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When Tightening Stabilizes: Optimal Fiscal–Monetary Mix under Economic Shocks

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1. Introduction

Since 2023, many countries, including Korea, have experienced a significant rise in inflation in the aftermath of the COVID-19 pandemic. This phenomenon has been observed globally and is largely attributed to the interaction between expansionary fiscal policies, such as direct cash transfers during the pandemic, and accommodative monetary policies characterized by persistently low interest rates. In response to rising inflation, many governments, including Korea's, have increasingly recognized the importance of a well-coordinated fiscal-monetary policy mix and are closely monitoring its implementation.

Against this backdrop, the present study aims to investigate the interaction between fiscal and monetary policy. In the case of advanced economies, considerable research has been conducted on the optimal coordination of fiscal and monetary policies, both under the zero lower bound (ZLB) constraint and in normal times. Even beyond the context of optimal policy, the broader literature on fiscal-monetary policy mixes has remained active.

Foundational contributions included Chari et al. (1991), who analyzed the optimal policy mix in response to exogenous business cycle shocks under flexible prices; Aiyagari et al. (2002), who explored optimal policies in the presence of distortionary taxation, state-contingent policy instruments, and state-incontingent government debt in response to government spending shocks; and Schmitt-Grohé and Uribe (2004a, 2004b), who examined the optimal mix in models with nominal rigidities and imperfect competition in goods markets. The literature on the optimal fiscal-monetary policy mix continued to evolve, as demonstrated by the contributions of Correia et al. (2008), Nakata (2016), Kiarsi (2021), McKay and Wolf (2023), and Sims (2025), who each advanced this line of research

in important ways. A study on the optimal fiscal-monetary policy mix originated from the theory of tax smoothing developed by Barro (1979) and was formally initiated by Lucas and Stokey (1982). Barro (1979) argued that distortionary taxation causes inefficiencies in resource allocation. In order to minimize such inefficiencies, the government optimally chooses to smooth taxes over time. As a result of this tax-smoothing behavior, government expenditures follow a random walk, and the ratio of public spending to GDP did not remain constant, thereby implying that fiscal deficits were inevitable and potentially inefficient. Lucas and Stokey (1982) further explored the optimal financing of fiscal expenditures through labor income taxation and state-contingent government debt. Their model, incorporating complete financial markets and monetary elements, showed that optimal tax rates and government debt levels follow a random walk, while optimal taxation was time-inconsistent. Their key insight was that if a tax-smoothing path exists, the government should not have adjusted tax rates in response to temporary fluctuations in government spending. This, in effect, justified running fiscal deficits via the issuance of state-contingent debt.

Subsequent studies extended the analysis of optimal fiscal-monetary policy in environments characterized by incomplete financial markets and business cycle fluctuations, employing various modeling approaches. Chari et al. (1991) showed that in an economy with flexible prices and exogenous productivity shocks, the optimal path of distortionary taxes tends to be constant or close to zero. They also argued that the government prefers state-dependent policy instruments, reflecting the state-contingent nature of optimal decisions. Schmitt-Grohé and Uribe (2004a) introduced nominal price rigidity into the model and demonstrated that, in contrast to the flexible price setting of

Chari et al. (1991), optimal taxes and government debt follow a random walk. A comparison between these two studies revealed that incorporating more realistic nominal rigidities significantly alters the optimal path of fiscal policy. Building on this framework, Schmitt-Grohé and Uribe (2007) incorporated both distortionary taxes and price rigidity, and added implementability constraints derived from household and firm optimization to the government's problem. They showed that under these constraints, an optimal policy path still exists. Correia et al. (2008) shifted the focus to the presence or absence of price rigidity and argued that the structure of the optimal fiscal-monetary policy mix remained essentially unchanged regardless of whether prices were flexible or sticky.

Another strand of the literature explored how inflation responded under different fiscal-monetary configurations (e.g., Sims (2001, 2013); Leeper and Zhou (2013)). Leeper and Zhou (2013), in particular, investigated how the maturity structure of government debt affects policy outcomes and inflation dynamics, depending on how government expenditures were financed.

Recent studies also examined the role of policy commitment (e.g., Nakata (2016)) and the implications of household heterogeneity and income redistribution in determining the optimal policy mix (Bhandari, Evans, Golosov, and Sargent (2017); Bilbiie et al. (2021)). More recent contributions include Kiarsi (2021), McKay and Wolf (2023), and Sims (2025). Kiarsi (2021) incorporated distortionary taxation and a cash-in-advance framework into a Ramsey optimal policy model, showing that the Friedman rule was not optimal in this context. They found that when nominal rigidity was present, a zero inflation rate constituted the optimal outcome. McKay and Wolf (2023) utilized the HANK framework to derive Ramsey-optimal policies. They argued that monetary policy was not an effective

tool for reducing income inequality through redistribution and emphasized the dual role of monetary policy in price stability and employment stabilization. In contrast, fiscal policy played a key redistributive role via transfer payments. Sims (2025) challenged the universal applicability of the Friedman rule and argued that seigniorage revenues could be used to reduce distortionary labor income taxation. He found that the contribution of seigniorage becomes more significant when the government's spending-to-GDP ratio is high. Moreover, Sims suggested that it was optimal for the government to begin with low initial tax rates, heavily rely on seigniorage, and gradually increase tax rates toward 100%, though this strategy raises issues of time-inconsistency in optimal policy.

In the context of Korean economic research, studies on the (optimal) fiscal-monetary policy mix include Baek and Lee (1995), Hong (2011), Lee and Park (2013), Sung et al. (2015), Nam (2023), and Kim et al. (2024). Baek and Lee (1995) employed a stochastic dynamic general equilibrium (DSGE) model to simulate alternative policy scenarios and estimate changes in the loss function under varying fiscal and monetary policy parameters. Their results indicate that, in order to minimize the loss function, an optimal monetary policy must be contractionary when the fiscal stance is either neutral or expansionary. In other words, the optimal policy mix requires monetary policy to be contractionary (or strongly contractionary) when fiscal policy is contractionary (or expansionary), respectively. Hong (2011) analyzed the appropriateness of discretionary fiscal policy in Korea by estimating structural budget balances that abstract from cyclical effects using annual fiscal data. The findings revealed that discretionary fiscal policy has generally been countercyclical, though not infrequently procyclical as well. Moreover, fiscal policy exhibited asymmetric behavior, being contractionary during recessions and expansionary

during booms. Hong (2011) also identified three episodes in 1994, 1999, and 2004 during which the combination of expansionary fiscal policy and simultaneous interest rate cuts constituted inappropriate policy mixes. However, he concluded that fiscal-monetary coordination has improved since the 2000s. Yi and Park (2013) tested for fiscal sustainability and assess the cyclical responsiveness of fiscal policy (FI), monetary policy (modeled via Taylor's rule), and fiscal soundness (measured by the government debt-to-GDP ratio). Their results suggested that during booms, both fiscal and monetary policies were procyclical, whereas during recessions, they became countercyclical. They argued that inadequate policy coordination could threaten fiscal sustainability. Sung et al. (2015) employed a New Keynesian DSGE model to evaluate the credibility of Korea's macroeconomic policy regime, showed that a small open economy model with active fiscal policy and limited monetary autonomy performs well in explaining observed macroeconomic dynamics. Their analysis supported the Fiscal Theory of the Price Level (FTPL) as a plausible framework for Korea. Nam (2023) estimated fiscal multipliers conditional on the monetary policy regime, showing that the effectiveness of fiscal policy depends on the central bank's responsiveness to inflation. Specifically, fiscal multipliers are found to be larger under active monetary policy than under passive monetary policy, underscoring the importance of policy coordination. Kim et al. (2024), using time series analysis, emphasized the necessity of strong fiscal interventions to stabilize the business cycle. However, in the current environment where monetary policy prioritizes inflation stability, fiscal multipliers have weakened, indicating a growing need for fiscal-monetary cooperation to achieve effective countercyclical policy.

Although studies focusing specifically on the fiscal-monetary policy mix are relatively limited in Korea, a considerable number of papers have explored optimal taxation and

optimal monetary policy individually. Kim et al. (2010) constructed a DSGE model incorporating imperfect competition in the goods market and examined how exogenously given total factor productivity (TFP) shock affected the endogenous path of distortionary taxes (i.e., labor and capital income taxes) and government debt. Their findings suggest that a positive productivity shock increases income, leading to an expansionary fiscal response. In this setting, it is optimal to finance increased expenditures through government debt, allowing tax rates to remain temporarily low. Over time, however, tax rates converge toward the steady state, with labor income taxes rising gradually and capital income taxes increasing more sharply. The sharper rise in capital income taxes is attributed to higher capital and labor utilization resulting from productivity growth. Chang et al. (2015) defined optimal capital income taxation as the combination of tax rates and progressivity levels that maximize social welfare. Their simulations suggested that the optimal capital income tax rate is 39%, with a tax progressivity of 27%. More recently, Lee (2024) developed a DSGE model with two agent types based on their labor income tax liabilities and assumes that the government acts as a Ramsey planner, choosing optimal tax and fiscal policies to maximize social welfare. Using impulse response functions (IRFs), Lee (2024) simulated the optimal responses of labor, capital, and consumption taxes to exogenous shocks, such as government spending or TFP shocks.

In the area of optimal monetary policy, studies by Jung (2010, 2019) and Kim and Lee (2014) are notable. Jung (2010) used a New Keynesian DSGE model with nominal rigidity to study optimal monetary policy in a small open economy. His results showed that firm-level financial frictions do not significantly affect the transmission of exogenous shocks. Furthermore, simple and implementable interest rate rules can reduce welfare and increase

macroeconomic volatility. Also, this study found that monetary policy responses to exchange rate fluctuations tend to amplify macroeconomic volatility. Kim and Lee (2014) used a DSGE framework to evaluate the effectiveness of monetary policy in responding to unemployment. They argued that interest rate rules targeting the rate of change in unemployment, rather than the unemployment gap, are more effective in minimizing welfare losses. Based on these findings, they recommend that central banks take labor market indicators such as unemployment into account, alongside inflation and output stabilization. Jung (2019) applied a two-agent new Keynesian (TANK) model and showed that the transmission of cost-push shocks differs between borrowing and saving households. He found that a flexible inflation-targeting regime, which jointly considers the output gap and inflation gap, closely resembles Ramsey-optimal policy and leads to smoother adjustments in consumption and labor supply across household types.

A common feature of domestic studies is their focus on cyclical responsiveness of fiscal and monetary policy using empirical data, rather than theoretical simulations based on DSGE models, as is more typical in the international literature. The study by Kim et al. (2010), which endogenizes taxes and state-incontingent debt under a Ramsey planner in a model with price rigidity and TFP shock, shared some similarities with the present study. However, a key limitation is its exclusion of endogenous nominal interest rates as determined by monetary policy of the central bank, as well as the absence of analysis on how tax rates, government spending, and nominal interest rates respond to government debt shocks.

Given this context, it is crucial to adopt an appropriate methodology and modeling framework informed by international literature on policy coordination. This study follows

this approach by applying the HANK model based on Aiyagari (1994), as adapted by Seok and You (2018), which incorporated a continuum of heterogeneous households. Calibration targets for the Korean economy are drawn from an extensive review of domestic empirical studies.

In summary, this paper investigates how policy instruments—namely taxes, government spending, and nominal interest rates—should respond in an economy where these variables are endogenously determined in general equilibrium and where exogenous shocks such as markup shocks, TFP shocks, and government debt shocks occur. By analyzing the dynamic responses of macroeconomic variables, including output, labor supply, and consumption, the study aims to offer implications for optimal fiscal-monetary policy.

The rest of the paper is organized as follows: Section 2 presents the model; Section 3 outlines the calibration strategy; Section 4 reports simulation results and quantitative analysis; Section 5 discusses policy implications derived from the findings.

2. The Model

The baseline model is a Heterogeneous Agents framework based on Aiyagari (1994). Following Seok and You (2018), the model incorporates a continuum of heterogeneous households that are subject to idiosyncratic income risk in a stochastic environment. Firms are assumed to maximize profits in a setting with monopolistic competition in the intermediate goods market. The final goods producer faces price rigidity, such that current prices are partially dependent on past prices.

Fiscal instruments consist of labor income taxes, capital income taxes, and consumption taxes, all of which are endogenous. In response to exogenous shocks, the central bank sets

the nominal interest rate according to a Taylor rule.

2.1 Decision Making of Households

Following Christiano et al. (2011), Seok and You (2018), the household's preferences are represented by a utility function in which utility is derived solely from consumption.

$$\mathrm{U}(C_t) = \frac{C_t^{1-\gamma}}{1-\gamma} \tag{1}$$

There exists a continuum of heterogeneous households, each subject to idiosyncratic, exogenous labor productivity shock. These shock is introduced to capture the wage differentials observed among workers in the real economy. The labor productivity of a household in period t follows an AR(1) process, which is specified as Equation (2):

$$\log(x_{t+1}) = \rho \log(x_t) + \eta_{t+1} \tag{2}$$

The stochastic shock $\eta_{t+1}$is assumed to follow a normal distribution with mean zero and standard deviation σ, i.e., $\eta_{t+1} \sim N(0, \sigma^2)$. Based on empirical findings that the wage elasticity of labor supply in the Korean labor market is extremely low, this model adopts the assumption—following Seok and You (2018)—that individual households cannot adjust their labor supply.

Consequently, each household derives utility solely from individual consumption $C_t$in period t, and earns labor income by supplying labor in efficiency units x_t, which is given

by the product of the real wage per efficiency unit w_t and its idiosyncratic labor productivity x_t, that is $w_t x_t$.

The utility maximization problem of heterogeneous households can be represented by Equations (3) as follows.

$$\max_{\{C_t, K_{t+1}, B_{t+1}\}_{t=0}^{\infty}} = E_0 \sum_{t=0}^{\infty} \beta^t U(C_t) \tag{3}$$

$$(1+\tau_t^c)C_t + K_{t+1} + \frac{B_{t+1}}{P_t} = (1-\tau_t^n)w_t x_t + \left(1-\tau_t^k\right)r_t K_t + (1+i_t)\frac{B_t}{P_t} + (1-\delta)K_t$$

The computation of the competitive equilibrium follows the approach of Krusell and Smith (1998), in which a value function is defined and a sequence of allocations is iteratively computed—starting from an initial guess—until convergence to the steady state is achieved. The corresponding Bellman equation is given by Equation (4) [1]:

$$V_t(K, B, x) = \max_{\{C\}} \{U(C_t) + \beta EV[(B', K', x'|x)]\} \tag{4}$$

$$s.t. (1+\tau^c)C + K + \frac{B'}{P} = (1-\tau^n)wx + \left(1-\tau^k\right)rk + (1+i)\frac{B}{P} + (1-\delta)K$$

2.2 Decision Making of Firm

2.2.1 Intermediate goods firm

[1] We would like to clarify that the household utility maximization problem, formulated through the Bellma -n equation as proposed in Krusell and Smith (1998), has been fully computed to obtain the equilibrium of the HANK model.

Each intermediate-goods producer Z operates under monopolistic competition and faces.

$$Y_t(z) = F_t(z) = [N_t(z)]^{\alpha}[K_t(z)]^{1-\alpha} \quad (5)$$

Price adjustment cost propoed by Rotemberg(1982):

$$\psi_t(z) = \frac{\phi}{2}\left(\frac{P_t(z)}{P_{t-1}(z)}\right)^2 Y_t(z) \quad (6)$$

(ϕ = Price Adjustment Cost Parameter)

From the first-order condition with respect to intermediate input $Y_t(z)$, the following equation (7) is derived:

$$Y_t(z) = \left(\frac{P_t(z)}{P_t}\right)^{-\varepsilon} Y_t \quad (7)$$

($P_t(z), P_t$: Price of Intermediate Goods z, Price of the Homogeneous Final Goods, respectively.)

$$P_t(z) = \left(\frac{Y_t}{Y_t(z)}\right)^{1/\varepsilon} \quad (8)$$

The above equation represents the demand function for intermediate goods, where μ captures the degree of monopoly power arising from the monopolistic competitive market structure faced by intermediate goods producer.

To induce a symmetric equilibrium, we impose the condition that, $Y_t(z) = Y_t, N_t(z) = N_t, K_t(z) = K_t$ for all z. Under these conditions, factor prices are equal to the marginal cost

faced by intermediate goods producer.

2.2.2 Final goods firm

Homogeneous final goods are produced by aggregating a continuum of intermediate goods Z using a CES production technology, as described in Equations (9), and P_t present aggregate price index in Equation (10). In this context, $\frac{\varepsilon-1}{\varepsilon}$ denotes the markup μ, reflecting the degree of market power in the intermediate goods sector.

$$Y_t = \left(\int_0^1 Y_t(z)^{\frac{\varepsilon-1}{\varepsilon}}\, dz\right)^{\frac{\varepsilon}{\varepsilon-1}} \tag{9}$$

(ε = Elasticity of Substitution Across Intermediate Goods, $\varepsilon = [0, 1)$)

$$P_t = \left(\int_0^1 P_t(z)^{1-\varepsilon}\, dz\right)^{\frac{1}{1-\varepsilon}} \tag{10}$$

The final output is produced by aggregating a continuum of differentiated intermediate goods, and the firm's objective is to minimize the total cost of acquiring these inputs, subject to a CES production function.

$$\underset{\{Y_t(Z)\}_{t=0}^{\infty}}{max} \left[\left(\int_0^1 Y_t(z)^{1-\varepsilon}\, dz\right)^{\frac{1}{1-\varepsilon}} - \int_0^1 P_t(z) Y_t(z)\, dz\right] \tag{10}$$

In addition, final goods production is represented by the following equation (11).

$$Y_t = A_t N_t^{\alpha} K_t^{1-\alpha} \tag{11}$$

2.3. Decision Making of Government

The government's budget constraint is given as follows. On the revenue side, the government collects capital income taxes, labor income taxes, and consumption taxes, and issues government bonds to finance its total expenditure. Government expenditure consists of government consumption and interest payments on previously issued bonds. Government bond issued in period t is assumed to be zero and matures in period t+1. The government bond is assumed to be a state-incontingent debt, and financial markets are assumed to be incomplete. That is, agents have no claims on other financial assets such as capital beyond the state-incontingent government bond. [2]

$$(1 + i_t)\frac{B_{t-1}}{P_t} + G_t = \tau_t^c C_t + \tau_t^n w_t x_t + \tau_t^k r_t K_t + \frac{B_t}{P_t} \tag{13}$$

Each type of investment is subject to an adjustment cost, following Lucas and Prescott (1971) and Christiano et al. (2005). The adjustment cost is modeled in the same Rotemberg-type quadratic form as used for output adjustment costs. The investment adjustment cost function is assumed to be increasing and convex, satisfying the conditions $S(1)=S'(1)=0$.

$$\mathrm{S} = \frac{\upsilon}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)^2 \tag{14}$$

[2] That is, households hold no claims to other financial assets such as capital, except for risk-free government debt.

In addition, the equilibrium condition in the output market is given by equation (15).

$$\left(1-\frac{\psi}{2}\pi_t^2\right)Y_t = C_t + (K_{t+1} - (1-\delta)K_t + G_t \tag{15}$$

2.4. Monetary Policy

The central bank sets the nominal interest rate according to Taylor's rule, as specified in You (2024), and the policy rule is represented by the following equation. A zero lower bound (ZLB) is imposed, reflecting the constraint that the nominal interest rate cannot fall below zero.

$$i_t = max\left[0, i_{t-1}^{r_i}\left(\frac{\pi_t^A}{\overline{\pi^A}}\right)^{(1-r_i)r_\pi} i_{t-1}^{r_i}\left(\frac{Y_t}{\overline{Y}}\right)^{(1-r_i)r_Y} \overline{i^A}^{1-r_i} e^{\epsilon_{r,t}}\right] \tag{16}$$

In this context, $\overline{\pi^A}$ represents the steady-state year-on-year inflation rate, $\overline{Y}$ denotes the steady-state GDP, and $\overline{i^A}$ is the steady-state nominal interest rate. The monetary policy shock, $e^{\epsilon_{r,t}}$, follows a normal distribution with mean zero and variance σ^2. The parameter r_i captures the degree of interest rate smoothing, reflecting the central bank's responsiveness to the lagged nominal interest rate. The parameters r_π and r_Y represent the influence of the lagged inflation gap and GDP gap, respectively, on the determination of the nominal interest rate.

3. Calibration

This section describes the calibration of parameters related to household preferences. The coefficient of relative risk aversion, σ, is set to 1.4 following Seok and Yoo (2018). The household discount factor, β is set to 0.98, which is commonly used in domestic studies employing DSGE models. The labor income share, α, is calibrated based on the values reported in Chang et al. (2015). The depreciation rate of capital, δ, is set at 0.1, as suggested by Seok and You (2018). In the AR(1) processes for shocks, the persistence parameters for markup shocks ρ_ϵ, ρ_a, ρ_B are set to 0.8, 0.89, and 0.9, respectively, based on values commonly found in the literature.[3]

In the steady state, the government consumption-to-GDP ratio is fixed at 20%, based on the 2023 figure of 18.9% reported in the *National Accounts* published by the Bank of Korea in 2025.[4] The government debt-to-GDP ratio for G2 economies is calibrated to 60%, following the OECD standard. The target inflation rate is set to 2%, consistent with the Bank of Korea's inflation targeting regime.

[Table 1 about here]

4. Analysis of quantitative results

[3] In particular, the parameter ρ is chosen following Adrian et al. (2022), who demonstrate the appropriateness of this value in a medium-scale DSGE model calibrated for Korea.

[4] The steady-state level of government consumption is set at 20%, with reference to the 18.9% level recorded in 2023. Notably, the national accounts published in 2025 provide data on general government consumption expenditure only up to the year 2023.

The IRFs are derived to evaluate the dynamic effects of exogenous shocks in the baseline economy. The analysis considers three types of exogenous disturbances: a cost-push (markup) shock, a productivity (TFP) shock, and a government debt shock.

The negative and positive shocks, as well as the government debt shock, are each defined by the following equations.

(1) negative(-) shocks : positive(+) Mark-up shock and negative TFP shock

$$\log \mu_t = \rho_\varepsilon \log \mu_{t-1} + \eta_{\varepsilon,t} \tag{17}$$

$$\log A_t = -\rho_A \log A_{t-1} + \eta_{A,t} \tag{18}$$

(2) positive(+) shocks: negative(-) Mark-up shock and positive TFP shock

$$\log \mu_t = -\rho_\varepsilon \log \mu_{t-1} + \eta_{\varepsilon,t} \tag{19}$$

$$\log A_t = \rho_A \log A_{t-1} + \eta_{A,t} \tag{20}$$

(3) Government debt shocks: positive and negative government bond shocks

$$\log \mathrm{B}_t = \rho_B \log B_{t-1} + \eta_{B,t} \tag{21}$$

$$\log \mathrm{B}_t = -\rho_B \log B_{t-1} + \eta_{B,t} \tag{22}$$

The markup shock is modeled as an exogenous change in the markup parameter, and the resulting responses of policy variables and key macroeconomic indicators are examined. This approach allows us to trace the endogenous adjustment of the price level in response

to an exogenous cost shock, highlighting the importance of such shock as supply-side disturbances that influence inflation and other responses of macroeconomic variables. Since inflation is endogenously determined, the cost-push shock provides a meaningful framework to assess how inflationary pressures affect policy instruments and macroeconomic dynamics.

This paper builds on existing studies of TFP shocks by focusing on the effects of a negative TFP shock within a HANK-DSGE framework, analyzing its implications for taxes, government spending, and the policy interest rate. It also investigates how an exogenously determined government debt shock affects macroeconomic outcomes, especially in relation to fiscal soundness. The analysis proceeds as follows. First, the responses of macroeconomic and policy variables are examined under a negative economic shock generated by a positive markup shock and a negative TFP shock. Second, a positive economic shock is considered, represented by a negative markup shock and a positive TFP shock. Lastly, both positive and negative shocks to government debt are analyzed to study the implications for macroeconomic and policy variables. The shock processes are summarized in the following equations.

4.1. Negative Exogenous Shock

Negative exogenous shocks are classified into two types: positive markup shocks and negative TFP shocks. As a result of such adverse shocks, key macroeconomic variables tend to deteriorate, while policy instruments exhibit the following characteristics.

First, tax policy acts countercyclically, functioning as an automatic stabilizer. In contrast, government spending and public debt exhibit procyclical behavior, suggesting that they

should be reduced in response to negative shocks. Monetary policy is also countercyclical, with the nominal interest rate initially lowered and then gradually adjusted upward over time. Inflation responds variably, increasing or decreasing depending on the direction and intensity of expected inflation. Notably, investment rises even in the face of higher real interest rates, a counterintuitive result consistent with New Keynesian model predictions. Regarding the policy mix, fiscal and monetary policies appear to be decoupled. The results suggest that a policy mix consists of a passive fiscal policy, paired with active monetary and tax policies.

4.1.1. Positive Markup Shock

As prices rise, tax policy functions both countercyclically and as an automatic stabilizer. At the same time, increases in expected inflation and consumption tax rates lead to a decline in private consumption. Despite the economic downturn, a slight increase in taxes is necessary, indicating the appropriateness of mobilizing fiscal resources without expanding public debt. This result also reflects the reality that, as Korea transitions into a super-aged society, fiscal soundness must be maintained through debt reduction and expanded tax revenue.

Government spending and public debt respond procyclically, while monetary policy is countercyclical, initially lowering the nominal interest rate and then gradually easing the pace of rate cuts. Inflation is found to rise, which can be explained by the following mechanisms: (i) lower nominal interest rates increase expected inflation, (ii) anticipated economic downturn leads households to expect higher inflation, and (iii) markup shocks directly raise inflation expectations. Consequently, the inflation rate tends to increase.

Meanwhile, real wages decline, and the marginal product of capital rises, leading to an

increase in the real interest rate. However, investment does not decline; on the contrary, it increases. This suggests that, unlike in the Real Business Cycle (RBC) framework, the New Keynesian model does not exhibit a crowding-out effect on investment but instead reveals a crowding-in effect. Despite the increase in investment, aggregate output declines due to reductions in private consumption and government spending. In other words, a positive markup shock triggers an economic contraction. Although tax rates on capital and consumption income increase countercyclically, the limited decline in consumption and rising investment imply that the distortionary effects of taxation may be relatively small. Furthermore, the FTPL, which posits a link between fiscal policy and inflation, does not appear to hold in the Korean context. In conclusion, in response to a positive markup shock, a policy mix comprising passive fiscal policy and active tax and monetary policies appears to be most appropriate.

[Figure 1 about here]

4.1.2. Negative TFP Shock

The negative TFP shock produces responses that are qualitatively similar to those observed under the positive markup shock. However, a key difference lies in the behavior of inflation, which declines in response to the TFP shock. This disinflationary effect can be attributed to the nature of the positive supply shock, which lowers households' inflation expectations. Additionally, the nominal interest rate response under the TFP shock is smaller in magnitude and recovers more rapidly compared to the markup shock, further contributing to the decline in expected inflation.

As in the case of the markup shock, an appropriate policy mix under a negative TFP shock involves a passive fiscal policy combined with active tax and monetary policies. However, the policy stance should place greater emphasis on stabilizing the inflation rate in response to the disinflationary pressure induced by the supply-side shock.

[Figure 2 about here]

4.2. Positive Exogenous Shock

Positive exogenous shocks, like their negative counterparts, are examined separately as markup shocks and TFP shocks. A common outcome of both types of positive shocks is an expansion in economic activity, as evidenced by simultaneous increases in private consumption, government spending, and investment, resulting in an overall rise in GDP.

Both tax and fiscal policies respond procyclically, while monetary policy also exhibits procyclical behavior through an increase in the nominal interest rate. Interestingly, the inflation rate declines following the shock. This decline can be attributed to two reinforcing factors: (i) the increase in the nominal interest rate is relatively modest and quickly reverses, lowering inflation expectations; and (ii) the economic boom itself contributes to reduced inflation expectations.

It is important to emphasize that this phenomenon does not indicate deflation; the inflation rate remains positive and does not turn negative. Accordingly, in response to a positive exogenous shock, an active mix of fiscal and monetary policies is required to effectively manage the resulting economic expansion.

4.2.1. Negative Markup Shock

As prices decline, consumption, government spending, and investment all increase, leading to an expansion in GDP. Both tax policy and fiscal spending respond procyclically, while monetary policy also exhibits procyclical behavior through an increase in the nominal interest rate. The inflation rate decreases following the shock. This decline is explained by two reinforcing mechanisms: (i) the rise in the nominal interest rate is moderate and quickly reverses, which lowers expected inflation; and (ii) the economic boom itself leads to a reduction in inflation expectations. Importantly, this decline in inflation should not be interpreted as deflation, as the inflation rate remains positive and does not fall below zero. In response to such a positive shock, an appropriate policy mix involves active fiscal and monetary policies aimed at stabilizing the economy during periods of expansion.

[Figure 3 about here]

4.2.2. Positive TFP Shock

The responses of macroeconomic and policy variables are qualitatively similar to those observed under a markup shock. However, two key differences are identified: the magnitude of the increase in the nominal interest rate is smaller, and the inflation rate tends to rise. These differences suggest that the price-reducing effect of a decline in markup dominates the supply-expanding effect of technological progress.

[Figure 4 about here]

4.3. Government Debt Shock

The effects of government debt shock are analyzed by distinguishing between positive shock (increased issuance) and negative shock (reduced issuance or repayment). A common result across both types of shock is that government debt shocks lead to a decline in consumption, thereby causing a reduction in GDP. This result arises in an economy without transfers, where the burden of government debt shocks disproportionately affects low-income households with lower labor productivity, resulting in a direct negative impact on their consumption. In addition, an increase in the real interest rate following the debt shock discourages capital accumulation, further suppressing consumption. These combined effects contribute to the overall contraction in consumption and output.

4.3.1. positive shock (new government debt issuance)

Despite the positive shock to government debt, the government is assumed to maintain a balanced budget, which necessitates a reduction in government spending and an increase in taxation. As a result, both lower government expenditures and higher taxes contribute to a decline in private consumption. Although government debt can serve as a household asset that facilitates consumption smoothing, an increase in debt issuance ultimately leads to a reduction in consumption.

Real wages decline, and the marginal product of capital increases, raising the real interest rate. However, there is no evidence of a crowding-out effect on investment. Instead, the decrease in consumption and government spending outweighs the increase in investment, leading to a net decline in GDP. As the economy enters a recession and nominal interest

rates are lowered, expected inflation rises, resulting in an increase in the inflation rate. Even though the real interest rate increases, investment is not crowded out. This result, consistent with earlier simulations, confirms a robust feature of the HANK model: real interest rates crowd in investment.

In terms of policy responses, taxes behave countercyclically, government spending responds procyclically, and monetary policy remains countercyclical. These patterns are qualitatively consistent with those observed under negative shocks. Therefore, an appropriate policy mix in response to a government debt shock involves passive fiscal policy combined with active tax and monetary policies.

[Figure 5 about here]

4.3.2. Negative Shock (Repayment of Existing Government Debt or Reduction in Government Debt Issuance)

A negative government debt shock, interpreted as debt repayment, leads to a reduction in government spending and an increase in taxation, both of which suppress private consumption. This response pattern is qualitatively similar to that observed under a positive debt shock. The behavior of policy instruments also mirrors that of the positive shock: tax policy responds countercyclically, government spending is procyclical, and monetary policy acts countercyclically. While the economic downturn and the associated decline in nominal interest rates lead to a rise in expected inflation, the actual inflation rate falls.

[Figure 6 about here]

4.4. Sensitive Analysis

To verify the robustness of the preceding results, a sensitivity analysis is conducted. The procedure is as follows. First, the standard deviation of the markup shock is varied from the baseline value of 0.01 to a lower value (0.005) and a higher value (0.02). The results show no qualitative differences across these specifications. Second, the discount factor β is altered from the baseline value of 0.98 to lower (0.96) and higher (0.99) levels. With the exception of the TFP shock case, the impulse response functions (IRFs) remain qualitatively similar to those under the baseline specification. These findings confirm the robustness of the main results.

4.4.1. sigma

The standard deviation of the markup shock is varied from the baseline value of 0.01 to a lower value (0.005) and a higher value (0.02) for sensitivity analysis. The results reveal no qualitative differences across these scenarios, indicating that the previous findings are robust.

[Figure 7 about here]

[Figure 8 about here]

[Figure 9 about here]

4.4.2. beta

The discount factor β is varied from the baseline value of 0.98 to a lower value (0.96) and a higher value (0.99) for the sensitivity analysis. The discount factor is defined as $\frac{1}{1+\rho}$, where ρ denotes the rate of time preference. A lower β implies a higher ρ, indicating a stronger preference for present consumption over future consumption. Conversely, a higher β implies a lower ρ, reflecting greater patience and a stronger preference for future consumption.

Variation in β produces qualitatively similar results across all shocks, including markup and government debt shocks, with the exception of the TFP shock. This suggests that the baseline findings are robust to changes in the discount factor. When the discount factor β increases relative to the baseline, households become more patient and thus further reduce current consumption. As a result, there arises an incentive to stimulate consumption by lowering the increase in the consumption tax rate and temporarily reducing the capital income tax. Due to the amplified decline in both consumption and government spending, the drop in GDP becomes more pronounced. In response, the central bank adopts a more aggressive stance by implementing a larger nominal interest rate cut to support the economy. However, the inflation rate declines, with a deeper deflationary impact observed.

[Figure 10 about here]

5. Concluding Remarks

This study develops the HANK-DSGE model that incorporates a continuum of

households exposed to idiosyncratic income risk. To capture price stickiness, the model includes both intermediate and final goods markets. Additionally, a monetary authority operating independently sets the nominal interest rate according to Taylor's rule, allowing the model to distinguish among fiscal, tax, and monetary policy instruments in a manner consistent with real-world institutional arrangements. Through calibration tailored to the Korean economy, the model is constructed to closely reflect Korea's economic conditions.

In this framework, we examine how combinations of macroeconomic and policy variables endogenously respond to exogenous shocks, whether positive or negative. Specifically, the model investigates how fiscal-monetary policy mix between government taxation, government spending, and monetary policy should be formulated in response to such shocks. These simulations offer insights into the appropriate coordination of fiscal and monetary policies in the presence of exogenous disturbances. Compared to earlier literature, this study considers various institutional and economic frictions, particularly those arising from distortionary taxation, in assessing the fiscal-monetary policy mix.

To more accurately reflect reality, the model incorporates a continuous distribution of labor productivity across households, introducing heterogeneity in productivity. It also features intermediate goods producers and final goods producers who set prices, thereby introducing nominal rigidities. The parameters are calibrated specifically to the Korean economy to ensure realism and policy relevance.

One key finding of the study is that the FTPL does not appear to hold in the Korean context. That is, no clear causal relationship is found between exogenously determined government spending and inflation, suggesting that fiscal expansions do not lead to significant price increases. Furthermore, in response to negative or debt-related shocks, the

model recommends adopting a passive fiscal stance—characterized by reduced government spending and limited debt issuance—to ensure fiscal sustainability, particularly given Korea's demographic challenges, including low fertility and rapid population aging. In the context of persistent budget deficits, this finding suggests that continued fiscal expansion is not viable in the long run. The study also highlights the importance of active monetary policy in managing inflation, particularly in the face of temporary booms or recessions driven by exogenous shocks. Since such shocks influence consumption and GDP and consequently affect price dynamics, a proactive monetary stance is essential. Tax policy, which displays countercyclical behavior during downturns and procyclical behavior during upturns, proves more effective for fiscal resource mobilization than debt issuance. This suggests that, in contexts where direct tax hikes are politically or economically constrained, improving the effective tax rate by reducing tax expenditures may be a more viable strategy.

Given that government spending responds procyclically, Korea, which is already grappling with low birth rates and a rapidly aging population, should consider reducing public debt to ease the fiscal burden on future generations, even if it requires increasing the tax burden on the current generation. Ultimately, the results of this study suggest that government fiscal management plays a crucial role in responding to GDP fluctuations induced by exogenous shocks. While conventional wisdom advocates increased spending and tax cuts during downturns, and spending cuts and tax increases during upturns, the findings of this study suggest that fiscal policy may instead follow a procyclical pattern, expanding during booms and contracting during recessions. In contrast, monetary policy should respond countercyclically, indicating the need for an actively coordinated fiscal-monetary policy mix.

Policy authorities are encouraged to draw upon these findings in formulating and

implementing macroeconomic policy. Given Korea's high exogenous dependency and vulnerability to global shocks, it is especially important that the insights from this model are fed back into practical policymaking.

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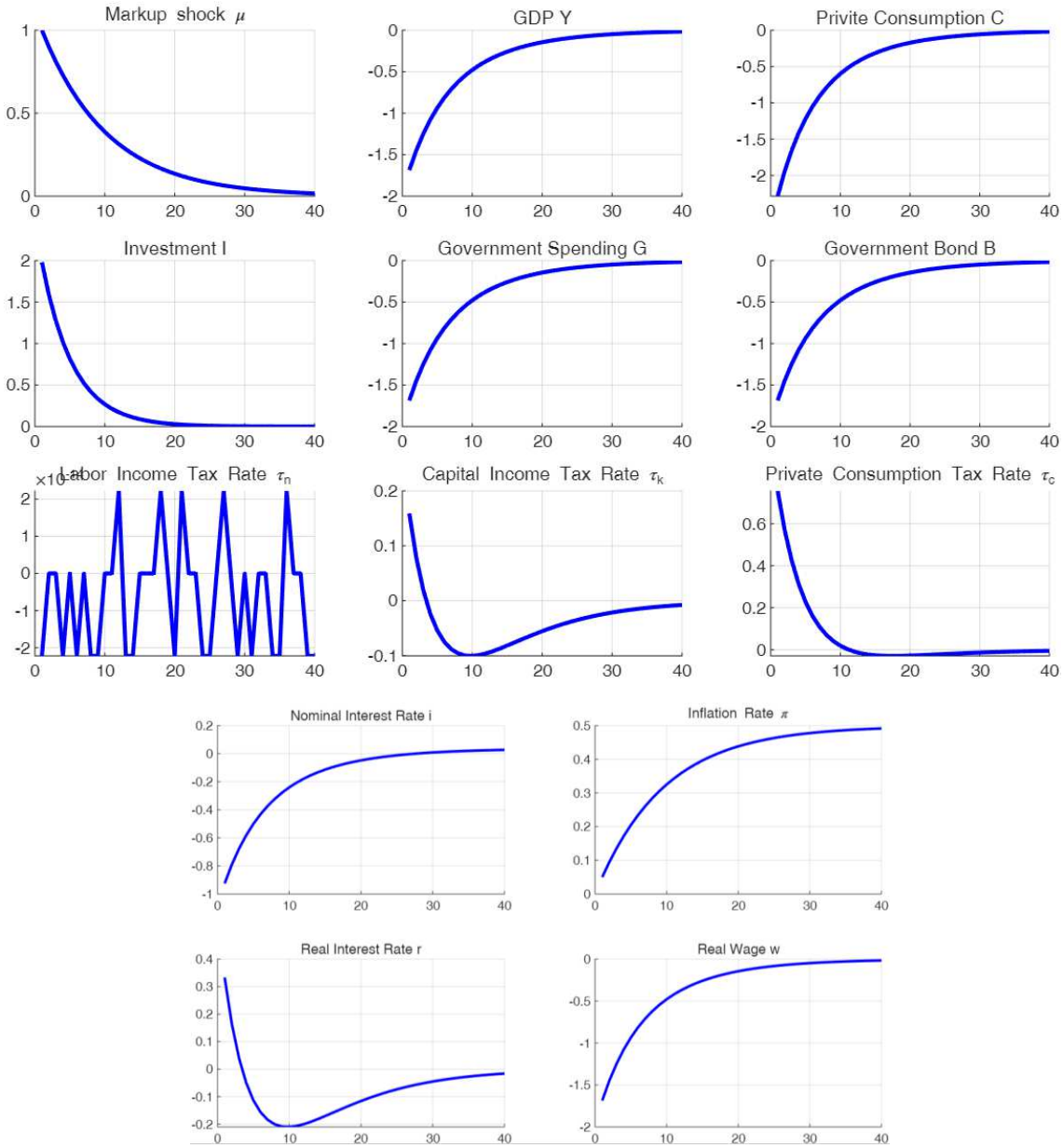
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Table 1. Calibration

parameters	calibration	evidence
β	0.98	standard discount factor
μ	1.11	Nam (2023)
1−α	0.64	Chang et al. (2015), Seok and You (2018)
δ	0.1	Seok and You (2018)
ρ_{ε}	0.8	Adrian et al. (2022)
ρ_{A}	0.9	Kim et al. (2010)
ρ_{B}	0.9	ρ_{B} is set to 0.9 based on existing literature
r_{π}	1.97	You (2024)
r_{i}	0.65	
r_{Y}	0.05	

Figure 1. IRFs on positive mark-up shock



Source: Author's calculations

Note: 1) The vertical axis indicates the percentage deviation from the steady state (applies to all subsequent figures).

2) The same applies to the following IRFs.

Figure 2. IRFs on negative TFP shock

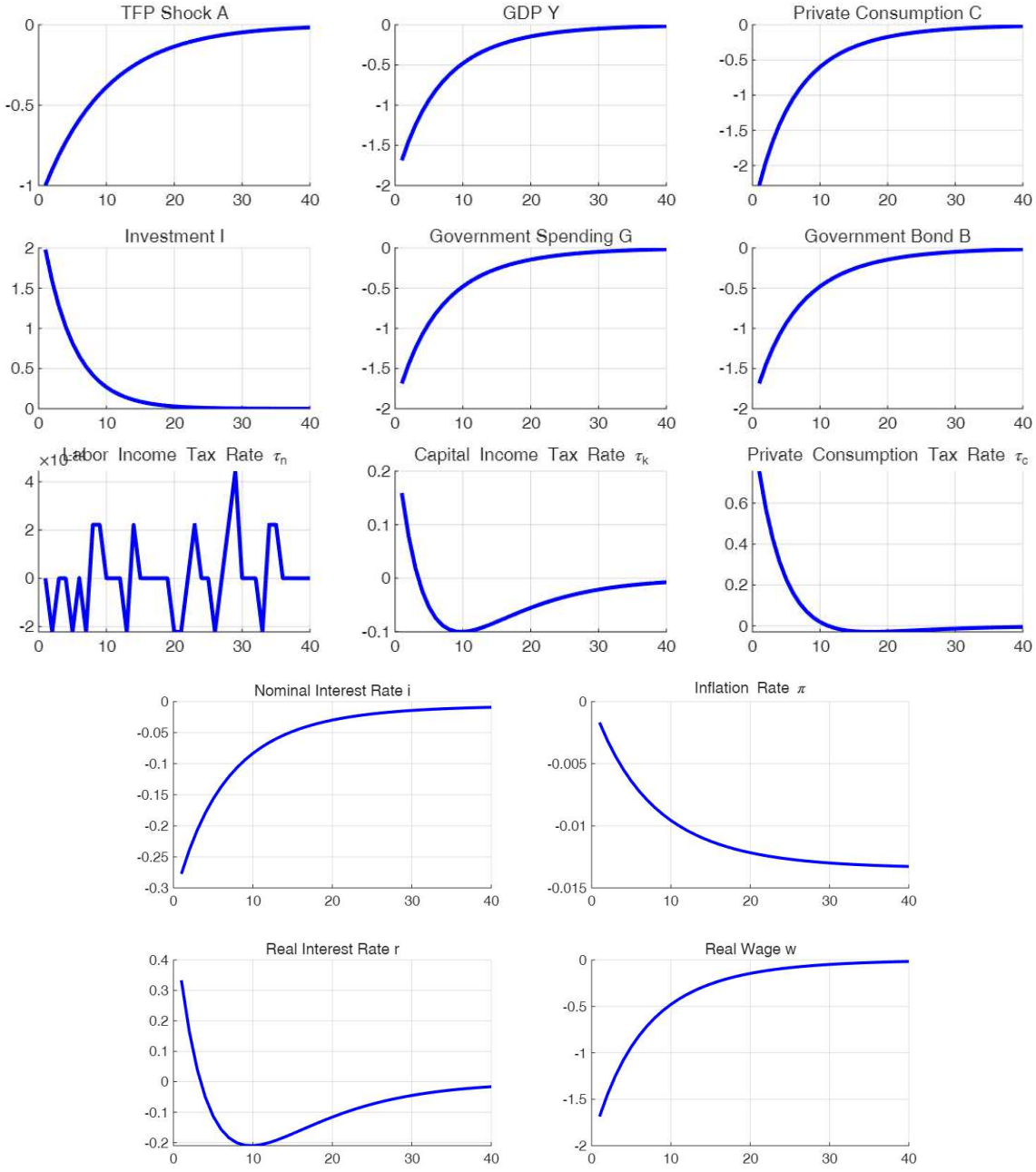


Figure 3. IRFs on negative mark-up shock

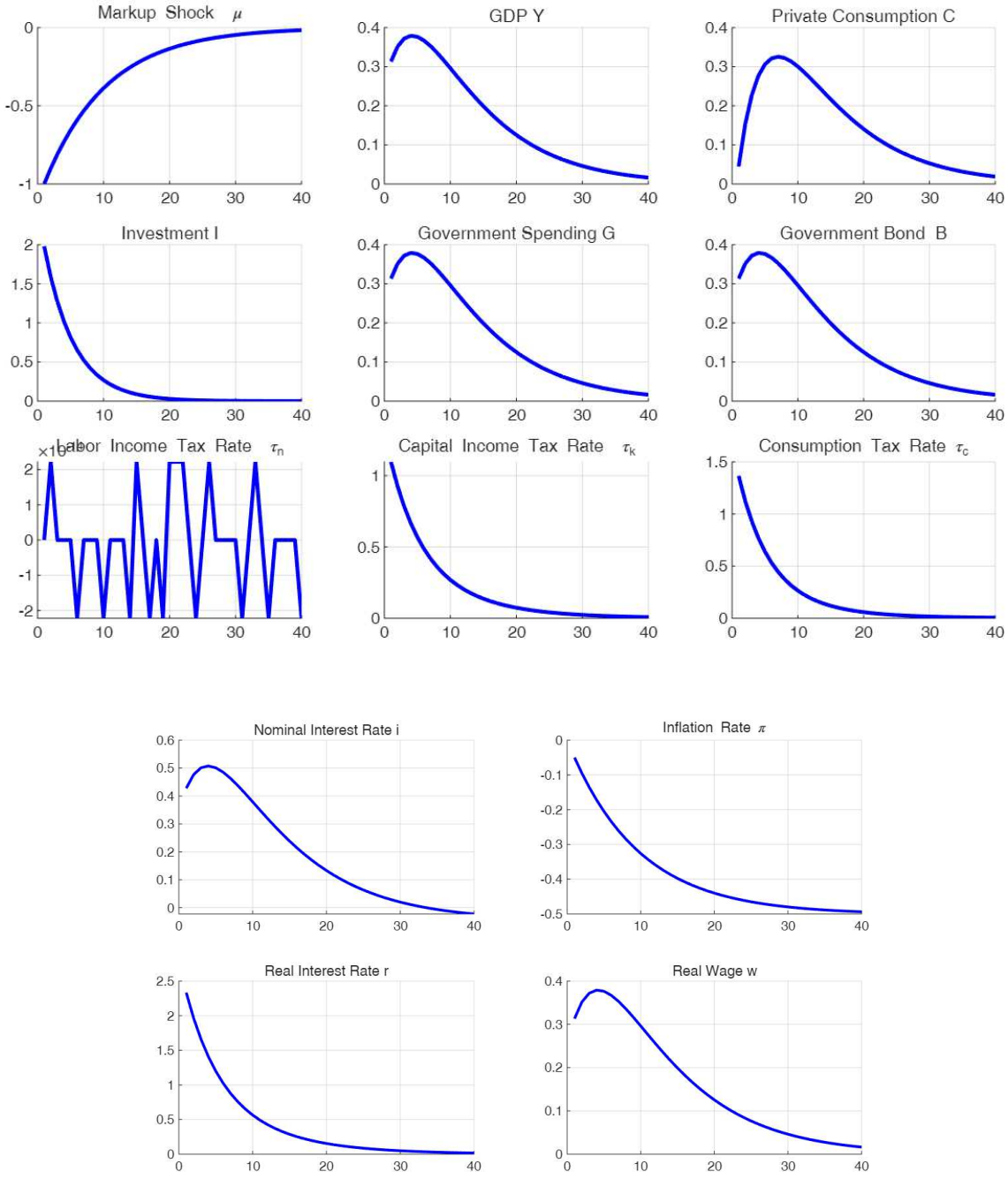


Figure 4. IRFs on positive TFP shock

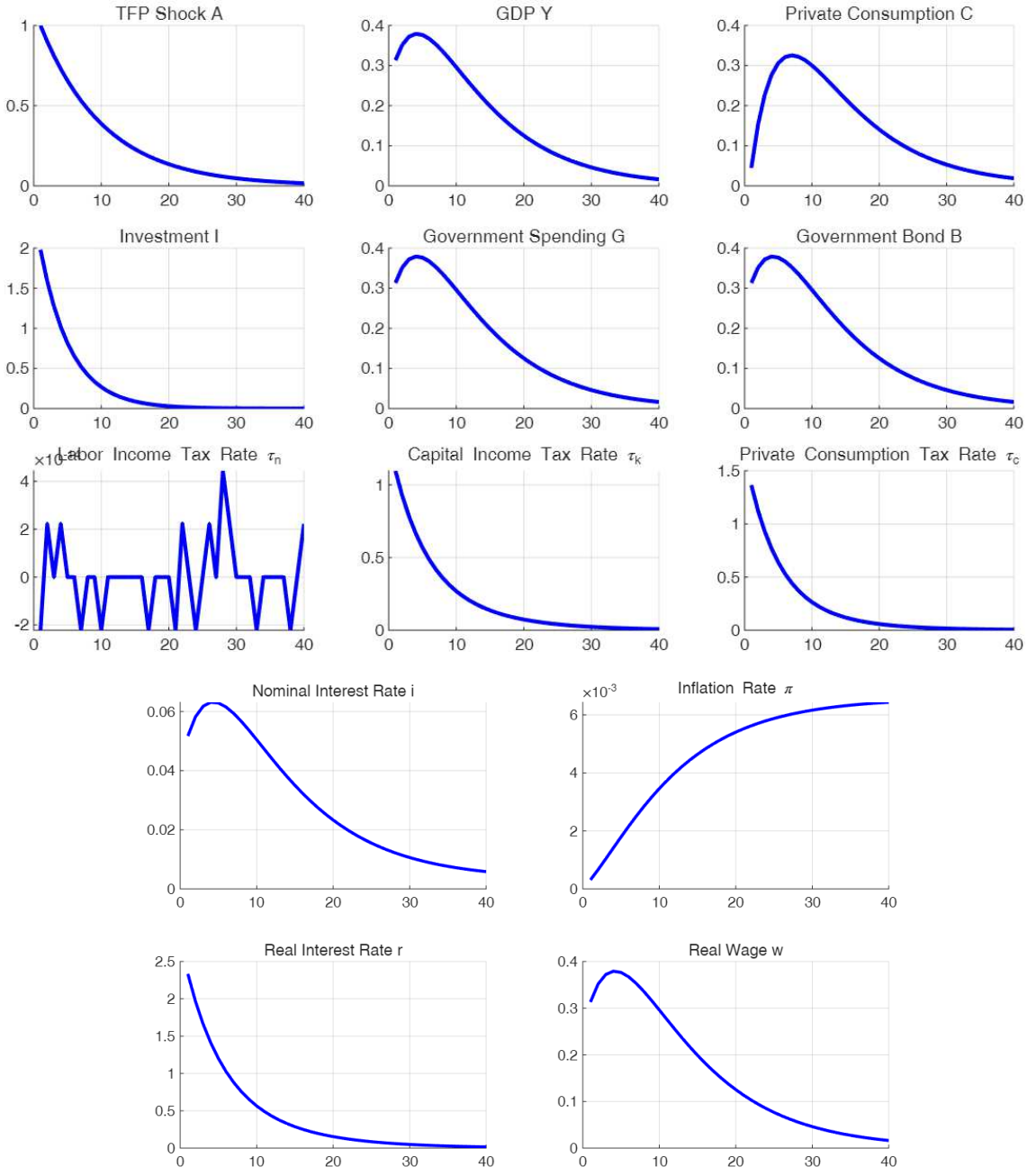


Figure 5. IRFs on positive government debt shock

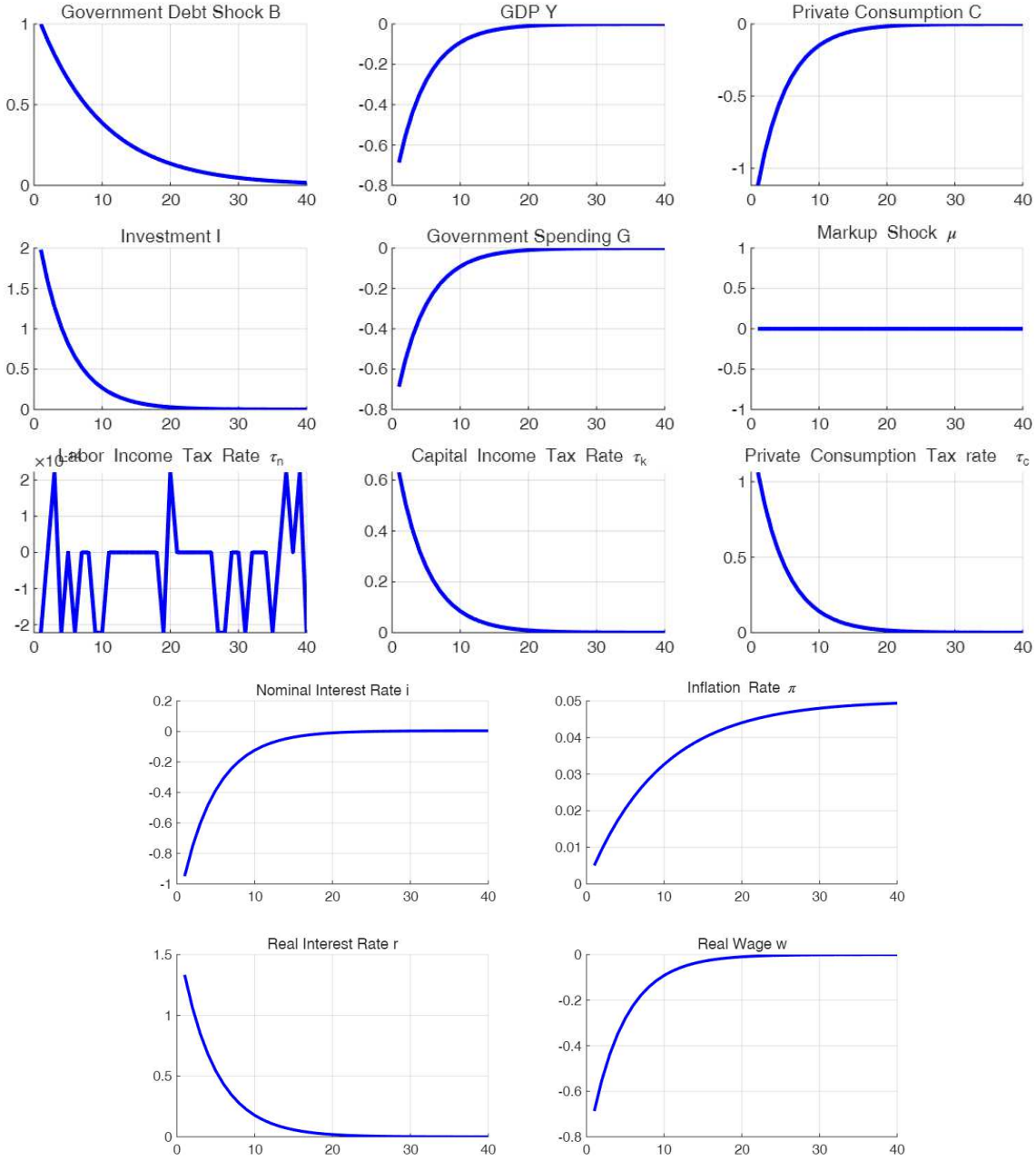


Figure 6. IRFs on nagative government debt shock

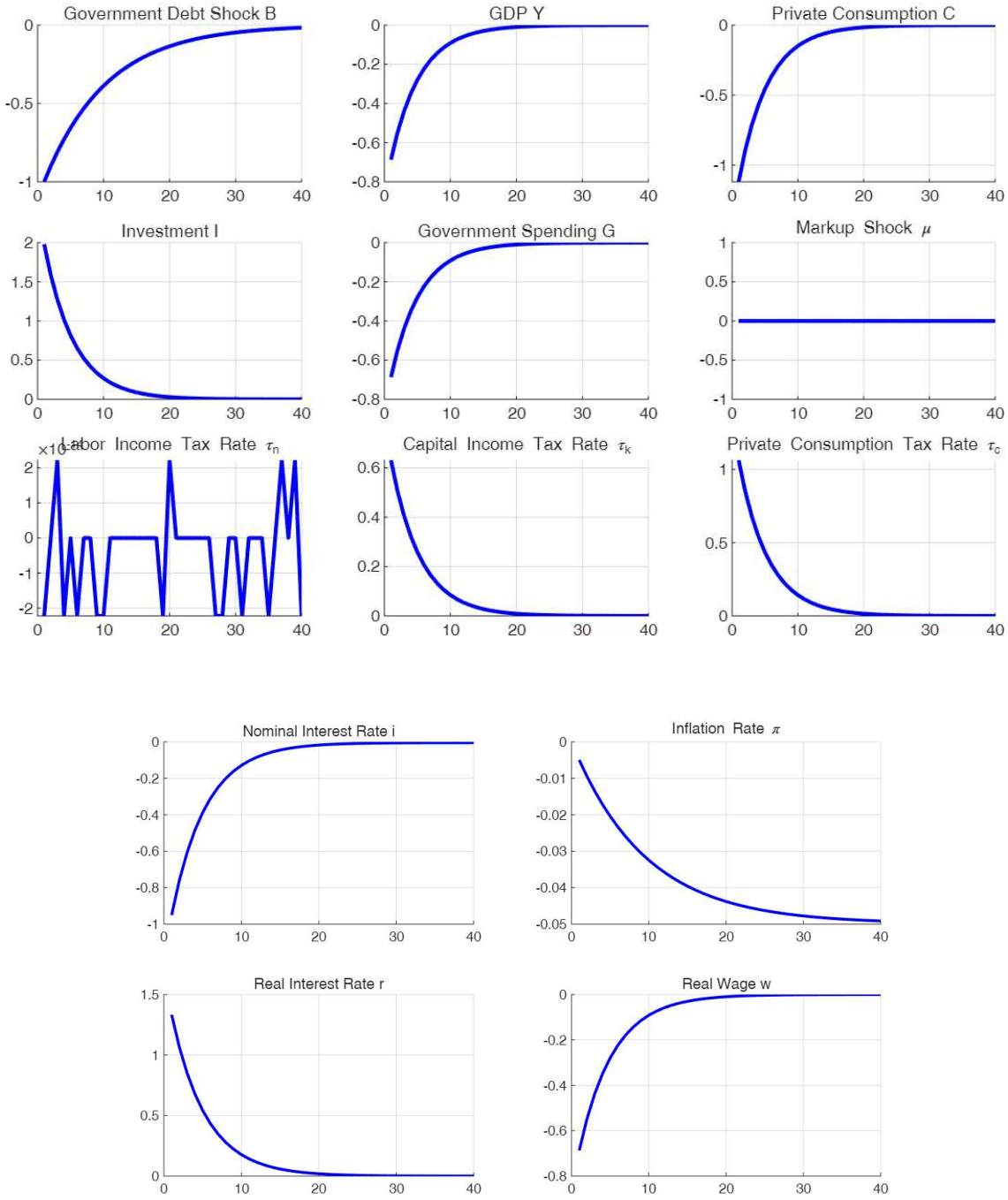


Figure 7. sensitive analysis(1): IRFs on positive mark-up shock

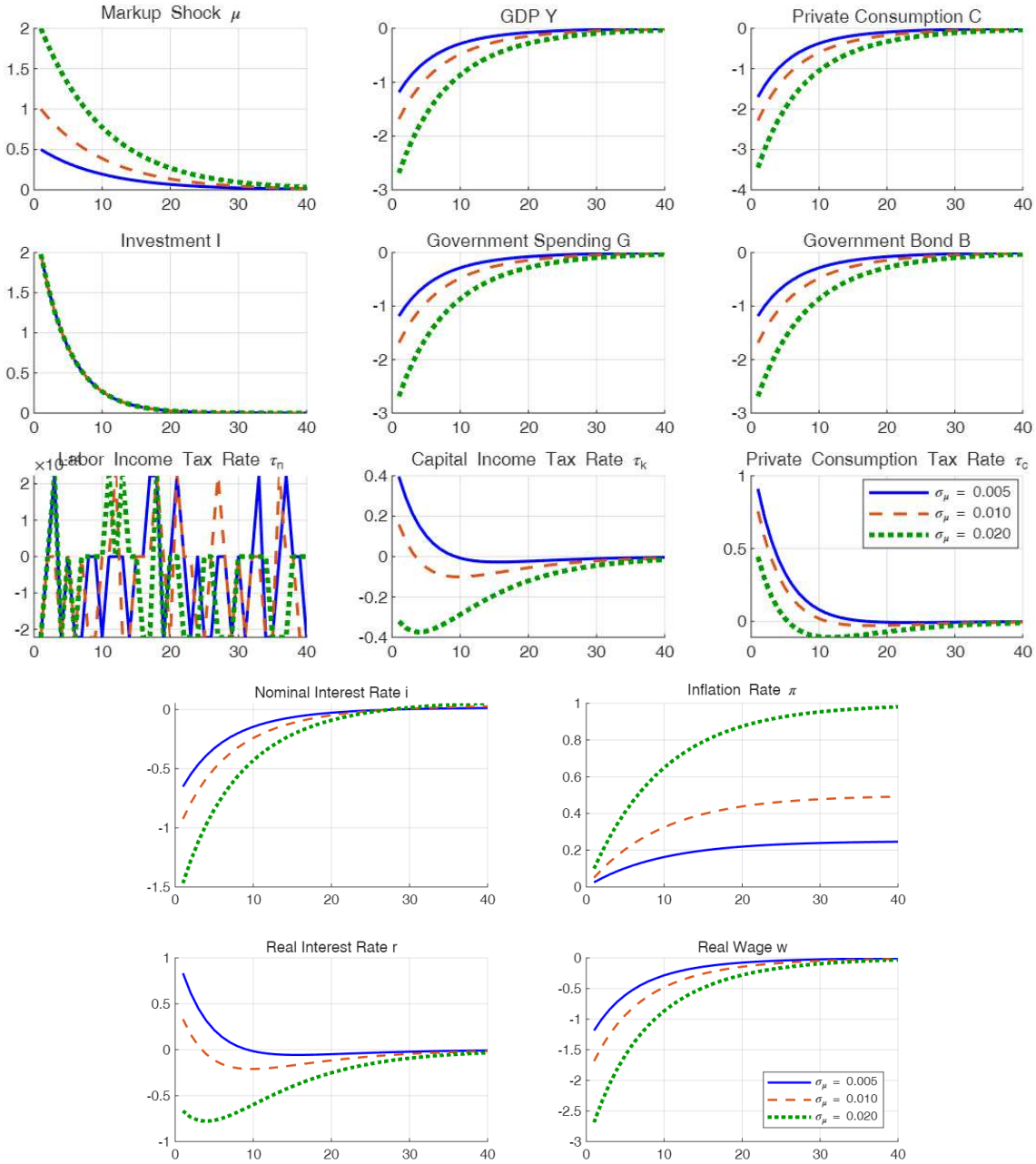


Figure 8. sensitive analysis(1): IRFs on negative(-) TFP shock

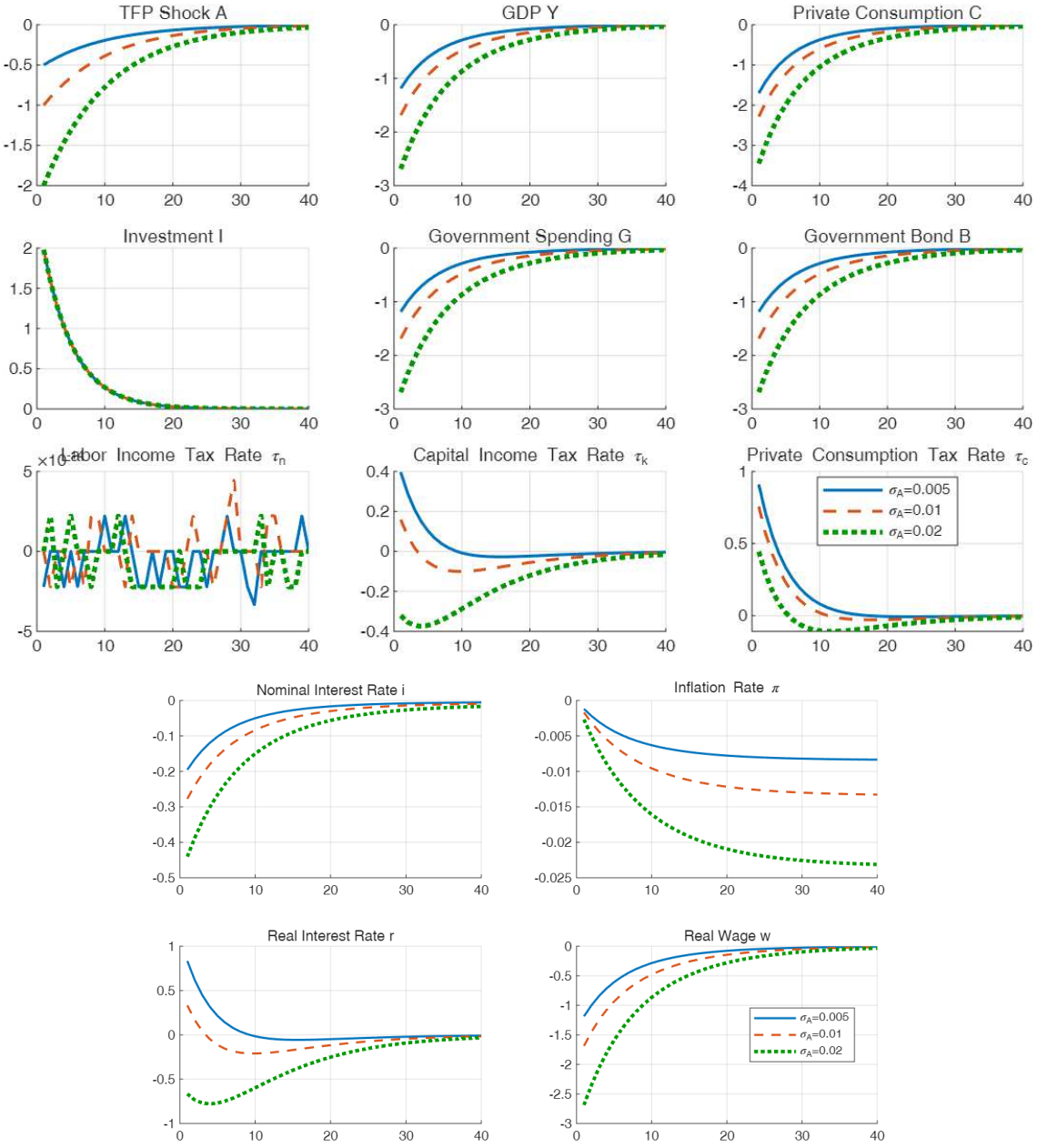


Figure 9. sensitive analysis(1): IRFs on positive government debt shock

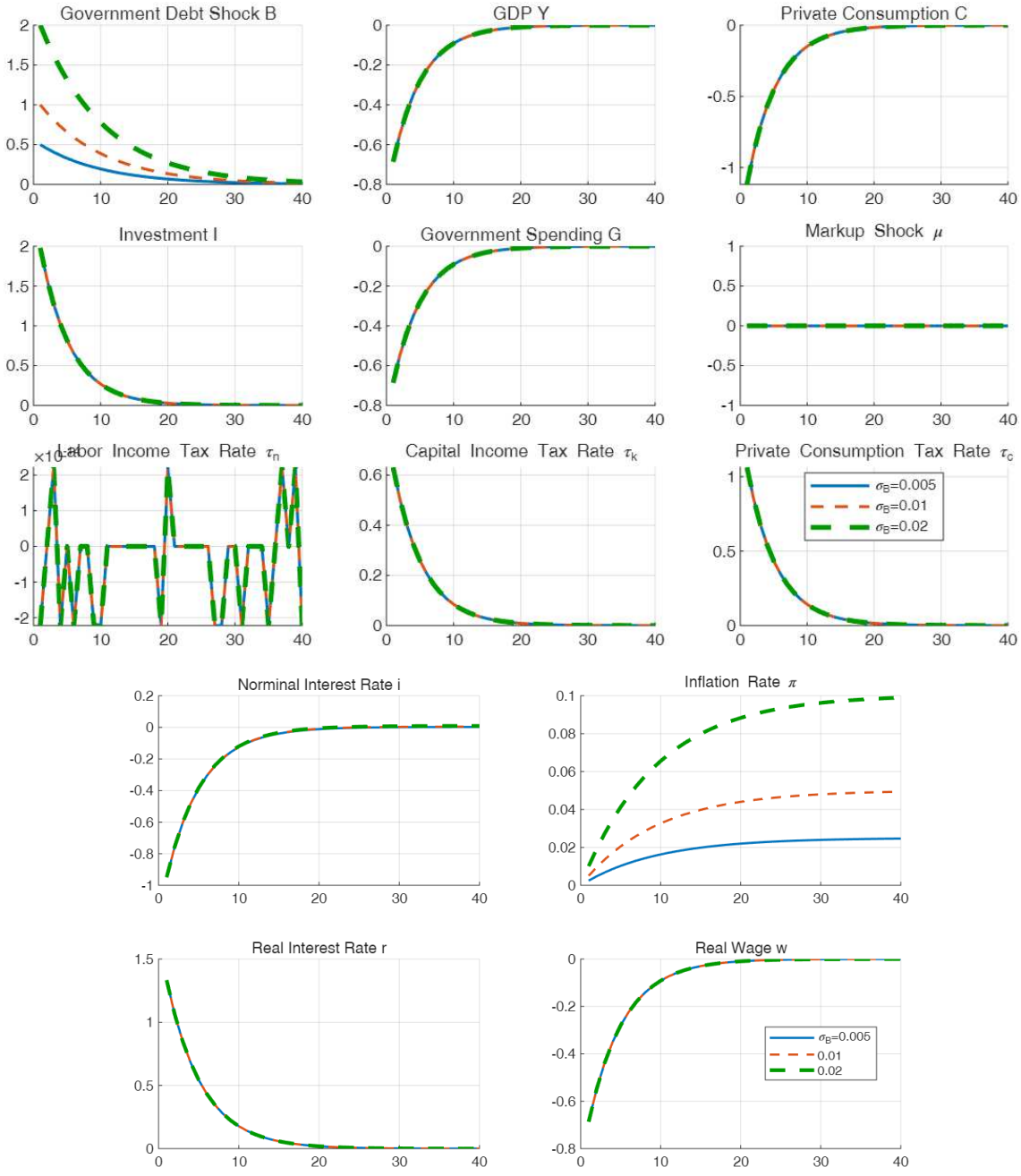
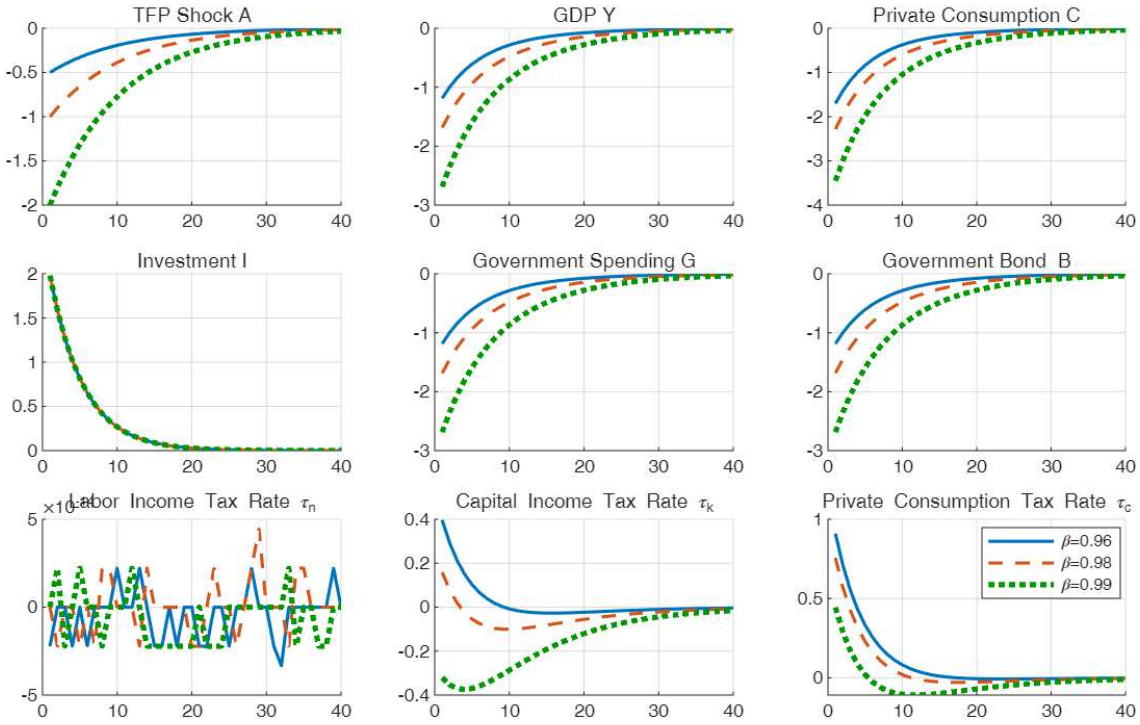
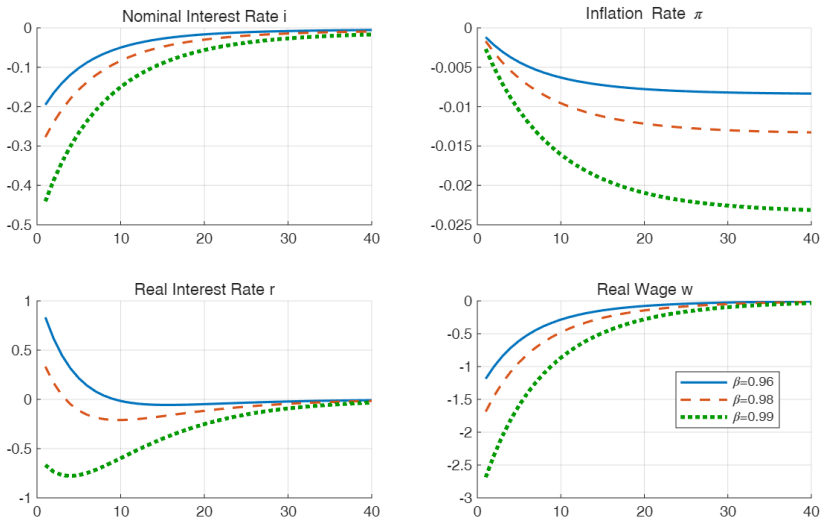


Figure 10. sensitive analysis(2): IRFs on negative TFP shock





Note: The results for markup shocks and government debt shocks are not reported separately by discount factor (β) since they show no significant differences across specifications.