Monetary-fiscal policy interactions when price stability occasionally takes a back seat*

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February 2023

Abstract

Can a central bank occasionally subordinate its price stability objective to the goal of fiscal sustainability without jeopardizing price stability more generally? This paper suggests that the answer is no. I build a model with a fiscal authority that is limited in its willingness or ability to raise primary surpluses—represented by a truncated surplus rule—and a central bank that accommodates its policy to the fiscal constraint. As long as the surplus is below its limit, the central bank's policy rate follows a conventional Taylor rule, but when the surplus is at its limit, the central bank, worried about the fiscal consequences of high interest rates, keeps the policy rate below some upper bound. The model generates endogenous shifts between an orthodox and a fiscally-dominant policy regime. The risk of future regime shifts has encompassing effects on equilibrium. Inflation is systematically higher than it would be if fiscal policy always adjusted its primary surplus sufficiently and monetary policy was solely concerned with price stability.

Keywords: monetary policy, fiscal policy, fiscal dominance, inflation bias, endogenous regime shifts (*JEL*: E31, E52, E62, E63)

*I thank for comments Marco Bassetto, Giorgio Primiceri, and seminar participants at the ECB. The views expressed in this paper are those of the author and do not necessarily reflect those of the European Central Bank.

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1 Introduction

Recent economic events have once again brought to the forefront the interdependence of monetary and fiscal policies. After a decade of low inflation and low interest rates, the global economy experienced a strong surge in inflation, and central banks embarked on a path of rising policy rates. The prospect of rising interest rates, in turn, has sparked concerns about fiscal policy and the sustainability of elevated government debt levels.[1] Some observers have warned that "[p]olitical pressures could arise and grow to keep interest rates lower than the rationale of price stability would call for" (Weidmann, 2020).[2] Can a central bank occasionally give in to such pressures without jeopardizing price stability more generally?

To shed light on this question, I study a monetary-fiscal policy configuration whereby the fiscal authority's efforts to stabilize government debt only go so far, and the central bank accommodates its interest rate policy to the fiscal stance. This configuration is consistent with the notion of fiscal dominance put forward in Sargent (1982), in the sense that "the fiscal authorit[y] select[s] a path or policy for government expenditures and explicit taxes implying growth rates of total government indebtedness to which the monetary authority must adjust".[3] Using a stochastic New Keynesian model, I show that an *occasional* subordination of the goal of price stability to the goal of fiscal stability may result in a *systematic* failure to achieve the price stability goal. Inflation may be systematically higher than it would be if fiscal policy always adjusted its primary surplus sufficiently to variations in government debt and monetary policy was solely concerned with inflation stabilization. This *inflation bias*, in turn, can beget an upward bias in government debt in those states of the world where the conventional dichotomy between fiscal and monetary policy holds.

In the model, fiscal policy is governed by a feedback rule for the primary surplus with an upper limit. Monetary policy follows a conventional Taylor rule, but when the surplus is at its limit, the central bank keeps the policy rate below some upper bound. This setup gives rise to *endogenous* policy regime shifts. Suppose that the fiscal surplus is below its limit—the economy is in the "orthodox" policy regime—when the economy is buffeted by an inflationary shock. The central bank raises the nominal interest rate aggressively so as to engineer an increase in the real interest rate (i.e. it abides by the so-called Taylor principle). The monetary policy tightening affects fiscal policy through its impact on the government budget constraint. Debt servicing costs increase, and the real amount of outstanding government debt goes up. In response, the fiscal authority

[1] See, for instance, The Economist, "How higher interest rates will squeeze government budgets", 12 July 2022.

[2] Historically, it is quite common for governments to put pressure on central banks to soften their policy stance. A prominent and well-documented example are the interactions between monetary and fiscal policymakers in the United States during the Great Inflation in the 1960s and 70s (e.g. Abrams, 2006; Weise, 2012). Constructing a cross-country data set on political pressure faced by central banks, Binder (2021) finds that even central banks with high legal independence are frequently subject to political pressure, and mostly in favor of more accommodative monetary policy.

[3] Sargent (1982), page 386. See also Woodford (2001).

raises its primary surplus. When the shock is sufficiently large, or when there is a series of inflationary shocks, the surplus limit becomes binding—the economy transitions to the "fiscally-dominant" regime.

In the fiscally-dominant regime, the monetary policy response to shocks is generically asymmetric. The central bank always lowers the policy rate in response to deflationary shocks, but because of the interest-rate upper bound it increases the policy rate less aggressively, if at all, in response to sufficiently large inflationary shocks. Consequently, the increase in inflation in the latter case is larger in absolute magnitude than the decline in inflation in the former case.

This asymmetric inflation profile gets baked into agents' expectations. The mere possibility of a binding upper bound on the policy rate in the fiscally-dominant regime shifts inflation expectations upwards in all states of the world, i.e. both in the fiscally-dominant regime and in the orthodox regime. Higher inflation expectations, in turn, put upward pressure on actual inflation. Under conventional parameterizations of the monetary policy rule, the central bank does not fully offset these inflationary pressures so that actual inflation shifts upwards as well. In the risky steady state of the baseline model, the inflation bias equals 0.27 percentage points, and it can become considerably larger in other regions of the state space.[4]

The change in the monetary policy rule when the economy enters the fiscally-dominant regime helps to stabilize the real value of government debt and thereby ensures that the economy will eventually escape from the fiscally-dominant regime. At the same time, the inflation bias resulting from the change in the policy rule begets a *government debt bias* in the orthodox policy regime. So long as the government surplus limit is slack the inflation bias goes along with a higher real interest rate, reflecting the central bank's adherence to the Taylor principle. The higher real interest rate, in turn, leads, in equilibrium, to a higher stock of government debt. Hence, although monetary policy helps to stabilize government debt in the fiscally-dominant regime, the occasional subordination of the price stability goal to the goal of fiscal stability leads to a higher level of government debt in the orthodox policy regime when the central bank focuses on delivering price stability.

Finally, I find that the central bank can mitigate both the inflation bias and the debt bias by responding sufficiently moderately to inflation in normal times so that the probability of a shift to the fiscally-dominant regime becomes small while still making sure that the policy rate moves more than one-for-one with inflation.

The paper belongs to the literature on monetary-fiscal policy interactions. In a seminal paper, Sargent and Wallace (1981) show that if a central bank is forced to finance government budget deficits by providing sufficient seigniorage it will loose control over inflation. My paper emphasizes that the mere possibility of a subordination of price stability to the goal of fiscal sustainability can give rise to inflationary pressures, making it more complicated for the central bank to attain its price stability goal.

[4]The risky steady state is the point to which the economy converges when contemporaneous shocks have receded, but agents take into account the risk associated with future shocks (Coeurdacier et al., 2011).

Several studies consider the possibility of occasional shifts in monetary and fiscal policy regimes (e.g. Davig and Leeper, 2006, 2007; Bianchi and Ilut, 2017; Chen et al., 2022). The present paper shares with these studies the observation that the risk of a future policy regime shift affects agents' expectations formation and, therefore, equilibrium outcomes. The present paper differs from these studies in that in my model, regime changes, and the probability of their occurrence, are determined endogenously whereas regime changes are exogenous—typically governed by a Markov process—in the aforementioned studies.[5]

Cochrane (2023), chapter 6, and Miller (2021) study price level determination in two-period models with an upper bound on the primary surplus. I employ a similar fiscal policy specification in a stochastic infinite-horizon model to study whether the central ban is still able to attain price stability when it accommodates its interest-rate policy to the fiscal constraint.

The remainder of the paper is organized as follows. Section 2 describes the model and the monetary-fiscal policy configuration. Section 3 presents the main results, and Section 4 considers various extensions. Section 5 concludes.

2 A model of the macro economy

The economy is represented by a New Keynesian rational-expectations model formulated in discrete time. I first describe the private sector, and then the public sector.

2.1 Private sector

The private-sector block of the model is standard. A representative household consumes, works, saves in government bonds, and pays taxes. Goods-producing firms act under monopolistic competition and are subject to nominal rigidities. A detailed text-book description can be found in Woodford (2003). Aggregate private-sector behavior is summarized by a consumption Euler equation and a forward-looking Phillips curve. Log-linearizing them around a zero-inflation deterministic steady state, we have

$$\hat{y}_t = \mathrm{E}_t \hat{y}_{t+1} - \sigma \left(\hat{R}_t - \mathrm{E}_t \hat{\pi}_{t+1} \right) \tag{1}$$

$$\hat{\pi}_t = \beta \mathrm{E}_t \hat{\pi}_{t+1} + \kappa \hat{y}_t + \hat{\mu}_t, \tag{2}$$

where y_t is output in period t, R_t is the one-period gross nominal interest rate between periods t and $t+1$, π_t denotes gross inflation between periods $t-1$ and t, and μ_t is an exogenous cost-push shock. A hat indicates that the variable is expressed in percentage

[5] Sims (2006), in a comment on Davig and Leeper (2006), writes "In this paper the assumption of exogenous regime switching may have a big impact not on the estimates of regimes but on calculations of impulse responses in the equilibrium model. [...] It would be interesting to see how sensitive the paper's exercises with the equilibrium model might be to modifying the policy rules so that they coincide with those estimated near the model steady state, but tend endogenously to switch toward active fiscal policy at high levels of debt [...]."

deviations from its deterministic steady state, e.g. $\hat{R}_t \equiv (R_t - R)/R$. E_t is the rational expectations operator conditional on information available in period t, $\sigma > 0$ is the intertemporal elasticity of substitution, and $\kappa > 0$ is the "slope" of the Phillips curve.[6]

2.2 Public sector

The public sector consists of a fiscal authority and a central bank. The fiscal authority issues nominal bonds, collects taxes and provides transfers. It faces the following flow budget constraint

$$\tilde{b}_t = \frac{1}{\beta}\left(\tilde{b}_{t-1} - \frac{b}{y}\hat{\pi}_t - \tilde{s}_t\right) + \frac{b}{y}\hat{R}_t, \tag{3}$$

where b_t denotes the real stock of one-period nominal government bonds at the end of period t, and s_t is the real primary budget surplus.[7] A tilde indicates that the variable is expressed as a share of steady state output in deviation from its steady state ratio, e.g. $\tilde{b}_t \equiv (b_t - b)/y$.

The fiscal authority sets the primary surplus. It lowers the primary surplus when the real value of government debt falls and it raises the primary surplus when the real value of government debt rises, provided that the surplus remains moderate. The fiscal authority is, however, unable or unwilling to raise the primary surplus above some upper limit. Formally,

$$\tilde{s}_t = \min\left(\phi\tilde{b}_{t-1}, \bar{s}\right), \tag{4}$$

where $\bar{s} > 0$, i.e. the upper limit on the primary surplus is slack in the deterministic steady state around which the model is linearized. I will refer to the policy configuration where $\tilde{s}_t < \bar{s}$ as the *orthodox policy regime*, and to the configuration where $\tilde{s}_t = \bar{s}$ as the *fiscally-dominant policy regime*. I assume that $\phi > 1/\beta - 1$; in the terminology of Leeper (1991), fiscal policy is (locally) passive when the economy is in the orthodox regime.

The central bank sets the one-period nominal interest rate, also referred to as the policy rate. When the surplus limit is not binding, interest rate policy is governed by a standard Taylor rule. When the surplus limit is binding, the central bank, worried about the fiscal consequences of high interest rates, keeps the policy rate below some upper bound. Formally,

$$\hat{R}_t = \begin{cases} \alpha\hat{\pi}_t & \text{if } \tilde{s}_t < \bar{s} \\ \min\left(\alpha\hat{\pi}_t, \bar{R}\right) & \text{else,} \end{cases} \tag{5}$$

where $\bar{R} > 0$, and $\alpha > 1/\beta$; in the terminology of Leeper, monetary policy is active in the orthodox regime.[8]

[6] Assuming that prices are sticky a la Calvo, and that labor is firm-specific, it holds $\kappa = \frac{(1-\beta\omega)(1-\omega)}{\omega}\frac{\sigma^{-1}+\eta}{1+\eta\theta}$, where ω is the share of firms that keep their price unchanged in a given period, η is the inverse of the elasticity of labor supply, and θ is the price elasticty of demand.

[7] In the baseline model, taxes and transfers are lump sum. See Section 4 for an extension with distortionary taxation.

[8] In Section 4, I consider an alternative monetary policy configuration where the central bank switches

The central bank's interest-rate policy has fiscal effects. The level of the policy rate impinges on the real value of government debt, both, directly and indirectly through its effect on inflation, see equation (3). All else equal, a higher policy rate raises debt servicing costs, whereas a higher inflation rate erodes the real value of legacy debt.

For future reference, let us also define an alternative monetary-fiscal policy configuration that serves as a useful *benchmark*. Under this benchmark policy configuration, the fiscal authority always adjusts its primary surplus sufficiently to variations in government debt, and the central bank is solely concerned with inflation stabilization. From the perspective of the fiscal and monetary policy rules (4) and (5), we can think of the benchmark configuration as the limiting case where $\bar{s} \to \infty$. In this limiting case, the economy is always in the orthodox policy regime.

2.3 Equilibrium

A rational expectations equilibrium consists of sequences of allocations $\{\hat{y}_t\}_{t=0}^{\infty}$, prices $\{\hat{\pi}_t\}_{t=0}^{\infty}$ and policies $\{\hat{R}_t, \tilde{s}_t, \tilde{b}_t\}_{t=0}^{\infty}$ such that for a given initial level of government debt $\tilde{b}_{-1}$ and a process $\{\hat{\mu}_t\}_{t=0}^{\infty}$, equations (1)-(5) hold for all $t \geq 0$.

2.4 Parameterization and solution

Table 1 reports the baseline parameterization. One period corresponds to one quarter. The assigned parameter values are standard in the literature. A discount factor of 0.995

Table 1: **Parameterization**

Parameter	Value	Economic interpretation
β	0.995	Subjective discount factor
σ	1	Intertemporal elasticity of substitution in consumption
η	1	Inverse labor supply elasticity
θ	10	Price elasticity of demand
ω	0.8	Share of firms per period keeping prices unchanged
α	2.5	Monetary policy rule coefficient
ϕ	0.1	Fiscal policy rule coefficient
$b/(4y)$	1	Government debt to output ratio in deterministic steady state
$\bar{s}$	0.01	Surplus limit (in deviation from steady state)
$\bar{R}$	0.0074	Cond. upper bound on policy rate (in % dev. from steady state)
ρ	0.6	AR coefficient cost-push shock
σ_μ	$\frac{0.16}{100}$	Standard deviation cost-push shock

is tantamount to an annualized steady state interest rate of 2%. The slope coefficient of the Phillips curve κ equals 0.0093. The response coefficient on inflation in the Taylor rule

to a rule that responds less than one-for-one to inflation—a passive monetary policy rule—when the government surplus limit is binding.

is set to 2.5, and the response coefficient on government debt in the fiscal rule is set to 0.1. In the deterministic steady state, the real stock of government debt equals 100% of annualized output, consistent with our focus on episodes of elevated government debt levels. The debt ratio and the discount factor together imply a steady state primary surplus of 2% of output. I set the surplus limit to 3% of steady state output, and the conditional upper bound on the nominal interest rate to 5% in annualized terms. Finally, the cost-push shock is assumed to follow an autoregressive process of order one with an autocorrelation coefficient of 0.6. The innovations are normally distributed with a zero mean and a standard deviation of 0.16/100 (e.g. Coenen et al., 2018).

To account for the non-linearities in the fiscal and monetary policy rules, I solve the model globally using the collocation method. Details are provided in the Appendix.

3 Putting the model to work

First, I show how the model gives rise to endogenous policy regime shifts. Then I explore how the policy regimes, and the risk of a future regime shift, impinge on the macro economy in general, and the inflation rate and government debt in particular.

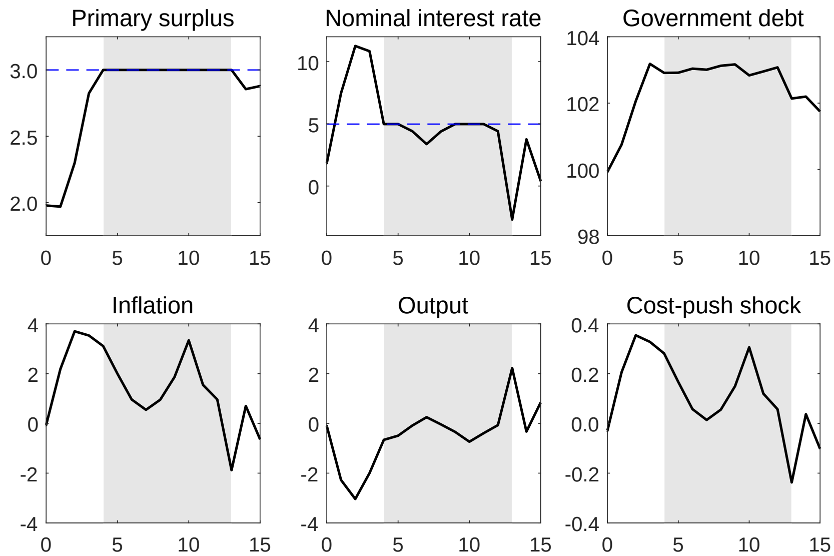
3.1 Endogenous policy regime shifts

Figure 1 shows an excerpt from a model simulation. At the outset of the simulation excerpt, the economy is in the orthodox policy regime (non-shaded area), and close to its deterministic steady state. Then, a series of inflationary cost-push shocks materialize, and inflation moves upwards. In response to the surge in inflation, the central bank aggressively raises the policy rate with a view to increase the real interest rate. The increase in the real interest rate depresses output, and raises debt servicing costs. Consequently, the fiscal authority raises the primary surplus. After a few periods of rising primary surpluses, the surplus limit becomes binding. The economy has transitioned from the orthodox policy regime to the fiscally-dominant policy regime—indicated by the gray-shaded area in Figure 1. As a result of the regime shift, the central bank lowers the nominal interest rate to the conditional upper bound. The policy rate reduction attenuates government borrowing costs. Nevertheless, government debt remains at an elevated level, and the surplus limit remains binding. Only when the economy is buffeted by a series of dis-inflationary cost-push shocks, accompanied by an aggressive reduction in the policy rate, does the government debt level decline sufficiently to relax the upper limit on primary surpluses, and the economy moves back to the orthodox regime.

Table 2 reports the frequency with which the fiscally-dominant regime occurs and its average duration based on 3000 simulations of the model over 1100 quarters.[9] The economy is in the fiscally-dominant policy regime in 20% of the simulated periods, and it stays in the fiscally-dominant regime on average for 3.6 quarters. The table also shows

[9] For each simulation the observations corresponding to the first 100 quarters are discarded.

Figure 1: **Model simulation**



The surplus is expressed as percent of steady state output. The interest rate and inflation are expressed in annualized percent. Government debt is expressed as percent of annualized steady state output. Output and the cost-push shock are expressed in percentage deviations from steady state. The dashed blue horizontal line in the first (second) panel indicates the surplus limit (interest rate bound).

that the conditional upper bound on the policy rate is binding in 10% of the simulated periods for an average of 1.8 quarters.

Table 2: **Frequency and duration of fiscally-dominant regime**

	$\tilde{s}_t = \bar{s}$	$\tilde{s}_t = \bar{s}$ and $\hat{R}_t = \bar{R}$
Frequency in %	20	10
Average duration in quarters	3.6	1.8

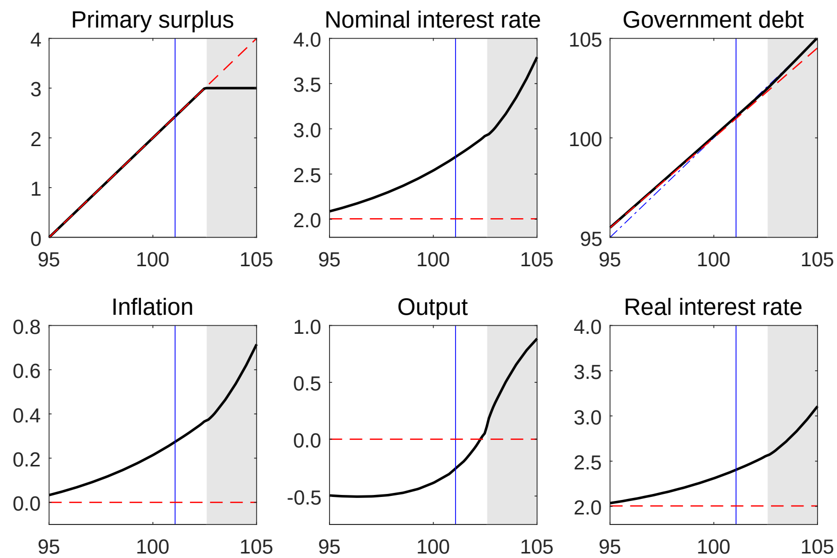
I classify periods in which $\tilde{s}_t \geq \bar{s} - \epsilon$ as periods in which the economy is in the fiscally-dominant regime, and periods in which, in addition, $\hat{r}_t \geq \bar{r} - \epsilon$, as periods in which the conditional upper bound on nominal interest rates is binding. I set $\epsilon = 10^{-6}$.

To summarize, monetary and fiscal policy in the model are intertwined, and variations in the economy's fundamentals give rise to endogenous shifts in the policy regime. Next, we take a more systematic look at how these regime changes impinge on the macro economy.

3.2 Regime change risk and inflation bias

Figure 2 shows equilibrium responses of the model's endogenous variables to the beginning-of-period government debt level when the contemporaneous cost-push shock equals zero (solid black lines). We can translate the primary surplus limit of the fiscal authority into

Figure 2: **Equilibrium responses to beginning-of-period government debt**



Solid black lines: policy configuration with regime shifts. Dashed red lines: benchmark configuration. The real interest rate is expressed in annualized percent. For the other variables see Figure 1. The thin blue vertical line indicates the risky steady state. The contemporaneous cost-push shock is set equal to zero.

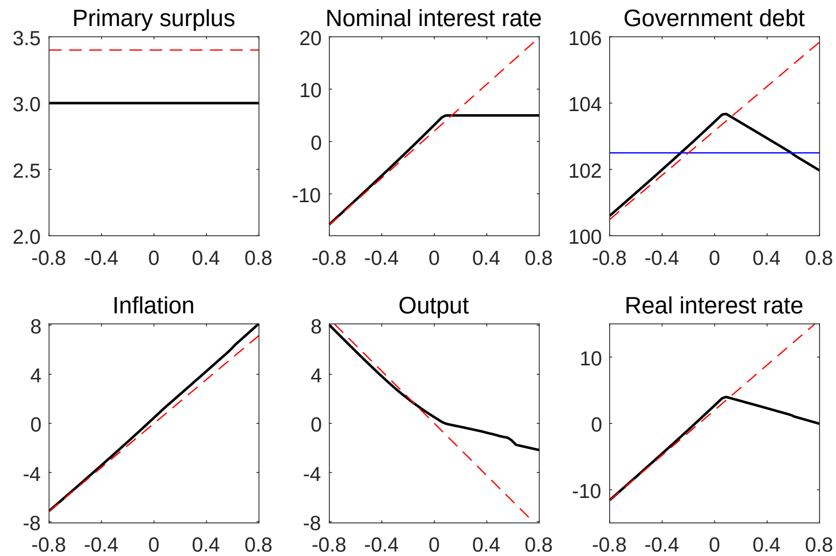
a threshold for government debt $\bar{b} \equiv \bar{s}/\phi$. When beginning-of-period government debt is higher than $\bar{b}$, the economy is in the fiscally-dominant policy regime (gray-shaded area), and it is in the orthodox policy regime (non-shaded area) otherwise.

In both policy regimes and for all levels of government debt, the equilibrium response of inflation is strictly positive. The size of the inflation response is increasing in the debt level. This is very different from the response of inflation under the benchmark configuration (dashed red lines). When the primary surplus always responds to variations in government debt, the inflation rate is invariant to the debt level, and it is perfectly stabilized at its deterministic steady state. Hence, the configuration with occasional policy regime shifts gives rise to a systematic inflation bias.

At the heart of the inflation bias is the central bank's willingness to accommodate its interest-rate policy to the fiscal stability goal when the latter is at risk. This is shown in Figure 3, which plots equilibrium responses to the cost-push shock in the fiscally-dominant regime (solid black lines).[10] The central bank lowers the policy rate in response to dis-inflationary shocks, but is constrained from above when raising the policy rate in response to inflationary shocks. Hence, the real interest rate falls, both, in response to deflationary and inflationary shocks. Consequently, inflation increases more in response

[10] Beginning-of-period government debt is set to 103.5% of annualized steady-state output, i.e. above the debt threshold for which the economy is in the fiscally-dominant regime.

Figure 3: **Equilibrium responses to cost-push shock in the fiscally-dominant regime**



Solid black lines: policy configuration with regime shifts. Dashed red lines: benchmark configuration. Beginning-of-period government debt amounts to 103.5% of annualized steady-state output. For debt levels below (above) the horizontal solid blue line the economy will be in the orthodox regime (fiscally-dominant) regime in the next period.

to an inflationary shock than it declines in response to a dis-inflationary shock, i.e. the inflation response is asymmetric.

This asymmetric inflation profile impinges on private-sector expectations, and, therefore, on private-sector behavior in all states of the world. Consider again Figure 2 and suppose that the beginning-of-period government debt level is sufficiently low that the economy is in the orthodox regime. In this case, the mere possibility of a future shift to the fiscally-dominant regime puts upward pressure on inflation expectations, and, thereby, on actual inflation, see equation (2). Under conventional parameterizations of parameter α, the central bank does not fully counteract these inflationary pressures, so that an inflation bias arises in equilibrium. Agents understand that the higher the debt level at the beginning of the period, the higher the probability that the surplus limit will become binding and monetary policy will become constrained. Hence, the size of the inflation bias increases with the debt level. As shown in Figure 2, even when the contemporaneous cost-push shock is zero the inflation bias can be as high as 0.7 percentage points.

A useful summary statistic capturing the effect of *regime change risk* on economic outcomes can be obtained by comparing the economy's deterministic and risky steady states (Hills et al., 2019).[11] The risky steady state, marked by the vertical blue lines in Figure 2, is the point to which the economy converges when contemporaneous shocks have re-

[11]Hills et al. (2019) assess how the risk of a binding lower bound on nominal interest rates affects inflation in states of nature where the lower bound is not binding.

ceded, but, unlike in case of the deterministic steady state, agents take into account the risk associated with *future* shocks, and, therefore, *future* regime shifts. Table 3 reports the deterministic steady state (first row) and the risky steady state (second row) for the baseline parameterization. Note that at the risky steady state, the economy is in the

Table 3: **Deterministic and risky steady states**

	Inflation	Output	Real interest rate	Government debt
Deterministic steady state	0	0	2	100
Risky steady state	0.27	−0.26	2.41	101.07

Inflation and the real interest rate are expressed in annualized percent. Output is expressed in percentage deviations from the deterministic steady state. Government debt is expressed in percent of annualized steady state output.

orthodox policy regime. In the risky steady state inflation is 27 basis points higher than in the deterministic steady state. In the orthodox policy regime, heightened inflation translates into a tighter monetary policy stance. The real interest rate is 41 basis points higher in the risky steady state than in the deterministic steady state. The tighter monetary policy stance attenuates the inflation bias, but it also depresses economic activity. In the risky steady state, output is 0.26 percentage points lower than in the deterministic steady state.

3.3 From inflation bias to debt bias

Let us now turn to the fiscal side of the model. Figure 3 shows that in the fiscally-dominant regime monetary policy helps to stabilize government debt. Government debt falls in response to both, inflationary and dis-inflationary shocks. In case of inflationary shocks, the stabilizing effect of a rising inflation rate on the real value of government debt is accommodated by a non-increasing policy rate. In case of dis-inflationary shocks, the reduction in the policy rate more than compensates for the decline in inflation and lowers the real value of government debt. When the shock is sufficiently large in absolute magnitude, government debt declines sufficiently to trigger a shift to the orthodox policy regime in the *next* period. In the upper-right panel showing the equilibrium response of government debt, this threshold is indicated by a horizontal solid blue line.

As with inflation, policy actions in the fiscally-dominant regime affect fiscal variables in the orthodox regime. At the risky steady state, the government debt to steady-state output ratio is 1.07 percentage points higher than in the deterministic steady state; see the last column in Table 3. This upward bias in government debt is a direct consequence of the elevated real interest rate in the risky steady state, which, in turn, emerges as a result of the inflationary bias. Hence, the debt bias and the inflation bias are two sides of the same coin.

The link between inflation and government debt in the orthodox policy regime has features of a vicious cycle: A higher debt level begets a higher primary surplus and raises the risk of a future shift to the fiscally-dominant regime. The higher the risk of a shift to the fiscally-dominant regime, the larger is the inflation bias and, as a result of the monetary policy tightening, the real interest rate. A higher real interest rate, in turn, puts upward pressure on the debt level.

3.4 Can the central bank alleviate the inflation bias?

It may be tempting to conclude from the previous analysis that the central bank could have avoided the inflation bias if it had refrained from imposing a conditional upper bound on its policy rate. However, if the central bank had further raised its policy rate with no corresponding adjustment in the primary surplus, then that would have resulted in a soaring public debt level, ultimately leading to government default, or in a commensurate upward shift in the price level—an example of the "stepping on a rake" conundrum discussed in Sims (2011).

Even if the central bank is occasionally forced to succumb its price stability goal to the fiscal sustainability goal, it may still be able to mitigate the inflation bias. The central bank can lower the risk of a shift towards the fiscally-dominant regime by responding less aggressively to inflation in normal times than implied by the baseline parameterization while still abiding by the Taylor principle. The first row of Table 4 reports the risky steady states of inflation and government debt, and the frequency of the fiscally-dominant regime when $\alpha = 1.5$ (compare to $\alpha = 2.5$ in the baseline parameterization). With the smaller response coefficient to inflation, the economy is only rarely shifting to the fiscally-dominant regime, and, consequently, the risky steady state of inflation is very close to the deterministic steady state. In the absence of a quantitatively meaningful inflation bias, there is also no government debt bias.

Table 4: **Additional results**

Extension	Riksy steady state		Frequency of fiscally-dominant regime	
	Inflation	Gov. debt	$\tilde{s}_t = \bar{s}$	$\tilde{s}_t = \bar{s}$ and $\hat{R}_t = \bar{R}$
Smaller Taylor rule coefficient	0.01	100.01	0	0
Distortionary taxation	0.56	101.60	29	16
Passive monetary policy	0.23	100.89	15	-

Notes: Inflation is expressed in annualized percent. Government debt is expressed in percent of annualized steady state output. The frequency of binding constraints is expressed in percent.

Remarkably, the decimation of the inflation bias does not come at the cost of higher inflation volatility. The standard deviation of annualized inflation is 1.93% when $\alpha = 2.5$, and 1.89% when $\alpha = 1.5$%. Hence, the stabilizing effect from avoiding the fiscally-dominant regime in the case of $\alpha = 1.5$ more than offsets the destabilizing effect of a less aggressive response to shocks in normal times.

4 Extensions

This section considers two modifications of the model. The first modification extends the model to include distortionary taxation. The second extension modifies the way in which monetary policy accommodates fiscal policy in the fiscally-dominant regime.

4.1 Distortionary taxation

Suppose that households pay taxes on their labor income. The labor income tax rate τ^L then shows up in the linearized Phillips curve, and we replace equation (2) with

$$\hat{\pi}_t = \beta \mathrm{E}_t \hat{\pi}_{t+1} + \kappa \left(\hat{y}_t + \frac{Y}{(1-\tau^L)(\sigma^{-1}+\eta)} \tilde{\tau}_t^L \right) + \hat{\mu}_t, \tag{6}$$

where $\tilde{\tau}_t^L \equiv (\tau_t^L - \tau^L)/Y$.

Suppose, furthermore, that the government adjusts the labor income tax rate, rather than lump-sum taxes and transfers, in response to fluctuations in government debt. We thus replace the surplus rule (4) with the following labor income tax rule

$$\tilde{\tau}_t^L = \min \left(\phi \tilde{b}_{t-1}, \bar{\tau}^L \right), \tag{7}$$

where $\bar{\tau}^L > 0$. In the spirit of the baseline model, I will refer to the policy configuration where $\tilde{\tau}_t^L < \bar{\tau}^L$ as the orthodox policy regime, and to the configuration where $\tilde{\tau}_t^L = \bar{\tau}^L$ as the fiscally-dominant regime.

In addition to labor income taxes, the government continues to levy lump-sum taxes. Lump-sum taxes consist of two components. The first component is time-varying and finances an employment subsidy that offsets the distortions from monopolistic competition and distortionary taxation in the deterministic steady state so as to facilitate comparison with the baseline model in Section 2. The second component is constant, and negative, allowing me to choose a plausible steady-state labor income tax rate. With these assumptions, the primary surplus equals

$$\tilde{s}_t = \frac{Y}{(1-\tau^L)^2} \tilde{\tau}_t^L + \frac{\tau^L}{1-\tau^L} \hat{Y}_t. \tag{8}$$

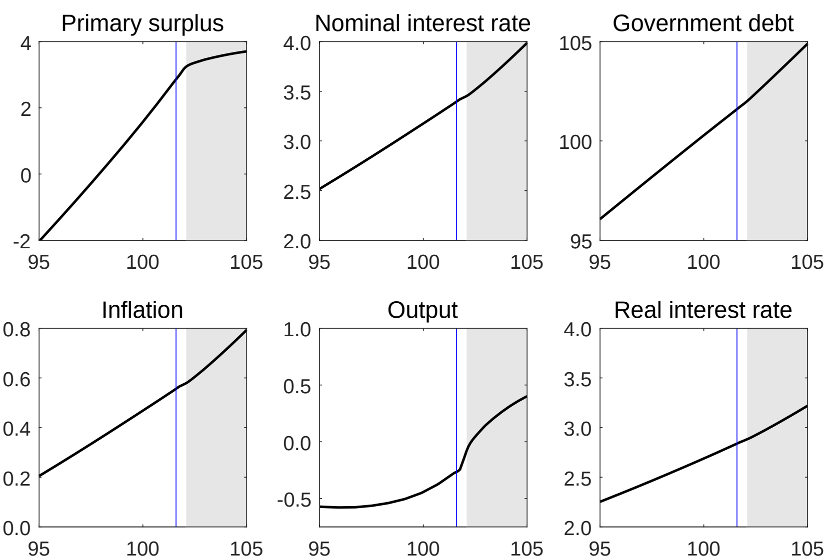
Where applicable, I use the same parameterization as for the baseline model (see Table 1). I set the steady-state labor income tax rate τ^L equal to 24% and the upper limit to 25%.[12]

[12] I assume that the constant component of lump-sum taxes equals $T^A/Y = -0.3$ so that the primary surplus equals 2% of steady state output as in the baseline model. Note that $S = \tau^L w Y + T^A$, where w is the steady-state real wage rate. With the appropriate employment subsidy in place, it holds $w = 1/(1-\tau^L)$. I map the surplus limit from the baseline model into a limit for the labor income tax rate as follows $\bar{\tau}^L = \bar{s}/(wY) = 0.0076$.

The second of Table 4 reports the risky steady states of inflation and government debt, and the frequency of the fiscally-dominant regime. As in the baseline setup, the model gives rise to an inflation bias and a government debt bias. At the risky steady state, the annualized inflation rate is 0.56 percentage points above the deterministic steady state. The economy is in the fiscally-dominant regime in 29% of the simulated periods, and in 16% of the periods the conditional upper bound on the nominal interest rate is binding.

Figure 4 shows the equilibrium responses to government debt when the cost-push shock is fixed at zero. The responses are similar to those in Figure 2, except that the primary surplus keeps rising with beginning-of-period government debt in the fiscally-dominant regime. That is because the upper limit is imposed on the labor income tax rate rather than on the primary surplus. The latter is not only a function of the tax rate, but also of output, see equation (8). Output is increasing with beginning-of-period government debt, because a higher debt level makes it more likely that the upper bound on the nominal interest rate becomes binding.

Figure 4: **Equilibrium responses to lagged government debt - distortionary taxation**



Notes: The real interest rate is expressed in annualized percent. For the other variables see Figure 1. The thin blue vertical line indicates the risky steady state. The contemporaneous cost-push shock is set equal to zero.

4.2 Passive monetary policy in the fiscally-dominant regime

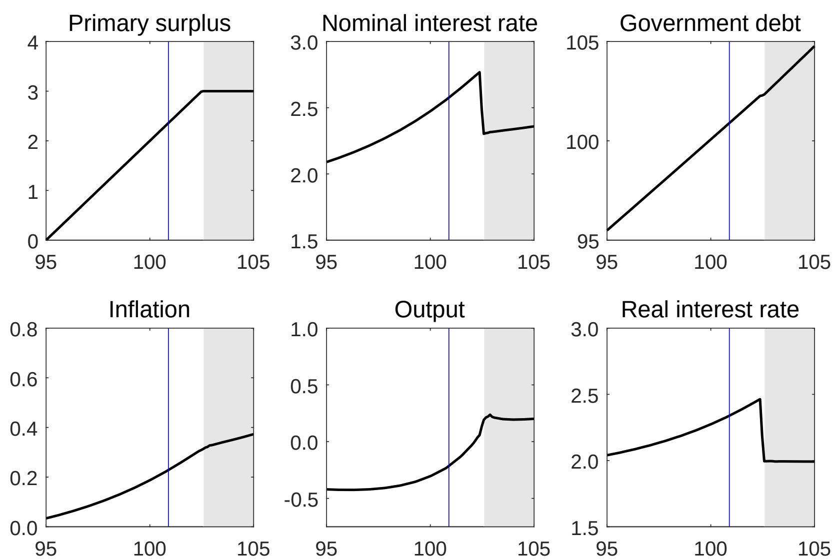
Suppose that, instead of imposing an upper bound on the nominal interest rate, the central bank switches to a passive interest-rate rule when the economy is in the fiscally-dominant regime. Hence, we replace monetary policy rule (5) with

$$\hat{r}_t = \begin{cases} \alpha \hat{\pi}_t & \text{if } \tilde{s}_t < \bar{s} \\ \alpha_F \hat{\pi}_t & \text{else,} \end{cases} \tag{9}$$

where $\alpha > 1/\beta$, as before, and $\alpha_F < 1$. I set $\alpha_F = 0.95$, and keep all parameter values from the baseline model unchanged (see Table 1). The third row of Table 4 reports the results. The inflation bias and the debt bias are somewhat smaller, and the frequency of the economy being in the fiscally-dominant regime is lower than under the baseline setup.

Figure 5 shows the equilibrium responses to beginning-of-period government debt when the contemporaneous cost-push shock is set to zero. The nominal interest rate in-

Figure 5: **Equilibrium responses to lagged government debt - passive monetary policy**



Notes: The real interest rate is expressed in annualized percent. For the other variables see Figure 1. The dashed blue vertical line indicates the risky steady state. The contemporaneous cost-push shock is set equal to zero.

creases with beginning-of-period government debt in the orthodox regime, jumps down when switching to the fiscally-dominant regime, and increases with beginning-of-period debt in the fiscally-dominant regime, although at a slower pace than in the orthodox regime.

5 Conclusion

Monetary and fiscal policy are intricately interlinked. If the fiscal authority is limited in its willing or ability to raise primary surpluses, the central bank may be forced to occasionally subordinate the goal of price stability to the goal of fiscal stability. I show that such a policy configuration may deal a blow to price stability more generally.

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