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Discussion Paper No. 2024-E-12

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IMES Discussion Paper Series 2024-E-12
October 2024

On the Interaction between Monetary and Fiscal Policy: Developments in Macroeconomics since the Global Financial Crisis

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Abstract

In macroeconomics, fiscal and monetary policies are both viewed as important macro policy tools for stabilizing aggregate demand, and their transmission channels and effects are considered to interact with each other. By adjusting interest rates, monetary policy can affect the extent to which the intertemporal substitution of aggregate demand occurs and thus alter the size of fiscal multipliers. These adjustments can also impact government debt accumulation through changes in interest payments. Conversely, fiscal policy and resulting government debt levels, just like other economic and social environments, can influence the transmission and impact of monetary policy by affecting the decision-making of households and firms. In addition, some theories posit that primary fiscal balance dynamics themselves impact the determination of the aggregate price level. Academic interest in the interaction of the two policies has intensified, sparked by debates on how stimulative policies should be executed in response to the global financial crisis and inflation surges after the COVID-19 pandemic. This paper overviews recent macroeconomic studies on monetary and fiscal policy interactions mainly from three perspectives: the Taylor rule and fiscal multipliers, interest rates and government debt, and the fiscal theory of the price level.

Keywords: Taylor rule; fiscal multipliers; interest rates and government debt; fiscal theory of the price level

JEL classification: E12, E21, E31, E52, E62

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The authors would like to thank Takuji Fueki, Harumasa Shirakawa, and the staff of the Bank of Japan for their valuable comments. The views expressed in this paper are those of the authors and do not necessarily reflect the official views of the Bank of Japan.

1 Introduction

Monetary policy and fiscal policy, although implemented independently by separate authorities, both function as instruments of macroeconomic stability, boosting households' consumption and firms' business investment to mitigate economic downturns during recessions. The level of aggregate demand by private economic agents is determined by a complex interplay of various factors of macroeconomic structure, including the tax system, individual prospects for future income and earnings, current and projected interest rate paths, and liquidity constraints. As a result, the transmission mechanisms and effects of the two policies can become interdependent with each other. Moreover, the two policies could work complementarily. For example, during the global financial crisis and subsequent economic downturn, policy interest rates in major countries fell to an effective lower bound and expectations for the role of fiscal policy measures rose to a higher level, as the effectiveness of conventional monetary policy tools was considered limited.

Research on the interaction between monetary and fiscal policies has long been of great interest to macroeconomists. It has gained even further interest in recent years, for two reasons. The first is that two crises, the global financial crisis in 2008 and the spread of COVID-19 in 2020 and beyond, generated greater interest in both policies as instruments to mitigate the rapid and substantial fall in aggregate demand brought about by the crises. During the global financial crisis, large-scale monetary and fiscal policies were implemented and various unconventional monetary policies, such as asset purchases, were introduced. Consequently, there were discussions in many countries about the boundaries between monetary and fiscal policy. During the pandemic, the relationship between monetary policy and government debt attracted public attention, as government debt increased markedly following large government spending, including income transfers, and inflation subsequently surged, which in turn led to a tightening cycle of the interest rate.

The second reason is that, in economic analysis, it has become increasingly possible and common to assess and precisely quantify characteristics of the target, such as the demand function of households with different income levels, that of firms of different sizes, or the heterogeneity and nonlinearity of different policy instruments, against the backdrop of the expanding scope of data that can be used for such analysis, such as granular or high-frequency data, as well as the increasing processing power of computers. For example, in recent years, in addition to the Representative Agent New Keynesian (RANK) model, the Heterogeneous Agent New Keynesian (HANK) model, which takes households' heterogeneity into account, has gained acceptance as a tool for analyzing monetary policy. The HANK model is able to accurately describe the income and wealth distribution of households and various government policies, thereby facilitating quantitative assessment of the interaction between monetary and fiscal policies, which could not necessarily be fully described by the RANK model.

The purpose of this paper is to summarize the discussion on the interactions between the two policies. Because of the long-standing interest among macroeconomists, there is already a significant body of both theoretical and empirical analyses from various perspectives. This paper therefore does not summarize the discussion comprehensively, but instead focuses on three perspectives: interactions in the business cycle, the interactions in the process of government debt accumulation, and the fiscal theory of the price level (FTPL).

The structure of this paper is as follows. Section 2 describes theoretical relationships between the Taylor rule and fiscal multipliers using a standard New Keynesian model, and offers an overview of the related literature. Section 3 summarizes the studies of Blanchard [2019] and related research that explore the impact of interest rates and economic growth rates on government debt from a medium- to long-term perspective. Section 4 outlines the concept of FTPL and then overviews recent developments in the area of FTPL, focusing in particular on quantitative analyses. Section 5 provides a summary and outlook for future research.

2 The Taylor Rule and Fiscal Multipliers

(1) Theoretical Implications Obtained from a Standard New Keynesian Model

A. Model Setup

First, we use a standard RANK model to show a relationship between the Taylor rule and the fiscal multiplier. This model consists of (i) a representative household that chooses consumption and labor supply to maximize its own utility, (ii) firms that choose output and factor inputs to maximize profits under the constraint of being unable to freely change their prices (nominal price rigidity), and (iii) the government sector, including the government and the central bank.

First, the utility maximization problem of the household can be expressed as follows:

$$\max_{\{C_t, N_t, B_t\}_{t=0}^{\infty}} \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \, U(C_t, N_t)\,, \tag{1}$$

s.t.

$$P_tC_t + B_t \le (1 + i_{t-1})B_{t-1} + W_tN_t - T_t + \tau_t. \tag{2}$$

Here, $C_t, N_t, B_t, P_t, i_t, W_t, T_t,$ and τ_t represent consumption, hours of work, the household's bond holdings (debt issued by the government) at the end of the period, the goods price, the nominal interest rate, the nominal wage, taxes, and the income transfer from the government sector to households, respectively, and $\beta \in (0,1)$ is the subjective discount factor. We assume that the bonds are short-term and mature in one period. Equation (2) is the current period's budget constraint; under the assumption of the transversality condition (the assumption that households' consumption cannot be financed by debt that cannot be repaid), when expanded to infinity, the following equation is obtained:

$$\mathrm{E}_0\left\{P_0C_0 + \sum_{t=1}^{\infty}\frac{P_tC_t}{\prod_{s=0}^{t-1}(1+i_s)}\right\} \le$$

$$(1+i_{-1})B_{-1} + \mathrm{E}_0\left\{W_0N_0 - T_0 + \tau_0 + \sum_{t=1}^{\infty}\frac{W_tN_t - T_t + \tau_t}{\prod_{s=0}^{t-1}(1+i_s)}\right\}. \tag{3}$$

Assuming that the utility function can be separated into consumption and leisure, and that the former is of the constant relative risk aversion (CRRA) type ($C_t^{1-\sigma}/(1-\sigma)$), the following equation can be derived from the first-order conditions:

$$(C_t)^{-\sigma} = \beta\mathrm{E}_t\left\{(1+i_t)\frac{P_t}{P_{t+1}}(C_{t+1})^{-\sigma}\right\} = \beta\mathrm{E}_t\left\{\frac{1+i_t}{1+\pi_{t+1}}(C_{t+1})^{-\sigma}\right\}. \tag{4}$$

Here, σ is the inverse of the coefficient of relative risk aversion, and π_t is the inflation rate.

Equation (4) is called the Euler equation and represents the optimal allocation of consumption between the present and the future (intertemporal). Theoretically, this substitution plays a major role in the transmission mechanism of monetary policy. For example, under the assumption of no economic uncertainty and that $\sigma = 1$, the relationship $C_{t+1} = \beta(1+r_t)C_t$ can be derived from equation (4) (where r_t is the real interest rate, defined as $r_t \equiv (1+i_t)/(1+E_t\{\pi_{t+1}\}) - 1$). As is clear from this equation, the growth rate of consumption from the current period to the next period, C_{t+1}/C_t, is determined by the real interest rate.

For firms, instead of a single representative firm, we consider that multiple firms exist, and assume that each firm l produces goods from labor $N_{l,t}$. Assuming that the production of goods by firm l is $Y_{l,t} = N_{l,t}$ and denoting the price of that good as $P_{l,t}^*$, the firm's profit maximization problem is described as follows:

$$\max_{P^*_{l,t}} \sum_{k=0}^{\infty} \theta^k \mathrm{E_t}\{Q_{t,t+k}(P^*_{l,t}\, Y_{l,t+k} - \mathrm{W}_{t+k}N_{l,t+k})\}. \tag{5}$$

Here, $\theta \in (0,1)$ and $Q_{t,t+k}$ are the probability of being unable to change prices (Calvo parameter) and the discount factor from period t to $t+k$, respectively, where the latter is a function of the household's marginal utility. From the optimization conditions, we derive the following New Keynesian Phillips Curve (NKPC)[1] with the constant $\kappa > 0$:

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa \widetilde{y}_t. \tag{6}$$

Here $\widetilde{y}_t$ is the deviation of aggregate demand from its steady state (GDP gap), and the inflation rate increases as the gap expands.

For monetary policy, we consider the following Taylor rule:

$$1 + i_t = \max\left[1, \frac{1}{\beta}(1+\bar{\pi})\left(\frac{1+\pi_t}{1+\bar{\pi}}\right)^{\phi_\pi}\right]. \tag{7}$$

Here, $\bar{\pi}$ and $\phi_\pi > 0$ are the central bank's inflation target and the weight on the inflation rate, respectively. As shown in the equation, the nominal interest rate i_t is adjusted with reference to the inflation rate π_t, with the constraint that it cannot fall below zero. ϕ_π indicates how much the nominal interest rate is adjusted in response to the deviation of the inflation rate from the target rate. As discussed later, the size of this parameter has important implications for the fiscal multiplier. When $\phi_\pi > 1$, the "Taylor principle" is said to be satisfied.

Regarding the government sector, for this section, we assume that expenditures (G_t), transfers (τ_t) and revenue (T_t) are given exogenously. Note that G_t is government expenditure and income transfers τ_t are defined separately. The budget constraint is represented as follows[2]:

$$B_t = (1 + i_{t-1})B_{t-1} + P_t G_t - T_t + \tau_t. \tag{8}$$

Finally, the following resource constraint holds. As seen from the equation, although τ_t is spent by the government as is government expenditure G_t, it is included in households' consumption C_t and therefore does not appear in the equation below.

$$Y_t = C_t + G_t. \tag{9}$$

In the RANK model, the dynamics of aggregate demand, price level, and the nominal interest rate can be described by equations (4), (6), and (7). Monetary policy analysis

[1] See Galí [2015] for the derivation of the Phillips curve (equation (6)).

[2] Here we impose an additional implicit assumption that fiscal policy stabilizes the government debt B_t by adjusting tax revenues and government spending. This is discussed in detail in section 3 below.

therefore often focuses only on these three equations.

B. Fiscal Multiplier

Next, we consider the impact on the macroeconomy of an exogenous increase in government expenditure G_t, focusing in particular on the fiscal multiplier defined by the following equation, which is obtained by differentiating equation (9). Note that here we consider a temporal increase in government expenditure.

$$\frac{dY_t}{dG_t} = \frac{dC_t}{dG_t} + \frac{dG_t}{dG_t}. \qquad (10)$$

As the above equation shows, the second term on the right-hand side is unity, and whether or not the fiscal multiplier exceeds unity depends on whether consumption increases or decreases following an increase in government expenditure. To see how consumption is determined, we extend equation (4) into the future and obtain the current level of consumption C_t as a function of the sequence of the real interest rates r_t from the current period to infinity.

$$(C_t)^{-\sigma} = E_t(C_{t+\infty})^{-\sigma} \prod_{s=0}^{\infty} \beta^s \left\{\frac{1 + i_{t+s}}{1 + \pi_{t+s+1}}\right\} = E_t(C_{t+\infty})^{-\sigma} \prod_{s=0}^{\infty} \beta^s (1 + r_{t+s}). \qquad (11)$$

Because $E_t(C_{t+\infty})$ is considered to be unaffected by this temporary increase in government expenditure, equation (11) implies that the size of the fiscal multiplier is affected by the Taylor rule determining the relationship between the inflation rate and the nominal interest rate. Following Woodford [2011], we consider three cases in what follows[3].

First, we consider the case where the central bank fixes the real interest rate $\{r_{t+s}\}$ at the level before the increase in government expenditure by raising the nominal interest rate by exactly the amount of inflationary pressure after the expenditure increase. This corresponds to the case where $\phi_\pi = 1$ in equation (7). Since the right-hand side of equation (11) does not change, consumption C_t does not change either, and as indicated by equation (10), the fiscal multiplier becomes unity. Although consumption C_t does not

[3] The summary of the cases are presented in Figure 1. For the cases in which the Taylor principle is violated, we consider situations where the central bank, while generally following the Taylor principle, temporarily deviates from it due to large negative shocks or other exceptional factors. In other words, monetary policy eventually returns to a policy in line with the Taylor principle. This differs from situations where the central bank's interest rate policy consistently fails to satisfy the Taylor principle, regardless of economic conditions. The latter case, examined in Section 4, may result in prices being determined by government debt dynamics within the fiscal authority's budget constraint, or in equilibrium indeterminacy.

change, since aggregate demand Y_t increases by the amount of government expenditure G_t, the inflation rate π_t increases as indicated by equation (6).

Next, we consider the case where the central bank does not change the nominal interest rate as much as the rise in inflation. This is the case, for example, when the central bank keeps the interest rate at zero after a large negative shock. Under such conditions, since it is equivalent to the case where $\phi_\pi < 1$ for a temporary period, the real interest rate r_t falls and, as indicated by equation (11), current consumption C_t increases and the fiscal multiplier exceeds unity. Moreover, since aggregate demand Y_t increases not only by the amount of the increase in government expenditure G_t but also by the amount of private consumption C_t, inflation increases even more significantly as indicated by equation (6).

Finally, we consider the case where the central bank raises the nominal interest rate by more than the inflationary pressure ($\phi_\pi > 1$). Following the same line of reasoning, consumption C_t falls and the fiscal multiplier falls below unity. Aggregate demand Y_t does not increase much, as the decrease in private consumption C_t offsets the increase in government expenditure G_t, which contains an increase in inflation.

It should be noted that government expenditure here is on goods that are actually consumed by the government[4]. On the other hand, government spending that does not appear in the resource constraint (9), such as income transfers (τ_t), does not affect macroeconomic variables, including the fiscal multiplier. The fiscal multiplier is therefore zero. As pointed out by Ramey [2011], this is because the model is a representative agent model, and the current increase in income transfer is accompanied by future tax increases or decreases in income transfers, thus not affecting the total amount of goods that households can consume. So why does government expenditure G_t, which appears in the resource constraint equation, have an effect? As discussed in Aiyagari, Christiano, and Eichenbaum [1992] and Baxter and King [1993], it is because of a negative wealth effect that operates on households[5].

As shown in equation (1), an increase in government expenditure G_t does not

[4] Here, for the sake of simplicity, we abstract from the capital stock. When government investment and the public capital stock are explicitly considered, the government investment appears in the resource constraint equation. Similar to government consumption, such investment affects macroeconomic variables through various channels, including negative wealth effects.

[5] Both papers use a model with flexible prices (a neoclassical model) rather than a New Keynesian model to examine the impact of changes in government spending and investment on GDP, although the wealth effect also operates in these models. Moreover, Baxter and King [1993] point out that not only is the short-term government spending multiplier less than 1, but the multiplier can fall further when government expenditure is financed by taxation that generates distortions in the resource allocation. They also state that when the increase in government expenditure is permanent, the multiplier can exceed unity.

directly affect household utility. Instead, it generates a negative wealth effect. The size of production being equal, as indicated by equation (9), the total amount of goods that serves for the household's consumption falls, lowering utility. This in turn implies that the marginal utility from consuming goods rises, creating an incentive for the household to increase its hours of work N_t, so that it can increase goods production and mitigate a drop in consumption[6]. This change in the hours of work N_t is the main channel of the fiscal multiplier. How much N_t increases depends on the size of the household's demand for consumption, which itself is pinned down by equation (11), as described above. When the real interest rate is constant, it is optimal for households to maintain the level of consumption expenditure unchanged even after an increase in government expenditure. The households increase labor supply by an amount just enough to offset the reduction in goods consumption caused by the rise in government expenditure G_t, i.e. $dC_t = 0$. As a result, the fiscal multiplier becomes unity. Similarly, when the real interest rate is raised (lowered), then consumption falls (rises), resulting in a fiscal multiplier below (above) unity.

C. Fiscal Multipliers in HANK Models

In HANK models, instead of a representative household, there are an infinite number of households, and each household's consumption behavior differs depending on its particular wealth and income profile. Specifically, a household j chooses its optimal level of consumption and hours of work under the following constraints:

$$P_t C_{j,t} + B_{j,t} \leq (1 + i_{t-1}) B_{j,t-1} + W_t N_{j,t} Z_{j,t} - T_{j,t} + \tau_{j,t}. \tag{12}$$

$$0 \leq \frac{B_{j,t}}{P_t}. \tag{13}$$

Here, $C_{j,t}, N_{j,t}, Z_{j,t}, B_{j,t}, T_{j,t}, \tau_{j,t}$ are consumption, hours of work, labor productivity, bond holdings, tax amount, and income transfer from the government for household j. $Z_{j,t}$ represents household-specific productivity, and as a result of this value differing between households, the level of both labor income and consumption and wealth differ between households. Equation (13) is referred to as the borrowing constraint. $B_{j,t}$ becomes a negative value when the household borrows, which implies that according to equation (13) households cannot borrow at all.

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[6] For example, assuming for the sake of simplicity that the utility function is $U(C_t, N_t) = \log(C_t) + \log(1 - N_t)$, and that the relative price of consumption and leisure is constant, households have an incentive to equalize the marginal utility derived from consumption and the marginal utility derived from leisure (which are $(C_t)^{-1}$ and $(1 - N_t)^{-1}$, respectively). When consumption falls due to an increase in government expenditure, households avoid a disproportionately large decline in either consumption or leisure by additionally reducing leisure (i.e., increasing labor supply).

For households with large bond holdings, equation (13) does not bind, and consumption is expressed by an equation similar to equation (4)[7]:

$$\left(C_{j,t}\right)^{-\sigma} = \beta \mathrm{E}_t\left\{(1+i_t)\frac{P_t}{P_{t+1}}\left(C_{j,t+1}\right)^{-\sigma}\right\} = \beta \mathrm{E}_t\left\{\frac{1+i_t}{1+\pi_{t+1}}\left(C_{j,t+1}\right)^{-\sigma}\right\}. \tag{14}$$

On the other hand, for households where equation (13) is binding, consumption is expressed by the following equation:

$$C_{j,t} = \frac{(1+i_{t-1})B_{j,t-1}}{P_t} + \frac{W_t N_{j,t} Z_{j,t} - T_{j,t} + \tau_{j,t}}{P_t}. \tag{15}$$

As the equation shows, for such households, it is the level of disposable income ($W_t N_{j,t} Z_{j,t} - T_{j,t} + \tau_{j,t}$), rather than the interest rate, that affects consumption. In HANK models, households facing such borrowing constraints are generally referred to as "hand-to-mouth" (hereafter HtM)[8] households.

Consider an increase in government expenditure G_t. First, for households where equation (14) holds, the same mechanism as what operates under the RANK model applies. In other words, if, for example, the central bank fixes the real interest rate, the consumption of such households remains unchanged in response to an increase in government expenditure. On the other hand, for households where equation (15) holds, as suggested by the equation, the level of consumption depends on bond holdings $B_{j,t-1}$, current labor income $W_t N_{j,t}$, and the amount of taxes and income transfers $T_{j,t}$, $\tau_{j,t}$. Consequently, as discussed in Auclert, Rognlie, and Straub [2023] and others, if taxes on the HtM household are raised to finance an increase in government expenditure G_t, for example, then the household's consumption may fall. By contrast, if the labor income received by the HtM household increases along with the increase in government expenditure G_t, its consumption may increase. How much consumption increases in the economy as a whole depends on the consumption of households acting according to equation (14), the consumption of households acting according to equation (15), and the proportion of each type of household. The resulting fiscal multiplier therefore depends not only on the Taylor rule, but also on the proportion of households in the economy that follow equation (15) and the changes in income and taxes faced by these households.

[7] Households make decisions about consumption taking into consideration the possibility that the situation described by equation (13) may come about in the future. As a result, the intertemporal substitution equation for households under the HANK model is, strictly speaking, different from that of the household in the RANK model.

[8] For the description of HANK models, see, for example, Iwasaki et al. [2021]. See Figure 2 for the differences between RANK and HANK models.

(2) Related Studies

The number of studies on fiscal multipliers, including those that address the role of the Taylor rule, has grown rapidly, in particular since the global financial crisis. The increased focus on this subject may be related to the experience of the effective lower bound on policy rates in major countries during the crisis. In this section, we overview the main trends in this expanding area of study.

A. Overview of Theoretical Analyses

Christiano, Eichenbaum, and Rebelo [2011] (CER) is a study that quantitatively analyzes how the fiscal multiplier changes with monetary policy using a RANK model with parameters calibrated to U.S. data[9]. Before the global financial crisis, it was commonly thought that the fiscal multiplier was at least theoretically less than unity, since it was rarely imagined in practice or in macroeconomics that monetary policy could be conducted without satisfying the Taylor principle (Aiyagari, Christiano, and Eichenbaum [1992], Baxter and King [1993]). In this sense, CER and the aforementioned Woodford [2011] are positioned as pioneering studies that dramatically changed the way the size of the fiscal multiplier is thought about.

Figure 3 shows the simulated path of macroeconomic variables under the CER model when a positive temporary shock to government expenditure (G_t) occurs under three monetary policy formulations. For the simulation of an economy with an effective lower bound, first a large negative shock that pushes short-term interest rates down to the lower bound is given, and then a shock to government expenditure is given. In the case where the central bank raises interest rates ($\phi_\pi > 1$), after an increase in government expenditure G_t , the real interest rate rises as shown in equation (11), reducing consumption. This in turn mitigates an increase in GDP. As shown in equation (10), the fiscal multiplier thus becomes less than unity. Also, because the increase in GDP becomes negligible, the increase in the inflation rate also becomes negligible. By contrast, in the case of the zero interest rate constraint (ZLB), as shown in equation (11), the real interest rate falls significantly, resulting in a large increase in consumption and GDP, with the fiscal multiplier becoming greater than unity. The inflation rate also becomes significantly higher compared to other cases.

There are also studies that employ HANK models, such as Hagedorn, Manovskii, and Mitman [2019] and Auclert, Rognlie, and Straub [2023], to study the effect of

[9] Braun and Waki [2006] conduct a similar analysis on the Japanese economy and report that the results are qualitatively unchanged from CER [2011].

government expenditure. The importance of the Taylor rule for fiscal multipliers remains unchanged in HANK models. However, as mentioned earlier, in HANK models, households that determine their consumption levels according to equation (14) constitute only a part of the overall economy, and the fiscal multiplier can change due to various structural properties in the economy. In particular, many studies agree that the fiscal multiplier is larger when government expenditure is financed by debt issuance as compared with the case of taxation. As a result, as discussed in Auclert, Rognlie, and Straub [2023], for example, even when the central bank conducts monetary policy so that the real interest rate is kept unchanged, theoretically, the fiscal multiplier can deviate from unity. Also, even when monetary policy is conducted in a way consistent with the Taylor principle, the fiscal multiplier can exceed unity.

Figure 4 illustrates these points using a HANK model. It is seen that the effect of government expenditure shocks on the economy varies with monetary policy, with the largest effect occurring when the ZLB becomes binding, similarly to the observation shown in Figure 3. However, the HANK model consists of HtM households whose consumption is not sensitive to interest rate fluctuations, in contrast to RANK models. As a result, differences in the responses of key economic variables are less pronounced between the three cases when compared with the differences in Figure 3. In particular, the fiscal multiplier remains below unity even when the real interest rate is kept unchanged ($\phi_\pi = 1$).

B. Empirical Analyses

Not surprisingly, empirical studies on the size of fiscal multipliers have been conducted in the United States, Japan, and a good number of other countries. In many cases, similar to the estimates of monetary policy shocks, some types of vector autoregression (VAR) are exploited for these estimations[10]. Compared with the policy rate, each type of government expenditure is different in terms of its composition, persistence, and sources of financing, which generally yields a large confidence interval regarding the estimates[11].

[10] For example, Blanchard and Perotti [2002] estimate a structural VAR that consists of quarterly series of GDP, government spending (sum of government consumption and government investment), and taxes for the United States from the 1960s to the 1990s. They report that the fiscal multiplier, represented by the response of GDP to government spending shocks, ranges from 0.9 to approximately 1.29 at its peak after the shock. The empirical methodology of this paper, while being extended and modified, has been widely used in subsequent studies.

[11] As Baxter and King [1993] argue, it is widely accepted theoretically that the magnitude of fiscal multipliers falls when a larger portion of government expenditure is financed through distortionary taxation. Along this line, Ramey [2011] notes that, although it is desirable to examine periods with constant tax rates when empirically analyzing fiscal multipliers, it is difficult to find such periods. She also notes that, even during episodes typically associated with substantial increases in government

Ramey [2011], summarizing previous studies for the United States, states that the fiscal multiplier for a "temporary, deficit-financed increase in government purchases" is basically between 0.8 and 1.5, but the possibility that it is between 0.5 and 2.0 cannot be ruled out. For Japan, Kuttner and Posen [2002] report that the value exceeds 1, using data from 1976 to 1999, while Watanabe, Yabu, and Ito [2008] report that the fiscal multiplier is generally around 0.7 to 1, using data up to 2004.

As the above theoretical discussion underscores the dependence of the fiscal multiplier on the monetary policy rule, the multiplier may also depend on the economic environment at the time when government expenditure is made. Indeed, there are empirical studies focusing on the relationship between business cycles and fiscal multipliers, exploring whether the crowding out of government expenditure is less likely to occur during economic downturns, when there is slack in labor and capital stock markets. For example, Auerbach and Gorodnichenko [2013] estimate a regime-switching VAR, using panel data from OECD countries up to 2008, and report that the fiscal multiplier during recessions exceeds 2, over three years, while the multiplier during expansions cannot be statistically rejected as zero. On the other hand, Ramey and Zubairy [2018] estimate fiscal multipliers using U.S. data since 1889, and report that the value generally falls in a range between 0.6 and 1 and does not change whether or not slack in the economy is present.

Regarding state dependency stemming from the effective lower bound on nominal interest rates, the number of studies is limited as the experience to test this is limited. Miyamoto, Nguyen, and Sergeyev [2018], using data from Japan from 1980 to 2014, compare fiscal multipliers in periods when monetary policy faces the zero lower bound constraint (after 1995) and when it does not (up until 1995), by regressing GDP on fiscal expenditure (government consumption plus government investment) shocks in each of the periods. They document that, in the former period, the point estimate of the multiplier at the impact is 1.5, above unity, while in the latter period, it is 0.6. In contrast, Ramey and Zubairy [2018], using historical data in the U.S., report that there is evidence that the fiscal multiplier exceeds unity when interest rates are low, if data from the World War II period are excluded from the estimation, but the results change when alternative estimation specifications are used.

3 Interest Rates, Growth Rates, and the Sustainability of Government Debt

During the economic downturn following the global financial crisis, as the effective lower

expenditure, such as World War II and the Korean War, tax rates were concurrently rising.

bound manifested itself in many advanced economies, a larger role for expansionary fiscal policy was gradually called for, which in turn led to aggressive fiscal stimulus in some countries. Amid growing concerns over and interest in the accumulating government debt, Blanchard argued in his 2019 American Economic Association (AEA) Presidential Address, "Public Debt and Low Interest Rates," that there have been many periods in the United States when government bond yields were below the nominal GDP growth, and "r < g" is not an exceptional event (where r and g are the real interest rate and the real GDP growth rate, respectively), and that safe asset yields have been on a downward trend globally.

According to textbook models, the real interest rate should exceed the growth rate of the real GDP in long-run equilibrium[12]. This prediction implies that, unless the primary budget balance is in surplus, the amount of debt should explode, although whether the statement holds depends on views regarding whether the interest rate considered in these models conceptually coincides with the safe asset yield. As Blanchard [2019] points out, if for some reason the safe asset yield is stably below the real GDP growth rate, government debt does not explode even when the primary fiscal balance is in deficit, as long as the primary balance itself does not explode. In the following, we first present the discussion of Blanchard [2019] and then summarize its extension by Mian, Straub, and Sufi [2022].

(1) Discussion of Blanchard [2019]

Consider the government's budget constraint, similar to equation (8) in Section 2.

$$B_t = (1+i_t)B_{t-1} + P_t G_t - T_t = (1+i_t)B_{t-1} - S_t. \tag{16}$$

Here, $S_t \equiv T_t - P_t G_t$ is the primary fiscal balance (positive when the fiscal balance is in surplus). Dividing both sides by GDP and the current price level P_t, and denoting real government debt and the real primary fiscal balance as ratios to GDP with lowercase b_t and s_t, we obtain the following equation:

$$\frac{B_t}{P_t Y_t} = \frac{(1+i_t)}{(1+\pi_t)} \frac{B_{t-1}}{P_{t-1} Y_{t-1}} \times \frac{Y_{t-1}}{Y_t} - \frac{S_t}{P_t Y_t}, \qquad b_t = \frac{(1+r_t)}{(1+g_t)} b_{t-1} - s_t. \tag{17}$$

From this equation, if $r_t > g_t$ continues to hold, it is necessary to keep the primary fiscal balance constantly in surplus in order to prevent the government debt/GDP ratio b_t from exploding, since the rate at which interest payments grow exceeds the rate of GDP

[12] This implication is also derived from the RANK model used in Section 1. Considering equation (4) in the long-term steady state, given that the growth rates of GDP and consumption coincide, we can establish the relationship $g = \beta(1+i)(1+\pi)^{-1}$. (As in the latter part, subscripts are omitted here as these values represent long-term equilibrium.)

growth. On the other hand, if $r_t < g_t$, the primary fiscal balance does not necessarily explode even if it remains in deficit. To confirm this point, we consider a long-run equilibrium solution where b_t, s_t, r_t, g_t are constants, for simplicity. We the obtain the following equation (for long-run equilibrium solutions, we omit the t subscript):

$$s = \frac{(r-g)}{(1+g)} b. \tag{18}$$

This equation shows that if $r < g$, even when the primary fiscal balance s is permanently in deficit, the government debt/GDP ratio b may become a large number but does not explode.

Blanchard [2019] extends the above discussion by using an overlapping generations model, theoretically examining whether the income transfer through social security benefits and the resulting expansion of government debt improves economic welfare. In his model, the transfer is made from the working generation to the retired generation. The working generation receives labor income, allocating it between consumption and saving, which serves for accumulating capital stock. The retired generation, in turn, consumes the interest income earned on these savings. Using this model, he shows that, when the real interest rate is extremely low, the income transfer could improve welfare, for two reasons. First, considering the rate of return calculated by dividing the benefits received by the retired generation by the burden paid by the working generation, the rate of return from such a social security system may be higher than the case when households themselves invest in the market. Second, with the introduction of social security benefits, the resources allocated to capital stock accumulation decrease, resulting in a higher return on capital, which potentially increases the interest income received by the retired generation[13].

(2) Discussion of Mian, Straub, and Sufi [2022]

Equation (18) indicates that, for any finite values of the primary fiscal balance s, there exists a corresponding finite value of government debt b. A key assumption here is that the interest rate r on government debt is independent of the debt level b. However, empirical studies generally support a positive correlation[14] between the level of

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[13] Blanchard [2019] points out that in the U.S., safe asset rates are lower than market rates while returns on capital exceed economic growth rates. He then argues that the second observation implies that capital stock levels may not necessarily be excessive, which further implies that it is not clear whether income transfers considered in the analysis actually improve economic welfare.

[14] Nakamura and Yagi [2017], using panel data from 23 OECD countries (1980-2013), report that nominal long-term interest rates could be affected by fiscal balance. They also find that the elasticity of these rates to fiscal balance varies with government debt levels.

government debt b and the associated interest rate r.

Mian, Straub, and Sufi [2022] assume a bond-in-utility function where the holding of government debt itself generates utility for households, and re-analyze the relationship between r and g and government debt b. Suppose that households have the following utility function:

$$\log C_t + \rho \log\left(\frac{B_t}{P_t}\right). \tag{19}$$

Here, $\rho > 0$ is the parameter related to households' utility derived from holding government debt. With the utility function (19), the Euler equation shown in equation (4) in Section 1, is expressed as follows:

$$(C_t)^{-1} = \beta \mathrm{E}_t\left\{\frac{1+i_t}{1+\pi_{t+1}}(C_{t+1})^{-1}\right\} + \rho\frac{P_t}{B_t}. \tag{20}$$

Note that i_t is the nominal interest rate on government debt. The first term on the right-hand side represents the amount of utility derived from consuming the returns on holding government debt, and the second term represents the amount of utility derived from holding the debt itself, such as a reduction in liquidity costs thanks to the holding of government debt.

To see the implications for r and g, we rewrite equation (20) under the assumption that the growth rate of consumption C_t converges to the GDP growth rate g_t in the long run, and obtain the following expression:

$$(1+r_t) = \left((1+g_t) - \rho\frac{P_t}{B_t}C_{t+1}\right)\beta^{-1}. \tag{21}$$

Here, r_t is the yield on government debt. There are two implications of this equation. First, the existence of the second term on the right-hand side means that r_t can be less than g_t. For example, if ρ is non-zero and government debt $B_t P_t^{-1}$ is extremely small relative to consumption C_t, then g_t becomes larger than r_t. This is interpreted as households requiring a lower rate of return on government debt because of the utility gains from holding the government debt itself. Another implication is that, when government debt $B_t P_t^{-1}$ greatly exceeds consumption C_t, the value of the second term becomes small, and when the debt balance exceeds a certain value, the relationship reverses and g_t becomes smaller than r_t. The relationship between g_t and r_t when government debt $B_t P_t^{-1}$ increases further is close to the case where ρ is 0. In other words, the arguments of Blanchard [2019] hold in an economy with positive ρ, as long as government debt falls below a certain threshold.

In the discussion of Blanchard [2019], since the interest rate r is independent of government debt b, there exists a level of government debt b that has a one-to-one correspondence to any level of fiscal deficit z $(= -s)$. On the other hand, in Mian, Straub, and Sufi [2022], there is an upper bound on the size of the fiscal deficit that does not cause government debt to explode, depending on the level of government debt. For example, when government debt is sufficiently small, although the fiscal deficit increases government debt and the interest rate increases through the second term of equation (21), narrowing the negative margin of $r - g$, the inequality $r - g < 0$ still holds. Similar to the argument of Blanchard [2019], the fiscal deficit increases along with government debt, as higher government debt requires the corresponding fiscal deficit to be larger.

However, once government debt reaches a certain value, the increase in the interest payment burden due to the additional expansion of government debt, through a rise in r, becomes larger, and the fiscal deficit that satisfies equation (18) shrinks. Consider a case when $r - g = 0$ as a result of government debt becoming sufficiently large. As shown by equation (17), government debt does not change or explode, as long as the fiscal deficit is zero. Even a small fiscal deficit, however, results in an increase in government debt in the next period, and through the second term in equation (21), the inequality $r - g > 0$ holds so that government debt explodes. In other words, there is an upper limit (the point at which $r - g = 0$ continues to hold) to government debt that allows the government to run a fiscal deficit, and there is also an upper limit to government debt that can accommodate increases in both the fiscal deficit and government debt (the point at which the effect of government debt on interest payments becomes dominant). Mian, Straub, and Sufi [2022] refer to the region in which the latter holds as the “free lunch region” (Figure 5).

(3) The Impact of Government Debt on Economic Activities

In the textbook model, including that described in Section 2, the level of government debt does not affect economic activity. As noted in Mian, Straub, and Sufi [2022] and numerous other studies, however, it has commonly been pointed out that the level of government debt affects the government bond yield. There are also studies that argue that it affects other economic variables. In addition, if economic structures such as unemployment insurance schemes and tax systems change along with government debt, monetary policy transmission can be affected indirectly.

Reinhart and Rogoff [2010], for example, empirically examine the relationship between the government debt-to-GDP ratio and the inflation rate and GDP growth rate, using long-term data spanning 200 years for 20 advanced countries and 24 emerging markets. They document that, when the ratio is small there is no particular relationship between the ratio and each of the two variables, and when the ratio exceeds a certain threshold (90%), GDP growth rates fall sharply in both advanced and emerging economies while the inflation rate rises for emerging economies. Although Reinhart and Rogoff [2010] do not present a theoretical explanation of the relationship between government debt and these two variables, the authors consider that a decline in the GDP growth rate may be due to the contractionary fiscal policies implemented to maintain investor confidence as the risk premium on government debt rises.

Along a similar line, Arellano, Bai, and Mihalache [2020] extend the RANK model to a small open economy, focusing on emerging economies, and theoretically examine the conditions under which a government that has foreign currency borrowings chooses to default, exploring how the increase in the default risk of the government affects domestic economic variables, such as the inflation rate and monetary policy[15]. In their model, default risks affect the inflation rate by means of an expected increase in the cost of funds for firms. When the probability of default rises due to increases in government debt, the inflation rate rises and the policy rate is raised, which in turn elevates interest payment costs and reduces the government's incentive to borrow, somewhat suppressing government debt. Arellano, Bai, and Mihalache [2020] also point out an empirical pattern in emerging economies, in particular in Latin America: The inflation rate first increases along with the risk premium on government debt, and then the nominal interest rate is raised to suppress inflation, and this is followed by a simultaneous decline in the inflation rate and government debt. They go on to argue that such an observation is consistent with what the model predicts.

From a different perspective, if for some reason additional debt accumulation becomes difficult, as discussed in Mian, Straub, and Sufi [2022], the effectiveness of monetary policy can be affected at least theoretically. For example, Kaplan and Violante [2018] use the HANK model to study how the effects of monetary tightening differ depending on whether the increase in interest payments on government debt caused by a higher interest rate is financed by further government debt issuance or taxation. Figure 6, based on a similar HANK model, compares the responses of key economic variables after an interest rate hike, in the case where taxation is implemented along with the interest rate hike and in the case where it is not. As seen in Section 2, HANK models assume that there

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15 Following preceding related studies like Mendoza and Yue [2012], the model assumes that the default of the government results in a loss of the opportunity of foreign currency funding and a fall in the productivity of domestic firms. Even without default, of course, interest payment needs to be financed by taxes on households and firms. The government chooses whether to default or not so that it can maximize the utility of domestic households. For a review of the default model literature, see Okachi [2019].

is a certain proportion of HtM households and that the current consumption of these households is strongly positively related to their current disposable income. When the interest rate rises, and when the interest payment is financed by additional tax imposed on the income of households, including HtM households, as seen in equation (15), the current disposable income of the HtM households falls further, leading to a further decline in their current consumption and aggregate GDP. On the other hand, when the interest payment is financed by the issuance of government debt, the disposable income of HtM households does not fall significantly and the overall decline in GDP is limited. By contrast, as already seen in Section 2, the representative household in RANK models follows a smooth consumption path, given its permanent income, and current consumption is not strongly linked to current disposable income. Consequently, how interest payments are financed does not affect the response of aggregate consumption to increases in the interest rate.

The presence of certain institutional settings may also have implications for monetary policy transmission. McKay and Reis [2016] use a HANK model to conduct a simulation analysis studying the relationship between automatic stabilizers, such as unemployment insurance, and the easing effects of monetary policy. They report that, in the absence of automatic stabilizers, when monetary policy faces a zero interest rate constraint, the magnitude of the macroeconomic decline in response to recessionary shocks becomes disproportionately larger than when this is not the case. In such an economy, recognizing that insurance against adverse macroeconomic shocks is limited, households make precautionary savings to prepare for severe future recessions, and such precautionary savings amplify the response of the macroeconomy to adverse shocks[16]. McKay and Reis [2016] document that, as long as either automatic stabilizers or the effectiveness of monetary policy is ensured, the extent of macroeconomic decline is limited, which in turn suggests that if automatic fiscal stabilizers are absent for some reason, including fiscal factors, the role required of monetary policy becomes larger.

There are also studies suggesting that the outstanding amount of government bonds circulating in the markets as a result of government debt issuance affects the transmission effects of unconventional monetary policies such as Large-Scale Asset Purchases (LSAP).

[16] Precautionary savings refer to savings made in preparation for future income uncertainty. While such savings would not occur if all future income fluctuations could be known, in HANK models, individual households are assumed to face idiosyncratic income shocks (corresponding to $Z_{j,t}$ in equation (12)). Consequently, household saving behavior depends not only on interest rates but also significantly on this income uncertainty. McKay, Nakamura, and Steinsson [2016] focus on precautionary savings from the perspective of monetary policy transmission. Using a HANK model, they indicate that precautionary savings make household consumption less responsive to future policy rate reductions through forward guidance.

In the aftermath of the global financial crisis, various unconventional monetary policy instruments were implemented in major countries as short-term interest rates reached their effective lower bound, including long-term government bond purchases targeting term premiums and other factors. Among the theoretical justifications of the effectiveness of such policies are the market segmentation hypothesis and preferred-habitat theory[17]. For example, Chen, Cúrdia, and Ferrero [2012][18] construct a dynamic stochastic general equilibrium (DSGE) model based on these theories to quantitatively assess the impact of a second LSAP on GDP growth and inflation.

4 Fiscal Theory of the Price Level

In Section 2, we discussed the fiscal multiplier when the Taylor rule parameter ϕ_π is less than unity. In standard models, such a situation only arises when considering non-normal times where large negative shocks reduce the policy rate to its effective lower bound. In such contexts, where prices are under sustained downward pressure due to a prolonged and severe economic downturn, such as the banking crisis in Japan or the global financial crisis, central banks may adopt zero interest rate policies or forward guidance and the nominal interest rate may be, or at least appear to be, unresponsive to price movements for a prolonged period. When the parameter ϕ_π is estimated using data from such a period, the value could be less than one. Of course, within the framework of standard models, this is a situation in which the central bank temporarily conducts monetary easing to bring prices back to the target inflation rate amid temporary price stagnation. However, there is also a school of thought that views the same situation as one in which the fiscal

[17] The market segmentation hypothesis and preferred-habitat theory are both proposed to explain the actual shape of yield curve. The prediction of these theories contrasts with that of the standard expectation hypothesis. The expectation hypothesis argues that under bond market arbitrage, long-term rates converge to expected short-term rates, and if current short-term rates are expected to persist, the yield curve flattens. The preferred-habitat theory was first introduced by Modigliani and Sutch [1966] and has recently been incorporated into term structure models by Vayanos and Vila [2009]. In this theory, long-term rates are decomposed into the component driven by expected future short-term rates and the rest, i.e., the term premium component. The premium, affected by imperfect substitutability between long- and short-term bonds, responds to long-term bond supply-demand fluctuations (where "supply" refers to the amount of bonds issued by the government minus central bank purchases). The market segmentation hypothesis argues that short- and long-term bond market participants have different preferences for bonds, which in turn leads to insufficient inter-market arbitrage, impeding rate convergence. Together, these hypotheses provide an explanation for long-term rate formation that deviates from expected short-term interest rates, and for changes in long-term rate reduction through bond purchases. For analyses testing these hypotheses in Japan, see Fukunaga, Kato, and Koeda [2015] and Sudo and Tanaka [2021].

[18] The model assumes that, in the long run, government debt issuance grows at the same rate as GDP. In this model, the term premium fluctuates when short-term shocks, including LSAP, cause the amount of bonds circulating in the market to deviate from the levels suggested by this growth rate.

authority, rather than the central bank, determines the price level. This is known as the fiscal theory of the price level (FTPL).

FTPL has long been proposed by influential economists such as Leeper [1991], Sims [1994], and Woodford [1995], but it is not necessarily widely seen as the prevailing theory. However, it has gained some support as a perspective that provides an alternative view when standard models fail to explain actual price movements. There are also cases in history where economic variables are said to have followed a path consistent with FTPL. In recent years, there has been renewed interest in FTPL in the United States in the wake of the pandemic and the large fiscal stimulus at the time, and the subsequent spike in inflation. At the 2022 Jackson Hole conference, a paper on FTPL entitled "Inflation as a Fiscal Limit" was presented. In this section, we briefly describe FTPL and then overview the recent research.

(1) Basic Mechanism of the Fiscal Theory of the Price Level

A. Basic Mechanism

In the standard model explained in Section 2, aggregate prices and aggregate demand are determined by the real interest rate set by the central bank based on equation (7); the Euler equation (equation (4)) that determines the growth rate of aggregate demand C_t given the real interest rate; the resource constraint equation represented by equation (9); and the Phillips curve (equation (6)). The model assumes that the parameter ϕ_π in equation (7) is greater than unity, at least in normal times.

On the other hand, FTPL considers that the parameter ϕ_π in equation (7) is less than unity (regardless of whether the economy is in normal or in crisis). This means that when inflationary pressure occurs, the real interest rate decreases, and when deflationary pressure occurs, the real interest rate increases. From equation (4), a decrease (increase) in the real interest rate boosts (tightens) current demand and creates further inflationary (deflationary) pressure. In other words, in this situation, the Taylor rule cannot stabilize prices, but rather amplifies them. As a result, there is room for the fiscal sector to act on prices. To see this point, we expand the fiscal budget constraint equation (8) to infinity (note that T_t and τ_t denote real values in equations below) in the same way as for households, and obtain an intertemporal budget constraint equation for the government sector. Similar to the derivation of equation (3), we also assume the transversality condition here (the assumption that government spending is not financed by debt that cannot be repaid in the infinite future).

$$\mathrm{E}_0\left\{(1+i_{-1})B_{-1}+P_0G_0+P_0\tau_0+\sum_{t=1}^{\infty}\frac{P_tG_t+P_0\tau_t}{\prod_{s=0}^{t-1}(1+i_s)}\right\}\leq \mathrm{E}_0\left\{P_0T_0+\sum_{t=1}^{\infty}\frac{P_tT_t}{\prod_{s=0}^{t-1}(1+i_s)}\right\}.$$

If we convert the variables in this equation into real variables, we get the following equation:

$$\frac{(1+i_{-1})B_{-1}}{P_0}\leq \mathrm{E}_0\left\{T_0-(G_0+\tau_0)+\sum_{t=1}^{\infty}\frac{T_t-(G_t+\tau_t)}{\prod_{s=0}^{t-1}(1+i_s)/(1+\pi_s)}\right\}. \qquad (22)$$

Note that the price level P_0 appears on the left-hand side. The idea behind FTPL is that equation (22) determines P_0 when the parameter ϕ_π is less than unity and thus monetary policy is incapable of stabilizing price fluctuations. In standard models, it is assumed that the price level P_0 is determined first and, given that, the fiscal authority adjusts the tax T_t and income transfer τ_t to satisfy equation (22). On the other hand, when the Taylor rule cannot determine prices and the fiscal authority does not adjust the primary fiscal balance at all, as suggested by the fact that the variables other than interest rates included in equation (22) are fiscal variables, the fiscal variables determine[19] the price level P_0.

The price-determination mechanism of FTPL is shown in Figure 7. For example, suppose there is an unanticipated increase in income transfer τ_0, and the schedules of current and future government spending G_t, income transfer τ_t, and tax amount T_t do not change at all in response to this increase (i.e., the increase in income transfer is financed by new issuance of government debt B_t, and not by taxes or spending cuts). From the household's perspective, income increases by the amount of the increase in τ_0 (wealth effect) according to equation (3), leading to an increase in consumption and generating upward pressure on prices. Here, since the Taylor rule has a parameter ϕ_π less than unity, the real interest rate falls, generating further upward pressure on prices. The greater the increase in household income, the greater the magnitude of the price

[19] In words, equation (22) can be expressed as follows: The left-hand side—"nominal debt outstanding"—is typically interpreted as the sum of net liabilities of the general government at the beginning of period t and the central bank's liabilities (banknotes + current deposits). The right-hand side is the sum of the primary fiscal balance sequence from period t to infinity, discounted by the interest rate in each period (present discounted value of primary fiscal balances). For this equation to hold as an equality, for instance, when the primary fiscal balance in period s increases, the price level in period t must fall by the amount necessary to maintain the equality.

$$\frac{Nominal\ \ Debt_{t-1}}{Price\ \ Level_t}=\sum_{s=\mathrm{t}}^{\infty}\frac{Primary\ \ Balance_s}{Interest\ \ Rate_s}$$

increase. However, the price increase also reduces the real value of government debt B_t held by households, and the decline in the real interest rate reduces interest income. The upward pressure on prices gradually diminishes and disappears at the point where the increase in income is offset by the increase in prices.

Fiscal and monetary policies play important roles in this price-determination mechanism. For example, if the fiscal authority finances income transfers through taxation, T_0 and τ_0 will offset each other in equation (3), and prices will not rise. Moreover, for this mechanism to hold, the central bank must keep the parameter ϕ_π at a value less than unity. Following Leeper [1991], who formalizes these ideas, and Leeper and Leith [2016], who summarize various FTPL studies, we introduce the concept of fiscal policy rules into the model.

$$S_t(s^*)^{-1} = \delta\left(\frac{B_t}{P_t}(b^*)^{-1}\right). \quad (23)$$

$$1 + i_t = \max\left[1, \frac{1}{\beta}(1+\bar{\pi})\left(\frac{1+\pi_t}{1+\bar{\pi}}\right)^{\phi_\pi}\right]. \quad (24)$$

Equation (23) is the fiscal policy rule. s^* and b^* are the long-run equilibrium values of the real primary balance and real government debt, respectively. This equation shows how much the government changes the primary balance (deviation from the long-run equilibrium) when the debt deviates from its long-run equilibrium. The parameter δ is the elasticity governing how much government adjusts the primary balance. According to the rule in equation (23), government debt grows at the rate[20] $\beta^{-1} - \delta$. Thus, as discussed in Leeper [1991], if the value of δ is greater than $\beta^{-1} - 1$, government debt decreases over time and eventually converges to its long-term equilibrium value. In the illustration shown in Figure 7, this implies that even when households receive unexpected income transfers, such fiscal measures are offset by future reductions in transfers or tax increases. Consequently, the intertemporal budget constraint remains unchanged, and no wealth effect occurs. However, if δ is less than $\beta^{-1} - 1$, future improvements in the primary balance do not offset the current increase in income transfers. Government debt explodes if the previously discussed price-determination mechanism of FTPL would not take effect.

Equation (24) is the same as equation (7). As discussed earlier, if ϕ_π is greater than unity, the Taylor principle is satisfied and the real interest rate r_t rises more than the upward pressure on prices π_t, thereby suppressing aggregate demand through equation

[20] Government debt grows by its yield when repayments are not made. Considering a standard setup where the yield is determined by the inverse of the subjective discount rate (β^{-1}), the net growth rate of government debt, including the debt reduction due to primary balance surplus, becomes $\beta^{-1} - \delta$.

(11). Conversely, if it is less than unity, the real interest rate falls, so aggregate demand is not suppressed and the upward pressure on prices becomes even greater.

Leeper [1991] categorizes fiscal policy based on the value of δ in the fiscal policy rule. When δ is smaller than $\beta^{-1} - 1$, the fiscal policy regime is referred to as Active FP, where the policy does not sufficiently adjust tax revenue or expenditure to stabilize government debt when real debt increases. Conversely, when δ is larger, it is referred to as Passive FP, where the policy adjusts tax revenue or expenditure to bring the primary balance back to equilibrium when real debt increases. Similarly, for the monetary policy rule, Leeper [1991] refers to both Active MP, when ϕ_π exceeds unity, and Passive MP, when ϕ_π is less than or equal to unity. The standard economic model, where monetary policy aims for price stability and fiscal policy seeks to stabilize government debt, corresponds to the combination of Active MP and Passive FP in the above framework. This is known as Regime M. Conversely, an economy where FTPL holds, i.e., where Passive MP and Active FP hold, is referred to as Regime F. In Regime F, the primary balance is not sufficiently adjusted for fluctuations in government debt. While this should lead to the explosion of government debt, because monetary policy does not suppress upward price pressure, government debt converges to its long-term equilibrium value as its real value falls due to price increases[21].

B. Economic Dynamics under FTPL

In Regime F (where FTPL holds), the underlying economic structures—such as IS curves and Phillips curves—remain the same as in the standard model (Regime M), despite differences in fiscal and monetary policy rules. Not all relationships between economic variables therefore change dramatically across regimes. However, some variables may

[21] Theoretically, regimes with other pairs of fiscal and monetary regimes are also possible. In Active MP and Active FP, with the aggressive monetary response to inflation and fiscal policy not pursuing debt stabilization, inflation pressures may cause monetary tightening, reducing the right side of equation (22) due to real rate increases, while demand from households, which are the holders of government debt, rises in line with increased interest payments. This could lead to an escalating, potentially explosive path of inflation. In Passive MP, Passive FP, the modest monetary response to inflation and fiscal policy pursuing debt stabilization may cause further inflationary pressure as real rates fall. In this case, while the government seeks to stabilize debt, there is no mechanism to determine inflation uniquely. This could theoretically result in self-fulfilling inflation expectations and indeterminacy. Regarding this point, several studies argue that inflation stability has been achieved in the U.S. since the 1980s because of the shift from Passive MP, i.e., an economy with indeterminacy, to Active MP, i.e., monetary policy consistent with the Taylor principle (Clarida, Galí, and Gertler [2000]; Coibion and Gorodnichenko [2011]). Relatedly, Cochrane [2018] argues that Active FP may be prevailing when stable inflation is observed under zero interest rate constraints. Indeed, as mentioned earlier, some view prolonged zero interest rates as suggestive evidence of Passive MP. From this standpoint, if Passive FP is in effect, the self-fulfilling inflation rate should arise, which in turn implies that the lack of such observations may serve as evidence for Active FP.

exhibit starkly different dynamics. Comparing these model-implied dynamics with actual data can help us assessing whether FTPL is indeed operative in reality.

Figure 8 illustrates how economic variables respond to government spending shocks (increased G_t) and income transfer shocks (increased τ_t) under Regime F. In Regime M, as discussed in Section 2, income transfer shocks do not affect the economy. This is because such shocks do not impact the resource constraint like government spending shocks do and, under Passive FP, households anticipate future improvements in the primary balance, leaving their expected lifetime income unchanged. By contrast, in Regime F, both shocks lead to increased consumption, causing GDP to rise, with the fiscal multiplier exceeding unity. Inflation also increases. This occurs because, under Active FP, households do not expect any future changes in fiscal measures, such as tax hikes, to improve the primary balance, following an income transfer shock. Consequently, households' expected lifetime income rises. As consumption increases, inflation rises through the Phillips curve. Yet, the central bank does not raise policy rates, resulting in lower real interest rates.

Figure 9 shows the responses of economic variables to a positive policy rate shock under Regime F. In Regime M, interest rate hikes increase government interest payments, but under Passive FP, households anticipate future improvements in the primary balance. Thus, their expected lifetime income remains unchanged, and they adjust consumption based on real interest rates, following equation (4). Conversely, in Regime F, while interest payments rise due to rate hikes, households do not expect the government to improve the future primary balance through measures like tax increases. This raises households' expected lifetime income, leading to increased consumption. Consequently, the inflation rate rises through the Phillips curve.

(2) FTPL in the Real Economy

The relevance of discussing Regime F hinges on whether or not it holds in the actual economy. However, as Woodford [1999] notes in his comment on Cochrane [1999], the identification of regimes ultimately lies in the underlying causes of inflation fluctuations. This cannot be determined solely by time-series properties such as correlations between inflation rates and fiscal variables. Moreover, fiscal and monetary policy regimes are not directly observable. Considering these limitations, researchers have proposed methods to identify regime types, imposing necessary assumptions and reservations[22]. Recently, as

[22] Prior research presents several historical episodes that are potentially consistent with FTPL. Woodford [2001] argues that the Fed's explicit agreement with the Treasury to stabilize interest rates from 1942 to the 1951 Accord, including interventions when bond prices rose, aligns with Regime F. He also points out that inflation came with a delay, only increasing with the outbreak of the Korean

government debt levels have surged and inflation has spiked in advanced economies, numerous approaches have been suggested. Some of the results are indeed consistent with the predictions of Regime F.

One approach examines actual policy rules, measuring their sensitivity to changes in inflation rates and government debt. Davig and Leeper [2007] apply this method to U.S. data from 1948 to 2004. They estimate the following two equations, allowing both fiscal and monetary policy rules to switch between Active and Passive states:

$$i_t = \alpha_0(S_t^M) + \alpha_\pi(S_t^M)\pi_t + \alpha_y(S_t^M)\tilde{y}_t + \sigma_i(S_t^M)\epsilon_t^i. \tag{25}$$

$$\tau_t = \gamma_0(S_t^F) + \gamma_b(S_t^F)b_{t-1} + \gamma_g(S_t^F)g_t + \gamma_y(S_t^F)\tilde{y}_t + \sigma_\tau(S_t^F)\epsilon_t^\tau. \tag{26}$$

Here, τ_t represents government revenue excluding income transfers. S_t^M and S_t^F denote monetary and fiscal policy regimes, respectively, alternating between Active and Passive states. $\tilde{y}_t$ is the GDP gap, while ε_t^i and ε_t^τ are disturbance terms in both rules. The parameters $\alpha_0(S_t^M)$, $\alpha_\pi(S_t^M)$, $\alpha_y(S_t^M)$, $\sigma_i(S_t^M)$, $\gamma_0(S_t^F)$, $\gamma_b(S_t^F)$, $\gamma_y(S_t^F)$, and $\sigma_\tau(S_t^F)$ can vary with each regime.

For instance, if $\alpha_\pi(S_t^M)$ exceeds unity and $\gamma_b(S_t^F)$ is positive in a given period, this indicates that the policy rate rises by more than one percent in response to a change in inflation by one percent, and that tax revenue increases in line with expansion in government debt. In this case, Regime M (Active MP, Passive FP) holds. Conversely, if $\alpha_\pi(S_t^M)$ is less than unity and $\gamma_b(S_t^F)$ is negative, this indicates that Regime F (Passive MP, Active FP) holds.

The estimation results reveal that, from the mid-1980s onwards, there are extended periods where Active MP and Passive FP prevail. By contrast, for the preceding period, we generally find Passive MP with fiscal policy frequently switching between Passive and Active states[23][24].

In recent years, a growing number of studies have estimated models following the estimation methodology used for standard RANK models, such as that developed by Smets and Wouters [2007]. These approach fiscal variables as observables alongside the

War, partly due to wartime price controls. Loyo [1999] examines the case of Brazil from the late 1970s to 1980s, suggesting a shift to Active MP and Active FP in 1980 due to monetary policy regime change (with the Taylor rule coefficient reportedly shifting from 0.04 in the late 1970s to 1.21 in the early 1980s) while fiscal policy remained unchanged. Theoretically, such a regime change should lead the inflation rate to explode, which indeed was observed in Brazil in the early 1980s.

23 Bianchi and Ilut [2017] argue that while fiscal policy rules frequently transition and remain unstable, monetary policy rules show relative stability, being Active from the mid-1980s onward and Passive before then. They note that this finding aligns with the results stressed in Clarida, Galí, and Gertler [2000], which highlight changes in monetary policy rules.

24 Doi, Hoshi, and Okimoto [2011] conducted a similar analysis using Japanese data from 1981 to 2010. They show that Active FP may have been in effect for much of the period since the 1990s, with some exceptions.

variables used for estimating RANK models, such as inflation rates, GDP, and other macroeconomic variables. For instance, Bianchi and Ilut [2017], focusing on the U.S. example from the 1950s to 2009, consider and estimate a model where the economy probabilistically transitions among Regime F, Regime M, and Active MP and Active FP. Their method simultaneously estimates parameters related to economic structure and monetary and fiscal policy rules.

Regarding the high inflation period from the 1970s to early 1980s, their results show that Regime F dominated before Chairman Volcker assumed his position. In the first two years or so of Volcker's term, fiscal policy shifted from Active to Passive, transitioning to Regime M. The authors suggest that, without this fiscal regime change, the 1980s monetary tightening could have resulted in inflation rather than deflation[25]. Their study also concludes that Regime M has primarily prevailed throughout the subsequent period.

Bianchi, Faccini, and Melosi [2023] develop a model that identifies what are referred to as "funded fiscal shocks" and "unfunded fiscal shocks," rather than considering regimes such as Regime M or Regime F. The funded and unfunded shocks influence inflation dynamics through channels similar to Regime M or F. They use this model to analyze driving factors of inflation from the high inflation period of the 1970s to post-pandemic inflation surge.

In their framework, unfunded fiscal shocks refer to government spending shocks without government action to ensure repayment. With such shocks, the central bank accommodates the increase in inflation necessary to stabilize the unfunded amount of debt. By contrast, for funded shocks where fiscal policy ensures repayment, monetary policy targets inflation stabilization while fiscal authorities manage debt. Their estimation results suggest that unfunded fiscal shocks account for the majority of inflation rate increases following the spread of the pandemic[26][27].

Smets and Wouters [2024] introduce a model where a proportion λ of economic

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25 The paper argues that, in addition to the current economic regime, the expected duration of the regime and the likelihood of transitioning to different regimes also influence the dynamics of economic variables through expectations. For instance, even if the current regime is Regime M, if economic agents anticipate a possible transition to Regime F, government debt can impact inflation dynamics.

26 Sunakawa [2024], using the methodology of Bianchi, Faccini, and Melosi [2023], conducts a decomposition of inflation factors in Japan. The study reports that, while unfunded fiscal shocks contribute to inflation increases in certain periods, their quantitative impact in Japan is limited compared to the United States.

27 In this model, the distinction between inflation fluctuations caused by fiscal factors versus those caused by conventional supply shocks (such as markup shocks) is identified through differences in the responses of key variables. When an unfunded shock occurs, inflation rises while nominal interest rates are kept low under passive monetary policy, resulting in declining real interest rates and a decrease in the debt-to-GDP ratio due to reduced interest payments. Conversely, if inflation is driven by supply shocks, real interest rates rise and the debt-to-GDP ratio increases.

shocks are funded, with the rest unfunded. They estimate λ to gauge the fiscal authority's degree of fiscal backing, thereby quantifying the impact of government debt on inflation. Their estimation results in $\lambda = 0.8$, suggesting that 80% of shocks explaining the business cycle are funded, while 20% are unfunded. This finding contrasts with Bianchi, Faccini, and Melosi [2023], who ascribe most U.S. inflation to fiscal factors. Instead, the former authors conclude that monetary policy has been effectively stabilizing the inflation rate, except for the high inflation period of the 1960s-70s.

5 Conclusion

Recent global crises, notably the financial crisis and the COVID-19 pandemic, have pushed most of the major economies to their monetary policy limits, necessitating substantial fiscal interventions. This has rekindled interest in the role of fiscal policy in stabilizing macroeconomies, sparking a surge in research. In the meantime, macroeconomic analyses have been gradually shifting from those based on traditional Representative Agent New Keynesian (RANK) models to those based on Heterogeneous Agent New Keynesian (HANK) models, which are considered to better capture households' heterogeneity. HANK models have been increasingly used to evaluate various fiscal policy measures by precisely detailing their characteristics.

This paper reviews recent research on fiscal and monetary policy interactions, concentrating on three perspectives in particular: the relationship between the Taylor rule and fiscal multipliers, the interaction between interest rates and government debt, and the fiscal theory of the price level (FTPL). It overviews findings of theoretical and empirical studies, paying attention to the interaction between these policies.

In the first perspective, since the global financial crisis, the argument that monetary policy reaction to inflation matters to the fiscal multiplier has been increasingly accepted, as shown in work by Christiano, Eichenbaum, and Rebelo [2011] and Woodford [2011]. For example, when fiscal expansion causes inflationary pressure, monetary policy aiming to ensure constant real interest rates boosts demand by a greater margin than when monetary policy follows Taylor principle, thus enlarging the fiscal multiplier. While this mechanism holds in both RANK and HANK models, empirical studies along this line are limited, possibly because of the scarcity of the experience of economies that have long deviated from the Taylor principle. Current studies show mixed results: Some find fiscal multipliers significantly above one, while others report statistically insignificant effects.

The second perspective has attracted attention, triggered by the work of Blanchard [2019], which examines government debt sustainability from the perspective of the interplay between the interest rate and output growth rate, as well as by several subsequent theoretical studies. While conventional neoclassical models suggest that long-term growth rates converge to a value below interest rates, the recent analyses propose and study a model in which the yield spreads between safe and risky assets vary in line with government debt levels. These studies explore how spreads, debt issuance, debt sustainability, and maximum government spending interact. However, this field remains largely theoretical, with few quantitative or empirical studies to date.

Traditionally, FTPL has gained some support in the academic world as a theoretical explanation for price determination, particularly in contexts where major economies face effective lower bounds on interest rates. There have been recent increases in empirical studies, spurred by pandemic-related fiscal measures and subsequent inflation. These investigate FTPL's validity, likelihood, or partial applicability, with some studies arguing that that the mechanism of FTPL has held in recent U.S. inflation trends.

There are two key research directions looking forward. The first is deeper exploration of household and firm heterogeneity, including its characteristics, extent, and distribution among agents with different characteristics. Fiscal policy involves various tools, encompassing different taxes, different types of government spending, and different types of transfers, often targeting specific groups within the economy rather than affecting all households and firms equally, in contrast to monetary policy. These observations suggest that fiscal-monetary interaction outcomes may vary depending on the specificity of fiscal policy tools or the economic group considered. Developing frameworks that accurately represent the heterogeneity of households and firms and their distribution is vital for deeper analysis.

The second direction is the further accumulation of quantitative analysis. Fiscal policy typically involves extended and variable time lags between decision-making and implementation. This characteristic complicates the identification of fiscal policy shocks in time-series analyses. Furthermore, numerous fiscal variables exhibit low-frequency changes, often adjusting only annually or quarterly. While these factors present substantial challenges for empirical research, progress in addressing such methodological issues is essential for enhancing model validation and refinement, constituting a critical frontier in the field of macroeconomic research.

Figure 1: Monetary Policy Rule and Fiscal Expenditure in a Simple RANK Model

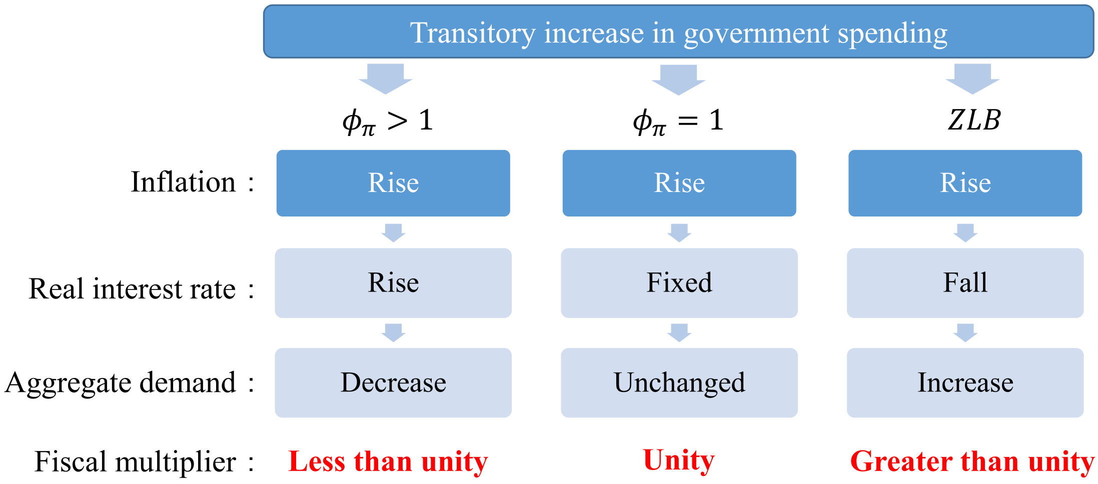
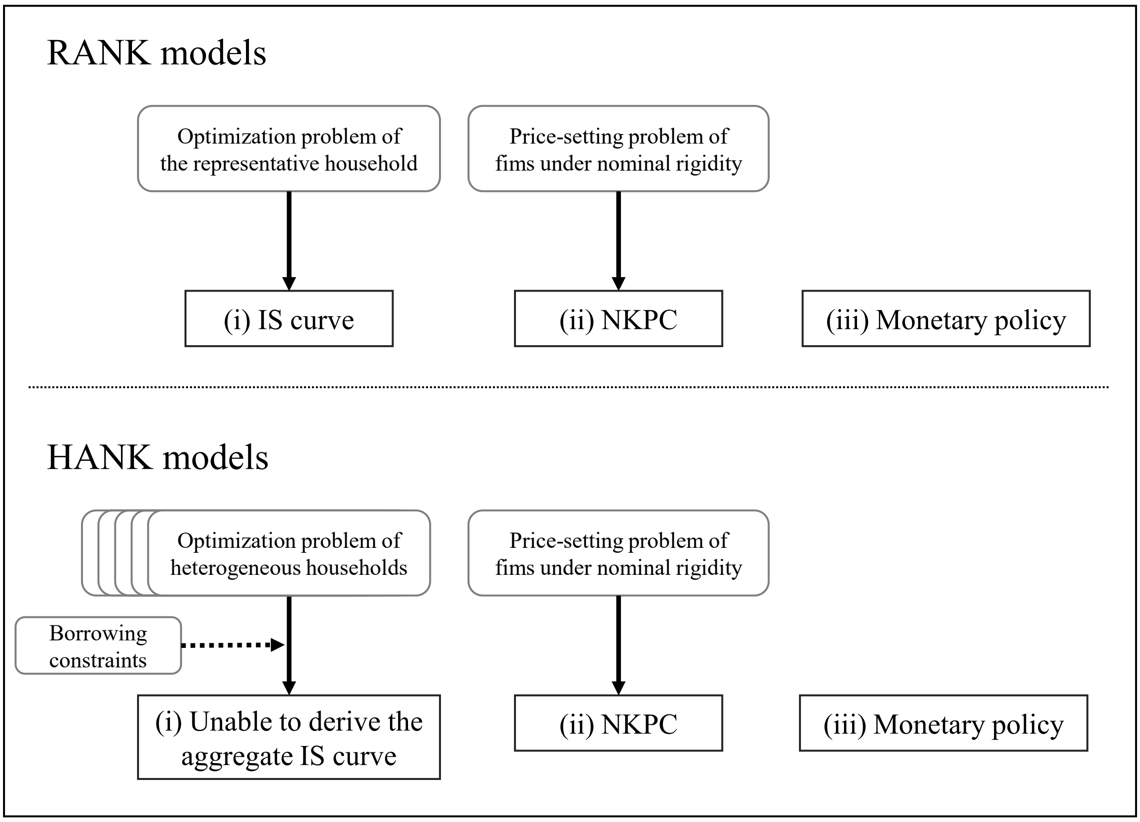
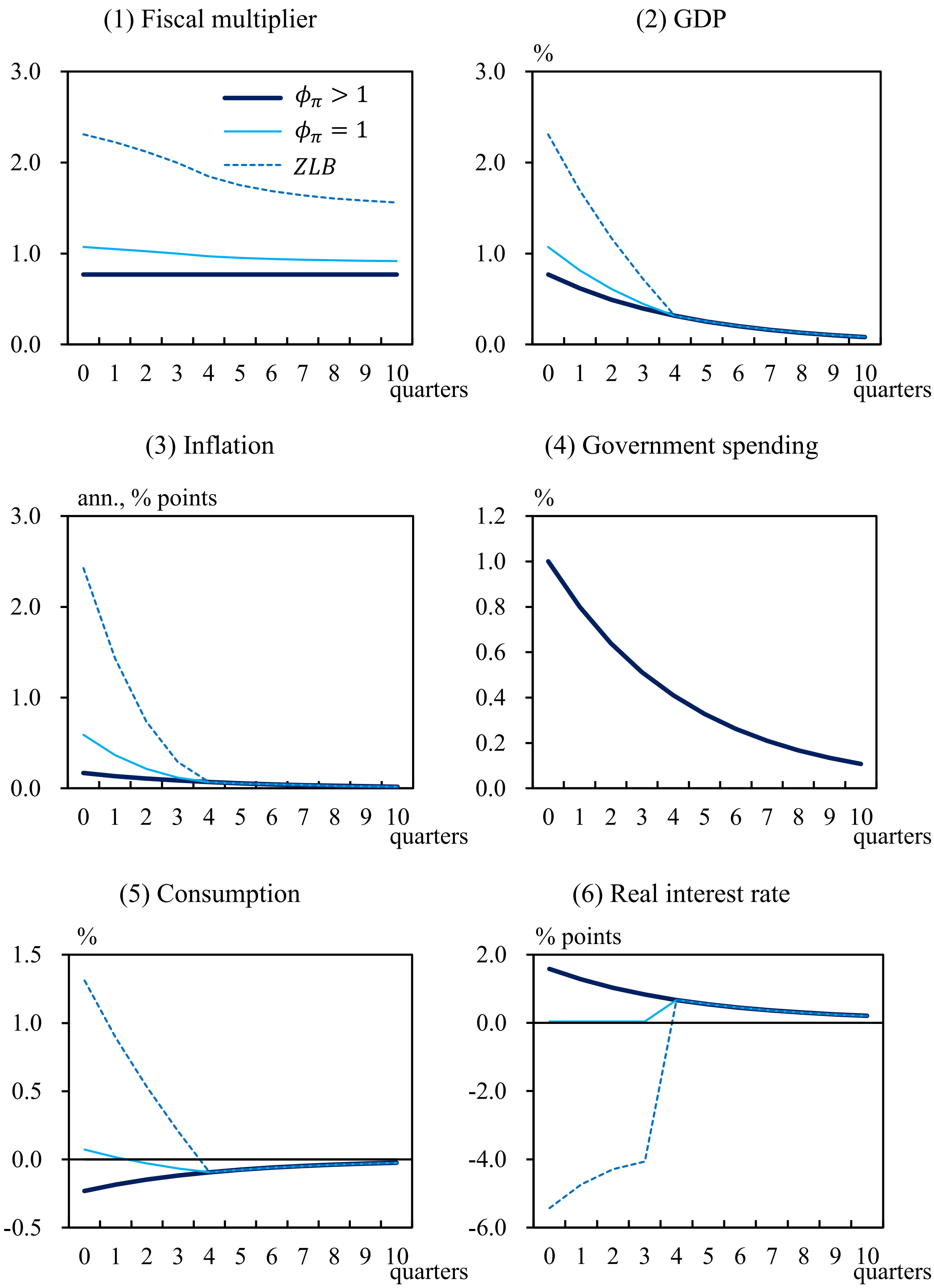


Figure 2: Differences between RANK and HANK Models



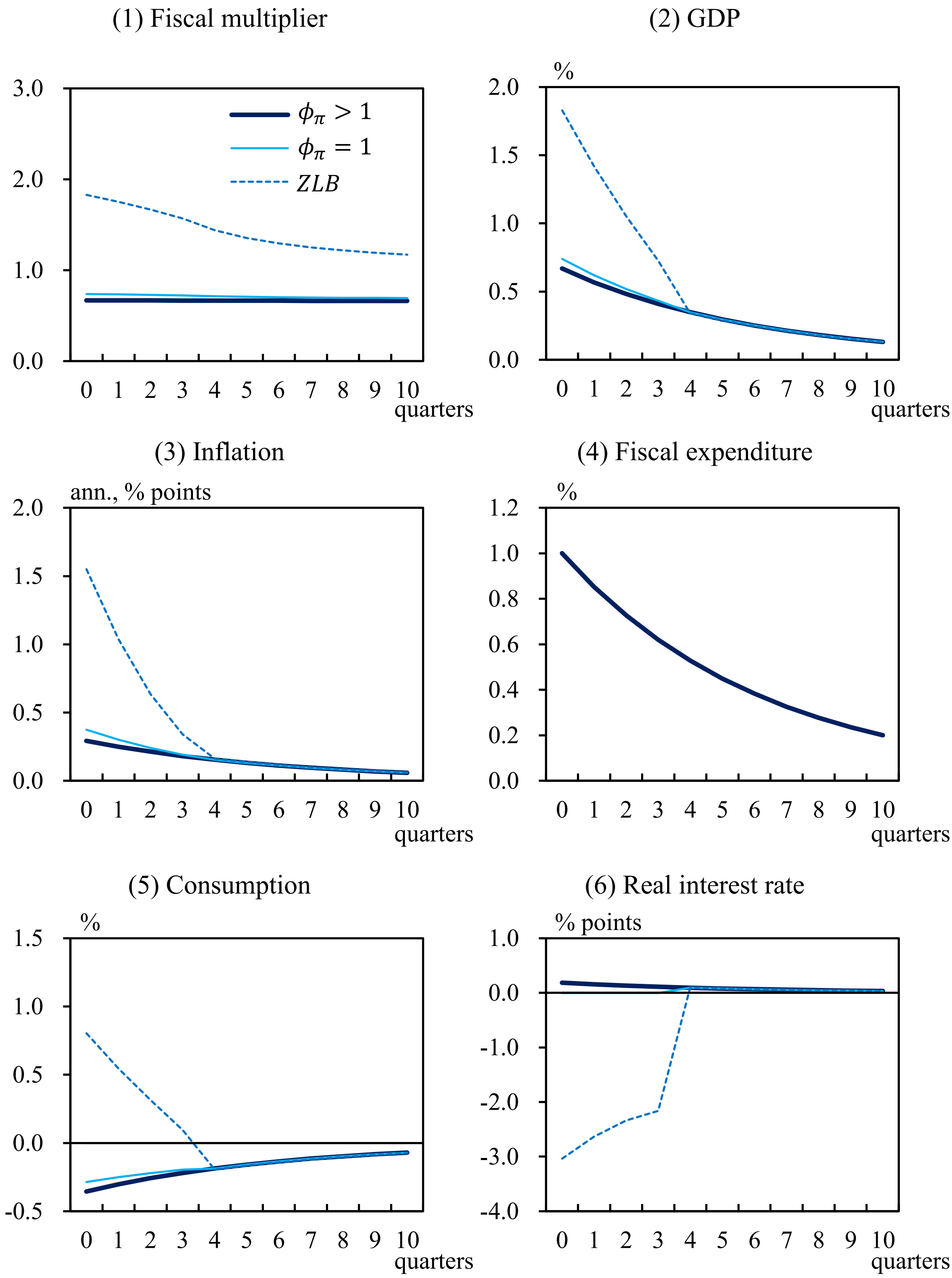
Note: Excerpted from Iwasaki et al. [2021] and translated by the authors.

Figure 3: Impulse Responses to a Positive Government Spending Shock



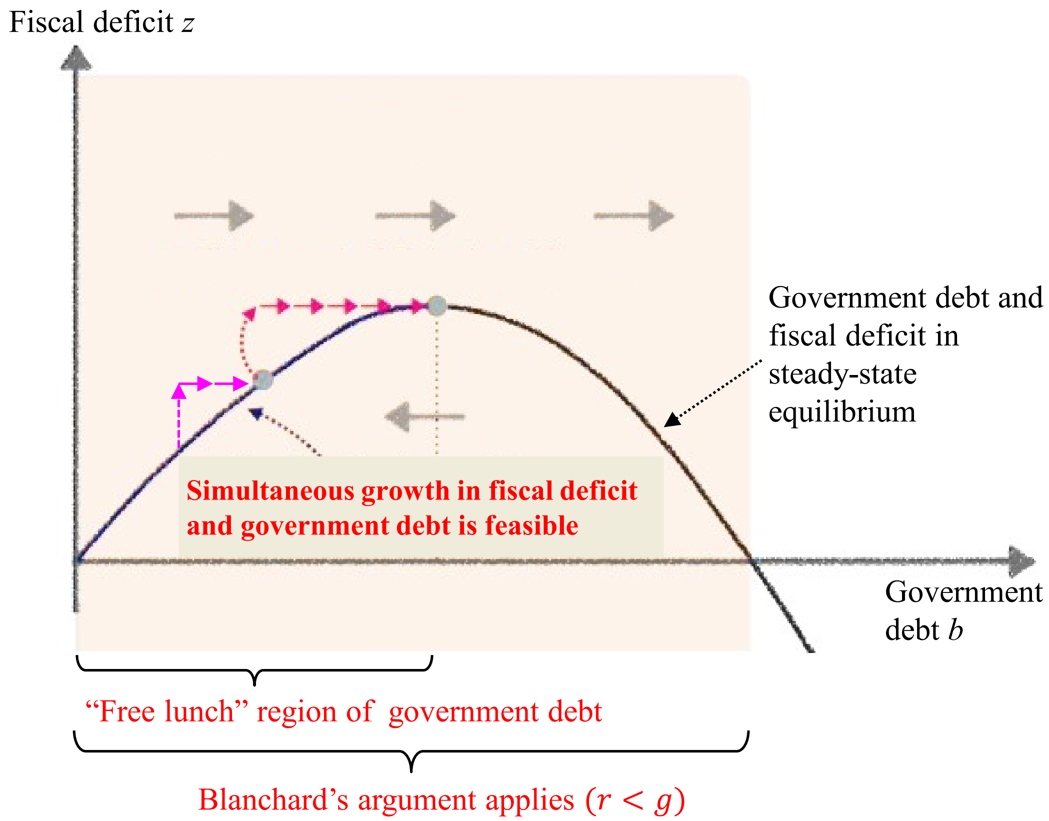
Note: For the ZLB case, it is assumed that the nominal interest rate is zero for the first four quarters, thereafter following the Taylor rule. For the $\phi_\pi = 1$ case, it is assumed that the nominal interest rate is adjusted to keep the real interest rate constant for the first four quarters, thereafter following the Taylor rule. (2), (4), and (5) show the percentage deviation from the steady-state value, while (3) and (6) show the percentage point difference from the steady-state value.

Figure 4: Impulse Responses to a Positive Government Spending Shock under a HANK Model



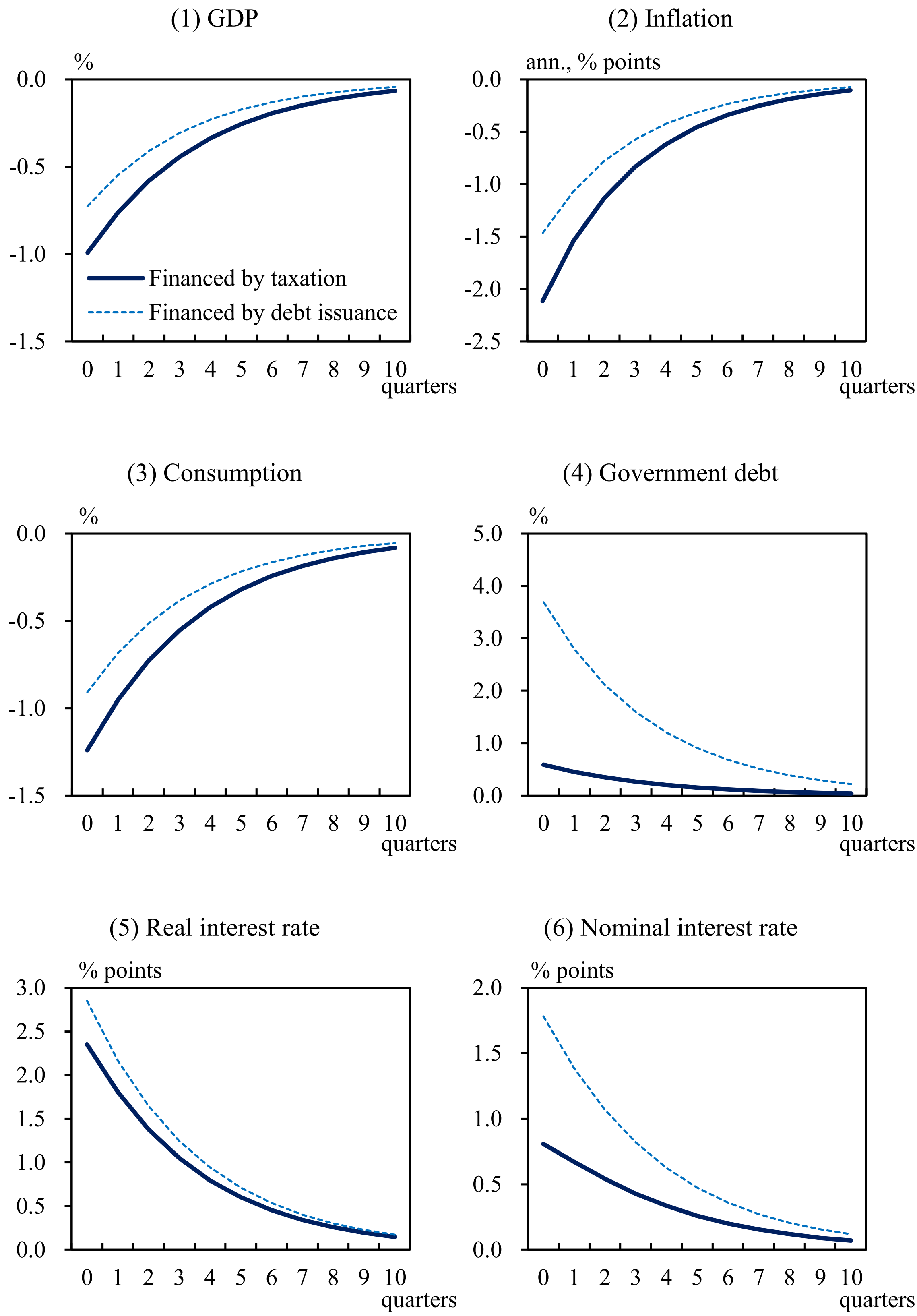
Note: For the ZLB case, it is assumed that the nominal interest rate is zero for the first four quarters, thereafter following the Taylor rule. For the $\phi_\pi = 1$ case, it is assumed that the nominal interest rate is adjusted to keep the real interest rate constant for the first four quarters, thereafter following the Taylor rule. (2), (4), and (5) show the percentage deviation from the steady-state value, while (3) and (6) show the percentage point difference from the steady-state value.

Figure 5: Relationship between Government Debt and Fiscal Deficit under an Endogenous Interest Rate Spread



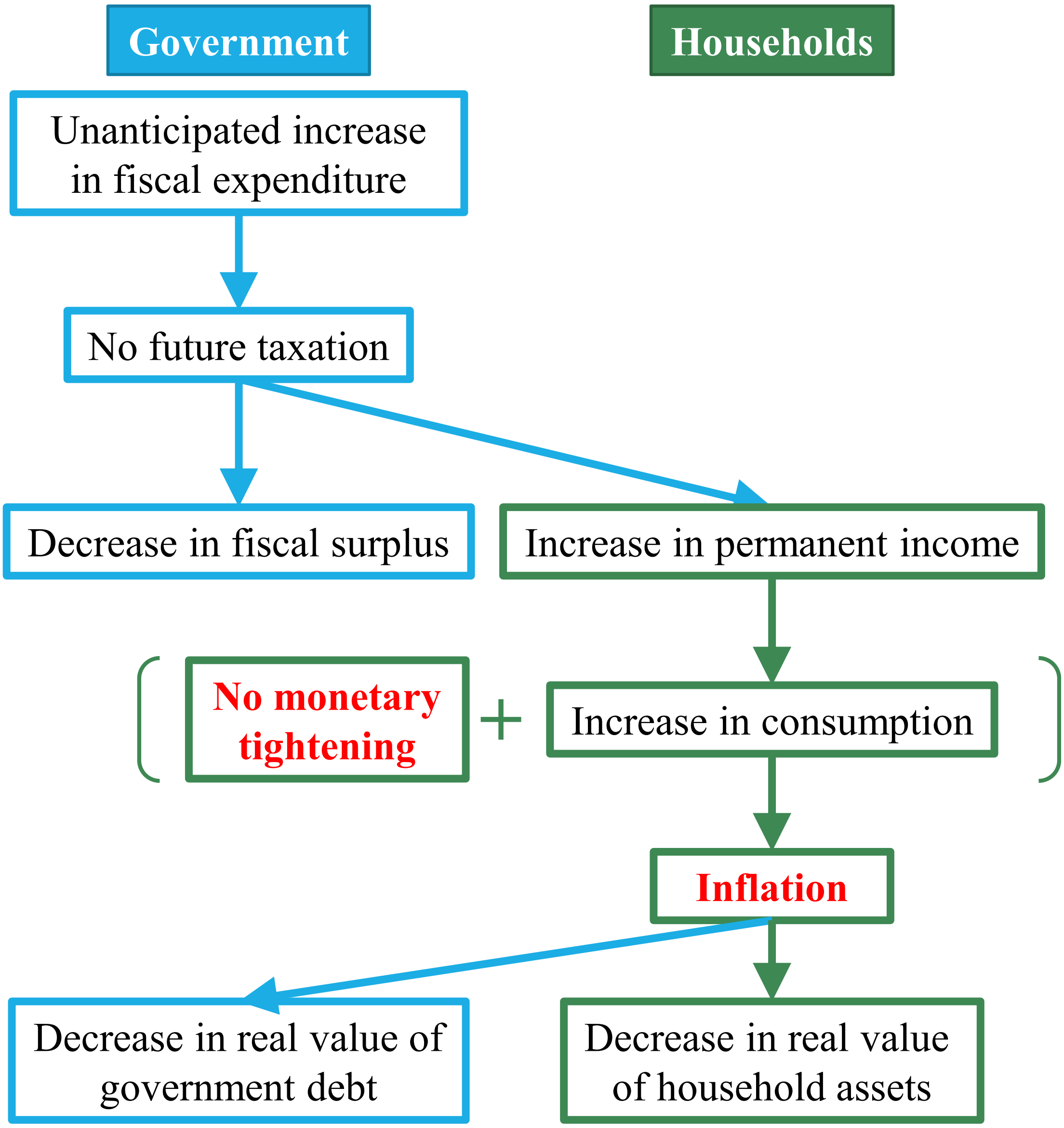
Note: Reproduced by the authors based on Figure 2(b) from Mian, Straub, and Sufi [2022].

Figure 6: Impulse Responses to a Positive Interest Rate Shock under a HANK Model



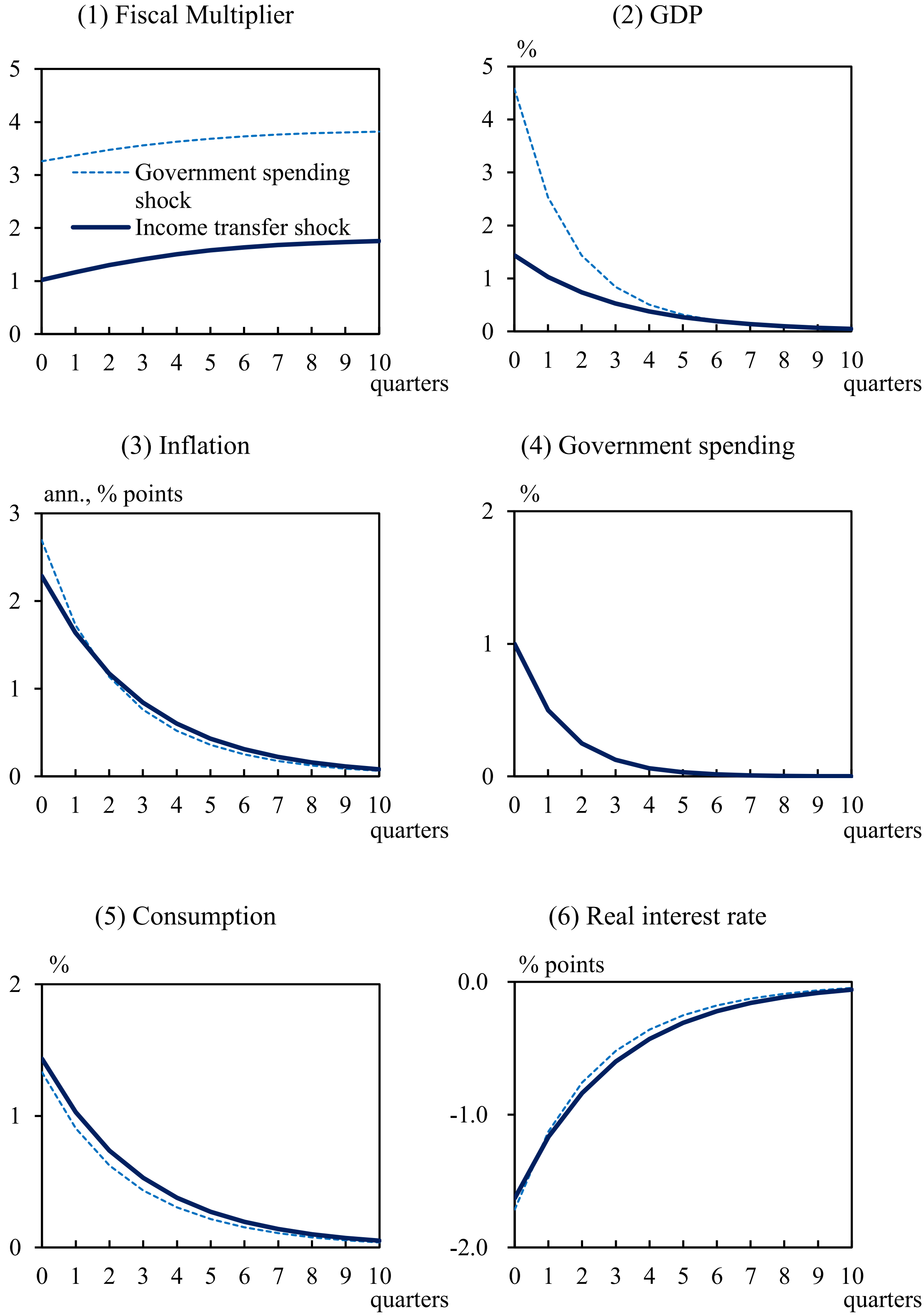
Note: (1), (3), and (4) show the percentage deviation from the steady-state value, while (2), (5), and (6) show the percentage point difference from the steady-state value.

Figure 7: Price Determination Mechanism in FTPL



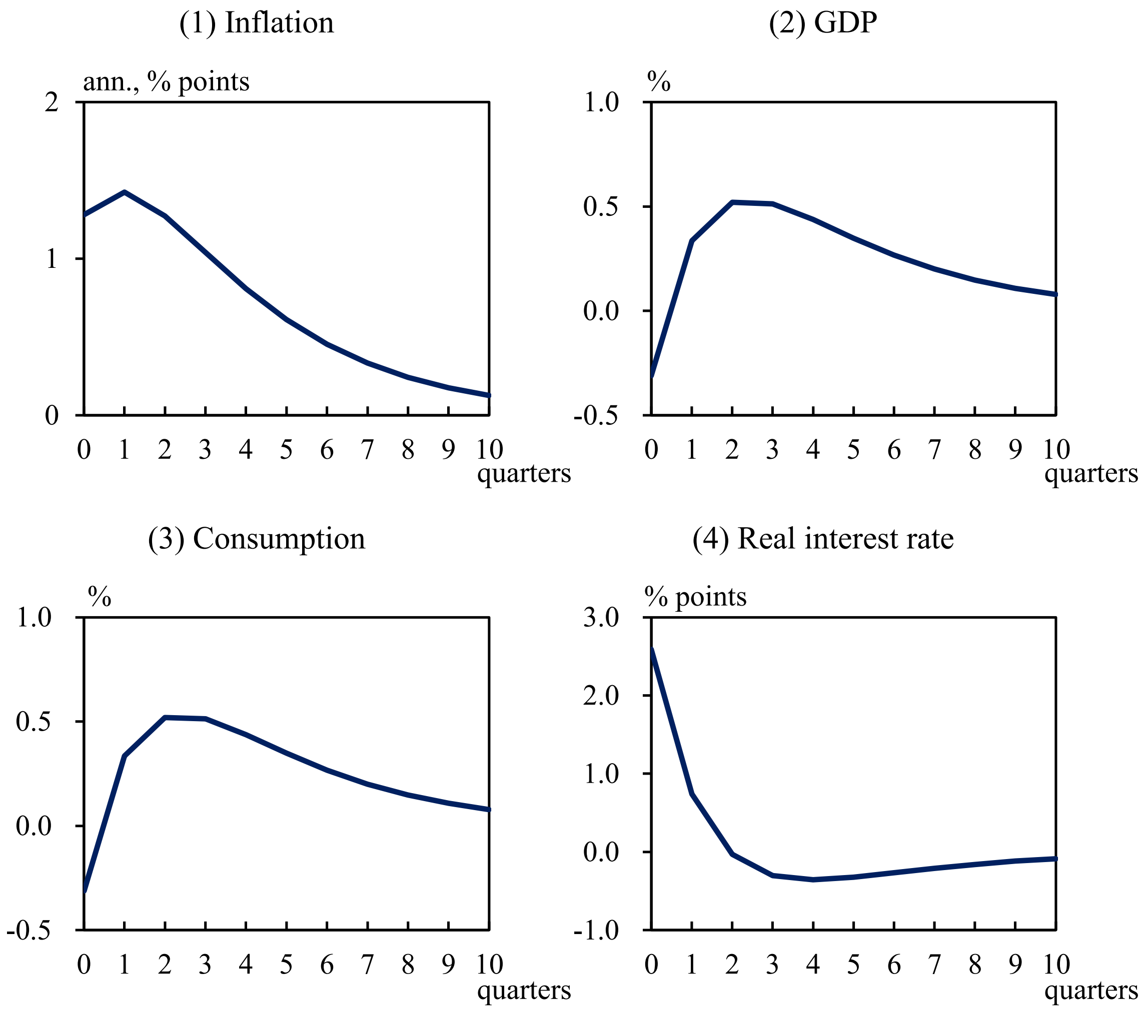
✓ When households perceive that unanticipated fiscal expenditures (including income transfers) are financed through government bonds rather than taxation, this results in an increase in their permanent income. This perceived increase in permanent income stimulates consumption, leading to a rise in inflation rate through macroeconomic supply-demand dynamics. However, as a consequence of this increase in inflation, the real value of household assets declines, effectively offsetting the increase in permanent income.

Figure 8: Impulse Responses under FTPL
(Government Spending Shock, Income Transfer Shock)



Note: (2), (4), and (5) show the percentage deviation from the steady-state value, while (3) and (6) show the percentage point difference from the steady-state value.

Figure 9: Impulse Responses under FTPL (Interest Rate Shock)



Note: (1) and (4) show the percentage point difference from the steady-state value, while (2) and (3) show the percentage deviation from the steady-state value.

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