of a price-wage spiral were observed, they conclude that self-reinforcing inflationary dynamics did not materialize due to well-anchored inflation expectations. Lorenzoni and Werning (2023) suggest a mechanism through which nominal wage growth can pass through to prices, but empirically they find little evidence of a sustained spiral.

Supply Chain Disruptions: Comin et al. (2023) provide empirical evidence that pandemic-induced supply chain disruptions significantly contributed to core goods inflation. Although supply shocks are transitory, their impact on inflation is found to be statistically significant.

Fiscal Policy: Bianchi and Melosi (2022) argue that fiscal stimulus during the pandemic, coupled with accommodative monetary policy, fueled inflation. They show that government spending without repayment guarantees can raise inflation expectations. Bianchi et al. (2023) estimate a medium-scale New Keynesian model using U.S. data and find that unfunded transfer shocks account for the bulk of inflation since 2021. They conclude that fiscal shocks play a more dominant role in inflation dynamics than conventional demand or supply shocks. Smets and Wouters (2024) extend the standard Smets-Wouters DSGE model to account for the effects of fiscal policy on inflation. They find that around 80% of fiscal shocks are funded, distinguishing their findings from BFM.

A few papers have examined recent developments in inflation and the role of fiscal policy in Japan. Nakamura et al. (2024) apply the Bernanke-Blanchard model to the Japanese economy. They find that the rise in inflation since 2022 is driven by supply constraints, rising import prices, and a tightening labor market that puts upward pressure on wages. Abe et al. (2019) conduct a study more closely related to the present paper. They develop a Markov-switching DSGE model to examine how different fiscal regimes affect macroeconomic outcomes. Their analysis reveals that the impact of fiscal shocks depends significantly on the prevailing policy regime, and that regime uncertainty is a key driver of macroeconomic fluctuations. However, their dataset does not cover the post-pandemic period, and inflation is not a central focus of their analysis.

The remainder of the paper proceeds as follows. Section 2 outlines the mechanism of how

FTPL works using a stylized toy model and introduces the medium-scale New Keynesian model employed for our quantitative analysis. Section 3 describes the data and estimation methodology. Section 4 presents the main results, including impulse response analyses and historical decompositions. Section 5 concludes. Additional materials—such as the model's steady-state and log-linearized equations, along with detailed descriptions of the data used—are provided in the Appendix.

2 Model

2.1 Toy Model

We illustrate how unfunded fiscal shocks can generate inflation using a simplified toy model. The baseline model, following BFM, consists of the following four equations:

$$
\begin{aligned}
\hat{r}_{n,t} &= \mathbb{E}_t \hat{\pi}_{t+1}, \\
\hat{s}_{b,t} &= \beta^{-1}[\hat{s}_{b,t-1} + \hat{r}_{n,t-1} - \hat{\pi}_t - (1-\beta)\hat{\tau}_t], \\
\hat{r}_{n,t} &= \phi \hat{\pi}_t, \\
\hat{\tau}_t &= \gamma \hat{s}_{b,t} + \zeta_t,
\end{aligned}
$$

where $\hat{r}_{n,t}$ denotes the nominal interest rate, $\hat{\pi}_t$ the inflation rate, $\hat{s}_{b,t}$ the debt-to-GDP ratio, and $\hat{\tau}_t$ the tax rate. $\beta \in (0,1)$ denotes the household's discount factor. All variables are expressed as deviations from their steady-state values. The first equation is the log-linearized Fisher equation. The second is the government's log-linearized intertemporal budget constraint. The third and fourth equations describe the monetary and fiscal policy rules, respectively. ζ_t represents an exogenous fiscal policy shock.

There are two key parameters, ϕ and γ, which determine the prevailing policy regime. When $\phi > 1$ and $\gamma > 1$, the policy mix corresponds to the Active-Monetary and Passive-Fiscal (AM/PF) regime, also known as the monetary-led regime. In contrast, when $\phi \leq 1$ and $\gamma \leq 1$, the policy mix falls under the Passive-Monetary and Active-Fiscal (PM/AF) regime, referred to as the fiscal-led regime.

We extend the baseline model to incorporate two blocks of the economy: the actual economy, which operates under a monetary-led regime, and the shadow economy, which operates under a fiscal-led regime. The variables in each regime are denoted by superscripts "M" and "F," respectively. The monetary and fiscal policy rules in each economy are specified as follows:

$$
\begin{aligned}
\hat{\tau}_t &= \gamma^M(\hat{s}_{b,t-1} - \hat{s}^F_{b,t-1}) + \gamma^F \hat{s}^F_{b,t-1} + \zeta^M_t + \zeta^F_t,\\
\hat{r}_{n,t} &= \phi^M(\hat{\pi}_t - \hat{\pi}^F_t) + \phi^F \hat{\pi}^F_t,\\
\hat{\tau}^F_t &= \gamma^F \hat{s}^F_{b,t-1} + \zeta^F_t,\\
\hat{r}^F_{n,t} &= \phi^F \hat{\pi}^F_t,
\end{aligned}
$$

where the actual economy follows a monetary-led regime with $\phi^M > 1$ and $\gamma^M > 1$, while the shadow economy follows a fiscal-led regime with $\phi^F \leq 1$ and $\gamma^F \leq 1$. In this framework, policies in the actual economy also respond to variables from the shadow economy. Both government debt and inflation in the actual economy are only partially funded; policy responses are based on funded debt, defined as $\hat{s}_{b,t-1} - \hat{s}^F_{b,t-1}$, and on funded inflation, defined as $\hat{\pi}_t - \hat{\pi}^F_t$.

Figure 2 presents the impulse responses of inflation and the debt-to-GDP ratio to funded and unfunded fiscal shocks. We set the parameters as follows: $\beta = 0.99$, $\phi^M = 2.0$, $\gamma^M = 20$, and $\phi^F = \gamma^F = 0$. In the baseline model, inflation rises in response to a negative ζ_t shock under the fiscal-led regime, in contrast to the monetary-led regime where inflation remains muted. Similarly, in the extended model, inflation increases in response only to an unfunded fiscal shock, ζ^F_t, but shows no reaction to a funded fiscal shock, ζ^M_t. These results highlight that unfunded fiscal shocks are inflationary.

In the monetary-led regime, the debt-to-GDP ratio rises. Interestingly, in the fiscally-led regime, it declines, driven by an increase in inflation and nominal GDP. We will demonstrate that this pattern also holds in the quantitative model, and we will leverage this feature to identify unfunded and funded shocks.

2.2 Medium-scale Quantitative DSGE Model

We introduce a medium-scale New Keynesian model that has been extensively examined in the literature (Smets and Wouters, 2007). The model includes saver and hand-to-mouth (HtM) households, intermediate and final goods producers, labor unions, and monetary and fiscal authorities.

2.2.1 A Summary of The Model Economy

In this subsection, we provide an overview of the model. The model employed in this paper is nearly identical to that analyzed in BFM; interested readers are encouraged to refer to their paper for further details. The steady-state and log-linearized equations of the model

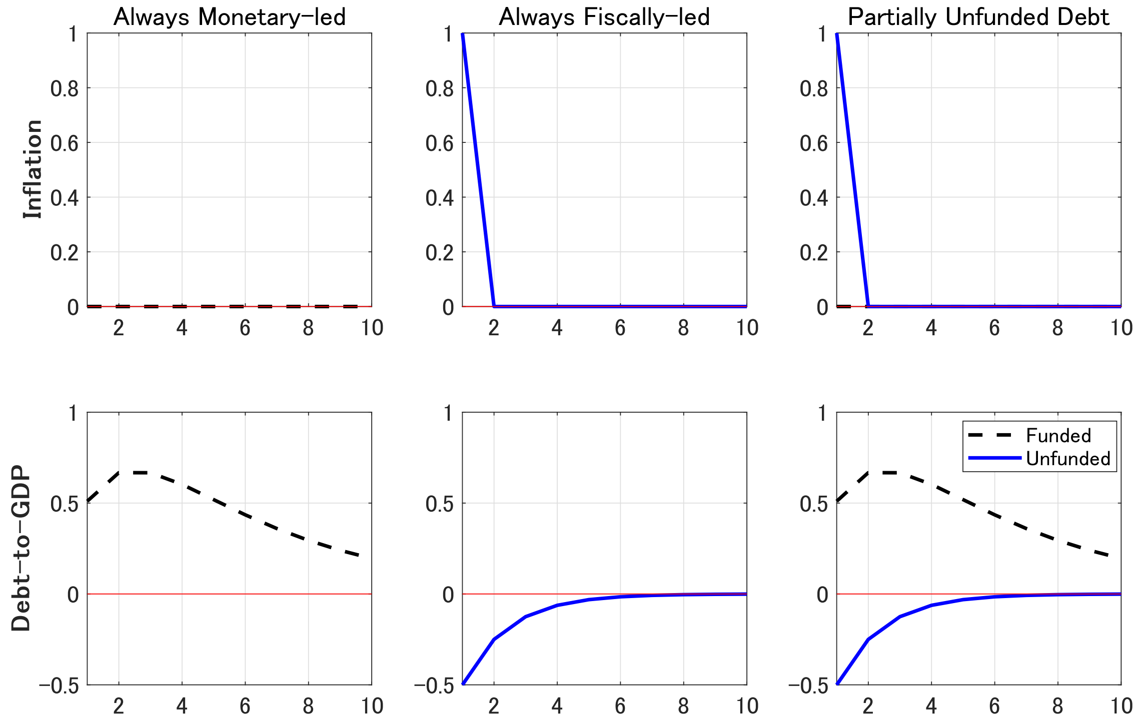


Figure 2. Impulse responses in the toy model

are presented in Appendix A.

Saver households derive utility from the difference in composite consumption—comprising private and government consumption—relative to its lagged value (external habit formation). They experience disutility from labor supply, which provides labor income. In addition, saver households invest in capital goods and earn capital income by lending them out. They also trade both short-term and long-term government bonds, earning different returns. Furthermore, they receive government transfers and dividends from firms. HtM households, by contrast, consume all of their labor income and government transfers, deriving utility from this consumption.

Final goods producers operate under perfect competition and produce final goods by aggregating differentiated intermediate goods, which they sell to households. Each intermediate goods producer uses labor and capital as inputs to produce intermediate goods. These firms set prices under monopolistic competition, and their prices can only be adjusted with a certain probability in each period. Intermediate goods prices are also partially indexed to past prices.

Saver and HtM households are organized into labor unions, which supply differentiated labor services to intermediate goods producers. As a result, households set the price of labor services (i.e., nominal wages) under monopolistic competition. Similar to intermediate goods prices, nominal wages can be adjusted only with a certain probability in each period and are partially indexed to past nominal wages.

The fiscal authority issues long-term government bonds, while short-term bonds are traded among households and net to zero. The fiscal authority also levies taxes on private consumption, labor income, and capital income, while providing income transfers and government consumption to households. Government consumption, transfers, and interest payments on long-term debt are financed through taxation and the issuance of new bonds.

Finally, the monetary authority sets the nominal interest rate according to a Taylor-type policy rule, responding to inflation and the output gap.

2.2.2 Monetary and Fiscal Policy Rules

Based on the model presented in the previous subsection, we extend the model to incorporate the actual and shadow economies, as in the toy model. Unfunded debt affects the actual economy via government variables. Specifically, in the actual economy, government consumption $\hat{g}_t$, transitory transfers $\hat{z}_t^b$, and tax rates on consumption, labor, and capital $\hat{\tau}_{J,t}$ for $J \in \{C, L, K\}$ respond only to funded debt, the total debt minus unfunded debt, $\hat{s}_{b,t-1} - \hat{s}_{b,t-1}^F$:

$$\hat{g}_t = \rho_G \hat{g}_{t-1} - (1-\rho_G)\gamma_G(\hat{s}_{b,t-1} - \hat{s}_{b,t-1}^F) + \hat{u}_t^g, \tag{1}$$

$$\hat{z}_t^b = \rho_Z \hat{z}_{t-1}^b - (1-\rho_Z)\gamma_Z[(\hat{s}_{b,t-1} - \hat{s}_{b,t-1}^F) + \phi_{zy}\hat{y}_t] + \hat{u}_t^z, \tag{2}$$

$$\hat{\tau}_{J,t} = \rho_J \hat{\tau}_{J,t-1} + (1-\rho_J)\gamma_J(\hat{s}_{b,t-1} - \hat{s}_{b,t-1}^F), \tag{3}$$

where $\rho_J \in [0, 1)$ and $\gamma_J > 0$ for $J \in \{G, Z, C, L, K\}$ show the fiscal policy is passive in the actual economy.The shocks $\hat{u}_t^g$ and $\hat{u}_t^z$ follow AR(1) processes.

Transfers have transitory and permanent components, and the permanent component is divided into funded and unfunded shocks:

$$\hat{z}_t = \hat{z}_t^b + \zeta_t^M + \zeta_t^F,$$

where ζ_t^M and ζ_t^F follow AR(1) processes. These processes are assumed to be highly persistent, reflecting the long-lasting effects of transfer shocks. As in the toy model, only unfunded transfer shocks ζ_t^F are inflationary.

Likewise, in the actual economy, the nominal interest rate responds solely to funded inflation:

$$\hat{r}_{n,t} = \rho_r \hat{r}_{n,t-1} + (1-\rho_r)\left[\phi_\pi(\hat{\pi}_t - \hat{\pi}_t^F) + \phi_y \hat{y}_t\right] + \hat{u}_t^m, \tag{4}$$

where $\phi_\pi > 1$ shows the monetary policy is active in the actual economy, and $\hat{u}_t^m$ follows an

AR(1) process.

One of the main objectives of this analysis is to examine which shocks in the model account for the long-term behavior of inflation. To this end, we assume that the long-term price markup shock, like funded and unfunded transfer shocks, follows a highly persistent AR(1) process. Specifically, we employ the following New Keynesian Phillips Curve in its log-linearized form:

$$\hat{\pi}_t = \frac{\beta}{1+\chi_p\beta}\mathbb{E}_t\hat{\pi}_{t+1} + \frac{\chi_p}{1+\chi_p\beta}\hat{\pi}_{t-1} + \kappa_p\hat{mc}_t + \kappa_p\hat{\eta}_t^p + \kappa_p\hat{u}_t^{NKPC} \tag{5}$$

where $\hat{\eta}_t^p$ denotes the short-term price markup shock, which has only transitory effects, while $\hat{u}_t^{NKPC}$ denotes the long-term price markup shock, which has permanent effects on inflation.

3 Inference

3.1 Data

For the model estimation, we use quarterly data of 10 variables for the Japanese economy from 1982:Q1 to 2023:Q4. For GDP, private consumption, private investment, wages, government consumption, and government transfers, we use the growth rates of real values deflated by the GDP deflator. The debt-to-GDP ratio is calculated as the nominal debt divided by the nominal GDP. For inflation, we use the consumer price index excluding fresh food and energy, adjusted to remove the direct effects of consumption tax hikes. Further details on the data construction are provided in Appendix B.

Figure 3 illustrates the time series of government transfers, government purchases, and the debt-to-GDP ratio. Focusing on government transfers, we observe an overall increasing trend over the sample period, with notable jumps in 1998:Q2, 2009:Q4, and 2020:Q2. These spikes correspond to fiscal responses to the 1997-1998 Japanese financial crisis, the 2008 global financial crisis, and the COVID-19 pandemic crisis in 2020, respectively.

In contrast, government purchases increased toward the end of the 1980s but declined during the middle of the 1990s, likely as a correction to the earlier expansion. Reflecting these developments, the debt-to-GDP ratio decreased slightly in the early 1990s but has exhibited a persistent upward trend since then.

For the nominal interest rate, we use the uncollateralized overnight call rate prior to 1994:Q4 and primarily the shadow rate (Krippner, 2015) from 1995:Q1 onward, as shown in Figure 4. The shadow rate is designed to capture the effects of unconventional monetary policies. The use of the shadow rate, in combination with the log-linearized structure of the

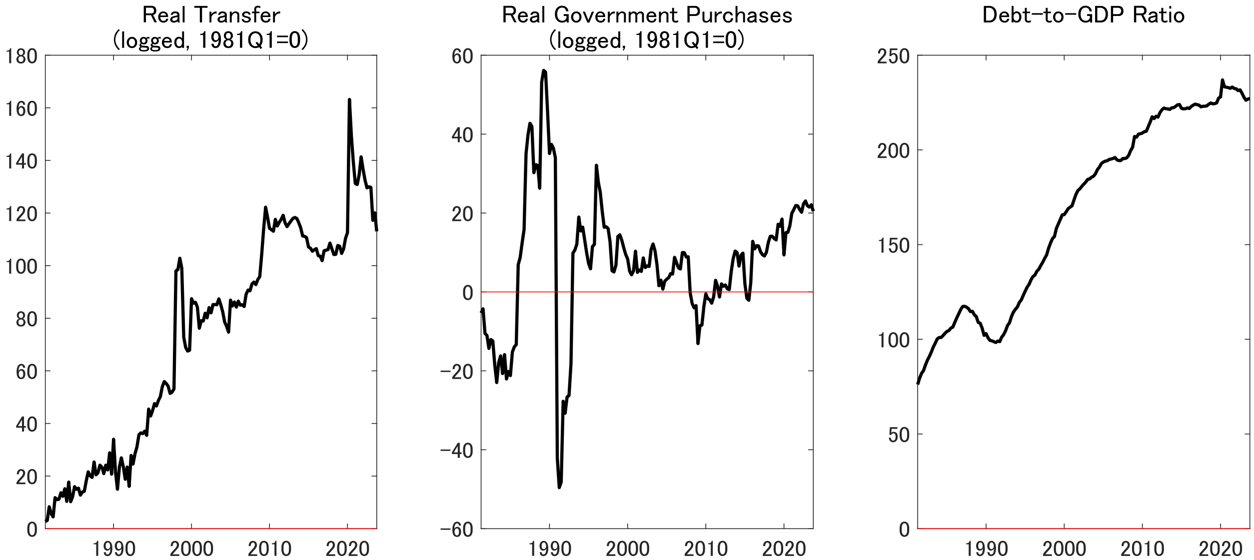


Figure 3. Fiscal variables

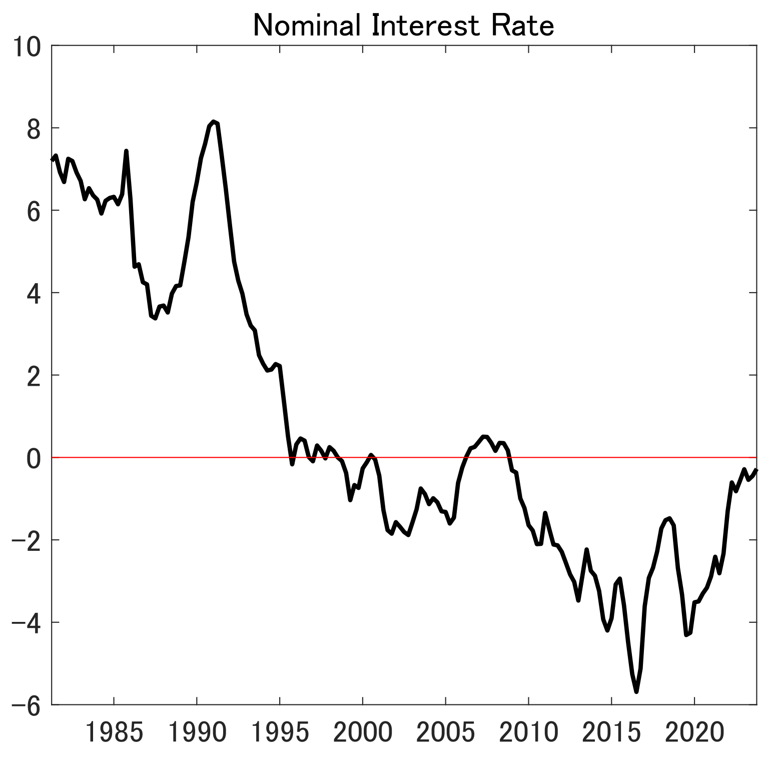


Figure 4. Nominal interest rate (Krippner, 2015)

model, enables us to apply the standard Kalman filter[3].

[3]In Section 4.3 and Appendix D, to account for potential biases in parameter estimation arising from the zero lower bound, the model is estimated using data from the period before the Japanese economy became subject to the zero lower bound.

3.2 Priors

The prior distributions are employed to estimate the structural parameters of the model using a Bayesian approach. In the estimation, some parameters are fixed or derived from steady-state relationships, as shown in Table 1. The household discount factor, β, is set to 0.99. The real interest rate in the model, $r = e^{\varkappa}/\beta - 1$, also depends on the balanced growth rate $\varkappa$, which is estimated in Section 3.3. The capital depreciation rate, δ, is set at 2.5%, and the capital share, α, at 0.33—both of which are standard values in the literature. The steady-state markup rates for wages and prices, η_w and η_p, are set to 0.14, following Leeper et al. (2017). The share of government consumption in GDP, s_{gc}, is set to 0.2.

The tax rates on labor, capital, and consumption in the steady state are set at 0.298, 0.398, and 0.10, respectively (Imrohoroglu and Sudo, 2011). In the steady state of the model, the decay rate of long-term bonds, ρ, depends on the average duration (AD) of government bonds and is given by $\rho = (1/\beta)(1 - 1/AD)$. According to the Ministry of Finance, the average maturity of Japanese government bonds is 9.2 years, which implies that the value of ρ is 0.9778.

Parameter	Value	Description
β	0.995	Discount factor (implies a 2% real interest rate)
δ	0.025	Depreciation rate (2.5%)
α	0.33	Capital elasticity of output
s_{gc}	0.20	Government expenditure-to-output ratio
η_w	0.14	Steady-state wage markup
η_p	0.14	Steady-state price markup
τ_L	0.298	Steady-state labor income tax rate
τ_K	0.398	Steady-state capital income tax rate
τ_C	0.10	Steady-state consumption tax rate
ρ	0.9778	Implied by an average bond maturity of 9.2 years

Table 1. Fixed Parameters

We estimate the remaining parameters. The left panel of Tables 2 and 3 presents the prior distributions of the structural and shock parameters, respectively. The prior distributions for macroeconomic and monetary and fiscal policy parameters are broadly consistent with BFM and are generally set to be highly diffuse.

For the long-term components of government transfers—namely, the exogenous funded and unfunded transfer shocks—the prior distributions of their autoregressive coefficients, ρ_{eZ}^{M} and ρ_{eZ}^{F}, are highly persistent and tightly concentrated, with a mean of 0.995 and a standard deviation of 0.001. This reflects the assumption that these exogenous shocks have long-lasting effects on government transfers, inflation, and other macroeconomic variables.

The prior distribution of the autoregressive coefficient for the long-term price markup, ρ_μ^{NKPC}, is also set to be highly persistent and tightly concentrated, with a mean of 0.995 and a standard deviation of 0.001. As noted earlier, one of the main objectives of this paper is to assess whether the long-term behavior of inflation is better explained by long-term price markup shocks or unfunded transfer shocks.

3.3 Posteriors

Posterior distributions are computed using the standard Random-Walk Metropolis-Hastings algorithm. A total of 200,000 draws are generated, with the first half discarded as burn-in.

The right panel of Tables 2 and 3 presents the posterior distributions of the structural and shock parameters estimated using Japanese data from the full sample period.

In what follows, we discuss the characteristics of the posterior means of the structural parameters by comparing them with estimates based on U.S. data—where, in contrast to BFM, the shadow rate is used instead of forward nominal interest rates. Additional details of the U.S. estimation results are provided in Appendix C.

The probabilities of wage and price adjustment are estimated as $1-\omega_w = 0.1831$ and $1-\omega_p = 0.0713$, respectively (compared to $1-\omega_w = 0.2534$ and $1-\omega_p = 0.0812$ in the U.S.). These imply that, on average, wages (prices) are adjusted once every 5.5 (14.5) quarters. The degree of wage indexation is very low at $\chi_w = 0.0148$ (U.S.: $\chi_w = 0.0944$), while price indexation is relatively high at $\chi_p = 0.8746$ (U.S.: $\chi_p = 0.2416$). This finding is consistent with earlier research suggesting that inflation expectations in Japan are backward-looking.

The parameter representing consumption habits is high at $\theta = 0.968$ (U.S.: $\theta = 0.99$).[4] The share of hand-to-mouth households is estimated at $\mu = 0.0904$ (U.S.: $\mu = 0.087$). The parameter representing the substitutability between government and private consumption is $\alpha_g = 0.11$ (U.S.: $\alpha_g = -0.1322$), although not statistically significant.[5]

Regarding the monetary policy rule, the parameter indicating the degree of interest rate smoothing in the Taylor rule is estimated at $\rho_e = 0.8822$ (U.S.: $\rho_e = 0.7971$). This higher value for Japan reflects the prolonged period during which the nominal interest rate remained at the zero lower bound. The response coefficients to inflation and the output gap are $\phi_\pi = 1.9785$ and $\phi_y = -0.0546$, respectively (U.S.: $\phi_\pi = 1.9729$ and $\phi_y = 0.0024$). In Japan, the response coefficient to the output gap is negative. This reflects a situation in which,

[4] This result is broadly consistent with previous findings. In BFM, the estimate is 0.91, while Leeper et al. (2017) report a value of 0.99.

[5] A negative value of this parameter indicates complementability between government and private consumption.

when the central bank tolerates fiscal-driven inflation, interest rates are kept low, thereby offsetting the interest rate's typical response to the output gap.

Regarding the fiscal policy rule, The response coefficient to the output gap is $\phi_{zy} = 0.1003$ (U.S.: $\phi_{zy} = 0.2132$). These results indicate that in Japan, income transfers are less countercyclical compared to the United States. The response coefficient of the labor income tax rate to the debt-to-GDP ratio is estimated at $\gamma_L = 0.5349$ (U.S.: $\gamma_L = 0.0185$), while the response coefficient of transfer payments is $\gamma_Z = 0.2501$ (U.S.: $\gamma_Z = 0.143$). It is worth noting that, in the baseline estimation using Japanese data, the response coefficients of the capital tax rate and government consumption to the debt-to-GDP ratio are set to zero, $\gamma_G = \gamma_K = 0$. This specification may influence the estimated values of the other response coefficients.

GDP growth experienced a sharp decline during both the 2008 global financial crisis and the 2020 COVID-19 pandemic crisis. Such abrupt contractions cannot be adequately captured by a linear Gaussian model like the one employed in this study; hence, measurement errors are introduced in the observation equation.[6] The measurement error for GDP growth is relatively large, with an estimated standard deviation of $\sigma^m_{dGDP} = 1.7266$ (U.S.: $\sigma^m_{dGDP} = 0.8882$). In addition, the measurement error for the debt-to-GDP ratio is estimated at $\sigma^m_{BY} = 0.3314$ (U.S.: $\sigma^m_{BY} = 0.3964$).

4 Results

4.1 Identification of Unfunded Transfer Shocks

In this subsection, we examine the effects of unfunded transfer shocks, funded transfer shocks, and both long- and short-term price markup shocks on the economy. Figure 5 presents the impulse responses of inflation, the real interest rate, and the debt-to-GDP ratio to these shocks. We exploit the distinct dynamics of these variables to identify the structural shocks in the model estimation.

Funded transfer shocks (dashed black line) lead to a slight fall in the inflation rate in the long run. This is due not only to the presence of hand-to-mouth households but also to the fiscal rules governing income taxes and transfers (equations (2)–(3)), which imply that taxes will ultimately finance an increase in public debt resulting from transfers.[7] Since income taxes are distortionary, such tax adjustments reduce household labor supply, thereby

[6] Appendix B presents the observation equations used in the estimation.

[7] When $\mu = 0$ (i.e., the share of non-Ricardian households) and $\gamma_G = \gamma_K = \gamma_L = 0$ (i.e., the response coefficients of fiscal rules to the debt-to-GDP ratio), the inflation rate does not respond to funded transfer shocks, as in the toy model in Section 2.1.

		Prior			Posterior		
Param.	Description	Type	Mean	Std.	Mean	5%	95%
s_b	Debt-to-GDP annualized	N	2.4	0.05	2.4912	2.4174	2.5706
$100\varkappa$	SS growth rate	N	0.5	0.05	0.4437	0.3706	0.5191
$100\ln\Pi$	SS inflation	N	0.5	0.05	0.4981	0.4229	0.5847
ξ	Inverse Frisch elasticity	G	2	0.25	1.8078	1.4747	2.1382
μ	Share of hand-to-mouth	B	0.11	0.01	0.0904	0.0769	0.1027
ω_w	Wage Calvo param.	B	0.5	0.1	0.8169	0.7925	0.84
ω_p	Price Calvo param.	B	0.5	0.1	0.9287	0.9159	0.9413
ψ	Capital util. cost	B	0.5	0.1	0.3633	0.2498	0.5002
s	Investment adj. cost	N	6	0.5	7.2435	6.4408	8.0084
χ_w	Wage infl. indexation	B	0.5	0.2	0.0148	0.0019	0.0253
χ_p	Price infl. indexation	B	0.5	0.2	0.8746	0.7962	0.9581
θ	Habits in consumption	B	0.5	0.2	0.968	0.9601	0.9761
α_G	Subs. private/gov. cons.	N	0	0.1	0.011	-0.0578	0.0832
ϕ_y	Interest response to GDP	N	0.25	0.1	-0.0546	-0.0697	-0.0397
ϕ_π	Interest response to infl.	N	2	0.1	1.9785	1.8394	2.1368
ϕ_{zy}	Transfer response to GDP	G	0.1	0.05	0.1003	0.0256	0.1696
γ_L	Labor tax response to debt	N	0.25	0.1	0.5349	0.4314	0.6386
γ_Z	Transfer response to debt	N	0.25	0.1	0.2501	0.1381	0.3694
ρ_c	AR coeff. monetary rule	B	0.5	0.1	0.8822	0.8557	0.9048
ρ_G	AR coeff. gov. cons. rule	B	0.5	0.1	0.516	0.3356	0.6907
ρ_Z	AR coeff. transfers rule	B	0.5	0.1	0.5043	0.3339	0.6575

Table 2. Priors and posteriors for the structural parameters: Japan, 1981:Q1-2023:Q4

exerting downward pressure on inflation. In Japan, the long-term contractionary effects of future tax increases outweigh the expansionary effects of higher transfers, resulting in a net decline in inflation. The deflationary effects of funded shocks may have non-negligible implications for the long-run trajectory of inflation.[8]

Unfunded transfer shocks (solid blue line) raise the inflation rate and lower the real interest rate. This occurs because the monetary authority tolerates higher inflation to stabilize the debt-to-GDP ratio. The decline in the real interest rate also boosts GDP, which further contributes to stabilizing the debt-to-GDP ratio. However, in Japan, the peak level and persistence of inflation are lower than in the United States. Approximately five years (20 quarters) after the shock, the inflation rate in Japan turns negative. In contrast, in the United States, inflation remains positive even ten years after the shock.

[8] In contrast, Figure 8 in Appendix C shows that in the United States, the inflationary effects of increased transfers dominate over time, resulting in a modest rise in inflation.

Param.	Description	Prior Type	Prior Mean	Prior Std.	Posterior Mean	Posterior 5%	Posterior 95%
ρ_{eG}	AR coeff. gov. cons	B	0.5	0.1	0.5597	0.3902	0.7059
ρ_{eZ}^{M}	AR coeff. funded trans.	B	0.995	0.001	0.9947	0.9931	0.9965
ρ_{eZ}^{F}	AR coeff. unfunded trans.	B	0.995	0.001	0.9956	0.9942	0.9972
ρ_z	AR coeff. short-term trans.	B	0.5	0.1	0.4914	0.3173	0.6563
ρ_a	AR coeff. technology	B	0.5	0.1	0.2252	0.1556	0.2978
ρ_b	AR coeff. preference	B	0.5	0.1	0.1486	0.0904	0.2012
ρ_m	AR coeff. mon. policy	B	0.5	0.1	0.4161	0.3285	0.4996
ρ_i	AR coeff. investment	B	0.5	0.1	0.9356	0.909	0.9596
ρ_{rp}	AR coeff. risk premium	B	0.5	0.1	0.888	0.8562	0.9174
$\rho_{\mu^{NKPC}}$	AR coeff. pers. cost push	B	0.995	0.001	0.9955	0.994	0.9971
σ_G	St.dev. gov. cons.	IG	0.5	0.2	5.6009	5.0488	6.1036
σ_Z^M	St.dev. funded transfers	IG	0.5	0.2	8.2328	7.5647	8.9058
σ_Z^F	St.dev. unfunded transfers	IG	0.5	0.2	1.2028	0.8425	1.57
σ_z	St.dev. short-term trans.	IG	0.5	0.2	0.4789	0.2435	0.7079
σ_a	St.dev. technology	IG	0.5	0.2	3.0106	2.7388	3.3047
σ_b	St.dev. preference	IG	0.5	0.2	43.9185	34.5751	53.836
σ_m	St.dev. mon. policy	IG	0.5	0.2	0.1424	0.1291	0.1552
σ_i	St.dev. investment	IG	0.5	0.2	0.3078	0.2524	0.3552
σ_w	St.dev. wage markup	IG	0.5	0.2	0.2742	0.2474	0.3048
σ_p	St.dev. transitory cost push	IG	0.5	0.2	0.1768	0.1606	0.1924
σ_{rp}	St.dev. risk premium	IG	0.5	0.2	0.2999	0.2519	0.3531
$\sigma_{\mu^{NKPC}}$	St.dev. persistent cost push	IG	0.5	0.2	1.0794	0.7571	1.3971
σ_{GDP}^m	Measur. error GDP	IG	0.5	0.2	1.7266	1.5865	1.8808
σ_{by}^m	Measur. error Debt/GDP	IG	0.5	0.2	0.3314	0.2379	0.4298

Table 3. Priors and posteriors for the exogenous shock parameters: Japan, 1981:Q1-2023:Q4

Long-run price markup shocks (dot-dashed red line) initially raise the inflation rate for a few quarters, followed by a decline. This is because the accompanying rise in the real interest rate depresses GDP, which in turn places downward pressure on inflation over the medium to long term. Short-run price markup shocks (dotted pink line) result in a greater rise in inflation than long-run price markup shocks, accompanied by a temporary decline in the real interest rate. Price markup shocks also lead to an increase in the debt-to-GDP ratio through a reduction in GDP.

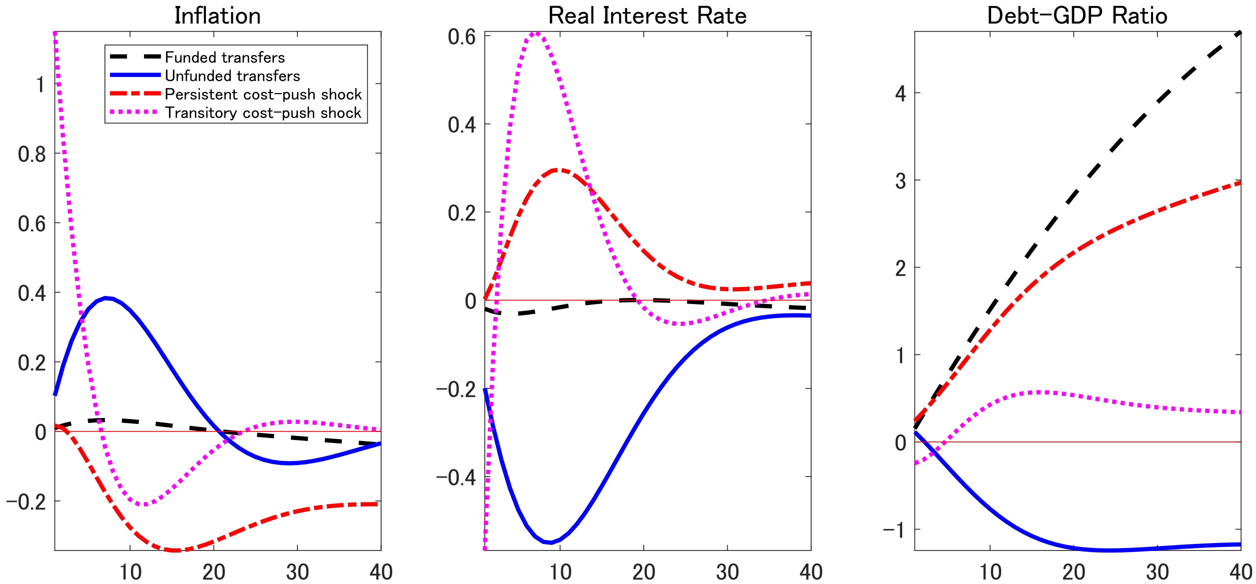


Figure 5. Impulse responses in the medium-scale model: Japan

4.2 Drivers of Inflation and GDP growth

Let us now examine the relationship between unfunded transfer shocks and the historical movements of inflation and GDP growth. Figure 6 presents a historical decomposition of inflation and GDP growth. The black bars represent the contributions of unfunded transfer shocks to changes in inflation and GDP growth. The red, blue, and gray bars indicate the contributions of monetary policy shocks, funded transfer shocks, and other policy shocks (including government consumption and short-term funded transfer shocks), respectively. The white bars represent the contributions of non-policy shocks and the steady-state component.

The main finding is that, unlike in the United States, fiscal factors have not been the primary driver of inflation dynamics in Japan.[9] In particular, the recent rise in the inflation rate since 2022 is largely explained by supply-side disturbances, such as price markup shocks. That said, unfunded transfer shocks have exerted upward pressure on inflation—except for a brief period in the early 1990s following the collapse of the asset price bubble. In contrast, funded transfer shocks have contributed to lower inflation by reinforcing fiscal credibility.[10] Moreover, monetary policy shocks have provided support to inflation, particularly after the introduction of the Bank of Japan's QQE policy in 2013. However, real economic shocks, such as demand and supply shocks, have acted as downward forces, keeping actual inflation

[9]Appendix C presents a historical decomposition of inflation for the United States, based on estimation results from a similar model. The findings of the appendix—that fiscal factors are the primary driver of inflation dynamics in the United States—are broadly consistent with the results of BFM.

[10]This finding also contrasts with the U.S. estimation results; see also the discussion in Section 4.3.

persistently low.

Regarding GDP growth, the impact of unfunded transfer shocks on the real economy has been limited, except from the late 1980s to the early 1990s, when Japan experienced the formation and subsequent collapse of the asset price bubble. In contrast, the increase in government spending in the early 1990s following the bubble collapse appears to have contributed positively to GDP growth. However, these fiscal expansions were not backed by future repayments, and the estimation results suggest that their effects were offset by unfunded transfer shocks.[11]

Figure 7, following the same approach as before, presents a historical decomposition of the debt-to-GDP ratio and income transfers. For income transfers, the cumulative sum of growth rates is used. As shown in the impulse responses in Figure 5, unfunded transfer shocks exert downward pressure on the debt-to-GDP ratio, while funded transfer shocks act as upward drivers. The decomposition suggests that in Japan, unfunded transfer shocks have played a significant role in stabilizing the debt-to-GDP ratio.

Turning to income transfers, the contribution attributable to unfunded transfer shocks has increased in recent years. However, most of the additional fiscal measures undertaken during the COVID-19 pandemic crisis are explained by funded transfer shocks. Similarly, the increases in income transfers in the 1997-1998 Japanese financial crisis and the 2008 global financial crisis are also largely accounted for by funded transfer shocks.

4.3 Robustness Checks

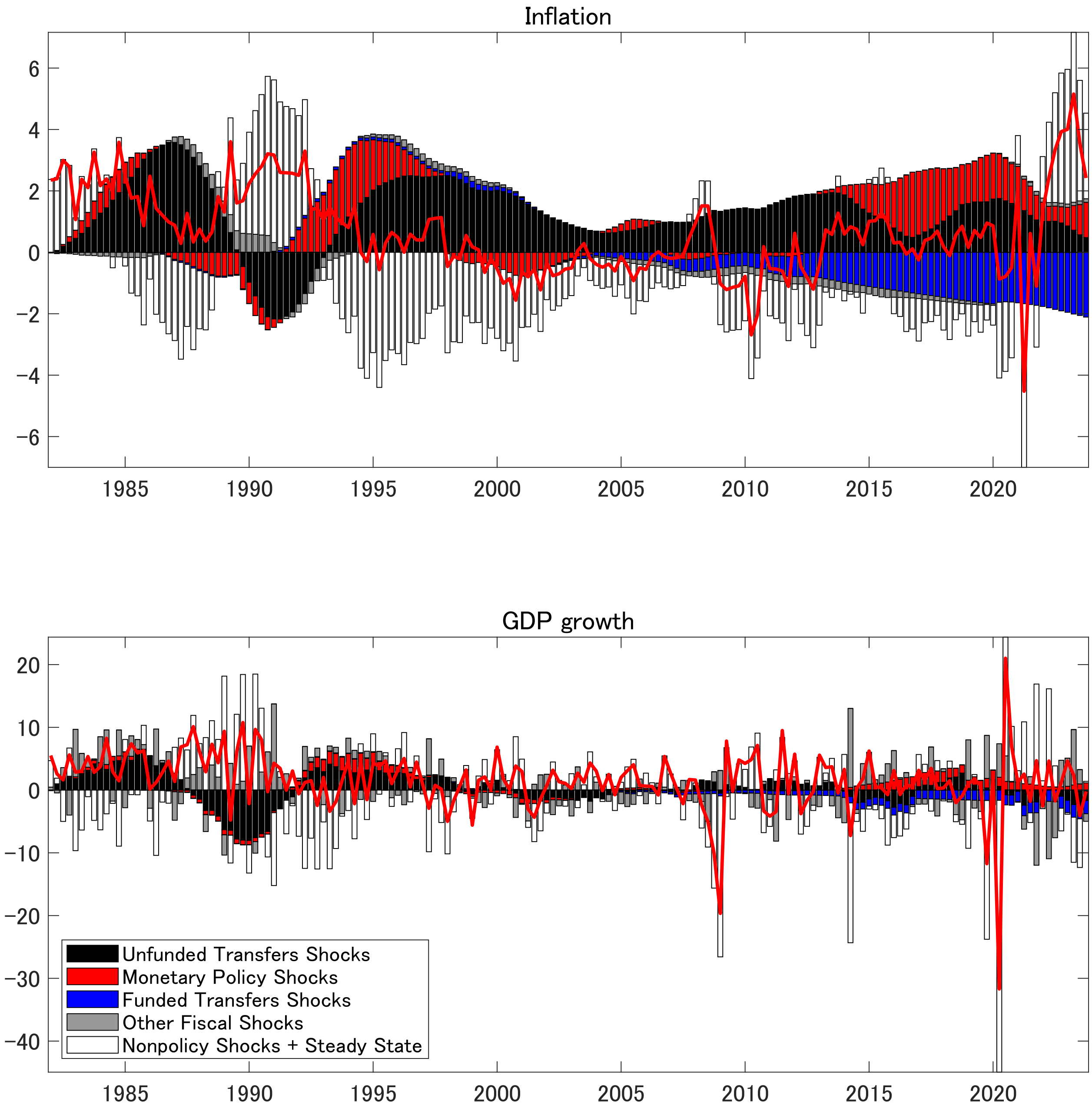
In this subsection, we conduct some robustness checks on the results obtained thus far.

Alternative Fiscal Rules: As previously discussed in Section 3.3, the baseline estimation using Japanese data imposes the restriction that the response coefficients of the capital tax rate and government consumption to the debt-to-GDP ratio are zero, i.e., $\gamma_G = \gamma_K = 0$. These parameter settings are necessary to prevent funded transfer shocks from exerting excessive downward pressure on the inflation rate.[12] However, even if these parameters were estimated rather than fixed, our main conclusion—that unfunded transfer shocks are not the primary drivers of inflation dynamics—remains unchanged.

When we relax this assumption and include these parameters in the estimation, the model yields a lower marginal likelihood of -3293.8, compared to -3291.0 in the benchmark

[11] Interestingly, in the recent post-COVID-19 period, unfunded transfer shocks have had a modest negative effect on GDP growth.

[12] Figure 5 in Section 4.1 presents that funded transfer shocks exert downward pressure on inflation in Japan. This result may suggest that funded transfer shocks end up explaining the ultra-long-term component of inflation through the gradual adjustment of fiscal instruments.



Note: Nonpolicy shocks include technology, preference, IST, risk-premium, wage markup, and short-run and long-run price markup shocks. Other policy shocks are transitory transfer and government spending shocks.

Figure 6. Drivers of Inflation and GDP growth: Japan

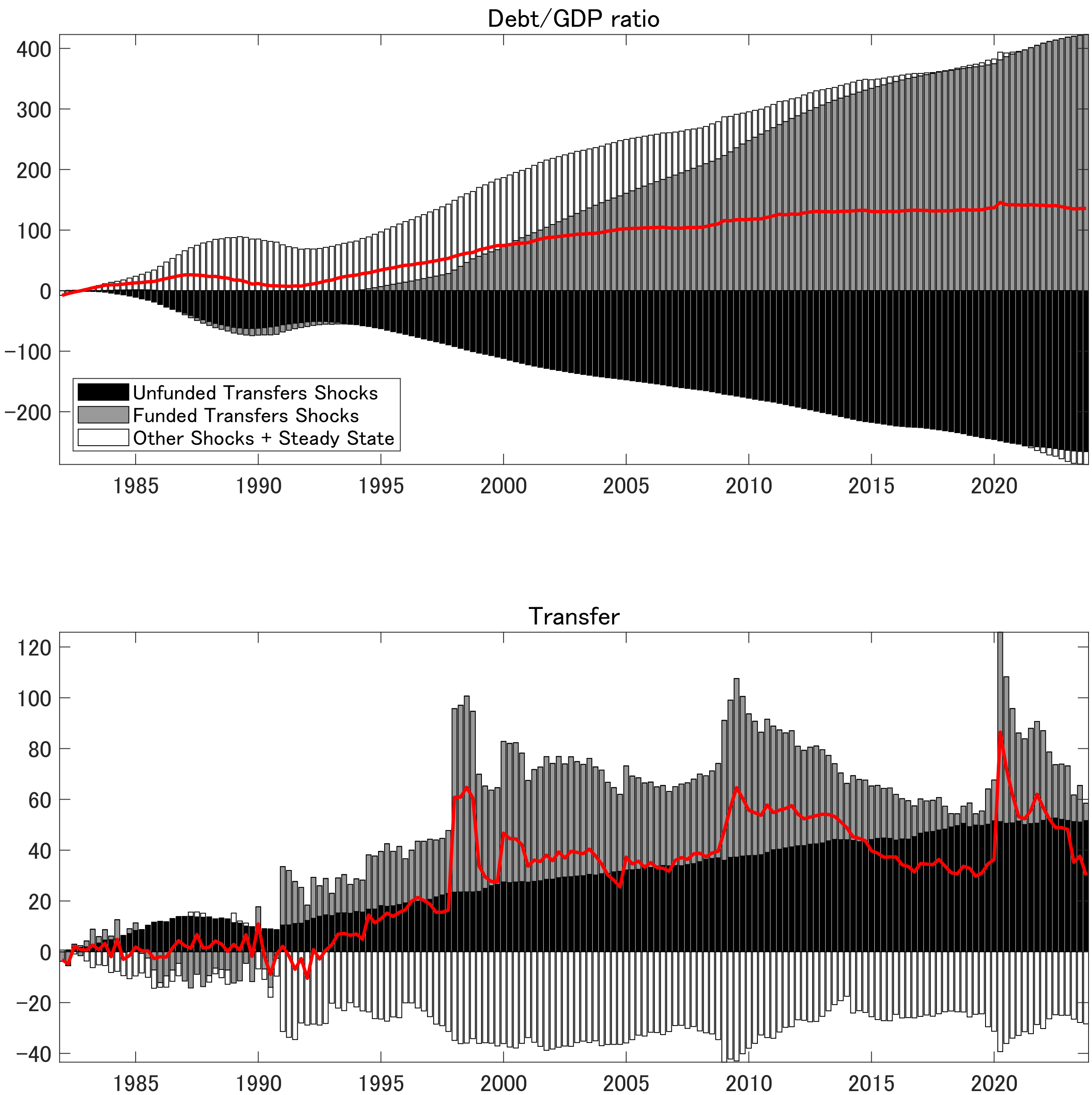


Figure 7. Drivers of Debt-to-GDP ratio and Transfers: Japan

specification. This decline in model fit suggests that the more parsimonious benchmark model better captures inflation dynamics in Japan.

Subsample Estimation: This study employs the shadow interest rate to estimate the model without explicitly accounting for the zero lower bound (ZLB) on nominal interest rates. The shadow rate incorporates the easing effects of unconventional monetary policies, such as forward guidance and quantitative easing (Wu and Xia, 2016). However, this method does not capture the nonlinear effects of the ZLB, and ignoring it may introduce biases into the estimated parameters (Hirose and Inoue, 2016; Hirose and Sunakawa, 2015).

To address this concern, a two-step estimation procedure is conducted as follows:

Step 1: Estimate the structural parameters of the model using the pre-ZLB sample period, specifically from 1982:Q1 to 1998:Q4 (sample size: 68), prior to the onset of the ZLB constraint around 1999:Q1.

Step 2: Hold all structural parameters fixed at the values estimated in Step 1—except for the autoregressive coefficients and standard deviations of the exogenous shocks—and re-estimate only the shock parameters using the full sample period (1982:Q1 to 2023:Q3; sample size: 168).

Appendix D summarizes the results from the subsample estimation. Even in this case, the main conclusion of the paper remains unchanged: unfunded transfer shocks are not the primary driver of inflation dynamics in Japan, and the rise in inflation since 2022 is mainly attributable to supply-side shocks.

5 Concluding Remarks

In this paper, we examined the role of fiscal factors in Japan's inflation dynamics using a medium-scale New Keynesian model adapted from Bianchi et al. (2023). While their analysis of U.S. data finds that unfunded fiscal shocks are key drivers of inflation, our estimation using Japanese data suggests that such shocks play a limited role. Instead, inflation in Japan has been primarily shaped by real demand and supply shocks, alongside monetary policy measures—particularly the Bank of Japan's QQE policy since 2013.

Looking ahead, we may refine the model to better reflect the macroeconomic environment in Japan. First, we could incorporate expected forward interest rates instead of the shadow rate to more accurately capture the effects of the zero lower bound and forward guidance, as discussed in Sudo and Tanaka (2021). Second, following Smets and Wouters (2024), we may consider fiscal shocks with partial repayment guarantees rather than relying solely on a binary distinction between funded and unfunded shocks. Finally, to account for Japan's prolonged low inflation and deflationary pressures, it may be fruitful to incorporate a framework with persistent deflation dynamics, such as that proposed by Cuba-Borda and Singh (2024). These extensions would provide a better understanding of the interaction between monetary and fiscal policies and inflation in Japan.

References

Abe, N., Fueki, T., and Kaihatsu, S. (2019). Estimating a Markov Switching DSGE Model with Macroeconomic Policy Interaction. Bank of Japan Working Paper Series 19-E-3, Bank of Japan.

Bianchi, F., Faccini, R., and Melosi, L. (2023). A Fiscal Theory of Persistent Inflation. *The Quarterly Journal of Economics*, 138(4):2127–2179.

Bianchi, F. and Melosi, L. (2022). Inflation as a Fiscal Limit. Working Paper Series WP 2022-37, Federal Reserve Bank of Chicago.

Blanchard, O. J. and Bernanke, B. S. (2023). What Caused the US Pandemic-Era Inflation? NBER Working Papers 31417, National Bureau of Economic Research, Inc.

Cochrane, J. H. (1999). A Frictionless View of US Inflation. In *NBER Macroeconomics Annual 1998, volume 13*, NBER Chapters, pages 323–421. National Bureau of Economic Research, Inc.

Comin, D., Johnson, R. C., and Jones, C. J. (2023). Supply Chain Constraints and Inflation. Finance and Economics Discussion Series 2023-075, Board of Governors of the Federal Reserve System (U.S.).

Cuba-Borda, P. and Singh, S. R. (2024). Understanding Persistent ZLB: Theory and Assessment. *American Economic Journal: Macroeconomics*, 16(3):389–416.

Hirose, Y. and Inoue, A. (2016). The Zero Lower Bound and Parameter Bias in an Estimated DSGE Model. *Journal of Applied Econometrics*, 31(4):630–651.

Hirose, Y. and Sunakawa, T. (2015). Parameter bias in an estimated DSGE model: does nonlinearity matter? CAMA Working Papers 2015-46.

Imrohoroglu, S. and Sudo, N. (2011). Will a Growth Miracle Reduce Debt in Japan? IMES Discussion Paper Series 11-E-01, Institute for Monetary and Economic Studies, Bank of Japan.

Krippner, L. (2015). A Theoretical Foundation for the Nelson–Siegel Class of Yield Curve Models. *Journal of Applied Econometrics*, 30(1):97–118.

Leeper, E. M. (1991). Equilibria under 'active' and 'passive' monetary and fiscal policies. *Journal of Monetary Economics*, 27(1):129–147.

Leeper, E. M., Traum, N., and Walker, T. B. (2017). Clearing up the fiscal multiplier morass. *American Economic Review*, 107(8):2409–54.

Lorenzoni, G. and Werning, I. (2023). Wage-Price Spirals. *Brookings Papers on Economic Activity*, 54(2 (Fall)):317–393.

Miyao, R. (2005). Use of the money supply in the conduct of japan's monetary policy: Re-examining the time series evidence. *The Japanese Economic Review*, 56(2):165–187.

Nakamura, K., Nakano, S., Osada, M., and Yamamoto, H. (2024). What Caused the Pandemic-Era Inflation?: Application of the Bernanke-Blanchard Model to Japan. Bank of Japan Working Paper Series 24-E-1, Bank of Japan.

Sargent, T. J. and Wallace, N. (1981). Some unpleasant monetarist arithmetic. *Quarterly Review*, 5(Fall).

Sims, C. A. (1994). A Simple Model for Study of the Determination of the Price Level and the Interaction of Monetary and Fiscal Policy. *Economic Theory*, 4(3):381–399.

Smets, F. and Wouters, R. (2007). Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach. *American Economic Review*, 97(3):586–606.

Smets, F. and Wouters, R. (2024). Fiscal backing, inflation and us business cycles. Technical report, CEPR Press, Paris & London., https://cepr.org/publications/dp19791.

Sudo, N. and Tanaka, M. (2021). Quantifying Stock and Flow Effects of QE. *Journal of Money, Credit and Banking*, 53(7):1719–1755.

Woodford, M. (1994). Monetary Policy and Price Level Determinacy in a Cash-in-Advance Economy. *Economic Theory*, 4(3):345–380.

Wu, J. C. and Xia, F. D. (2016). Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound. *Journal of Money, Credit and Banking*, 48(2-3):253–291.

Appendix A Model equations

The model employed in this paper is nearly identical to that analyzed in BFM; interested readers are encouraged to refer to their paper for further details.

A.1 Steady-state conditions

Given the parameter values shown in Tables 1-3, the model's steady-state conditions imply the following set of equations:

$$\begin{aligned}
&\rho = (1/\beta)(1 - 1/AD),\\
&R = (e^{\varkappa}/\beta)\Pi,\\
&P^m = 1/(R - \rho),\\
&r_K = \left(e^{\varkappa}/\beta - 1 + \delta\right)/(1 - \tau_K),\\
&\psi'(1) = r_K(1 - \tau_K),\\
&mc = 1/(1 + \eta^p),\\
&w = \left(mc(1 - \alpha)^{1-\alpha}\alpha^{\alpha} r_K^{-\alpha}\right)^{\frac{1}{1-\alpha}},\\
&k/L = (w/r_K)\alpha/(1 - \alpha),\\
&\Omega/L = (k/L)^{\alpha} - r_K(k/L) - w,\\
&y/L = (k/L)^{\alpha} - \Omega/L,\\
&i/L = \left(1 - (1 - \delta)e^{-\varkappa}\right) e^{\varkappa}(k/L),\\
&c/L = y/L(1 - s_{gc}) - i/L,\\
&z/L = \left((1 - Re^{-\varkappa})s_b - s_{gc}\right)(y/L) + \tau_C(c/L) + \tau_L w + \tau_K r_K(k/L),\\
&z^N/L = Z/L,\\
&c^N/L = \left((1 - \tau_L)w + z^N/L\right)/(1 + \tau_C),\\
&c^S/L = \left(c/L - \mu c^N/L\right)/(1 - \mu),\\
&c^{*S}/L = c^S/L + \alpha_g s_{gc}(y/L),\\
&L = \left(\frac{w(1 - \tau_L)}{(1 + \tau_C)(1 + \eta^w)}\frac{1}{(1 - \theta e^{-\varkappa})(c^{*S}/L)}\right)^{\frac{1}{1+\xi}}.
\end{aligned}$$

Note that the values of $(k, \Omega, y, i, c, z, c^N, c^S)$ are calculated by multiplying L by their corresponding ratios. Additionally, given the value of y, $b = s_b y$ and $g = s_{gc} y$ are obtained.

A.2 Log-linearized equations

We present the equations of the log-linearized model below, starting with those that describe the actual economy block. All variables with a hat symbol represent deviations from their steady-state values.

Production function:

$$\hat{y}_t = \frac{y+\Omega}{y}\left[\alpha\hat{k}_t + (1-\alpha)\hat{L}_t\right] \tag{A.1}$$

Capital-labor ratio:

$$\hat{r}_{K,t} - \hat{w}_t = \hat{L}_t - \hat{k}_t \tag{A.2}$$

Marginal cost:

$$\hat{mc}_t = \alpha\hat{r}_{K,t} + (1-\alpha)\hat{w}_t \tag{A.3}$$

Phillips curve:

$$\hat{\pi}_t = \frac{\beta}{1+\chi_p\beta}\mathbb{E}_t\hat{\pi}_{t+1} + \frac{\chi_p}{1+\chi_p\beta}\hat{\pi}_{t-1} + \kappa_p\hat{mc}_t + \kappa_p\hat{\eta}_t^p + \kappa_p\hat{u}_t^{NKPC} \tag{A.4}$$

where

$$\kappa_p = \frac{(1-\beta\omega_p)(1-\omega_p)}{\omega_p(1+\beta\chi_p)}$$

Saver household's FOC for consumption:

$$\hat{\lambda}_t^S = \hat{u}_t^b - \frac{\theta}{e^{\varkappa}-\theta}\hat{u}_t^a - \frac{e^{\varkappa}}{e^{\varkappa}-\theta}\hat{c}_t^{*S} + \frac{\theta}{e^{\varkappa}-\theta}\hat{c}_{t-1}^{*S} - \frac{\tau_C}{1+\tau_C}\hat{\tau}_{C,t} \tag{A.5}$$

where $\hat{u}_t^a = u_t^a - \varkappa$.

Public/private consumption in utility:

$$\hat{c}_t^{*S} = \frac{c^S}{c^S+\alpha_G g}\hat{c}_t^S + \frac{\alpha_G g}{c^S+\alpha_G g}\hat{g}_t \tag{A.6}$$

Euler equation:

$$\hat{\lambda}_t^S = \hat{r}_{n,t} + \mathbb{E}_t\hat{\lambda}_{t+1}^S - \mathbb{E}_t\hat{\pi}_{t+1} - \mathbb{E}_t\hat{u}_{t+1}^a + \hat{u}_t^{rp} \tag{A.7}$$

Maturity structure of debt:

$$\hat{r}_{n,t} + \hat{P}_t^m = \frac{\rho}{R}\mathbb{E}_t\hat{P}_{t+1}^m - \hat{u}_t^{rp} \tag{A.8}$$

Saver household's FOC for capacity utilization:

$$\hat{r}_{K,t} - \frac{\tau_K}{1-\tau_K}\hat{\tau}_{K,t} = \frac{\psi}{1-\psi}\hat{\nu}_t \tag{A.9}$$

Saver household's FOC for capital:

$$\hat{q}_t = \mathbb{E}_t\hat{\pi}_{t+1} - \hat{r}_{n,t} + \beta e^{-\varkappa}\left[(1-\tau_K)r_K\mathbb{E}_t\hat{r}_{K,t+1} - \tau_K r_K\mathbb{E}_t\hat{\tau}_{K,t+1} + (1-\delta)\mathbb{E}_t\hat{q}_{t+1}\right] - \hat{u}_t^{rp} \tag{A.10}$$

Saver household's FOC for investment:

$$\hat{i}_t + \frac{1}{1+\beta}\hat{u}_t^a - \frac{1}{(1+\beta)se^{2\varkappa}}\hat{q}_t - \hat{u}_t^i - \frac{\beta}{1+\beta}\mathbb{E}_t\hat{i}_{t+1} - \frac{\beta}{1+\beta}\mathbb{E}_t\hat{u}_{t+1}^a = \frac{1}{1+\beta}\hat{i}_{t-1} \tag{A.11}$$

Effective capital:

$$\hat{k}_t = \hat{\nu}_t + \hat{\bar{k}}_{t-1} - \hat{u}_t^a \tag{A.12}$$

Law of motion for capital:

$$\hat{\bar{k}}_t = (1-\delta)e^{-\varkappa}(\hat{\bar{k}} - \hat{u}_t^a) + \left[1-(1-\delta)e^{-\varkappa}\right]\left[(1+\beta)se^{2\varkappa} + \hat{i}_t\right] \tag{A.13}$$

Hand-to-mouth household's budget constraint:

$$\tau_C c^N\hat{\tau}_{C,t} + (1+\tau_C)c^N\hat{c}_t^N = (1-\tau_L)wL(\hat{w}_t + \hat{L}_t) - \tau_L wL\hat{\tau}_{L,t} + z\hat{z}_t \tag{A.14}$$

Wage equation:

$$\begin{aligned}\hat{w}_t = {} & \frac{1}{1+\beta}\hat{w}_{t-1} + \frac{\beta}{1+\beta}\mathbb{E}_t\hat{w}_{t+1} - \kappa_w\left(\hat{w}_t - \xi\hat{L}_t + \hat{\lambda}_t^S - \frac{\tau_L}{1-\tau_L}\hat{\tau}_{L,t}\right) \\ & + \frac{\chi_w}{1+\beta}\hat{\pi}_{t-1} - \frac{1+\beta\chi_w}{1+\beta}\hat{\pi}_t + \frac{\beta}{1+\beta}\mathbb{E}_t\hat{\pi}_{t+1} + \frac{\chi}{1+\beta}\hat{u}_{t-1}^a - \frac{1+\beta\chi_w - \rho_a\beta}{1+\beta}\hat{u}_t^a + \kappa_w\hat{\eta}_t^w\end{aligned} \tag{A.15}$$

where

$$\kappa_w \equiv \frac{(1-\beta\omega_w)(1-\omega_w)}{\omega_w(1+\beta)\left(1+\frac{(1+\eta_w)\xi}{\eta_w}\right)}$$

Aggregate households' consumption:

$$c\hat{c}_t = c^S(1-\mu)\hat{c}_t^S + c^N\mu\hat{c}_t^N \tag{A.16}$$

Aggregate resource constraint:

$$y\hat{y}_t = c\hat{c}_t + i\hat{i}_t + g\hat{g}_t + \psi'(1)k\hat{\nu}_t \tag{A.17}$$

Government budget constraint:

$$\begin{aligned}\frac{b}{y}(\hat{s}_{b,t} + \hat{y}_t) + \tau_K r_K \frac{k}{y}(\hat{\tau}_{K,t} + \hat{r}_K + \hat{k}_t) + \tau_L w \frac{L}{y}(\hat{\tau}_{L,t} + \hat{w}_t + \hat{L}_t) + \tau_C \frac{c}{y}\hat{c}_t \\ = \frac{1}{\beta}\frac{b}{y}(\hat{s}_{b,t-1} + \hat{y}_{t-1} - \hat{\pi}_t - \hat{P}^m_{t-1} - \hat{u}^a_t) + \frac{b}{y}\frac{\rho}{e^{\varkappa}}\hat{P}^m_t + \frac{g}{y}\hat{g}_t + \frac{z}{y}\hat{z}_t\end{aligned} \tag{A.18}$$

Fiscal Rules:

$$\hat{g}_t = \rho_G \hat{g}_{t-1} - (1-\rho_G)\gamma_G(\hat{s}_{b,t-1} - \hat{s}^F_{b,t-1}) + \hat{u}^g_t \tag{A.19}$$

$$\hat{z}^b_t = \rho_Z \hat{z}^b_{t-1} - (1-\rho_Z)\gamma_Z(\hat{s}_{b,t-1} - \hat{s}^F_{b,t-1}) + \phi_{zy}\hat{y}_t + \hat{u}^z_t \tag{A.20}$$

$$\hat{z}_t = \hat{z}^b_t + \zeta^M_t + \zeta^F_t \tag{A.21}$$

$$\hat{\tau}_{L,t} = \rho_L \hat{\tau}_{L,t-1} + (1-\rho_L)\gamma_L(\hat{s}_{b,t-1} - \hat{s}^F_{b,t-1}) \tag{A.22}$$

$$\hat{\tau}_{K,t} = \rho_K \hat{\tau}_{K,t-1} + (1-\rho_K)\gamma_K(\hat{s}_{b,t-1} - \hat{s}^F_{b,t-1}) \tag{A.23}$$

Monetary Rule:

$$\hat{r}_{n,t} = \rho_r \hat{r}_{n,t-1} + (1-\rho_r)\left[\phi_\pi(\hat{\pi}_t - \hat{\pi}^F_t) + \phi_y \hat{y}_t\right] + \hat{u}^m_t \tag{A.24}$$

The variables with the superscript F in equations (A.19) to (A.24) pertain to the shadow economy. This block mirrors equations (A.1) to (A.18), with each variable $\hat{x}_t$ replaced by $\hat{x}^F_t$, along with the following additional equations:

$$\hat{g}^F_t = \rho_G \hat{g}^F_{t-1} - (1-\rho_G)\gamma_G \hat{s}^F_{b,t-1} + \hat{u}^g_t \tag{A.25}$$

$$\hat{z}^{b,F}_t = \rho_Z \hat{z}^{b,F}_{t-1} - (1-\rho_Z)\gamma_Z \hat{s}^F_{b,t-1} + \phi_{zy}\hat{y}^F_t + \hat{u}^z_t \tag{A.26}$$

$$\hat{z}^F_t = \hat{z}^{b,F}_t + \zeta^F_t \tag{A.27}$$

$$\hat{\tau}^F_{L,t} = \rho_L \hat{\tau}^F_{L,t-1} + (1-\rho_L)\gamma_L \hat{s}^F_{b,t-1} \quad (A.28)$$

$$\hat{\tau}^F_{K,t} = \rho_K \hat{\tau}^F_{K,t-1} + (1-\rho_K)\gamma_K \hat{s}^F_{b,t-1} \quad (A.29)$$

$$\hat{r}^F_{n,t} = \rho_r \hat{r}^F_{n,t-1} + (1-\rho_r)\left[\phi_\pi \hat{\pi}^F_t + \phi_y \hat{y}^F_t\right] + \hat{u}^m_t \quad (A.30)$$

There are 48 endogenous variables, including $\{\hat{y}_t, \hat{k}_t, \hat{L}_t, \hat{r}_{K,t}, \hat{w}_t, \hat{mc}_t, \hat{\pi}_t, \hat{\lambda}^S_t, \hat{c}^{*S}_t, \hat{c}^S_t, \hat{r}_{n,t}, \hat{P}^m_t, \hat{\nu}_t, \hat{q}_t, \hat{i}_t, \hat{\bar{k}}_t, \hat{c}^N_t, \hat{c}_t, \hat{s}_{b,t}, \hat{g}_t, \hat{z}^b_t, \hat{z}_t, \hat{\tau}_{K,t}, \hat{\tau}_{L,t}\}$ along with their counterparts in the shadow economy, governed by 48 equations: (A.1)–(A.18) for the actual and shadow economies, and the policy rules in each regime, (A.19)–(A.30).

The exogenous shocks $\hat{u}^x_t$, for $x \in \{a, b, m, i, rp, \mu^{NKPC}, g, z\}$, follow AR(1) processes of the form $\hat{u}^x_t = \rho_x \hat{u}^x_{t-1} + \eta^x_t$, $\eta^x_t \sim N(0, \sigma^2_x)$. In addition, $\hat{\eta}^p_t$ and $\hat{\eta}^w_t$ are assumed to be i.i.d. normal shocks with zero mean and standard deviations σ_p and σ_w, respectively.

Appendix B Data and Sources

The observation equations, which link the observed data to the model's variables, are given by:

$$dGDP_t = \hat{y}_t - \hat{y}_{t-1} + 100\varkappa + \hat{u}^a_t + \mu^{GDP}_t$$

$$dC_t = \hat{c}_t - \hat{c}_{t-1} + 100\varkappa + \hat{u}^a_t$$

$$dI_t = \hat{i}_t - \hat{i}_{t-1} + 100\varkappa + \hat{u}^a_t$$

$$dW_t = \hat{w}_t - \hat{w}_{t-1} + 100\varkappa + \hat{u}^a_t$$

$$dZ_t = \hat{z}_t - \hat{z}_{t-1} + 100\varkappa + \hat{u}^a_t$$

$$dG_t = \hat{g}_t - \hat{g}_{t-1} + 100\varkappa + \hat{u}^a_t$$

$$HOURS_t = \hat{l}_t$$

$$CALL_t = 100 \log R + \hat{R}_t$$

$$INF_t = 100 \log \Pi + \hat{\pi}_t$$

$$BY_t = 100 \log s_b + \hat{s}_{b,t} + \mu^{by}_t$$

where the variables on the left-hand side represent the observed data: $dGDP_t, dC_t, dI_t, dW_t, dZ_t, dG_t$ denote the growth rates of real GDP, private consumption, private investment, wages, government transfer, and government consumption, respectively. $HOURS_t$ is hours worked, $CALL_t$ is the nominal interest rate, INF_t is the inflation rate, and BY_t is the debt-to-GDP ratio. μ_t^{GDP} and μ_t^{by} are the measurement errors of real GDP growth and the debt-to-GDP ratio, respectively.

Data Sources

We construct each time series as follows:

Real GDP, Private Consumption, and Private Investment *Source*: Cabinet Office, National Accounts. Data from 1994:Q1 onward are based on the 2015 benchmark. For periods prior to 1993:Q4, we construct the series by linking data using year-on-year growth rates of the quarterly data. Private investment includes private business investment, private residential investment, and changes in inventories. We deflate the series using the GDP deflator to obtain real values.

Inflation Rate *Source*: Ministry of Internal Affairs and Communications, Consumer Price Index (CPI). We use the tax-adjusted monthly CPI series (excluding fresh food and energy) from January 1990 to December 2019. For periods after January 2020 and before December 1989, we extend the series using year-on-year growth rates of the monthly data. We take the average of the monthly data to obtain the quarterly data and apply seasonal adjustment using the X12 method.

Nominal Interest Rate *Source*: Bank of Japan, Uncollateralized Call Rate; Krippner (2015). For periods prior to June 1985, we use the collateralized call rate as a proxy, following Miyao (2005). We take the average of the monthly data to obtain the quarterly data. When the uncollateralized call rate falls below 0.25% or is lower than the shadow rate, we instead use the shadow rate.

Hours Worked and Nominal Wages *Source*: Ministry of Health, Labour and Welfare, Monthly Labour Survey. We calculate hours worked by dividing the total hours worked index by the number of working days to obtain daily hours. We calculate nominal wages by dividing scheduled cash earnings by daily hours worked. We then convert both series from monthly to quarterly frequency by averaging the monthly data, and we seasonally adjust them using the X12 method. To obtain real values, we deflate the series using the GDP deflator. Finally, daily hours worked are demeaned so that their mean is zero.

Fiscal Variables *Source*: Cabinet Office, National Accounts. We use the 2023 edition of the National Accounts (2015 base, 2008 SNA) and the 2009 edition (2000 base, 1993 SNA). The latest available data extend through 2023:Q4. To construct the following data series, we follow the methodology outlined in Abe, Fueki, and Kaihatsu (2019).

Government Consumption We construct the raw series as the sum of Collective Consumption Expenditure, Gross Fixed Capital Formation (by General Government), Changes in Inventories (by General Government), and Net Purchases of Non-Produced Assets (Natural Resources), minus Net Saving.

Government Transfers We construct the raw series as the sum of Individual Consumption Expenditure, Subsidies (payable), Social Benefits Other Than Social Transfers in Kind (payable), Capital Transfers (payable minus receivable), and Other Current Transfers (payable minus receivable), minus Net Social Contributions (receivable).

We construct the quarterly series for both government consumption and government transfers prior to 1993:Q4 by linking the 2000-base data using year-on-year growth rates of the original quarterly data. For annual values, we link the series using year-on-year growth rates of the original annual data. We apply seasonal adjustment using the X12 method and deflate the series with the GDP deflator to obtain real values.

Debt-to-GDP ratio We use end-of-year values for liabilities. Quarterly values for each calendar year are constructed by linear interpolation.

Appendix C U.S. estimation results

Tables 4 and 5 show the estimation results of the parameters when using the shadow rate instead of forward interest rates for the U.S. data. The estimated values are generally consistent with those in BFM, except that the response coefficient of the capital tax rate to funded debt in the fiscal rule is significantly negative (whereas it is slightly positive in BFM). Compared to BFM, the value of the habit formation parameter is larger. In relation to this, while the persistence parameter of the preference shock is smaller, its standard deviation is substantially larger.

Figure 8 presents the impulse responses of inflation, the real interest rate, and the debt-to-GDP ratio to unfunded and funded transfer shocks, as well as long-run and short-run price markup shocks. Long-run price markup shocks elicit a stronger short-term positive response in inflation in the U.S. than in Japan. Interestingly, funded transfer shocks exert a modest positive effect on inflation.

Figure 9 shows the historical decomposition results for inflation and GDP growth. Similar to BFM, inflation dynamics are mostly explained by unfunded transfer shocks. In contrast, the contributions of funded transfer shocks and monetary policy shocks are negligible. Other non-policy shocks have exerted deflationary pressures, particularly in recent periods, consistent with the findings in BFM.

		Prior			Posterior		
Param.	Description	Type	Mean	Std.	Mean	5%	95%
s_b	Debt-to-GDP annualized	N	2.4	0.05	2.4509	2.3721	2.5235
$100\varkappa$	SS growth rate	N	0.5	0.05	0.3918	0.3216	0.4483
$100\ln\Pi$	SS inflation	N	0.5	0.05	0.4815	0.3969	0.5872
ξ	Inverse Frisch elasticity	G	2	0.25	3.1867	2.7165	3.6077
μ	Share of hand-to-mouth	B	0.11	0.01	0.087	0.0759	0.0987
ω_w	Wage Calvo param.	B	0.5	0.1	0.7466	0.7258	0.7676
ω_p	Price Calvo param.	B	0.5	0.1	0.9188	0.9056	0.9306
ψ	Capital util. cost	B	0.5	0.1	0.3335	0.2582	0.4097
s	Investment adj. cost	N	6	0.5	6.4355	5.805	7.0954
χ_w	Wage infl. indexation	B	0.5	0.2	0.0944	0.0471	0.1339
χ_p	Price infl. indexation	B	0.5	0.2	0.2416	0.1153	0.394
θ	Habits in consumption	B	0.5	0.2	0.99	0.9889	0.9914
α_G	Subs. private/gov. cons.	N	0	0.1	-0.1322	-0.3037	0.0143
ϕ_y	Interest response to GDP	N	0.25	0.1	0.0024	-0.0065	0.0104
ϕ_π	Interest response to infl.	N	2	0.1	1.9729	1.8437	2.1129
ϕ_{zy}	Transfer response to GDP	G	0.1	0.05	0.2132	0.0449	0.3721
γ_G	Gov. cons. response to debt	N	0.25	0.1	0.165	0.1287	0.2101
γ_K	Capital tax response to debt	N	0.25	0.1	-0.121	-0.2425	-0.0208
γ_L	Labor tax response to debt	N	0.25	0.1	0.0185	-0.0679	0.1152
γ_Z	Transfer response to debt	N	0.25	0.1	0.143	0.0537	0.2254
ρ_c	AR coeff. monetary rule	B	0.5	0.1	0.7971	0.7732	0.821
ρ_G	AR coeff. gov. cons. rule	B	0.5	0.1	0.2348	0.1368	0.3274
ρ_Z	AR coeff. transfers rule	B	0.5	0.1	0.3733	0.2247	0.5641

Table 4. Priors and posteriors for the structural parameters: U.S., 1960:Q1-2022:Q3

Appendix D Japanese subsample estimation results

Table 6 reports the estimation results for the structural parameters based on the subsample through 1998:Q4. Compared to the full-sample estimation results, the frequency of wage adjustment is relatively high, with $1-\omega_w = 0.2867$. The estimated value of $\alpha_G = -0.0293$ is negative—though not statistically significant—indicating that government consumption and private consumption may act as substitutes. The responsiveness of labor income taxes to

Param.	Description	Prior Type	Prior Mean	Prior Std.	Posterior Mean	Posterior 5%	Posterior 95%
ρ_{eG}	AR coeff. gov. cons	B	0.5	0.1	0.925	0.8943	0.9563
ρ_{eZ}^{M}	AR coeff. funded trans.	B	0.995	0.001	0.9954	0.994	0.9968
ρ_{eZ}^{F}	AR coeff. unfunded trans.	B	0.995	0.001	0.9957	0.9947	0.9972
ρ_z	AR coeff. short-term trans.	B	0.5	0.1	0.467	0.314	0.6151
ρ_a	AR coeff. technology	B	0.5	0.1	0.1049	0.0682	0.1575
ρ_b	AR coeff. preference	B	0.5	0.1	0.1349	0.0851	0.1832
ρ_m	AR coeff. mon. policy	B	0.5	0.1	0.264	0.21	0.3415
ρ_i	AR coeff. investment	B	0.5	0.1	0.9166	0.8972	0.9354
ρ_{rp}	AR coeff. risk premium	B	0.5	0.1	0.8971	0.876	0.9238
$\rho_{\mu^{NKPC}}$	AR coeff. pers. cost push	B	0.995	0.001	0.9961	0.995	0.9973
σ_G	St.dev. gov. cons.	IG	0.5	0.2	2.263	2.0912	2.4006
σ_Z^M	St.dev. funded transfers	IG	0.5	0.2	5.7942	5.3806	6.1867
σ_Z^F	St.dev. unfunded transfers	IG	0.5	0.2	1.4085	1.1106	1.6802
σ_z	St.dev. short-term trans.	IG	0.5	0.2	0.4715	0.2549	0.6701
σ_a	St.dev. technology	IG	0.5	0.2	2.0066	1.8738	2.1495
σ_b	St.dev. preference	IG	0.5	0.2	82.76	79.222	86.0477
σ_m	St.dev. mon. policy	IG	0.5	0.2	0.2255	0.2094	0.2438
σ_i	St.dev. investment	IG	0.5	0.2	0.515	0.4471	0.5771
σ_w	St.dev. wage markup	IG	0.5	0.2	0.4547	0.42	0.4906
σ_p	St.dev. transitory cost push	IG	0.5	0.2	0.1725	0.1554	0.1875
σ_{rp}	St.dev. risk premium	IG	0.5	0.2	0.3645	0.3028	0.424
$\sigma_{\mu^{NKPC}}$	St.dev. persistent cost push	IG	0.5	0.2	1.8101	1.3807	2.3455
σ_{GDP}^m	Measur. error GDP	IG	0.5	0.2	0.8882	0.8355	0.9423
σ_{by}^m	Measur. error Debt/GDP	IG	0.5	0.2	0.3964	0.2569	0.5253

Table 5. Priors and posteriors for the exogenous shock parameters: U.S., 1960:Q1-2022:Q3

the debt-to-GDP ratio is also modest, with $\gamma_L = 0.2741$. Table 7 presents the results for the shock parameters, estimated using the full sample while holding the structural parameters fixed. These estimates remain broadly consistent with those from the baseline specification.

Figure 10 demonstrates that the shape of the impulse response functions does not change significantly. However, the inflation response to unfunded transfer shocks is somewhat attenuated. This is also reflected in the historical decomposition of inflation in Figure 11, where the contribution of unfunded transfer shocks becomes smaller.

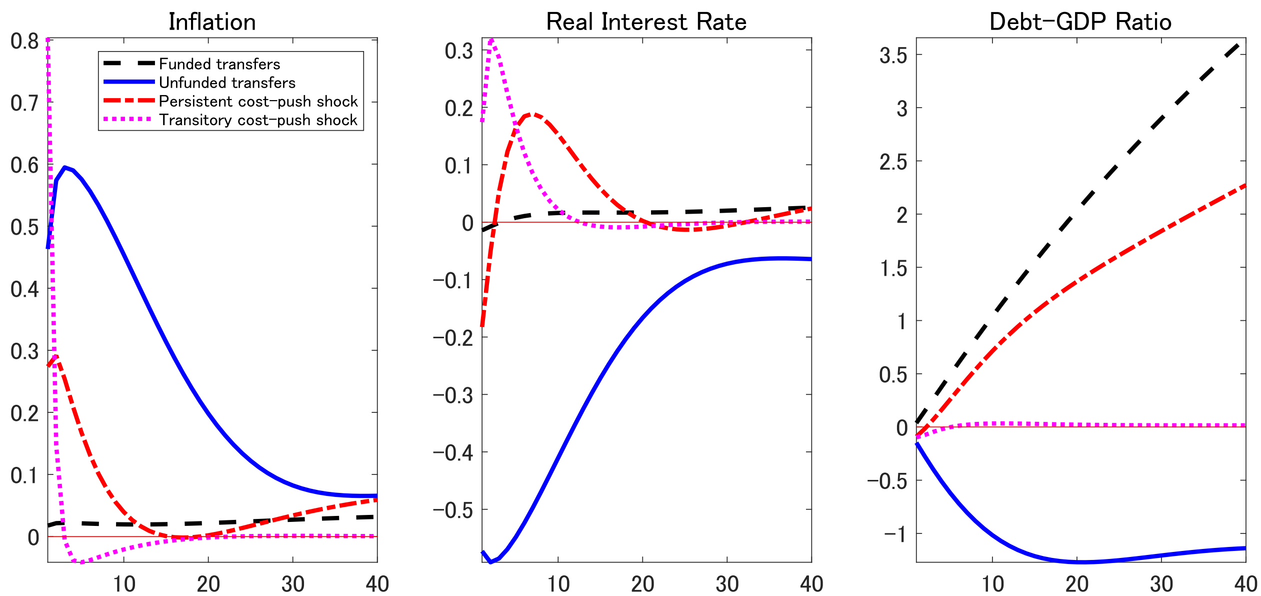
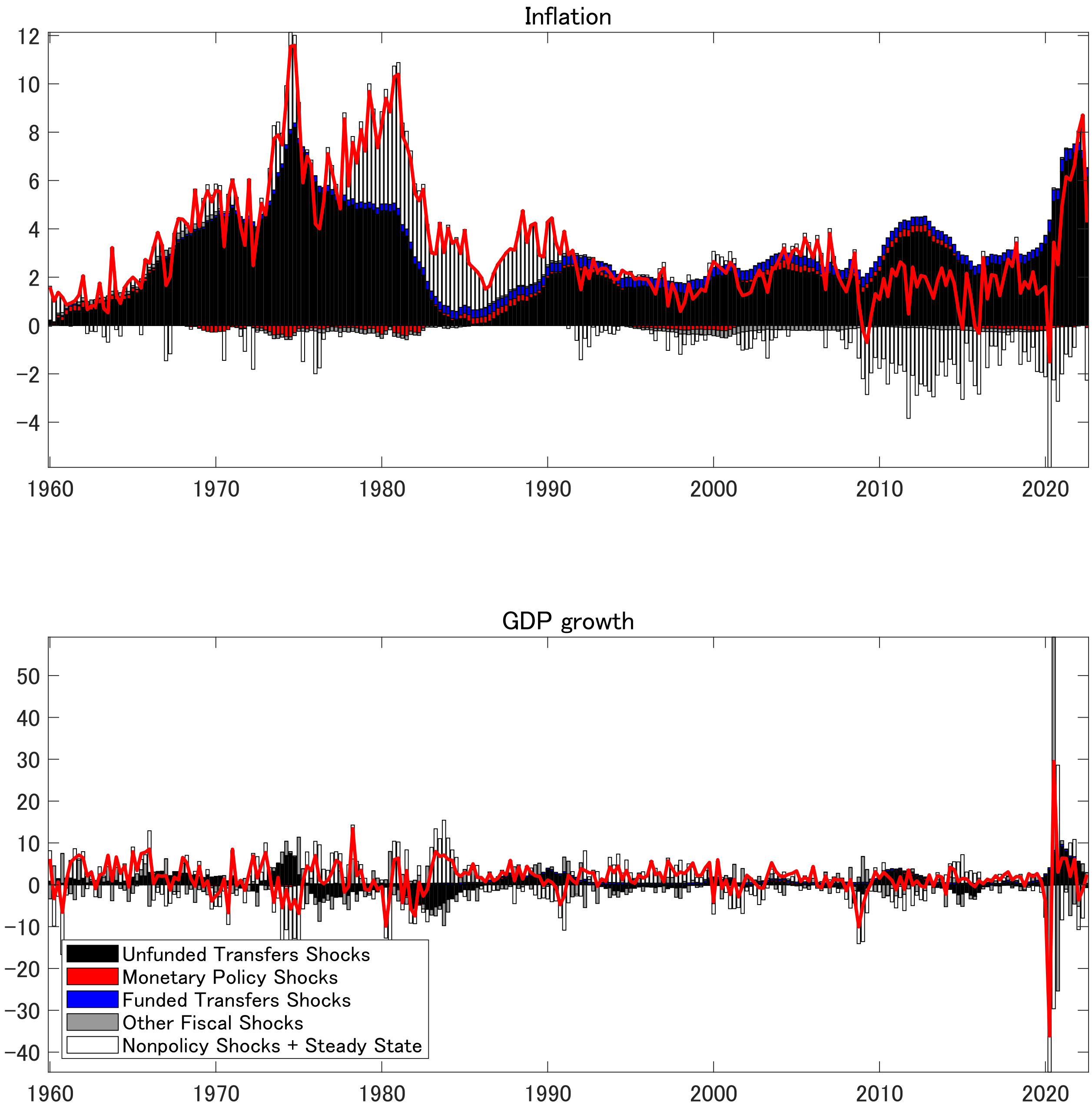


Figure 8. Impulse responses in the medium-scale model: U.S.



Note: Nonpolicy shocks include technology, preference, IST, risk-premium, wage markup, and short-run and long-run price markup shocks. Other policy shocks are transitory transfer and government spending shocks.

Figure 9. Drivers of Inflation and GDP growth: U.S.

Param.	Description	Prior Type	Prior Mean	Prior Std.	Posterior Mean	Posterior 5%	Posterior 95%
s_b	Debt-to-GDP annualized	N	2.4	0.05	2.477	2.4049	2.5562
$100\varkappa$	SS growth rate	N	0.5	0.05	0.477	0.4028	0.549
$100 \ln \Pi$	SS inflation	N	0.5	0.05	0.4838	0.4116	0.553
ξ	Inverse Frisch elasticity	G	2	0.25	2.2775	1.8674	2.6562
μ	Share of hand-to-mouth	B	0.11	0.01	0.0961	0.0831	0.1107
ω_w	Wage Calvo param.	B	0.5	0.1	0.7133	0.6668	0.7637
ω_p	Price Calvo param.	B	0.5	0.1	0.9333	0.922	0.9462
ψ	Capital util. cost	B	0.5	0.1	0.5515	0.381	0.7058
s	Investment adj. cost	N	6	0.5	7.2666	6.489	8.0665
χ_w	Wage infl. indexation	B	0.5	0.2	0.0414	0.0127	0.0654
χ_p	Price infl. indexation	B	0.5	0.2	0.8473	0.7687	0.943
θ	Habits in consumption	B	0.5	0.2	0.9561	0.9441	0.9731
α_G	Subs. private/gov. cons.	N	0	0.1	-0.0293	-0.0874	0.0287
ϕ_y	Interest response to GDP	N	0.25	0.1	-0.1105	-0.1363	-0.0839
ϕ_π	Interest response to infl.	N	2	0.1	1.9314	1.7834	2.0835
ϕ_{zy}	Transfer response to GDP	G	0.1	0.05	0.1015	0.0236	0.1814
γ_L	Labor tax response to debt	N	0.25	0.1	0.2741	0.1211	0.4232
γ_Z	Transfer response to debt	N	0.25	0.1	0.2827	0.164	0.3997
ρ_c	AR coeff. monetary rule	B	0.5	0.1	0.7956	0.7514	0.8484
ρ_G	AR coeff. gov. cons. rule	B	0.5	0.1	0.5213	0.3718	0.6551
ρ_Z	AR coeff. transfers rule	B	0.5	0.1	0.5086	0.3637	0.6567

Table 6. Priors and posteriors for the structural parameters: Japan, 1981:Q1-1998:Q4 (subsample estimation)

Param.	Description	Prior Type	Prior Mean	Prior Std.	Posterior Mean	Posterior 5%	Posterior 95%
ρ_{eG}	AR coeff. gov. cons	B	0.5	0.1	0.5798	0.4984	0.6672
ρ_{eZ}^{M}	AR coeff. funded trans.	B	0.995	0.001	0.9953	0.9939	0.9967
ρ_{eZ}^{F}	AR coeff. unfunded trans.	B	0.995	0.001	0.997	0.9956	0.9986
ρ_{z}	AR coeff. short-term trans.	B	0.5	0.1	0.5024	0.3535	0.6668
ρ_{a}	AR coeff. technology	B	0.5	0.1	0.3078	0.2179	0.3886
ρ_{b}	AR coeff. preference	B	0.5	0.1	0.1693	0.0981	0.2313
ρ_{m}	AR coeff. mon. policy	B	0.5	0.1	0.6268	0.5378	0.7077
ρ_{i}	AR coeff. investment	B	0.5	0.1	0.7654	0.706	0.8314
ρ_{rp}	AR coeff. risk premium	B	0.5	0.1	0.8927	0.8746	0.91
$\rho_{\mu^{NKPC}}$	AR coeff. pers. cost push	B	0.995	0.001	0.9956	0.9941	0.997
σ_{G}	St.dev. gov. cons.	IG	0.5	0.2	5.7128	5.2287	6.1866
σ_{Z}^{M}	St.dev. funded transfers	IG	0.5	0.2	8.2959	7.5	9.049
σ_{Z}^{F}	St.dev. unfunded transfers	IG	0.5	0.2	0.5146	0.4171	0.6181
σ_{z}	St.dev. short-term trans.	IG	0.5	0.2	0.5135	0.2589	0.7525
σ_{a}	St.dev. technology	IG	0.5	0.2	3.0995	2.8222	3.3772
σ_{b}	St.dev. preference	IG	0.5	0.2	37.0703	33.0672	40.708
σ_{m}	St.dev. mon. policy	IG	0.5	0.2	0.1694	0.1547	0.1868
σ_{i}	St.dev. investment	IG	0.5	0.2	0.5241	0.3865	0.6476
σ_{w}	St.dev. wage markup	IG	0.5	0.2	0.3205	0.2846	0.3604
σ_{p}	St.dev. transitory cost push	IG	0.5	0.2	0.1908	0.1727	0.2086
σ_{rp}	St.dev. risk premium	IG	0.5	0.2	0.4003	0.3285	0.4653
$\sigma_{\mu^{NKPC}}$	St.dev. persistent cost push	IG	0.5	0.2	0.6751	0.5311	0.8156
σ_{GDP}^{m}	Measur. error GDP	IG	0.5	0.2	1.6849	1.5381	1.8185
σ_{by}^{m}	Measur. error Debt/GDP	IG	0.5	0.2	0.3358	0.237	0.4279

Table 7. Priors and posteriors for the exogenous shock parameters: Japan, 1981:Q1-2023:Q4 (subsample estimation)

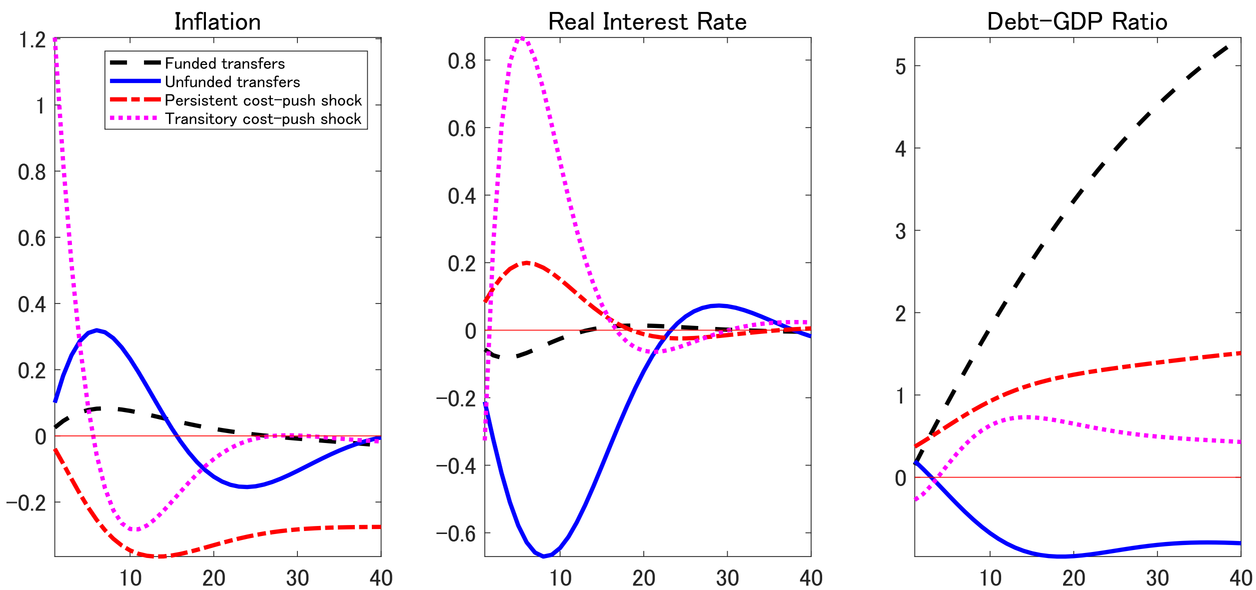
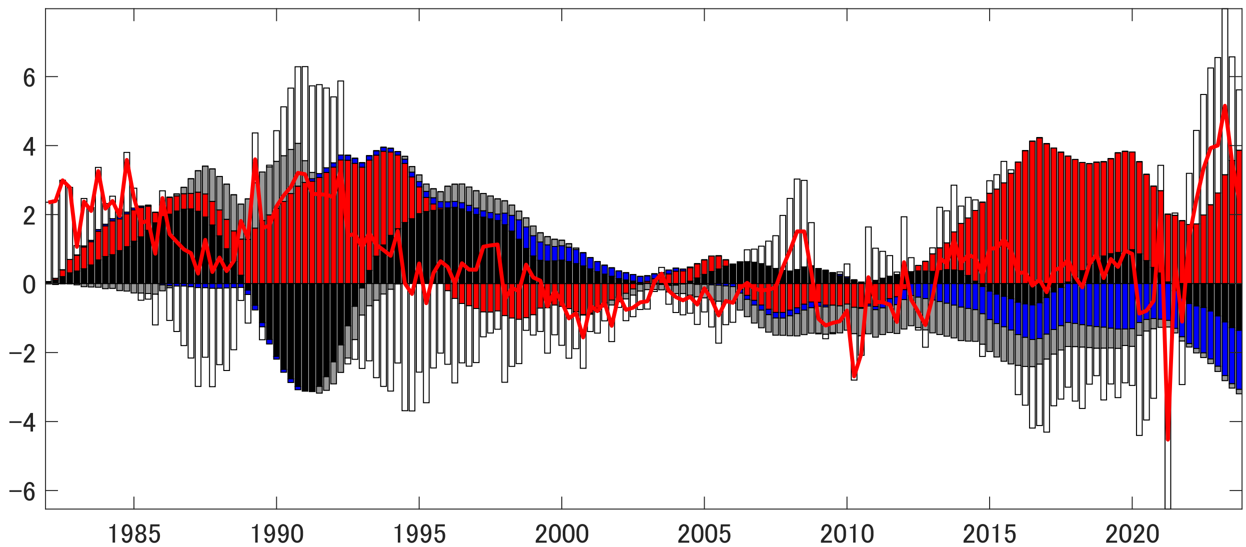
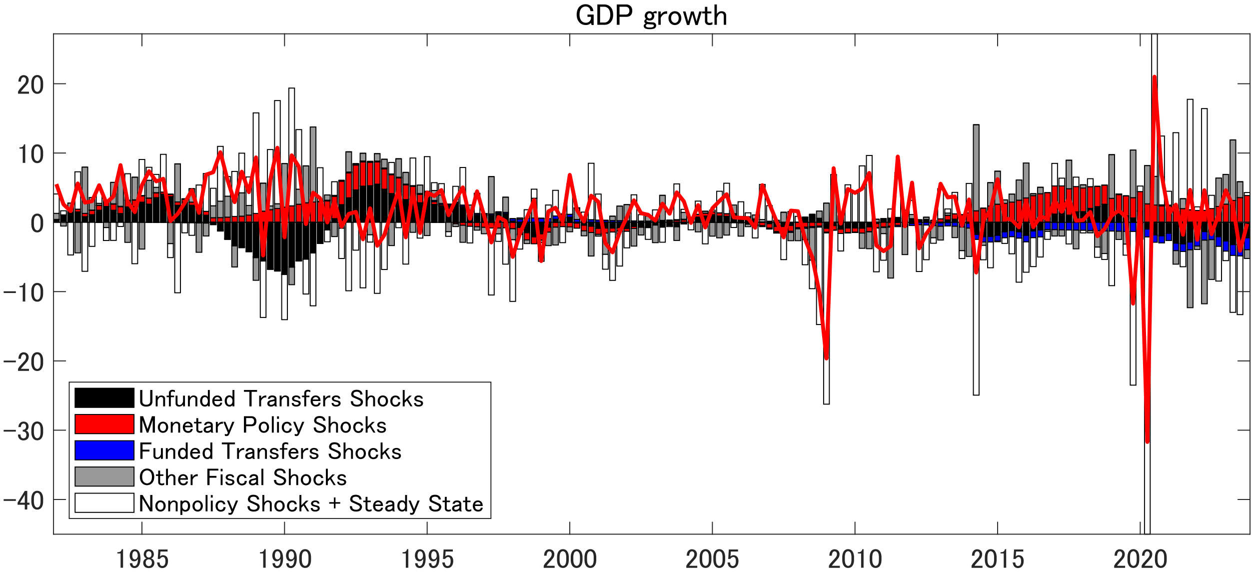


Figure 10. Impulse responses in the medium-scale model: Japan (subsample estimation)

Inflation



GDP growth



Note: Nonpolicy shocks include technology, preference, IST, risk-premium, wage markup, and short-run and long-run price markup shocks. Other policy shocks are transitory transfer and government spending shocks.

Figure 11. Drivers of Inflation and GDP growth: Japan (subsample estimation)