Fiscal inaction as monetary support*

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Abstract

How does the fiscal framework affect the central bank's ability to stabilize output and inflation? The textbook answer, which assumes Ricardian households, recommends that fiscal adjustment should be fast enough to allow for monetary dominance. We instead argue that, with non-Ricardian households, the central bank may welcome slow, or even absent, fiscal adjustment. On the demand side, slow fiscal adjustment helps stabilize aggregate spending; on the supply side, it eases tax distortions, improving the output-inflation trade off. And while the first channel favors slow fiscal adjustment only when the business cycle is dominated by demand shocks, the second channel extends this preference to supply shocks. A quantitative exercise affirms our lessons in the U.S. context, with the central bank preferring near absent fiscal adjustment over the business cycle.

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1 Introduction

What kind of fiscal support does a central bank want? According to the textbook answer (Woodford, 2003a; Galí, 2008), the fiscal authority should "step aside" and adjust taxes to ensure debt stabilization. Conditional on taxes adjusting sufficiently at some point, the precise time profile of the adjustment is irrelevant; in the complete absence of adjustment, in contrast, the economy could enter a regime of "fiscal dominance," with the monetary authority losing control over aggregate demand and thereby also output and inflation. This textbook answer is derived within the context of the representative-agent New Keynesian (RANK) model, and as such presumes that households are Ricardian (in the sense of Barro, 1974). We revisit this question when instead households are non-Ricardian, as in the fast-growing literature on the heterogeneous-agent New Keynesian (HANK) model (e.g., among many others, Kaplan et al., 2018; Auclert et al., 2024).

Our headline result is that, when households are non-Ricardian, the textbook conclusion is likely to flip, with slow or even absent fiscal adjustment *supporting* the central bank. The intuition is as follows. Recessions are times of budgetary shortfalls, with the fiscal framework dictating how quickly taxes will be hiked to stabilize debt. With Ricardian households, the timing of tax hikes is irrelevant—all that matters is that they occur at some point. With non-Ricardian households, instead, delaying tax hikes stimulates aggregate demand, stabilizing the economy. Our positive analysis shows that this simple mechanism can actually be surprisingly powerful: as tax hikes are delayed more and more, the cumulative response of equilibrium output to *any* aggregate demand or supply disturbance converges to zero. Our normative analysis then clarifies the conditions under which this stabilizing mechanism supports, or hinders, the central bank. Following recessionary demand shocks, the central bank wishes to stabilize economic activity and thus inflation—exactly what slow fiscal adjustment delivers. Following stagflationary supply shocks, such stabilization may instead at first glance not appear desirable, as it reinforces inflationary pressures. However, slow fiscal adjustment at the same time smoothes out and, crucially, endogenously lessens the tax burden that needs to be imposed, thereby improving the economy's output-inflation trade-off. We conclude our analysis with a quantitative assessment, verifying the desirability of slow fiscal adjustment in an empirically relevant setting.

Environment. We consider an overlapping-generations version of the New Keynesian model, as in our earlier work (Angeletos et al., 2024, 2025). Finite lives here accommodate a similar kind of non-Ricardian consumption behavior as that implied by liquidity constraints (see Farhi and Werning, 2019; Aguiar et al., 2024; Rachel and Ravn, 2025), connecting our analysis with the HANK literature. At the same time, the overlapping-generations structure permits clean theoretical characterizations.

We use our model economy as a laboratory to understand how different fiscal rules, and in particular the speed of fiscal adjustment, support (or complicate) the tasks of the central bank. The economy is subject to two disturbances, to consumer patience ("demand" shocks) and to firm mark-ups ("cost-push" or "supply" shocks). Fiscal policy is represented by a rule for how quickly taxes adjust to ensure long-run government budget balance, as parameterized by a single coefficient τ_d, ranging from absent ($\tau_d = 0$) to immediate adjustment ($\tau_d = 1$). This fiscal adjustment may be either lump-sum (in our baseline specification) or distortionary (in an extension). Tax revenue furthermore automatically co-varies with overall economic activity, i.e., there is a conventional automatic stabilizer (as modeled in McKay and Reis, 2016; Blanchard, 2025), whose magnitude is parameterized by the coefficient $\tau_y > 0$. The monetary authority operates under this fiscal backdrop. We consider a central bank with a "flexible inflation-targeting" objective, seeking to stabilize fluctuations in output, inflation, and interest rates. While the output and inflation stabilization objectives follow immediately from standard micro-foundations, the desire for interest rate stabilization is a reduced-form way of capturing the empirical reality that central banks in practice are unwilling or unable to move interest rates abruptly to achieve their output and inflation objectives (e.g., Brainard, 1967; Woodford, 2003a, Chapter 8.3). We now ask how the losses of this central bank vary with assumptions on fiscal reactions.

Fiscal adjustment and aggregate fluctuations. Before addressing our paper's *normative* question, we first zero in on a preliminary *positive* question: how does τ_d, the speed of fiscal adjustment, shape the business cycle for a *given* monetary policy stance, i.e., given a path for real interest rates?

The key lesson of this exercise is that slow fiscal adjustment exerts a surprisingly strong stabilizing force on the economy. In a recession, output declines, and thus through the automatic stabilizer (τ_y) so does fiscal revenue; this in turn necessitates tax hikes in the future. Since households are non-Ricardian, postponing tax hikes from any date t to periods further in the future (through a lower τ_d) naturally stimulates aggregate demand and thereby equilibrium output at date t. But since households are both (partially) forward-looking as well as consumption-smoothing, this boom at date t then goes hand-in-hand with an aggregate demand expansion also before and after t; we prove that, in our environment, this dynamic amplification is strong enough to unequivocally boost economic activity *across all horizons*. And not only is there a fiscal boost across all horizons, but the boom also converges to *perfect* stabilization in a present value sense: we prove that, as fiscal adjustment gets delayed more and more, the cumulative output impulse response necessarily converges to zero, with the delay in fiscal adjustment dampening the recession today and causing a dynamic overshoot of output tomorrow. The intuition for this limit result follows from the intertemporal government budget constraint: in equilibrium, if the present value of output is negative, then there is a budgetary shortfall, and so the present value of fiscal adjustments must be positive. Delays in tax hikes are then stimulative, increasing output and thus moving its present value closer to zero. This logic continues to apply until fiscal adjustment delays bring the present value output response to zero, delivering the limit.

The end result is that slow fiscal adjustment (small τ_d) provides an extremely powerful and hitherto under-appreciated dynamic amplification of the usual static automatic stabilizers ($\tau_y > 0$).

Implications for monetary policy. In the second part of our paper, we ask whether the mechanism described above aids or undermines the central bank in fulfilling its mandate. To do so we solve the central bank's problem and then ask how its solution, and in particular the minimized loss, varies with the speed of fiscal adjustment, τ_d. We pay particular attention to whether the central bank loss, along the optimal policy, is minimized at $\tau_d = 0$, i.e., the scenario equated with "active" or "dominant" fiscal policy in the traditional, RANK-based approach. In our analysis we distinguish both the origin of cyclical fluctuations—whether they are driven by disturbances to demand or supply—and between lump-sum and distortionary fiscal adjustment. While these distinctions did not matter for the positive mechanism described above, they loom large for its normative implications.

Suppose first that the business cycle is driven by demand shocks. In this case, the central bank faces no trade off between its objectives of stabilizing output and inflation: following a recessionary demand disturbance, it would like to boost activity and thereby inflation. As that recession causes a budgetary shortfall, slow fiscal adjustment here supports the central bank, though with a twist: as discussed above, dampening the recession today necessarily goes hand-in-hand with a future overshooting of the economy, echoing a trade-off familiar from the forward guidance literature (e.g., Eggertsson and Woodford, 2003). We identify sufficient conditions for this trade-off to be resolved in favor of very slow or even no fiscal adjustment, and we further argue that these conditions are easily satisfied in practice (i.e., for any plausible calibration of the model). This lesson is starkest if fiscal adjustments are lump-sum, but extends with little change to distortionary fiscal adjustments.

Suppose next that the business cycle is driven by supply shocks, giving rise to a trade-off between output and inflation stabilization. Following a stagflationary cost-push shock, the central bank optimally raises interest rates and depresses activity in order to moderate the inflationary pressures. Slow fiscal adjustment—which yet again stabilizes real activity—here now explicitly works against the central bank, undoing its efforts to ease inflationary pressures. The very same mechanism that makes the central bank prefer *slow* fiscal adjustment in the face of demand shocks thus makes it prefer *fast* fiscal adjustment in the face of supply shocks. Crucially, however, this logic can be moderated or even overturned if fiscal adjustment is distortionary. In this case, postponing tax hikes may ease the inflation-output trade off available to the central bank via two complementary channels: by smoothing tax distortions, in Barro (1979) and Lucas and Stokey (1983); and, novel to our analysis here, because the induced boom raises revenue, endogenously lessening the overall amount of tax hikes. We show that, if tax hikes are sufficiently distortionary, ensuring that these two forces are strong enough, then the central bank may actually welcome slow fiscal adjustment for *both* demand and supply shocks.

Quantitative exercise. While our theoretical analysis suggests that fiscal inaction (i.e., $\tau_d \approx 0$) can actually support a central bank in its objectives, it conditions this revision of the conventional wisdom on the relative importance of demand disturbances, the severity of tax distortions, and, the degree of non-Ricardian household behavior. Furthermore, our theoretical results rely on several simplifying assumptions, most notably we abstract from meaningful heterogeneity in household wealth and in marginal propensities to consume (MPCs). To address these limitations, the last part of our paper considers a much richer model, adapts it to the U.S. context, and quantitatively evaluates the effects of the speed of fiscal adjustment, τ_d, on the central bank's ability to fulfill its mandate.

The building block for our approach to quantification is a "sufficient statistics" identification result. Building on Caravello et al. (2025) we show that, even in our richer model environment, the effects of changes in τ_d on the central bank loss are pinned down by just two objects: the causal effects of interest rates and taxes on output, inflation and government debt; and the reduced-form autocovariance function of those same time series. Intuitively, the autocovariance function implicitly tells us about the mix of shocks hitting the macro-economy, while policy causal effects tell us how changes in fiscal and monetary policy reaction functions would alter the propagation of those shocks, pinning down the counterfactual evolution of the macro-economy and hence the central bank loss. Guided by this identification result, our quantitative analysis proceeds in two steps: first, we choose our specific model and its calibration so as to maximize the credibility of the model-implied policy causal effects; and second, we estimate the autocovariance function of the required macroeconomic aggregates on historical U.S. time series data. From here, we can evaluate the desired central bank loss.

The main finding of this exercise is that, consistent with our theoretical analysis, the Federal Reserve's objectives are indeed best supported by very slow fiscal adjustment ($\tau_d \approx 0$). The identification result guiding our approach to quantification allows us to see transparently where this result is coming from. First, delays in fiscal adjustment are strongly stimulative in our model, as it features both material fiscal revenue drops in recessions (the automatic stabilizer) and meaningful fiscal multipliers, because of an elevated average MPC. Second, the "typical" business cycle in the data looks like an aggregate demand disturbance, consistent with the "main business-cycle shock" of Angeletos et al. (2020). Putting the two together, our result necessarily follows—and breaking it requires breaking at least one of these two, empirically relevant, ingredients.

Discussion and qualifiers. As already noted, our main takeaway contradicts the conventional wisdom that fiscal support for an inflation-targeting central bank means sufficiently fast fiscal adjustment, i.e., a fiscal authority that "steps aside." The driving force behind this lesson is the accommodation of realistic non-Ricardian consumption behavior, along with the Keynesian premise that output is—at least partially—demand-determined. This last point underscores that our results apply only to cyclical fiscal adjustment, and not to long-run structural changes in government spending or taxation—long-run forces outside the purview of our analysis and of the New Keynesian framework more generally. Furthermore, our analysis presumes the existence of sufficient "fiscal space" so that the desirable τ_d and the corresponding cyclical movements in government debt are feasible, without causing default risk. Put differently, a corollary of our analysis is that the absence of fiscal space reduces the potency of the dynamic stabilization mechanism studied here.

Literature. Our analysis adds to a long literature on fiscal-monetary interactions. An important strand (from Leeper, 1991 to Bianchi and Ilut, 2017 and Bianchi and Melosi, 2019) assumes Ricardian households and lump-sum taxes. Under these assumptions, fiscal policy is irrelevant for macroeconomic outcomes, unless the economy switches from a regime of "monetary dominance" to one of "fiscal dominance." We instead follow the recent HANK literature and study monetary-fiscal interactions when households are non-Ricardian (see Auclert et al., 2025; Kaplan, 2025, for recent surveys). Key insights of that literature are that the fiscal backdrop shapes both the propagation of monetary policy as well as the economy's natural rate (e.g., Hagedorn et al., 2019; Campos et al., 2024). A separate strand studies the optimal *joint* design of fiscal and monetary policies (e.g., Bhandari et al., 2021; Bilbiie et al., 2024). Finally, particularly closely related are prior papers that share our use of OLG-NK models (Aguiar et al., 2024; Dupraz and Rogantini Picco, 2025; Rachel and Ravn, 2025); complementary to our analysis here, those papers study the risk-sharing benefits of government debt issuance and ask how the fiscal backdrop shapes the determinacy properties of the model.

A separate strand of the literature allows for distortionary taxes, connecting the Ramsey literature (Lucas and Stokey, 1983) with the representative-agent New Keynesian framework (Benigno and Woodford, 2003; Schmitt-Grohé and Uribe, 2004). The tax-smoothing motives discussed there are, in our setting, further reinforced by a new mechanism that emerges only with non-Ricardian households: delaying fiscal adjustment endogenously reduces the tax hikes needed.

Finally, our paper sits within a small but growing literature on the importance of automatic stabilizers for macroeconomic fluctuations (Blanchard, 2025; McKay and Reis, 2016, 2021). In Angeletos et al. (2024), we show that the associated endogenous feedback from output to tax revenue can allow one-off fiscal deficit shocks to "finance themselves," at least when the monetary policy reaction is sufficiently weak. Differently from our earlier work, we here instead study how automatic stabilizers interact with gradual fiscal adjustment to shape the propagation of a general set of demand and supply shocks, and under optimal monetary policy design. Our key novel insights are first, that slow adjustment provides surprisingly strong dynamic amplification of the familiar static automatic stabilizing effects in *any* recession, and second, that these forces overturn the conventional wisdom of central banks welcoming a fiscal authority that "steps aside."

2 Environment

Our baseline setting is similar to the perpetual-youth, overlapping-generations (OLG) version of the New Keynesian model, as studied in Farhi and Werning (2019), Aguiar et al. (2024), and Angeletos et al. (2024, 2025), among others. Relative to the particular setting in our prior work, we here make four changes. First, we shift the focus from "stimulus checks" (modeled as exogenous, deficit-financed fiscal transfers) to exogenous shifts in consumer spending ("demand shocks") and firm costs or markups ("supply shocks"). Second, instead of fixing the real interest rate at its steady state value (or restricting monetary policy to an *ad hoc* feedback rule), we let the monetary authority optimally adjust its policy in response to these fluctuations, so as to minimize a familiar loss function. Third, we assume that public debt is real. Finally, we consider a static Phillips curve. The first two elements are essential: they let us study how the fiscal framework interacts with optimal monetary policy and how it shapes the central bank's loss (i.e., its ability to meet its stabilization objectives or its mandates) in response to macroeconomic fluctuations. The remaining two assumptions are auxiliary: they are made in the interest of clarity and will be relaxed in the quantitative analysis.

Throughout the paper, we work with the (log-)linearized relations around a steady state in which inflation is zero, real allocations are given by their flexible-price counterparts, and real government debt is fixed at some arbitrary level $D^{ss} \geq 0$. Detailed micro-foundations and linearization steps are presented in Appendix A.1. Time is discrete and indexed by $t \in \{0, 1, \ldots\}$, uppercase variables denote levels, and lowercase variables denote (log-)deviations from steady state.[1] Finally, we cast our analysis in terms of perfect-foresight transition paths in response to shocks realized at the beginning of period 0. As usual, these transition paths can (and later will) be reinterpreted as impulse response functions in the analogous economy with aggregate risk.

2.1 Private sector

We summarize the private sector of our economy through two relations: an aggregate demand block and an aggregate supply block.

Aggregate demand. There is a unit continuum of households, with each household surviving from one period to the next with probability $\omega \in (0, 1)$, and then replaced by newborns upon death, as in Blanchard (1985). The households have separable preferences over consumption and labor, and they save and borrow through an actuarially fair, risk-free, one-period, real annuity, which is backed by government bonds. Following Angeletos et al. (2024, 2025), we abstract from steady-state effects of fi-

[1] To accommodate the case of zero debt, all fiscal and household wealth variables are measured in absolute deviations from this steady state, scaled by steady-state output; all other variables are measured in log-deviations.

nite lives and fiscal policy by introducing appropriate time-invariant transfers from older households to newborns; these transfers are designed to ensure that all households have identical wealth in the steady state. To facilitate aggregation, we furthermore assume that all households supply the same amount of labor (intermediated by labor unions), receive the same wages and dividend payments, and pay the same taxes. Finally, we let households be subject to a "patience" or discount-rate shock, the standard stand-in for aggregate demand disturbances.

Deriving the (log-linearized) consumption function for each individual household, and then aggregating across households, we obtain the following aggregate consumption function:

$$c_t = (1-\beta\omega)\left(a_t + \sum_{k=0}^{\infty}(\beta\omega)^k\left(y_{t+k}-t_{t+k}\right)\right) - \beta\left(\sigma\omega - (1-\beta\omega)\frac{A^{ss}}{Y^{ss}}\right)\left(\sum_{k=0}^{\infty}(\beta\omega)^k r_{t+k}\right) - \tilde{v}_t. \tag{1}$$

Here, c_t is real consumption; y_t is real income (and also real output); t_t is real tax payments; r_t is the real rate of interest between t and $t+1$; a_t is real private wealth at the beginning of period t (which in equilibrium will coincide with real government debt d_t); $\tilde{v}_t \equiv \beta\sigma\omega\left(\sum_{k=0}^{\infty}(\beta\omega)^k v_{t+k}\right)$ is the shock to period-t spending, with v_t being the underlying discount-rate shock; $\beta \in (0,1)$ is the steady-state household discount factor (and thus also the reciprocal of the steady-state gross real rate); $\sigma > 0$ is the elasticity of intertemporal substitution; and A^{ss}/Y^{ss} is the steady-state wealth-to-GDP ratio.

Equation (1) describes the aggregate demand block of our economy. For future reference, we note that, once we impose market clearing ($c_t = y_t$ and $a_t = d_t$) and the government's flow budget (introduced below), we can re-express (1) recursively as follows:

$$y_t = -\sigma\left(r_t - \frac{(1-\beta\omega)(1-\omega)}{\sigma\omega}d_{t+1}\right) + y_{t+1} - \sigma v_t. \tag{2}$$

Equation (2) is a natural generalization of the familiar representative-agent Euler equation. Indeed, had horizons been infinite ($\omega = 1$), the d_{t+1} term would have dropped and equation (2) would have reduced to $y_t = y_{t+1} - \sigma(r_t + v_t)$, exactly as in RANK. By assuming finite horizons ($\omega < 1$), we instead let private assets, or equivalently the quantity of government debt, enter equation (2) in the form of a wedge whose magnitude increases as ω gets further away from 1. This captures a classical non-Ricardian effect: we depart from the Permanent Income Hypothesis (PIH), government bonds are net wealth, and fiscal deficits stimulate consumer spending.

While the particular forms of equations (1) and (2) are special, the economic forces captured by them, and by extension the mechanisms discussed in our paper, are substantially more general. The key here is to note that (1) closely mirrors the aggregate consumption function found in richer HANK models: MPCs out of cash-in-hand are elevated, here equal to $1-\beta\omega$; spending out of income gains happens relatively quickly, decaying at rate $\omega < 1$ (instead of the usual random walk implied by the PIH); and future income and future taxes are discounted at a higher rate than the interest rate on government debt (i.e., at rate $\beta\omega < \beta$). These properties are the hallmark of non-Ricardian behavior, find ample empirical support, and are the drivers of the mechanisms at the core of our paper. The tractability of our model of consumer spending does, however, come at the cost of one important counterfactual implication—it features *equally* elevated MPCs out of income y_t and asset wealth a_t. We will relax this property in Section 6, where we verify that our lessons extend to a setting that delivers a very close fit to empirical evidence on consumption-savings behavior.

Aggregate supply. The supply block is represented by the following *static* Phillips curve:

$$\pi_t = \kappa y_t + u_t, \tag{3}$$

where π_t denotes inflation, $\kappa > 0$ is the slope of the Phillips curve, and u_t is an exogenous cost-push (i.e., mark-up) shock u_t, the usual stand-in for aggregate supply shocks. Equation (3) can be micro-founded as in the textbook NK model, subject to two additional assumptions.[2] First, that price-setters are myopic, in the sense that their expectations of future real marginal costs and future inflation are pegged to steady state; this removes the forward-looking term of the standard NKPC. Second, that any fiscal adjustment (which will be discussed in the next section) is lump-sum and so does not introduce any time-varying wedge in labor supply (and thus an endogenous cost-push term in (3)).

We stress that both of these strong assumptions are made purely for pedagogical reasons and will be relaxed gradually. The first assumption will simplify our analytical results in Sections 4-5, but will be relaxed in the quantitative analysis of Section 6; there, we will consider the empirically relevant case of a hybrid NKPC, which accommodates both a forward-looking and a backward-looking term. The second assumption will allow us, in Section 4, to focus on the *demand-side* implications of slower fiscal adjustment; it will be relaxed in Section 5, where we study theoretically the *supply-side* implications of slower fiscal adjustment through distortionary tax wedges, and also in Section 6, as part of our quantitative exercise. Finally, we note that the positive results in Section 3, on the stabilizing effects of fiscal inaction, do not depend at all on these two simplifying assumptions.

Our choice to consider cost-push rather than productivity supply shocks is motivated by empirical evidence: productivity disturbances appear to only account for a moderate share of short-run fluctuations (Angeletos et al., 2020), while cost-push disturbances are routinely estimated to be important drivers of short- to medium-run inflation (e.g., Smets and Wouters, 2007). That said, as we will discuss briefly in Sections 4 - 5, our normative conclusions on fiscal-monetary interactions would also extend with little change to such an alternative modeling. Further details on an alternative model economy with productivity instead of cost-push disturbances are provided in Appendix A.4.

[2]That is, there is a continuum of monopolistically competitive firms that hire labor on a spot market, produce according to a linear labor-only production technology, and adjust prices only gradually subject to the familiar Calvo friction.

2.2 Fiscal policy

The government issues non-contingent, short-term, real debt. The government flow budget is

$$d_{t+1} = \frac{1}{\beta}(d_t - t_t) + \frac{D^{ss}}{Y^{ss}} r_t, \tag{4}$$

where: d_t is real government debt; t_t denotes total real tax revenue; and $D^{ss}/Y^{ss} \geq 0$ is the steady-state debt-to-GDP ratio, which by market-clearing will equal the aggregated household steady-state wealth-to-GDP ratio A^{ss}/Y^{ss}. Note that inflation does not enter (4) since government debt here is real; we remark further on this simplifying assumption below. Finally, government debt must satisfy two boundary conditions: the initial condition $d_0 = 0$ and the usual no-Ponzi condition.[3]

The description of fiscal policy is completed by specifying a rule for how tax revenue, t_t, adjusts over time. We assume the following rule:

$$t_t = \underbrace{\tau_y y_t}_{\text{automatic stabilizer}} + \underbrace{\tau_d d_t}_{\text{fiscal adjustment } t_t^{\text{adj}}} + \underbrace{\beta \frac{D^{ss}}{Y^{ss}} r_t}_{\text{interest-rate offset}} . \tag{5}$$

Taxes consist of three terms. First, fluctuations in economic activity automatically change tax revenue by $\tau_y y_t$, where $\tau_y \in (0,1]$ is a time-invariant proportional tax on total household income; this first term captures the familiar, static, automatic stabilizer. Second, taxes are adjusted endogenously in response to fluctuations in outstanding real debt by $t_t^{\text{adj}} \equiv \tau_d d_t$, where $\tau_d \in [0,1)$; we will refer to this term as "fiscal adjustment," and interpret τ_d as the speed of this adjustment. For now, fiscal adjustment is assumed to be lump-sum, and the distortionary case will be considered in Sections 5 - 6. Third, we assume that the fiscal authority adjusts immediately and automatically (through a lump-sum tax) to offset the budgetary impacts of any real interest rate movements; we again do so for analytical clarity, and comment further on this simplifying assumption below.

The key features of the fiscal framework are the two parameters τ_d and τ_y, and they will play distinct roles in our subsequent analysis. On the one hand, τ_y regulates the familiar automatic stabilizer: recessions cause an automatic shortfall in tax revenue in proportion to τ_y, which in turn helps mitigate the recession because, and only because, households are non-Ricardian. On the other hand, τ_d governs the speed at which any such shortfall is then offset through future tax hikes, i.e., the pace of fiscal adjustment. By assuming that government debt is real and that tax revenue contains an automatic interest-rate offset, we ensure that budgetary deficits or surpluses in fact arise *solely* because of the automatic stabilizer τ_y. While additional feedbacks from interest rates or inflation to the budget are realistic, our quantitative analysis will verify that the automatic stabilizer-related effects are more important, and so we have designed our theoretical analysis to speak most cleanly to that particular

[3] When $\omega = 1$, the no-Ponzi condition can be interpreted as the transversality condition of the representative infinite-horizon household. Here, we *a priori* rule out Ponzi games even when $\omega < 1$.

margin. Moreover, as will become clear in Section 3, our key result on how the pace of fiscal adjustment shapes macroeconomic dynamics applies independently of *why* there is a budgetary shortfall, and thus generalizes immediately to the presence of interest-rate and inflation margins.

2.3 Monetary policy

The final actor in our model is the monetary authority. Echoing a large applied literature (e.g., Svensson, 1999; Woodford, 2003a, Chapter 8.3; Woodford, 1999, 2003b) as well as the Federal Reserve's own policy framework (Federal Reserve Tealbook, 2016), we consider a flexible inflation-targeting central bank with the following loss function:

$$\frac{1}{2}\mathbb{E}\left[\sum_{t=0}^{\infty}\beta^t\left\{\lambda_\pi \pi_t^2+\lambda_y y_t^2+\lambda_r r_t^2\right\}\right], \tag{6}$$

where $\mathbb{E}[\cdot]$ averages over the realizations of the date-0 aggregate shocks.

The first two terms in the central bank objective function (6) are the familiar "dual mandate" loss components, with the scalars $\lambda_\pi, \lambda_y > 0$ parameterizing the relative importance of the policy goals. The third term, a penalty on real interest fluctuations (with the coefficient $\lambda_r > 0$), captures the empirical fact that, in practice, central banks are unwilling or unable to move interest rates abruptly to achieve their output and inflation objectives. Such a concern is routinely modeled by central banks in their own policy evaluation (e.g., see the Federal Reserve Tealbook, 2016) and can be formally motivated by, *inter alia*, financial stability considerations (Stein and Sunderam, 2018) or uncertainty about policy transmission (in the Brainard, 1967, sense); for the U.S., it is also explicitly mandated in the Federal Reserve Act. For our purposes, what matters is less the precise functional form of the third term in (6), but rather the more general—and practically relevant—idea that the central bank cannot frictionlessly achieve the optimal dual-mandate outcome. This ensures that fiscal policy remains relevant even when monetary policy is optimally set, and allows us to meaningfully talk about how fiscal inaction can be aligned with, and thus support, a monetary authority in attaining its objectives.

The central bank's problem is to choose a state-contingent path for the real interest rate so as to minimize its loss (6) subject to the constraints imposed by the equilibrium behavior of the private sector as well as the exogenously specified fiscal framework.[4] We assume full commitment, which in particular allows optimal policy to embed "forward guidance," i.e., a commitment to condition future rates on current shocks.

[4] Strictly speaking, the central bank's policy instrument is the path of nominal interest rates. However, as explained in Section 3.1, the central bank can regulate the path of real rates and thereby all equilibrium outcomes. We can therefore equivalently recast the central bank's problem as the choice of a shock-contingent path for the real rate.

2.4 Equilibrium

As already noted, we cast our analysis in terms of perfect-foresight transition paths. In particular, the exogenous demand and supply shocks $\{v_t, u_t\}_{t=0}^{\infty}$ are drawn from some known distribution with mean zero and revealed to both the private agents and the central bank at the beginning of $t = 0$. The sole restriction we impose on the paths of those shocks is boundedness; this means that, when translated to the analogous stochastic economy, our perfect-foresight dynamics will give impulse responses to arbitrary MA(∞) processes.[5] With these points in mind, we can define an equilibrium as follows:

Definition 1. Given a path of aggregate demand and supply shocks $\{v_t, u_t\}_{t=0}^{\infty}$, an equilibrium is a bounded path $\left\{y_t, \pi_t, d_{t+1}, t_t, r_t\right\}_{t=0}^{\infty}$ for output, inflation, public debt, tax revenue and the real interest rate that satisfies the following restrictions: aggregate demand (2), aggregate supply (3), the law of motion for public debt (4), the government's no-Ponzi condition, and the tax rule (5).

Definition 1 applies to arbitrary monetary policy, i.e., for an arbitrary (bounded) path of real interest rates $\{r_t\}_{t=0}^{\infty}$. In Lemma 1 below we will show that, in our economy, we have equilibrium uniqueness conditional on the path of real interest rates: for given $\{v_t, u_t\}_{t=0}^{\infty}$ and $\{r_t\}_{t=0}^{\infty}$, equations (2)-(5) solve for a unique $\left\{y_t, \pi_t, d_{t+1}, t_t\right\}_{t=0}^{\infty}$. We can therefore formulate the optimal monetary policy problem as the choice of equilibrium that minimizes the central bank's loss function.[6]

Definition 2. Given a path of aggregate shocks $\{v_t, u_t\}_{t=0}^{\infty}$, let the path $\left\{y_t^*, \pi_t^*, d_{t+1}^*, t_t^*, r_t^*\right\}_{t=0}^{\infty}$ minimize the central bank's loss function (6) across all equilibria. We refer to this path as the *optimal monetary policy equilibrium* and to the corresponding rate path as the *optimal monetary policy*.

Because households are non-Ricardian, the equilibrium mapping from shocks and real interest rates to output and inflation naturally depends on the fiscal framework—and thus so does the optimal monetary policy. Our contribution rests on characterizing this dependence, focusing in particular on the role of the speed of fiscal adjustment, τ_d, and its interaction with the familiar automatic stabilizer, τ_y. In Section 3, we begin by asking how τ_d interacts with τ_y to shape macroeconomic outcomes *given* monetary policy. This first "building block" result will isolate the *positive* effects of the speed of fiscal adjustment, setting the stage for our *normative* analysis in Sections 4 and 5, where we characterize how τ_d shapes the optimal monetary policy and the associated central bank loss. Our contribution will be completed with a quantitative evaluation in a much larger-scale model in Section 6.

[5] By boundedness for a variable x we mean that there exists some $M > 0$ such that $|x_t| < M$ for all t and states of nature.

[6] Because the equilibrium mapping from $\{v_t, u_t\}_{t=0}^{\infty}$ and $\{r_t\}_{t=0}^{\infty}$ to $\left\{y_t, \pi_t, d_{t+1}, t_t\right\}_{t=0}^{\infty}$ is linear, the central bank's problem reduces to a quadratic objective over $\{r_t\}_{t=0}^{\infty}$, which in turn guarantees uniqueness of solution. In Definition 2, we can thus talk about *the* optimal policy, as opposed to *an* optimal policy.

3 The stabilizing effects of delayed fiscal adjustment

This section is our paper's key positive "building block." We begin with a brief preparatory discussion on equilibrium existence and uniqueness. We then establish our headline positive result: slower fiscal adjustment *dynamically stabilizes* the economy, in a sense to be made precise. We show that this result depends not on the origin of the business cycle *per se*, but on its fiscal footprint: the key is whether a shock triggers a recession and thereby a budgetary shortfall, not whether the recession is demand- or supply-driven. The latter distinction becomes important only when we shift focus from the positive questions in this section to the normative questions in the remainder of the paper.

3.1 Equilibrium existence and uniqueness

As a necessary backdrop for our analysis, we begin with the following result, which builds on our earlier work in Angeletos et al. (2024, 2025).[7]

Lemma 1. *Given arbitrary (bounded) paths of real rates* $\{r_t\}_{t=0}^{\infty}$ *and aggregate shocks* $\{v_t, u_t\}_{t=0}^{\infty}$*, there exists a unique equilibrium. The equilibrium path of aggregate output* y_t *satisfies*

$$y_t = \sum_{s=0}^{\infty} \mathscr{Y}_{t,s} (v_s + r_s), \quad \forall t \geq 0, \tag{7}$$

where $\mathscr{Y}_{t,s}$ *is the date-*t *impulse response of output to a one-off, date-*0 *news shock about date-*s *aggregate demand (i.e., the contractionary demand shock* v_s *and the real interest rate* r_s*). The impulse response coefficients* $\{\mathscr{Y}_{t,s}\}_{t,s\geq 0}$ *are continuous functions of* τ_d*,* τ_y*, and* ω*.*

Lemma 1 guarantees that the central bank can uniquely implement *any* equilibrium by pegging the path of real rates, or equivalently by following the nominal interest rate feedback rule $i_t = r_t + \mathbb{E}_t[\pi_{t+1}]$, where $\{r_t\}_{t=0}^{\infty}$ is the path of real rates that the central bank wishes to obtain. This substantiates our earlier discussion of monetary policy in Section 2.[8] The lemma furthermore reveals that demand shocks and real interest rates propagate identically, and that output is determined independently of the supply block once the path of real rates is fixed. This independence property is familiar from RANK (Woodford, 2011), and it extends not only to our model but also to more general HANK models (see the discussion in Auclert et al., 2024) provided that inflation and supply shocks do not have distributional effects. For our purposes, the key implication of this model property is that our

[7] In particular, the existence and uniqueness result stated in Lemma 1 is a direct extension of the corresponding results in Angeletos et al. (2024, 2025), just now allowing for an arbitrary time-varying path for the real interest rate and the demand shock. The present paper's real contribution begins with Proposition 1 below, which characterizes how fiscal policy shapes the dynamic response of output to arbitrary demand wedges.

[8] Either way, by unique implementation we mean uniqueness within the set of bounded equilibria, per Definition 1. The question of global determinacy is outside the scope of this paper and does not affect the characterization of the policy optimum or its comparative statics.

upcoming characterization of the impulse response coefficients $\{\mathscr{Y}_{t,s}\}_{t,s\geq 0}$ applies regardless of the specification of the Phillips curve and of whether fiscal adjustments are lump-sum or distortionary.

3.2 The stabilizing effects of fiscal adjustment delays

We now turn to our key positive lesson: that a lower speed of fiscal adjustment helps stabilize output during contractions. We first state the formal result (Proposition 1 below). We then explain the economic mechanism, which suggests that our conclusions should apply independently of *why* there is a budgetary shortfall—an intuition that we verify in Proposition A.1 in the Appendix. Throughout we relate our results to the literature on automatic stabilizers (McKay and Reis, 2016), showing that the *static* effects of such stabilizers are *dynamically* amplified through slow fiscal adjustment.

Proposition 1. *The output impulse response $\mathscr{Y}_{t,s}$ has the following properties:*

1. *For all impulse horizons $t \geq 0$ and all news horizons $s \geq 0$, the output impulse response $\mathscr{Y}_{t,s}$ increases with a delay in fiscal adjustment, i.e., it decreases with τ_d, $\frac{\partial \mathscr{Y}_{t,s}}{\partial \tau_d} < 0$.*
2. *For all news horizons $s \geq 0$, the cumulative output response $\sum_{t=0}^{\infty} \beta^t \mathscr{Y}_{t,s}$ increases with a delay in fiscal adjustment (i.e., it decreases with τ_d) and converges to zero as $\tau_d \to 0$.*

Recall that $\mathscr{Y}_{t,s}$ is the impulse response of output to an adverse aggregate demand shock, or equivalently to a real interest rate hike. The first part of Proposition 1 establishes that lowering τ_d (i.e., delaying fiscal adjustment) unambiguously *increases* output for all impulse response and shock horizons $t, s \geq 0$. The result is surprisingly general: not only does it apply uniformly across the entire impulse response path (all t), but it also holds for shocks at all horizons (all s), and thus extends to contractionary demand disturbances with arbitrary stochastic properties. This is the promised formalization of our claim that delaying fiscal adjustment robustly stabilizes the macroeconomy. The second part of the proposition then focuses on the cumulative output response: lowering τ_d uniformly shifts up the entire path, and the limiting cumulative impulse response (as $\tau_d \to 0$) is necessarily *zero*, corresponding to perfect stabilization in a present value sense. This result again applies for all shock horizons s, and thus extends to disturbances with arbitrary stochastic properties.

Proposition 1 reflects an interaction of automatic stabilizers τ_y and the speed of fiscal adjustment τ_d. Because of the automatic stabilizer, a recession causes a shortfall in fiscal revenue, and thus sooner or later necessitates fiscal adjustment. It is qualitatively unsurprising that delaying such tax hikes is stabilizing; what is more surprising, however, is how strongly stabilizing they turn out to be: output increases at all horizons and for shocks at all dates, and the limiting output impulse response has *zero* present value. The remainder of the section elaborates on the intuition for these results.

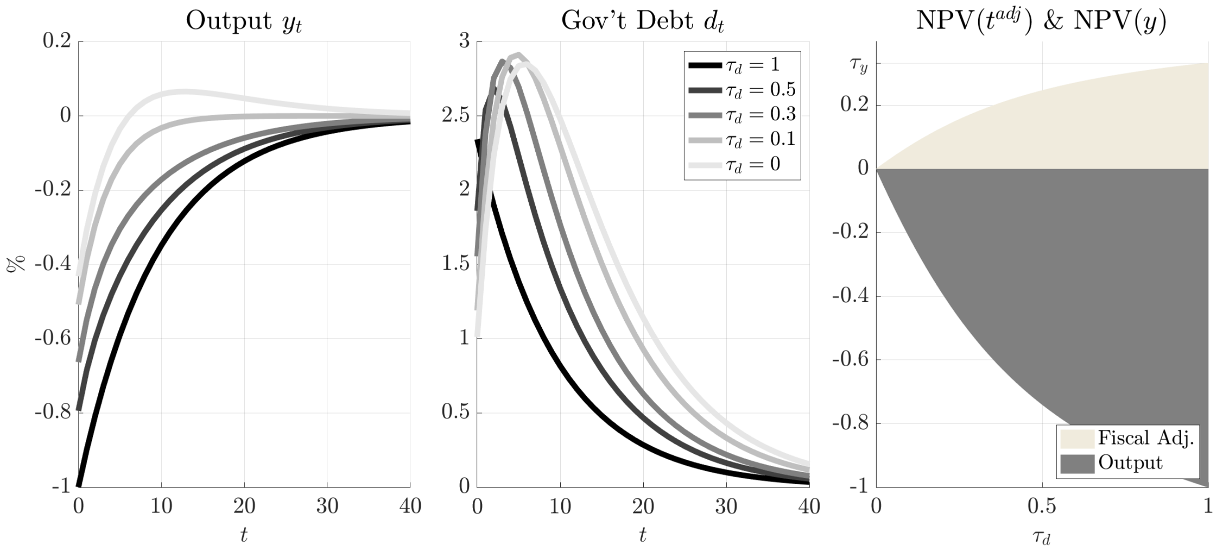

Figure 1: Impulse responses of output and government debt (left and middle panels) to a contractionary demand shock for different τ_d's (solid shades of grey). The right panel shows the net present value of the output and fiscal adjustment impulse responses, all normalized relative to the cumulative output response for $\tau_d = 1$.

Illustration and explanation. We illustrate Proposition 1 in Figure 1. The left and middle panels of the figure show the impulse responses of output (y_t) and government debt (d_t) to a persistent demand shock under different assumptions on fiscal adjustment speed (τ_d). The right panel displays the *cumulative* output and fiscal adjustment responses, again as a function of τ_d.[9]

To understand the effects of τ_d, it is instructive to begin with $\tau_d = 1$, i.e., the fastest possible pace of fiscal adjustment.[10] By construction, output falls during the shock, and thus so does tax revenue, because $\tau_y > 0$. As households are non-Ricardian, this reduction in current tax revenue helps mitigate the recession—the familiar static automatic stabilizer. When fiscal adjustment is fast, the drop in current taxes necessitates a quick and large hike in future taxes. This quick tax hike in turn reinforces the demand-driven contraction, dynamically undoing the stabilizing effects of the static automatic stabilizer. The end result is a relatively large and persistent recession, visible in the black line in the left panel of Figure 1. The flip side is that, because τ_d is large, the necessary fiscal consolidation happens quickly, with government debt returning to steady state relatively fast (black line, middle panel).

Consider now what happens as we lower τ_d below 1, that is, as we push the requisite tax hikes

[9]The figure uses a simple example parameterization of our model; the exercise is purely illustrative, so magnitudes should not be taken seriously. For our purposes, it is important that households are non-Ricardian ($\omega = 0.7/\beta$, delivering an MPC of 30 per cent) and that automatic stabilizers are non-trivial ($\tau_y = 1/3$). The demand shock is persistent, following an AR(1) process with persistence 0.9. We furthermore, for all computations, assume that the fiscal authority perfectly stabilizes government debt after some large but finite horizon H, consistent with the equilibrium refinement of Angeletos et al. (2025), and with our focus on cyclical fluctuations. See Appendix A.5 for further details.

[10]When τ_d is *exactly* 1, multiple equilibria may exist. For the rest of the draft, when we refer to $\tau_d = 1$, we focus on the unique equilibrium selected by the limit as $\tau_d \to 1$ from below.

from the immediate aftermath of the shock further and further into the future. Clearly, such an intertemporal shift in the tax burden would have not at all affected aggregate spending and thus output if households were Ricardian. Here, instead, the same shift stimulates output via a combination of two effects. First, in partial equilibrium, households respond to the delay in tax hikes by increasing their spending in the short run, precisely because they are non-Ricardian. Second, in general equilibrium, this short-run increase in aggregate spending feeds into higher aggregate income, and from there back into further spending, and so on—the "Intertemporal Keynesian Cross" (IKC) of Auclert et al. (2024). The end result of a lower τ_d is thus higher equilibrium output, and indeed in all periods, as illustrated by the grey lines in the left panel of Figure 5.

To summarize, while a higher τ_y helps stabilize the economy *statically*, its overall *dynamic* potency is inherently tied to the speed of fiscal adjustment, with a small τ_d dynamically amplifying the static stabilizer. A first key result is that, because of the dynamic IKC feedback, this amplification is *uniform*: the slowdown in fiscal adjustment does not just increase the potency of the automatic stabilizer when taxes are postponed in the short run, but also over longer horizons. This mechanism is reminiscent of the familiar "forward guidance" effects of monetary policy (as in Eggertsson and Woodford, 2003): when τ_d is low, government debt, private assets, and aggregate spending are allowed to increase and, in fact, overshoot tomorrow, thus providing additional stabilization today.

The limit of fiscal inaction ($\tau_d \to 0$). How strong can the mechanism described above be? The second part of Proposition 1 provides the answer: as we lower τ_d, the cumulative output response to a contractionary demand shock becomes less negative, converging to *zero* as $\tau_d \to 0$. Put differently, fiscal inaction interacts with the static automatic stabilizer τ_y to provide *perfect* stabilization of output in a present-value sense.

What is the intuition for this zero present-value limit? Just as in our discussion above, it is again useful to split the analysis into partial and general equilibrium steps. In partial equilibrium, given a contractionary shock to demand, households decide to postpone their spending, while leaving its net present value unchanged: consumer spending initially drops, before then subsequently overshooting. In general equilibrium, the initial drop in demand causes a contraction in economic activity, reducing tax revenue. If taxes are increased quickly, then consumer spending remains depressed throughout, with the tax hike offsetting the future partial equilibrium increase in demand. If instead the tax hike is delayed further and further, then the partial equilibrium overshoot also survives in general equilibrium, thus delivering the zero present value limit of the general equilibrium output impulse response.

A complementary way of seeing this limit comes from the government's intertemporal budget constraint. Summing the linearized budget constraint over all dates and using the initial condition and the government's no-Ponzi condition, we obtain that the present value of primary surpluses is always zero:

$$\tau_y \underbrace{\sum_{t=0}^{\infty} \beta^t y_t}_{NPV(y)} + \underbrace{\sum_{t=0}^{\infty} \beta^t t_t^{\text{adj}}}_{NPV(t^{\text{adj}})} = 0. \tag{8}$$

This equation makes clear that, in equilibrium, $NPV(y)$ and $NPV(t^{\text{adj}})$ move in tandem: whenever output is depressed in present-value terms, fiscal adjustments must necessarily also be increased in present-value terms, in order to make up for the budgetary shortfall caused by the recession. If, due to a recessionary shock, $NPV(y) < 0 < NPV(t^{\text{adj}})$, then pushing the tax hike further into the future (lower τ_d) stimulates output at all horizons, bringing $NPV(y)$ closer to zero. By equation (8), this also brings $NPV(t^{\text{adj}})$ closer to zero. And since this logic applies whenever $NPV(y) < 0 < NPV(t^{\text{adj}})$, both of these objects must converge to 0 as we lower τ_d towards zero.[11]

Summary. We conclude that, when coupled with sufficient delays in fiscal adjustment, the "classical" static automatic stabilizer becomes surprisingly powerful—providing output stabilization that is *uniform* across horizons and *perfect* in a present-value sense. Much of the remainder of the paper is concerned with the normative implications of this positive property. Before going there, however, we first provide some additional observations.

3.3 Additional discussion

We here collect several further implications and reinterpretations of Proposition 1 that all will loom large in the normative analyses of the upcoming sections.

Monetary policy effectiveness. The preceding discussion applied identically to contractions in demand induced by private demand shocks (v_t) and monetary policy (r_t). Our results thus imply immediately that slower fiscal adjustment reduces the effectiveness of monetary policy at all horizons, with the limiting effect of arbitrary monetary policy on the cumulative output path equal to zero. This observation offers an interesting contrast to our upcoming normative lesson: we will show that the central bank may prefer fiscal inaction *despite* the negative effect on its own effectiveness.

Demand vs. supply shocks. As remarked following Lemma 1, supply shocks do not influence equilibrium output *given* the path of real rates; accordingly, our previous discussion focused on how τ_d

[11] The same logic can also be seen more mechanically from the fact that $\sum_{t=0}^{\infty} \beta^t t_t^{\text{adj}} = \tau_d \sum_{t=0}^{\infty} \beta^t d_t$. Along with the property, proved in Lemma 1, that d_t remains bounded—and indeed converges back to steady state as time passes—regardless of τ_d, we immediately have that $\sum_{t=0}^{\infty} \beta^t t_t^{\text{adj}} \to 0$ as $\tau_d \to 0$. By (8), we then also necessarily have that $\sum_{t=0}^{\infty} \beta^t y_t \to 0$. However, the reason that d_t remains bounded in the first place is precisely the one described in the main text: postponing tax hikes stimulates output, thus also endogenously stabilizing government debt, even when $\tau_d = 0$.

shapes the propagation of changes in demand. That said, and as we will discuss further in the upcoming sections, the monetary authority tends to *optimally* respond to supply shocks by increasing real interest rates, depressing demand and mitigating inflationary pressures. Our previous analysis, and in particular the impulse responses in Figure 1, can thus be re-interpreted as showing the economy's response to an adverse supply shock that causes the monetary authority to tighten. Holding the shock and the monetary policy response fixed, a lower τ_d again stabilizes output.[12]

Other reasons for budgetary shortfalls. Nothing in the intuition for Proposition 1 really hinged on *why* there was a budgetary shortfall in the first place—we only leveraged the simple idea that postponing any required amount of tax hikes endogenously stimulates the economy and raises fiscal revenue, thus endogenously lessening the actually (in equilibrium) needed fiscal adjustments. This suggests that our stabilization logic should extend to *generic* budgetary shortfalls. We confirm this conjecture in Appendix A.3 by proving the following generalization: if, along an equilibrium, the government faces a budgetary shortfall at some horizon $t = H$ (in the sense of $d_H > 0$), then delaying period-H fiscal adjustment helps raise output (relative to the original equilibrium) in all periods, including those *before* date H, regardless of the history of shocks that lead to $d_H > 0$.

In addition to further substantiating our intuitions from above, this result will also prove useful for our quantitative explorations in Section 6, where we allow for inflation and interest rates to also affect budgetary shortfalls (or surpluses), and thus also the time path of government debt. By the preceding discussion, not responding to such shortfalls with fiscal adjustment will be stimulative, and of course *vice versa* for budgetary surpluses.

Inflation. We conclude this section by translating Proposition 1 to inflation dynamics. By combining Lemma 1 with the Phillips curve (3), we immediately have that

$$\pi_t = \sum_{s=0}^{\infty} \kappa \mathscr{Y}_{t,s} (v_s + r_s) + u_t, \quad \forall t \geq 0. \tag{9}$$

Output affects inflation proportionally to κ, the slope of the Phillips curve. It follows that, in response to contractionary demand shocks that are only partially offset by monetary policy (i.e., if $v_s + r_s > 0$), slower fiscal adjustment raises inflation in tandem with output. The same is true for inflationary supply shocks (i.e., $u_s > 0$), insofar as the central bank leans against them by hiking interest rates ($r_s > 0$). What changes, though, is the *co-movement* between output and inflation. With a contractionary demand shock, output and inflation are both depressed when $\tau_d = 1$, and so lowering τ_d helps stabilize both at the same time. With an adverse supply shock, instead, inflation is elevated when $\tau_d = 1$, so lowering τ_d stabilizes output at the expense of inflation. This difference will be the key to the norma-

[12]This re-interpretation implicitly supposes a simple monetary reaction of the form $r_t = \psi u_t$, for some $\psi > 0$. Our analysis in the upcoming sections will not consider such *ad hoc* rules, but instead consider optimal monetary reactions.

tive conclusions of the next section.

We finally note that equation (9) presumes that the tax hikes necessitated by equilibrium budgetary shortfalls are non-distortionary, and thus do not enter the Phillips curve. We continue to abstract from this (empirically relevant) possibility in the next section, but return to it in Section 5.

4 The demand-side channel of fiscal inaction

The preceding section established our key *positive* result on how slower fiscal consolidation dynamically stabilizes output. Building on this result, we in this section turn to the *normative* question of interest: what kind of fiscal support does a central bank prefer, and could it even be that complete fiscal *in*action (i.e., $\tau_d = 0$) actually aids the central bank? Throughout this section, we maintain the assumption of lump-sum fiscal adjustments, so that the impact of their delays operates solely through the aggregate demand stabilization channel studied in the previous section. Our discussion will be organized around an envelope theorem expression for how τ_d shapes the central bank's loss under the optimal monetary policy. We split our analysis by type of primitive shock, beginning with demand shocks and then turning to supply shocks.

4.1 An envelope theorem for the central bank

Consider the central bank's problem, described in Section 2.3, and let $\mathscr{L}_{CB}$ denote its *ex ante* loss under optimal monetary policy—that is, the value of the loss (6) evaluated at the optimal monetary policy equilibrium and integrated across the possible realizations of aggregate demand and supply shocks. Using an envelope theorem argument, we relate the effect of τ_d on $\mathscr{L}_{CB}$ to the corresponding effect of τ_d on output, as characterized in Proposition 1.

Proposition 2. *The sensitivity of the central bank's loss $\mathscr{L}_{CB}$ to the speed of fiscal adjustment τ_d satisfies*

$$\frac{\partial \mathscr{L}_{CB}}{\partial \tau_d} = \mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t \left\{\left(\lambda_\pi \kappa \pi_t^* + \lambda_y y_t^*\right)\left(\sum_{s=0}^{\infty} \frac{\partial \mathscr{Y}_{t,s}}{\partial \tau_d}\left(v_s + r_s^*\right)\right)\right\}\right], \tag{10}$$

where $\left\{\frac{\partial \mathscr{Y}_{t,s}}{\partial \tau_d}\right\}_{t,s\geq 0}$ denotes the sensitivities of the output impulse responses characterized in Proposition 1, and $\{r_t^*, y_t^*, \pi_t^*, d_{t+1}^*, t_t^*\}_{t=0}^{\infty}$ denote the equilibrium paths under the optimal monetary policy.

Proposition 2 will guide our discussion in the remainder of this section. It reveals that, to gauge whether a change in the pace of fiscal consolidation will help or hurt the central bank's objectives, it suffices to know, first, how this change affects the impulse response of output, and second, the output, inflation, and real rates in the optimal monetary policy equilibrium. Proposition 1 has already addressed the first question, and in particular has emphasized that the answer is independent of how the business cycle decomposes between demand and supply shocks. That decomposition, however, becomes critical for answering the second question. Intuitively, contractionary demand shocks tend to reduce both output and inflation, and they also invite interest rate cuts, whereas inflationary cost-push shocks invite interest rate hikes and tend to move output and inflation in opposite directions.[13] This explains why, in contrast to the sign of $\frac{\partial \mathscr{Y}_{t,s}}{\partial \tau_d}$, the sign of $\frac{\partial \mathscr{L}_{CB}}{\partial \tau_d}$ critically depends on the nature of the underlying shock. The rest of this section works out this dependence, first for the case of demand shocks (Section 4.2) and then for the case of supply shocks (Section 4.3).

4.2 Demand shocks

We begin with shocks to aggregate demand, $\{v_t\}_{t=0}^{\infty}$, proceeding in three steps: we first give some general intuition, then present numerical explorations, and finally turn to analytical results. Throughout, we will anchor our discussion around the envelope theorem expression (10).

Intuition. Consider a contractionary shock to aggregate demand (i.e., $v_t > 0$, at least temporarily), and set supply shocks to zero (i.e., $u_t = 0$ for all dates $t \geq 0$). If the central bank were able to instantaneously adjust real interest rates to *perfectly* stabilize aggregate demand (a scenario that is nested here with $\lambda_r = 0$), then there would be no recession and no budgetary shortfalls to start with, so the pace of fiscal adjustment would be irrelevant.[14] In the practically relevant case of imperfect stabilization (i.e., $\lambda_r > 0$), the envelope condition (10) and our results in Section 3 instead suggest that slow fiscal adjustment—perhaps even all the way to fiscal *in*action—may be desirable: at least in the short run, $v_s + r_s^*$ is likely positive (since interest rates are not cut enough), while $\lambda_\pi \kappa \pi_t^* + \lambda_y y_t^*$ is likely negative (since stabilization is imperfect), and so, with $\frac{\partial \mathscr{Y}_{t,s}}{\partial \tau_d} < 0$, we would expect the overall derivative $\frac{\partial \mathscr{L}_{CB}}{\partial \tau_d}$ to be positive. In words, we saw in Section 3 that a delay in fiscal consolidation endogenously (and very powerfully) moderates recessionary pressures, thus supporting the central bank in its objectives.

This basic intuition leaves two questions unanswered, however. First, there is an offsetting force: delayed fiscal adjustment necessarily causes subsequent overheating (recall the impulse responses in Figure 1 as well as the zero present value result), dynamically *de*stabilizing the economy—a trade-off that is familiar from the forward guidance literature (Eggertsson and Woodford, 2003). Second, the discussion is silent on how far fiscal adjustment should be delayed, and so in particular on whether

[13]This intuition is useful but incomplete, as the optimal monetary policy actually tends to dictate reversals in the signs of some of the variables, reflecting the value of forward guidance. This will be made clear in the subsequent analysis.

[14]This irrelevance holds for all $\tau_d \in [0, 1)$ under our simplifying assumption that the budgetary effects of interest rates are automatically and immediately offset. Under this assumption, the central bank attains the unrestricted optimum simply by setting $r_t = -v_t$. Output is then perfectly stabilized, and so is government debt, regardless of $\tau_d \in [0, 1)$. Otherwise, the variation in the interest rate causes government debt to vary even if output is perfectly stabilized, and $\tau_d > 1 - \beta$ becomes necessary to guarantee that government debt does not explode, as is familiar from RANK. Furthermore, the unrestricted optimum is now obtained with a different monetary policy, also offsetting the demand effects of debt fluctuations.

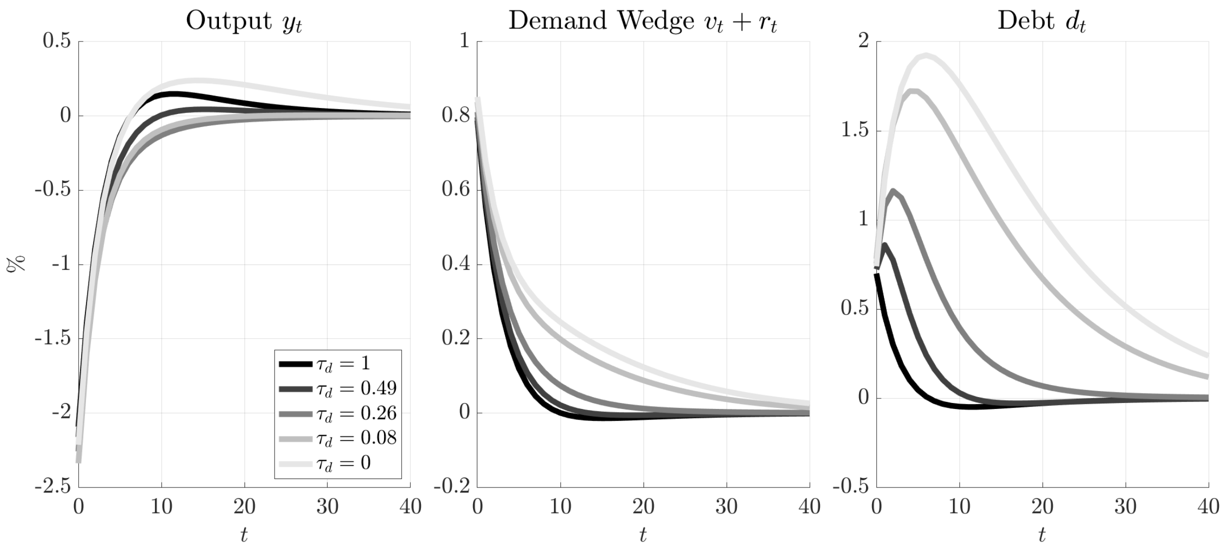

Figure 2: Impulse responses of output, the demand wedge, and government debt to a contractionary demand shock for different τ_d's (solid shades of grey) under optimal monetary policy.

complete fiscal inaction could ever be desirable. In the remainder of the section, we will explore these subtleties, first through numerical illustrations (under realistic configurations) and then analytically (under tighter assumptions).

Illustration. Figures 2–3 illustrate how the pace of fiscal adjustment, τ_d, shapes optimal monetary policy as well as the associated policy loss. For our numerical explorations we consider the same illustrative model economy as in Section 3; for the central bank, we assume equal loss weights on output, inflation, and interest rates.[15] We will later argue both analytically (in this section) and quantitatively (in Section 6) that the case depicted here is of general practical relevance.

Together, Figures 2–3 suggest that the intuition given in the previous paragraph is potent: slower fiscal adjustment stabilizes the economy and is desirable for the central bank, here in fact all the way even to the complete *absence* of fiscal adjustment (i.e., $\tau_d = 0$). Figure 2 begins by showing impulse responses of output y_t^*, the demand wedge $v_t + r_t^*$, and government debt d_t^* for different values of τ_d (shades of grey). If fiscal adjustment is fast, then interest rates are cut relatively aggressively, though insufficiently to stabilize output: the demand wedge is positive (middle panel), and output declines (left panel). As fiscal adjustment is delayed, the initial contraction is dampened, and there is some dynamic output overshooting (left panel), even though interest rates are now adjusted by much less and so the demand wedge remains larger (middle panel). All of this is intermediated through a persis-

[15]More specifically, following the main policy evaluation exercise reported in communication by the Federal Reserve itself (Federal Reserve Tealbook, 2016), we wish to consider equal weights on unemployment as well as annualized inflation and interest rates. With a standard Okun's law coefficient of 0.5, this gives $\lambda_y = 0.25$ together with $\lambda_r = \lambda_\pi = 16$. See Appendix A.5 for further details.

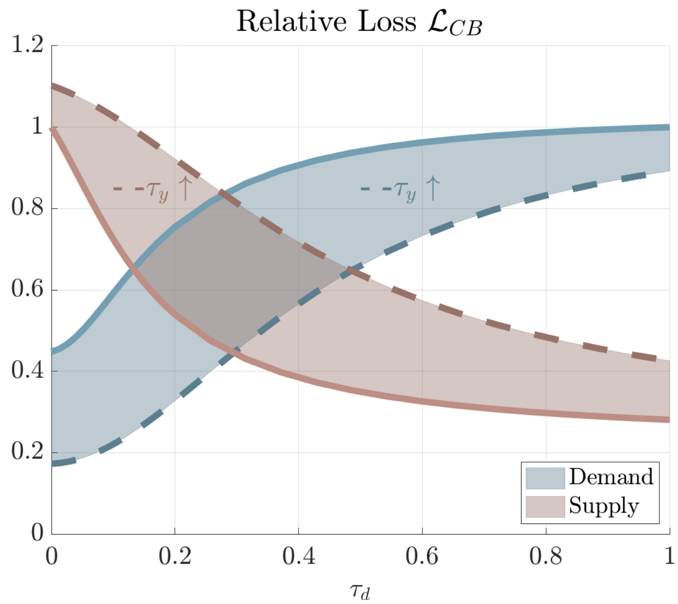

Figure 3: Minimized central bank loss $\mathscr{L}_{CB}$ as a function of τ_d for demand shocks (blue) and supply shocks (red), for a baseline (solid) and higher (dashed) level of the static automatic stabilizer τ_y.

tently elevated, but still ultimately stable, path of government debt (right panel). The solid blue line in Figure 3 then translates these impulse responses into the corresponding central bank loss: we see that the loss is increasing in τ_d, and here in fact over the entire range of τ_d. Thus, at least in this particular numerical exercise, and for demand shocks, fiscal adjustment delays provide monetary support all the way up to complete fiscal inaction.

An analytical result. We now turn to an analytical result, which helps shed further light on the theoretical conditions under which complete inaction may be desirable, as in the preceding illustrations, and thus on the practical relevance of this scenario. We consider a restricted special case of our model, with two key properties. First, the demand shock is now fully transitory; that is, we consider a one-off date-0 demand shock v_0. Second, the monetary and fiscal authority together frictionlessly implement perfect stabilization of the economy after two periods, i.e., $y_t = \pi_t = r_t = d_{t+1} = 0$ for all $t \geq 2$. All interesting dynamics thus occur only at dates 0 and 1. As it turns out, studying this simplified environment suffices to characterize the main forces shaping our results.

We provide a complete characterization of equilibrium dynamics in this restricted economy in the proof of Proposition 3, and summarize the main takeaway here.

Proposition 3. *Consider the restricted, two-period problem described above, featuring only demand shocks. The central bank loss $\mathscr{L}_{CB}$ is increasing over the entire range of $\tau_d \in [0,1]$ if and only if*

$$\tau_y \leq \frac{\beta\omega}{(1-\beta\omega)(1-\omega)}. \tag{11}$$

If (11) *holds, then the loss is minimized for* $\tau_d = 0$.

The two takeaways from Proposition 3 are, first, that monotonicity in τ_d over the entire $[0,1]$ range is *not* automatic but relies on condition (11), and second, that this condition is however very loose, and satisfied for standard values of τ_y (around 0.3) and ω (around 0.7-0.8). The intuition for the condition is as follows. As discussed in Section 3, delaying fiscal adjustment stabilizes output today (at $t = 0$) with subsequent overshooting (here at $t = 1$). If τ_y is small, then the date-0 output drop is significant, and the subsequent overshooting is small, so lowering τ_d even all the way to zero is desirable. If instead τ_y is large and so the static automatic stabilization is already powerful, then output is relatively stable at $t = 0$, and delayed fiscal adjustment achieves further stabilization only at the cost of a large subsequent overshoot at $t = 1$, thereby overall increasing the central bank's loss.[16]

The exact same forces are also present in our baseline infinite-horizon model, and illustrated visually through the blue-dashed line in Figure 3, which instead shows the central bank loss for a larger value of τ_y. Naturally, with τ_y bigger, the loss is now uniformly lower, reflecting the fact that the static automatic stabilizer already provides meaningful output support. Furthermore, and echoing the preceding discussion, the slope of the loss in τ_d is now shallower (for small τ_d): there is already stronger static automatic stabilization through τ_y, so there is less need to supplement it through the forward guidance-like dynamic effects of small τ_d. However, and consistent with (11), implausibly large values of τ_y would be needed to actually lead to a sign flip of the loss over $\tau_d \in [0,1]$.

Taking stock. The takeaway of this section is that, following demand shocks, delays in fiscal adjustment are not automatically, but in practice very likely, supportive of the central bank. We have seen that this conclusion relies on two key, and empirically relevant, ingredients: first, that contractions in economic activity lead to a budgetary shortfall, so that fiscal adjustment delays stabilize the economy; and second, that static automatic stabilizers alone are relatively weak. Once the second condition is satisfied, the forward guidance-like stabilizing effects of fiscal inaction are welcome, with stabilization benefits today outweighing the overshooting costs tomorrow.

4.3 Supply shocks

We now turn our attention to supply shocks $\{u_t\}_{t=0}^{\infty}$. We first review how monetary policy optimally leans against such shocks by raising interest rates and reducing aggregate demand to lower inflation,

[16] Formally, the envelope theorem expression in this case can be shown to become

$$\frac{\partial \mathcal{L}_{CB}}{\partial \tau_d} \propto \frac{\partial \mathscr{Y}_{0,1}}{\partial \tau_d} \mathbb{E}\left[\left(y_0^* + \left(1 + \frac{(1-\beta\omega)(1-\omega)\tau_y}{\beta\omega}\right)\beta y_1^*\right)\left(\left(1 + \frac{(1-\beta\omega)(1-\omega)\tau_y}{\beta\omega}\right)(v_0 + r_0^*) + r_1^*\right)\right].$$

where still $\frac{\partial \mathscr{Y}_{0,1}}{\partial \tau_d} < 0$. If (11) is violated then first term in the expectation becomes positive for small but still positive values of τ_d, flipping the sign of the derivative.

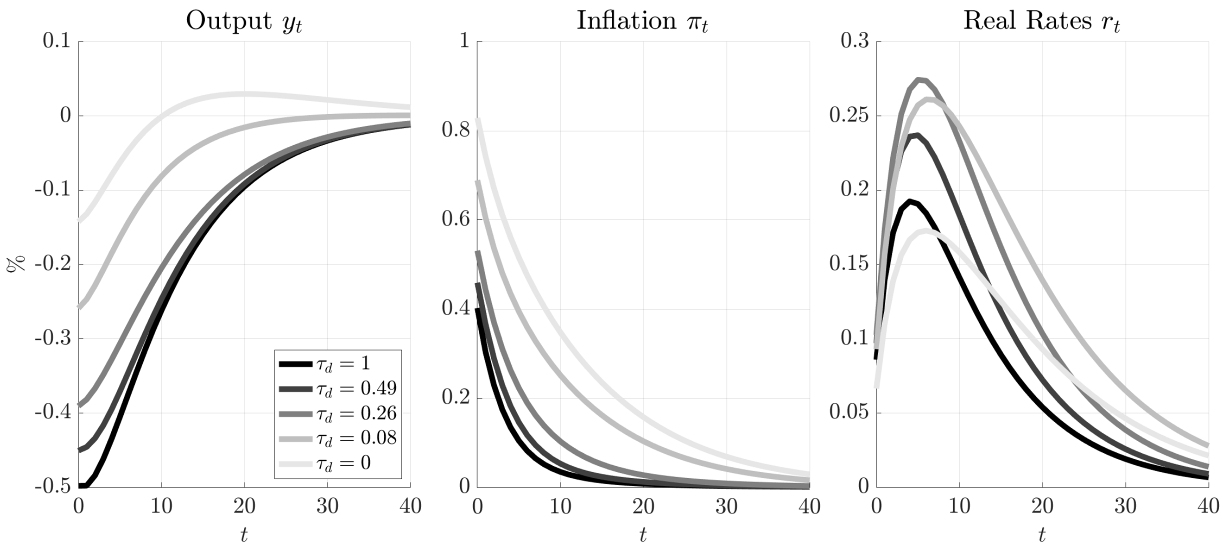

Figure 4: Impulse responses of output, the demand wedge, and government debt to a inflationary supply shock for different τ_d's (solid shades of grey) under optimal monetary policy.

and then show how slower fiscal adjustment interferes with this task. We conclude that, unlike the case of demand shocks, slow fiscal adjustment here is undesirable.

Intuition. Consider an adverse supply shock (i.e., $u_t > 0$, at least temporarily), and set demand shocks to zero (i.e., $v_t = 0$ for all dates $t \geq 0$). If the central bank kept real rates constant, then this cost-push shock would just pass through one-to-one into inflation, without output changing. The optimal policy response (as familiar from the textbook treatment of Galí, 2008) instead is to hike real rates and engineer a recession, thus moderating the inflationary pressures. In the envelope condition (10), we thus expect to have $r_t^* > 0$, i.e., real rates are increased in order to lean against the cost-push shock, and $\lambda_\pi \kappa \pi_t^* + \lambda_y y_t^* > 0$, since the output contraction only partially stabilizes inflation.

How does slow fiscal adjustment interact with this textbook optimal monetary policy response? As discussed in Section 3.3, delays in fiscal adjustment blunt the effectiveness of monetary policy, thus now in particular undermining its ability to moderate inflationary pressures. More formally, returning to the envelope condition, the fact that $\frac{\partial \mathscr{Y}_{t,s}}{\partial \tau_d} < 0$ (from Proposition 1) now suggests that the overall derivative is likely to be negative, with the fiscally induced stabilization of output counteracting the central bank's efforts. The remainder of the section corroborates this intuition.

Illustration. We provide a visual illustration in Figures 3–4, using the same model parameterization as in our previous analysis of demand shocks, now for a persistent supply disturbance. As before the purpose is illustration, not quantitative realism.

The two figures reveal, consistent with the preceding intuition, that *faster* fiscal adjustment is now desirable for the central bank. Figure 4 shows impulse responses to supply shocks under optimal monetary policy and for different values of the fiscal adjustment speed τ_d. As evident in the figure and as anticipated above, slower fiscal adjustment frustrates the monetary authority's attempts to use interest rate hikes to moderate inflation: output contracts by less, so inflation spikes by more. In fact, the right panel of the figure reveals an interesting non-monotonicity: as τ_d is lowered from 1 to 0, the central bank initially moves interest rates by more to counteract fiscal stabilization, but at some point relents, as prohibitively large rate movements would be required to implement the desired balance of output and inflation.[17] The solid red line in Figure 3 translates these impulse responses into central bank loss space: the central bank loss $\mathcal{L}_{CB}$ is now uniformly decreasing in τ_d, and thus smallest for an immediate fiscal adjustment (i.e., $\tau_d = 1$). Finally, the red dashed line in that same figure again offers a complementary lesson: if τ_y is large, then the usual static automatic stabilizers are already strong enough on their own to frustrate the monetary authority's attempts, largely independently of τ_d. This leads to a larger central bank loss and to an overall shallower slope with respect to τ_d, as the strength of dynamic stabilization matters less, echoing the earlier demand discussion.

An analytical result. We finally establish analytical insights using a restricted framework similar to that considered above for shocks to demand: the supply shock is now fully transitory (i.e., a one-off date-0 supply shock u_0) and the monetary and fiscal authorities together frictionlessly implement perfect stabilization of the economy after two periods, i.e., we have that $y_t = \pi_t = r_t = d_{t+1} = 0$ for all $t \geq 2$. We again state the main takeaway here, delegating a complete characterization of the equilibrium to the proof of Proposition 4 in the Appendix.

Proposition 4. *Consider the restricted, two-period, problem described above, featuring only supply shocks. The central bank loss $\mathcal{L}_{CB}$ is decreasing over the entire range of $\tau_d \in [0,1]$, and therefore it is minimized for $\tau_d = 1$.*

The monotonicity of τ_d over $[0,1]$ now holds without any qualifiers: as long as there is some static automatic stabilizer ($\tau_y > 0$), delaying fiscal adjustment increases the potency of that stabilizer and counteracts the central bank's interest rate hikes, thus destabilizing inflation and necessarily increasing the resulting central bank loss.

Productivity shocks. As discussed briefly in Section 2.1, our focus on cost-push supply disturbances is motivated by empirical evidence. It is immediate that, if we instead considered productivity disturbances but kept the central bank objective unchanged (i.e., featuring output, rather than the output *gap*), then our analysis would be entirely unchanged, with productivity shocks affecting the central

[17] If λ_r is very small, then there is no such non-monotonicity: the central bank always tries to approximate the dual-mandate optimum, which requires larger rate hikes for smaller τ_d, counteracting the stabilizing effects of slow adjustment.

bank exactly like the cost-push shocks considered here. Appendix A.4 studies the case of productivity shocks and the output gap appearing in the central bank objective. The key takeaway is that the conclusions of this section extend, with fast fiscal adjustment still preferred.

Taking stock. The analysis of this section suggests a tension: whether fiscal inaction supports or hinders the central bank's objectives depends on the nature of shocks buffeting the macroeconomy.

This ambiguity calls for a quantitative exercise, focused in particular on the decomposition of the business cycle between demand and supply forces. While we will provide such a quantitative exercise in Section 6, we first continue with theory, zeroing in on a mechanism that we have so far ignored: how fiscal adjustment modifies the inflation-output trade-off once such adjustment is distortionary rather than lump-sum. We will see that this supply-side channel can moderate or even overturn the present section's results on supply shocks.

5 The supply-side channel of fiscal inaction

We now alter our model environment and assume that fiscal adjustments are instead distortionary, in the form of a time-varying proportional tax rate on household income. Such distortionary adjustments introduce a time-varying tax wedge in the Phillips curve, with equation (3) replaced by

$$\pi_t = \kappa y_t + \tilde{\kappa} t_t^{\text{adj}} + u_t, \tag{12}$$

where $t_t^{\text{adj}} = \tau_d d_t$ is the date-t fiscal adjustment and $\tilde{\kappa} > 0$ is a scalar parameterizing the inflationary pressure caused by higher tax rates. The generalized Phillips curve relation (12) is derived from primitives of household labor supply, taxation, and firm pricing decisions in Appendix A.2.

The remainder of this section studies the implications of switching to this alternative supply block. Since the demand side of the economy is unchanged, Lemma 1 and Proposition 1 continue to hold, so a lower τ_d still stabilizes output, for a given monetary policy. What changes relative to our preceding analysis is that τ_d now also controls the *endogenous* cost-push term in (12). To understand how this supply-side channel influences our normative conclusions, it is essential first to understand its positive properties, i.e., how the fiscal adjustment speed τ_d affects t_t^{adj} and hence the cost-push term. In particular, we emphasize that there are two forces at work: one familiar from RANK ($\omega = 1$) and one new due to HANK ($\omega < 1$). Turning to the normative question in Section 5.2, we then show how the combination of those two forces can ensure that the central bank prefers a low τ_d *regardless* of the source of the business cycle, for shocks to both demand and supply.

5.1 Fiscal inaction, distortionary fiscal adjustments, and inflation

Our positive analysis proceeds in two steps. First, we show how a delay in fiscal adjustment, i.e., a reduction in τ_d, affects the equilibrium path of such fiscal adjustments. This first part is an immediate extension of our discussion in Section 3 and applies independently of whether the adjustments are lump-sum or distortionary. Second, we then use the adjusted Phillips curve (12) to translate this path of fiscal adjustments into inflation, focusing in particular on implications for the efficacy of monetary policy as a tool to control inflationary pressures.

Fiscal inaction and equilibrium fiscal adjustments. We begin with a lemma describing the equilibrium path of fiscal adjustments as a transformation of the output path.

Lemma 2. *The equilibrium path of fiscal adjustments satisfies*

$$t_t^{adj} = \sum_{s=0}^{\infty} \mathscr{T}_{t,s} (v_s + r_s) \quad t \geq 0, \tag{13}$$

where the impulse response coefficients for fiscal adjustments satisfy, for all $s \geq 0$, $\mathscr{T}_{0,s} = 0$, *and for all* $t \geq 1$, $\mathscr{T}_{t,s} = -\sum_{k=1}^{t} \mathscr{B}_k \mathscr{Y}_{t-k,s}$, *with* $\mathscr{B}_k = \tau_d \frac{\tau_y}{\beta} \left(\frac{1-\tau_d}{\beta}\right)^{k-1} > 0$ *for* $k \geq 1$.

Lemma 2 decomposes the path of fiscal adjustments into two components: the response of output to shocks (the $\mathscr{Y}_\bullet$'s), and the response of fiscal adjustments to changes in output (the $\mathscr{B}_\bullet$'s). By the fiscal adjustment rule (5), a one-off, one-unit decrease in period-t output translates into a concurrent budget shortfall of size of τ_y, and therefore increases period-$t+1$ debt by $\beta^{-1}\tau_y$. This debt increase in turn causes fiscal adjustments, equal to $\tau_d \frac{\tau_y}{\beta} \equiv \mathscr{B}_1$ at $t+1$, $\tau_d \frac{\tau_y}{\beta} \frac{1-\tau_d}{\beta} \equiv \mathscr{B}_2$ at $t+2$, and so on. In short, $\mathscr{B}_k$ measures the period-$(t+k)$ tax hike triggered by the budgetary shortfall in period t induced by a one-unit period-t output decrease. With output equilibrium paths already characterized in Section 3, Lemma 2 translates those to fiscal adjustments.

We now ask how the equilibrium path of fiscal adjustments varies with τ_d. Using the lemma, we answer this question in two steps: first only looking at the *direct* effect through the mapping from given output to fiscal adjustments (i.e., the $\mathscr{B}_\bullet$'s), and second also accounting for the *indirect* effect through τ_d moving output (i.e., the $\mathscr{Y}_\bullet$'s). We note here (and will discuss further below) that the first effect is present also in RANK, while the second is novel to the HANK setting studied here.

Proposition 5. *The equilibrium path of fiscal adjustments has the following properties.*

1. *The coefficients* $\mathscr{B}_\bullet$ *that map given output to fiscal adjustments satisfy*

$$\frac{\partial}{\partial \tau_d} \sum_{k=1}^{K} \beta^k \mathscr{B}_k > 0 \quad \textit{for all finite } K \geq 1. \tag{14}$$

   Moreover, for any $\tau_d > 0$, $\sum_{k=1}^{\infty} \beta^k \mathscr{B}_k = \tau_y$. *That is, given a path of output, a lower* τ_d *delays fiscal adjustment, shifting it from the short run to the long run without changing its net present value.*

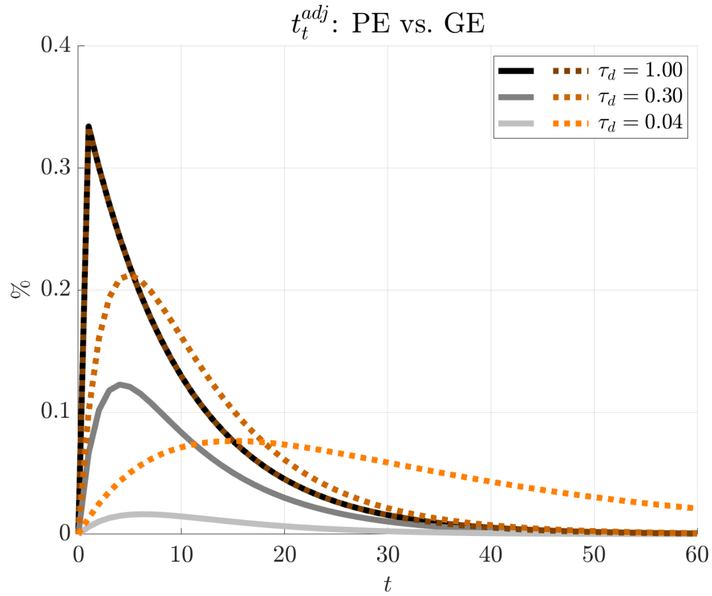

Figure 5: The solid gray lines show impulse responses of fiscal adjustment t_t^{adj} to a contractionary demand shock for different τ_d's. The dashed orange lines show the corresponding fiscal adjustment paths for different τ_d's, holding the output path fixed at the impulse response under $\tau_d = 1$.

2. *The overall path of fiscal adjustments, which also accounts for how τ_d affects the equilibrium path of output, satisfies, for all shock news horizons $s \geq 0$,*

$$\frac{\partial}{\partial \tau_d} \sum_{t=0}^{\infty} \beta^t \mathscr{T}_{t,s} > 0.$$

That is, a lower τ_d lowers the cumulative fiscal adjustment response. Furthermore, also for all $s \geq 0$, the entire impulse response $\mathscr{T}_{t,s}$ converges uniformly to 0 for all $t \geq 0$, and so in particular the cumulative fiscal adjustment converges to zero:

$$\lim_{\tau_d \to 0} \sum_{t=0}^{\infty} \beta^t \mathscr{T}_{t,s} = 0.$$

We illustrate and explain the two parts of Proposition 5 using Figure 5. The figure shows impulse responses of fiscal adjustments, t_t^{adj}, following the same persistent, contractionary demand shock as that considered for the illustrations in Section 3. Consider first the case of fast fiscal adjustment, $\tau_d = 1$ (shown as the black line). By construction, the shock depresses consumer spending in the short run, lowering output and thus the concurrent tax revenue, through the automatic stabilizer. When $\tau_d = 1$, this necessitates a quick and large hike in future taxes. Now consider the effect of lowering τ_d below 1. The orange dotted lines in Figure 5 show what happens if, as we lower τ_d, we counterfactually keep the output path at its equilibrium level under $\tau_d = 1$—i.e., we show the *direct*, partial equilibrium effect of delaying fiscal adjustment, echoing the first part of Proposition 5. We see that the fiscal adjustment path gets shifted to the right: the endogenous tax hikes are postponed but, by the government budget, the net present value of overall fiscal adjustments is unchanged. This is exactly the property (14): for any finite date K, lowering τ_d reduces the amount of fiscal adjustment that happens up to date K.

The grey lines of Figure 5—which show overall general equilibrium impulse responses of fiscal adjustment—also contain the *indirect* effect through output and thus help illustrate the second part of Proposition 5. If households were Ricardian ($\omega = 1$, as in RANK), then their spending would have been invariant to the timing of tax hikes, and so the intertemporal shift in tax hikes discussed above would be the only effect of lowering τ_d, with equilibrium output remaining unaffected. But now that households are non-Ricardian ($\omega < 1$), postponing tax hikes is expansionary (recall Proposition 1), and this endogenously moderates the required tax hikes—i.e., the second part of Proposition 5. Intuitively, postponing the fiscal adjustment dynamically amplifies the static automatic stabilizer, substituting for the need to hike taxes in the future. In the limit as $\tau_d \to 0$, this mechanism is so strong that the entire impulse response of fiscal adjustment becomes vanishingly small, and so naturally its net present value $\text{NPV}(t^{\text{adj}})$ converges to zero for any shock.[18]

The above lessons hold independently of whether the fiscal adjustments are lump-sum or distortionary. In the latter case, however, fiscal adjustment matters directly for inflation through (12), influencing the inflation-output trade-off faced by the central bank. We turn to this margin next.

The impact on inflation. Combining Proposition 5 with equation (12), which gives the Phillips curve under distortionary fiscal adjustment, we immediately obtain the following characterization of equilibrium path of inflation:

$$\pi_t = \sum_{s=0}^{\infty} \left(\kappa \mathscr{Y}_{t,s} + \tilde{\kappa} \mathscr{T}_{t,s}\right)(v_s + r_s) + u_t, \quad t \geq 0. \tag{15}$$

Equation (15) reveals how the switch from lump-sum to distortionary fiscal adjustments shapes the effect of changes in aggregate demand—and so in particular of real interest rate hikes—on inflation. Recall that $\mathscr{Y}_{t,s}$ is the response of output at date t to a date-s interest rate hike, which is unaffected by the switch to distortionary fiscal adjustment and is (typically, though not necessarily) negative; it is the conventional channel of interest rate hikes moderating inflation by reducing economic activity. The second term, $\mathscr{T}_{t,s}$, comes from the response of date-t distortionary fiscal adjustments and is typically positive, as the contraction in output sooner or later necessitates tax hikes, distorting the consumption-labor margin and thus increasing inflation. It follows that, when fiscal adjustments are distortionary, interest rate hikes become less effective as a tool to moderate inflationary pressures.

To zero in further on how the speed of fiscal adjustment shapes this mapping from interest rates to

[18] As noted in Section 3, this limit property is the flip side of the corresponding property for the cumulative output response: by guaranteeing that the present value of output is insulated from demand and supply shocks, $\tau_d \to 0$ guarantees that the present value of fiscal adjustment is also insulated.

INFLATION PATH INDUCED BY A REAL RATE HIKE

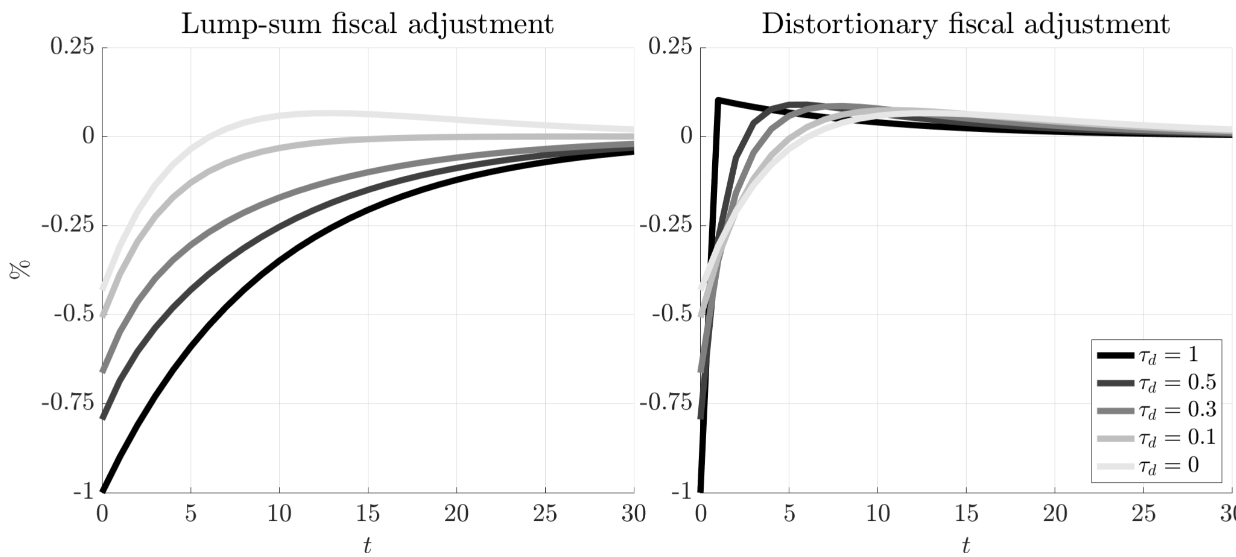

Figure 6: Impulse responses of inflation to a real interest rate hike (AR(1), persistence of 0.9), for different τ_d's (shades of grey), if fiscal adjustments are lump-sum (left panel, corresponding to $\tilde{\kappa} = 0$) or distortionary (right panel, so $\tilde{\kappa} \gg 0$).

inflation, we differentiate the inflation impulse response to rate changes with respect to τ_d, obtaining

$$\kappa \frac{\partial \mathscr{Y}_{t,s}}{\partial \tau_d} + \tilde{\kappa} \frac{\partial \mathscr{T}_{t,s}}{\partial \tau_d}, \tag{16}$$

where $\frac{\partial \mathscr{T}_{t,s}}{\partial \tau_d}$ is the effect of τ_d on the path of distortionary fiscal adjustments, as characterized in Proposition 5. The first term in (16) is negative: delays in fiscal adjustment boost output and thus, through the conventional NKPC channel, increase inflation. This is exactly the tension that we discussed at length in Section 4.3: slow fiscal adjustment interferes with the central bank's ability to lower inflation through interest rate hikes. The second term, on the other hand, is new and tends to be positive: slow fiscal adjustments help *reduce* the size of distortionary tax hikes and thereby also inflation—early on via the intertemporal shifting in the first part of Proposition 5, and later on via the endogenous stabilization of output in the second part. We thus now have an offsetting effect that can moderate or even overturn the logic of Section 4.3.

We illustrate these offsetting effects in Figure 6, which compares the impulse response of inflation to a persistent interest rate hike under lump-sum fiscal adjustment (left panel) to that under distortionary fiscal adjustment (right panel), for several values of τ_d (in grey).[19] If fiscal adjustments are lump-sum, then interest rate hikes do more to moderate inflation the larger τ_d, as their contractionary

[19]Figure 6 again is purely illustrative and as such assumes *ad hoc* values for κ and $\tilde{\kappa}$, discussed further in Appendix A.5. The quantitative exercise in Section 6 will instead discipline these coefficient in accordance with the underlying microfoundations and the relevant evidence.

effect on output is larger. If instead fiscal adjustments are distortionary, then fast tax responses make any attempt to use interest rate hikes to lower inflation self-defeating: distortionary taxes increase rapidly, here more than undoing the negative effect through the induced contraction in economic activity (which is unchanged across the two panels). For slow fiscal adjustment, on the other hand, real interest rate hikes remain useful as a tool to moderate inflation, as the (still-present, and still negative) output channel now dominates.

5.2 Implications for the central bank's loss

Building on the above positive results, we now reassess our earlier normative conclusions about the desirability of fiscal inaction. The new takeaway is that, when fiscal adjustments are sufficiently distortionary, the finding of Section 4.3 is overturned or at least materially weakened: even in response to supply shocks, slow fiscal adjustment may actually support, or at least do less to undermine, the central bank's desire to lower inflation. We establish this lesson by following similar steps as before, starting with the applicable envelope condition.

Proposition 6. *With the Phillips curve (12), the sensitivity of the central bank's loss $\mathcal{L}_{CB}$ to the speed of fiscal adjustment τ_d satisfies*

$$\frac{\partial \mathcal{L}_{CB}}{\partial \tau_d} = \underbrace{\mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t \left\{\left(\lambda_\pi \kappa \pi_t^* + \lambda_y y_t^*\right)\left(\sum_{s=0}^{\infty} \frac{\partial \mathcal{Y}_{t,s}}{\partial \tau_d}\left(v_s + r_s^*\right)\right)\right\}\right]}_{\text{term with lump-sum fical adjustment}} + \underbrace{\mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t \left\{\lambda_\pi \tilde{\kappa} \pi_t^* \left(\sum_{s=0}^{\infty} \frac{\partial \mathcal{T}_{t,s}}{\partial \tau_d}\left(v_s + r_s^*\right)\right)\right\}\right]}_{\text{additional term with distortionary fiscal adjustment}}, \quad (17)$$

where $\{r_t^*, y_t^*, \pi_t^*, d_{t+1}^*, t_t^*\}_{t=0}^{\infty}$ denote the equilibrium paths under optimal monetary policy, and the impulse response coefficients $\{\mathcal{Y}_{t,s}, \mathcal{T}_{t,s}\}_{t,s\geq 0}$ are characterized in Propositions 1 and 5, respectively.

As before, this result, now combined with our characterization of the impulse responses of both output and fiscal adjustments, will help to sign the effect of τ_d on$\mathcal{L}_{CB}$. For much of the remainder of this section, we focus on supply shocks, because this is where the switch to distortionary fiscal adjustment matters the most; demand shocks are discussed briefly at the end.

Intuition. The preceding discussion suggests that, following supply shocks, fast fiscal adjustment is likely to be much less desirable than in the lump-sum case: interest rate hikes, designed to stabilize inflation through a reduction in output, now quickly lead to distortionary fiscal adjustments, thereby increasing inflation and undoing the benefits of the induced output contraction. We see this in (17),

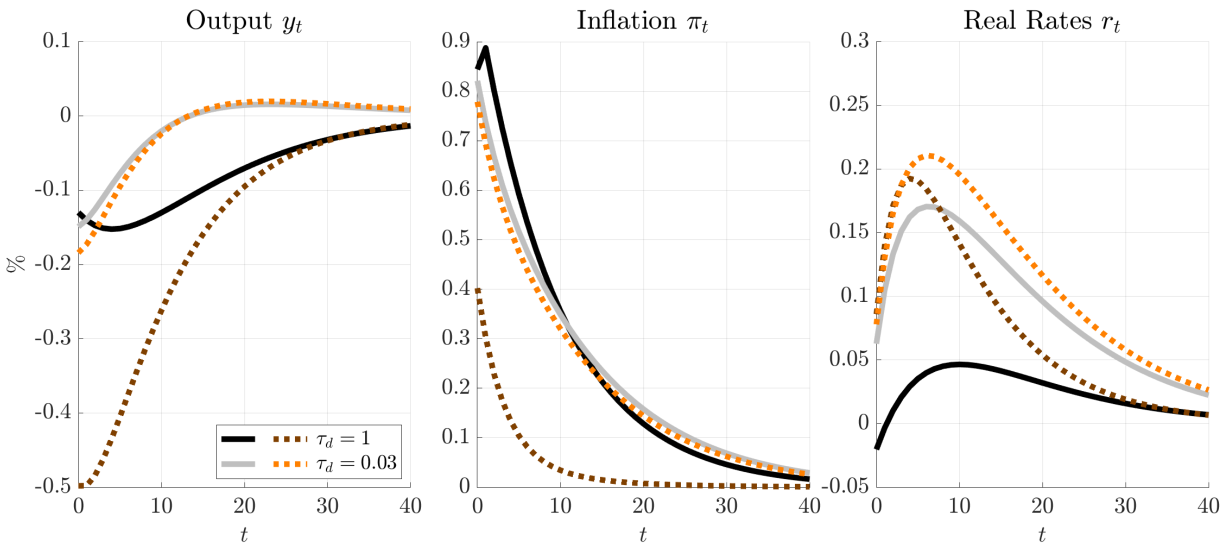

Figure 7: Impulse responses of output, inflation, and real interest rates to a inflationary supply shock for different τ_d's under optimal monetary policy. The solid lines (grey) are for the model with distortionary fiscal adjustments, while the dashed lines (orange) are for lump-sum fiscal adjustments.

where π_t^*, r_s^*, and $\frac{\partial \mathcal{T}_{t,s}}{\partial \tau_d}$ in the second line are all likely to be positive following an inflationary supply shock (at least at short horizons), thereby dampening or even reversing the negative sign of $\frac{\partial \mathcal{L}_{CB}}{\partial \tau_d}$.

Some complementary intuition comes from a Ramsey perspective. In the absence of cost-push disturbances, a standard Ramsey planner required to raise a given amount of tax revenue would prefer to increase distortionary taxes smoothly (Barro, 1979). When such disturbances are present, the same logic translates into an incentive to lower distortionary taxes precisely when the cost-push disturbance is large, because this smooths the combined distortion (Benigno and Woodford, 2003). Fast fiscal adjustment runs directly counter to both objectives, raising the tax distortion precisely when the cost-push distortion is large. Slow adjustment, in contrast, smoothes out the distortion, easing the output-inflation trade-off faced by the central bank. This smoothing margin is related to the *direct* effect of delays in fiscal adjustment (i.e., to the first part of Proposition 5), and is present even with permanent-income households. Non-Ricardian consumer behavior adds a second *indirect* channel, related to the second part of Proposition 5: slow adjustment now not only smoothes but in fact endogenously reduces equilibrium fiscal adjustments, and so the inflationary pressure of the cost-push shock is no longer compounded by the tax distortion wedge in the Phillips curve.

Illustration. We illustrate these forces in Figures 7–8, which show impulse responses to inflationary supply shocks together with the corresponding central bank losses, under optimal monetary policy and for different values of τ_d. The key takeaway is that, just as anticipated, switching to distortionary fiscal adjustments makes fast tax responses less desirable. Consider first the impulse responses in Figure 7. When fiscal adjustment is slow, there is little difference between the scenario with lump-

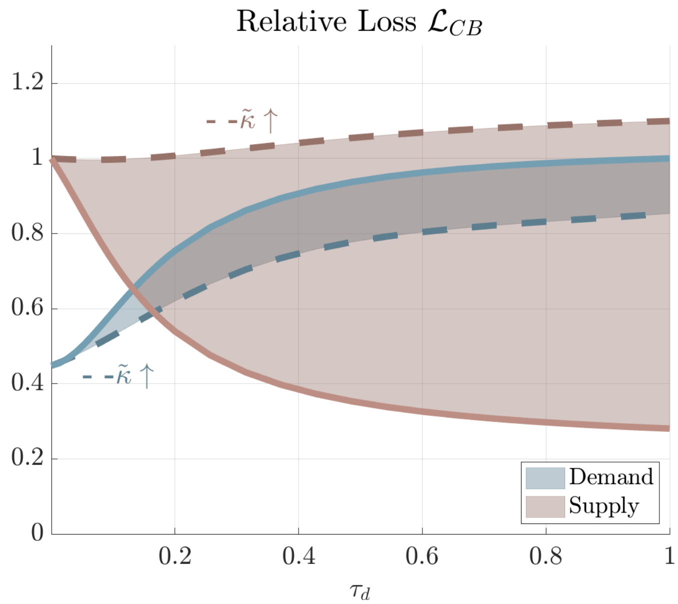

Figure 8: Minimized central bank loss $\mathcal{L}_{CB}$ as a function of τ_d for demand shocks (blue) and supply shocks (red), with lump-sum fiscal adjustments (solid, corresponding to $\tilde{\kappa} = 0$) and distortionary fiscal adjustments (dashed, corresponding to $\tilde{\kappa} > 0$).

sum adjustment (dashed orange lines) and that with distortionary adjustment (solid blue lines). This is because, in the limit as $\tau_d \to 0$, the equilibrium path of fiscal adjustments converges to zero in *both* scenarios (by Proposition 5). When fiscal adjustment is instead fast, we see large differences emerge: since any attempts to stabilize inflation through rate hikes are largely self-defeating, the central bank now endogenously decides to depress output by much less. Intuitively, as already discussed above, a large output drop would necessitate large and quick tax hikes, in turn undoing much of the desired inflation reduction. Figure 8 then reports the associated central bank loss as a function of τ_d for $\tilde{\kappa} = 0$ (i.e., lump-sum scenario, solid) and $\tilde{\kappa} \gg 0$ (i.e., distortionary scenario, dashed), with the red lines as before corresponding to supply shocks. As we move from $\tilde{\kappa} = 0$ to $\tilde{\kappa} \gg 0$, the slope of the central bank loss with respect to τ_d *flips*: the central bank prefers fast fiscal adjustment in the lump-sum case, but slow adjustment if the endogenous tax response is sufficiently distortionary.

An analytical result. To conclude, we provide an exact analytical result. For this we return to our earlier two-period framework, but now adapted to distortionary fiscal adjustment: the supply shock is fully transitory (i.e., a one-off date-0 supply shock u_0), output is perfectly stabilized after two periods ($y_t = 0$ for all $t \geq 2$), and taxes are smoothed thereafter ($t_t^{\text{adj}} = t_2^{\text{adj}} = (1-\beta)d_2$ and $d_t = d_2$ for all $t \geq 2$). We provide a complete characterization of equilibrium dynamics in this restricted economy in the proof of Proposition 7 in the Appendix, and summarize the main takeaway here.[20]

[20]Proposition 7 treats $\tilde{\kappa}$ as a primitive. We do so to maximize clarity, as the exercise allows us to establish cleanly that the $\tilde{\kappa}$-related channel studied here leans against that of Section 4.3. In terms of microfoundations, the interpretation of

Proposition 7. *Consider the restricted, two-period, problem described above, featuring only supply shocks. If $\tilde{\kappa}$ is sufficiently large, then the central bank loss $\mathcal{L}_{CB}$ is increasing over the entire range of $\tau_d \in [0,1]$, and therefore it is minimized for $\tau_d = 0$.*

The proposition affirms the intuition we developed above: if the inflationary pressure triggered by the distortionary fiscal adjustment is large enough, then the second effect in (17) dominates, and so the central bank is now supported by fiscal inaction even following supply disturbances. The analysis in this section thus offers an important qualification of our earlier takeaways in Section 4.3: once we take account of the distortionary, or supply-side, consequences of fast fiscal adjustment, the central bank may actually prefer a low τ_d in response to supply shocks.

Demand shocks. We conclude our analysis by noting that, for demand shocks, the switch to distortionary fiscal adjustments is likely to matter much less. Intuitively, following a contractionary demand shock, fast fiscal adjustment now has one new benefit: when output is depressed, higher distortionary taxes in the short run raise inflation and thus help stabilize it. This is what we see with the blue lines in Figure 8, where the dashed line (for distortionary fiscal adjustments) is shallower than the solid line (for lump-sum adjustments). That said, this dampening effect is likely to be moderate in practice, for a simple reason: as long as the Phillips curve is relatively flat or the central bank is not excessively concerned about inflation, the central bank's losses following aggregate demand shocks will be dominated by the output component, for which the conclusions of Section 4.2 apply unchanged. This basic logic is visible in Figure 8, where, unlike for supply shocks, the slope does not flip, and will be further confirmed in our quantitative explorations.

6 Quantitative analysis

The preceding analysis shed light on, first, how the speed of fiscal adjustment shapes the propagation of macroeconomic shocks, and second, how this in turn affects the central bank's ability to stabilize output and inflation. The analysis was, however, limited to a relatively simple model environment; in particular, we abstracted from household heterogeneity and from any feedback from interest rates and inflation to the government budget. Furthermore, even in that rather simple environment, there were offsetting forces, related to the types of shocks buffeting the economy and to the inflationary effects of tax hikes. To address these limitations and understand which theoretical scenario is most relevant in practice, we now pursue a quantitative exercise. We first accommodate a few additional

the exercise here—with $\tilde{\kappa}$ large relative to κ—is that prices are relatively flexible (delivering large $\tilde{\kappa}$), but the mapping from marginal cost to output is flat (delivering small κ). For our quantitative explorations in Section 6 we will tie $\tilde{\kappa}$ to its microfoundations and discipline it with the relevant evidence.

mechanisms that are relevant in practice but were absent from our baseline model. We then use aggregate U.S. time series to learn about the mix of shocks hitting the economy. This will turn out to be the key step to resolving our theory's ambiguities in an empirically grounded way.

6.1 An extended model

We begin with a description of the extended model. We first discuss how we generalize the demand and supply blocks of the economy, before turning to policy.

Aggregate demand. We extend the demand block by allowing for multiple types of households that differ in their steady-state wealth holdings A_i^{ss} and survival probabilities ω_i. In addition to proxying for cross-sectional heterogeneity in wealth and MPCs, these enrichments serve two key roles vis-à-vis the model's aggregate dynamics. First, they will allow us to match aggregate-level *intertemporal* MPCs to those implied by richer HANK models and observed in the data (Auclert et al., 2024; Angeletos et al., 2024; Wolf, 2025). Second, we can now have most government debt and thus wealth—both in steady state and over the business cycle—be held by low-MPC households, preventing the model from implying a counterfactually fast pass-through from changes in private-sector wealth holdings to consumer spending, consistent with Chodorow-Reich et al. (2021) and Auclert et al. (2023).

Aggregate supply. To accommodate more realistic inflation dynamics, we replace our static Phillips curve (3) with

$$\pi_t = \kappa y_t + \tilde{\kappa} t_t^{\text{adj}} + \xi \beta \pi_{t-1} + (1-\xi)\beta \mathbb{E}_t [\pi_{t+1}] + u_t, \tag{18}$$

where $\xi \in [0,1)$ parameterizes the degree of backward-lookingness in price-setting. This is the same "hybrid" version of the New Keynesian Phillips Curve as that featured in the related empirical and DSGE literatures (e.g., Galı and Gertler, 1999; Christiano et al., 2005), augmented here to allow for a tax wedge from distortionary fiscal adjustments.

Shocks. We allow for the stochastic disturbances to the aggregate demand and supply to follow general VARMA(p,q) processes. We can thus accommodate not only correlated shocks to aggregate demand and supply, but also arbitrary dynamic patterns, e.g., including news-type shocks. In short, the model's shock processes are left entirely flexible. Our discussion in Section 6.2 will reveal how we can use raw, reduced-form time series data to sidestep any need to take a stance on the underlying structural shocks driving our economy.

Monetary Policy. We continue to assume that monetary policy is optimally set so as to stabilize output and inflation, albeit subject to a realistic friction in the central bank's ability to regulate aggregate demand. In our baseline model, this friction was captured by letting the central bank face a cost for varying the *real* interest rate r_t (where $r_t \equiv i_t - \mathbb{E}_t[\pi_{t+1}]$). We now instead assume that there is a cost for varying the central bank's policy instrument itself, the *nominal* interest rate i_t. That is, the central bank's loss is now given by

$$\mathscr{L}_{CB} = \frac{1}{2}\mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t \left\{ \lambda_\pi \pi_t^2 + \lambda_y y_t^2 + \lambda_i i_t^2 \right\} \right]. \tag{19}$$

We make this change with an eye towards realism, mimicking more closely applied practice in monetary policy evaluation (e.g., the Federal Reserve Tealbook, 2016). For completeness we will also report results for a loss function over *changes* in nominal interest rates, or instead featuring *real* rates as in our baseline theoretical analysis.

Fiscal Policy. Like before, we wish to evaluate how the central bank's optimal policy and associated loss vary with the—exogenously fixed—behavior of the fiscal authority. Unlike before, however, we now let the fiscal authority issue long-term, nominal government debt. Accordingly, the government's flow budget constraint is now given by

$$d_{t+1} = \frac{1}{\beta}(d_t - t_t) + \frac{D^{ss}}{Y^{ss}} r_t - \frac{D^{ss}}{Y^{ss}} \left(\pi_{t+1} - \mathbb{E}_t\left[\pi_{t+1}\right] - \beta\delta \left(q_{t+1} - \mathbb{E}_t\left[q_{t+1}\right]\right)\right), \tag{20}$$

where $\delta \in [0, 1]$ is the maturity parameter of government debt and q_t is the post-coupon dollar price for a unit of government debt. Short-term one-period nominal debt and perpetuities are nested as the opposite extremes with, respectively, $\delta = 0$ and $\delta = 1$. Compared to (4), the two new terms at the end of equation (20) reflect the unexpected changes in the real value of public debt caused by surprises in, respectively, the rate of inflation and the price of long-term government bonds. Finally, we drop the simplifying assumption that taxes automatically adjust to absorb any variation in the in the interest-rate costs of government debt. That is, we drop the $\beta \frac{D^{ss}}{Y^{ss}} r_t$ term present in our prior fiscal rule (5) and instead specify tax revenue as

$$t_t = \tau_y y_t + \tau_d d_t, \tag{21}$$

where τ_y and τ_d parameterize, once again, the size of the automatic stabilizer and the speed of (distortionary) fiscal adjustment, $t_t^{\text{adj}} = \tau_d d_t$, respectively. All in all, the feedback from the macroeconomy to the government budget is thus now much richer than in our baseline setting: while we preserve the automatic feedback from real economic activity to tax revenue (via $\tau_y > 0$), we now also accommodate the budgetary shortfalls or gains triggered by business-cycle variation in interest rates and inflation (via (21)). By the same token, τ_d now measures how quickly the fiscal authority responds to the entire fiscal footprint of the business cycle, as intermediated through d_t in (21).

6.2 Empirical discipline

The question of interest is how the central bank loss—or, more basically, the volatilities of output, inflation and interest rates under the optimal monetary policy—varies with τ_d, the speed of fiscal adjustment. Clearly, macroeconomic time series *alone* cannot answer this question, because there is no direct analogue in the data of the necessary variation in τ_d. Nonetheless, those series do contain crucial information about the shocks buffeting the economy and, thereby, about our question of interest. Building on this basic observation, this section discusses how exactly theory and the data can be combined to learn about how different fiscal rules help or hinder the work of the central bank. We start with an identification result that provides "sufficient statistics" for our object of interest. We then describe how exactly this identification result can be used in our context.

An identification result. Consider the extended model described in Section 6.1 above, subject to the twist that monetary and fiscal policy instruments $\left(i_t, t_t^{\text{adj}}\right)$ are allowed to follow possibly different rules than those described earlier—e.g., monetary policy need not be optimal, and both policies could be subject to random shocks. A standard approach to evaluating our policy question of interest would be as follows: estimate the parameters of the extended model with likelihood-based methods on time series data (e.g., as in Smets and Wouters, 2007; Justiniano et al., 2010), then in that estimated model switch to the policies described in Section 6.1, and finally compute how the volatilities of output, inflation and interest rates, and thus the resulting central bank loss, vary with τ_d. We instead follow a different strategy which, in our assessment, is more transparent. It rests on the observation that, conditional on our model structure, the counterfactual of interest is actually pinned down by just two "sufficient statistics": the causal effects of the two policy instruments on the macro-economy, and the unconditional second moments of macroeconomic aggregates.

To formally state this identification result, we let $x_t \equiv (y_t, \pi_t, i_t, d_t)$ and write the Wold representation of x_t under the (arbitrary) baseline policy rules as

$$x_t = \sum_{\ell=0}^{\infty} \Psi_\ell e_{t-\ell}, \tag{22}$$

where the Wold innovations e_t are orthogonalized (i.e., $\text{Var}(u_t) = I$). Next, we express the dynamic causal effects of shocks to monetary and fiscal policy instruments at all impulse and news horizons on the four macroeconomic outcomes in x as $\{\Theta_{x,m}, \Theta_{x,f}\}$, defined exactly as in McKay and Wolf (2023, Section 2.3). We can now state the identification result.

Proposition 8. *Suppose that the Wold representation (22) is invertible. Then, the function $\mathcal{L}_{CB}$, which gives the central bank's optimal loss for different fiscal adjustment speeds $\tau_d \in [0,1]$, can be calculated as a function of the following three objects:*

1. *The Wold representation coefficients,* $\{\Psi_\ell\}_{\ell=0}^{\infty}$.

2. *The dynamic causal effects of monetary and fiscal policy instruments,* $\{\Theta_{x,m}, \Theta_{x,f}\}$.

3. *The central bank's preferences,* $\{\lambda_\pi, \lambda_y, \lambda_i\}$.

This result is proved in Appendix C.10; we here instead just explain the basic intuition. Under the assumption of invertibility, the Wold representation completely summarizes the stochastic properties of the macro-economy, and so in particular it implicitly reflects all the (unknown) shocks that shape the business cycle. Knowledge of policy causal effects then allows us to do two things. First, we can *strip out* the effects of policy—both systematic and through shocks, if any—from the Wold representation, leaving us only with the effects of non-policy disturbances. Second, we can then *add back in* the effects of our hypothesized fiscal feedback rule together with the assumed optimal monetary policy design. This gives us the Wold representation under the hypothesized fiscal-monetary policy mix, but still reflecting the (hidden) mix of non-policy shocks buffeting the economy. From here it simply remains to compute the object of interest—the central bank loss given the fiscal adjustment speed τ_d.

Using the identification result. Proposition 8 suggests a three-step strategy for answering the question of interest. We here describe that strategy and how we implement it in practice, with a discussion of the results following in the next section.

1. *Second moments.* We begin by estimating the Wold representation of $x_t \equiv (y_t, \pi_t, i_t, d_t)$ in U.S. data, using standard reduced-form time series techniques. As previewed above, this step, while completely a-theoretic, contains crucial information about the type of shocks buffeting the economy. In particular, for the purposes of our results in Section 6.3, the key feature of the average in-sample co-movement of x_t is that the typical short-run boom in output coincides with a modest increase in interest rates and an even more muted increase in inflation—i.e., it resembles the so-called "main business-cycle" shock identified in Angeletos et al. (2020). Mapping this fact to the theory, one infers that most of the business cycle in the data is driven by an "aggregate demand"-type disturbance, which operates along a rather flat NKPC and is only partially offset by monetary policy. This in turn suggests that our theoretical conclusions for demand shocks are likely to be most relevant in practice—an observation that will loom large in our subsequent results. Details on measurement and estimation are provided in Appendix B.2.

2. *Policy causal effects.* To obtain $\{\Theta_{x,m}, \Theta_{x,f}\}$, we use the model described in Section 6.1, minus the restriction to optimal monetary policy and to our specific assumptions on the fiscal adjustment rule. Specifically, we combine the private-sector block of the economy together with the steady-

state tax-and-transfer and government-debt profiles to evaluate the dynamic causal effects of arbitrary time paths of nominal interest rates and (distortionary) fiscal adjustments.

Since the purpose of the model is thus solely to provide policy causal effects, we discipline its calibration with an eye towards the available empirical evidence on such effects. First, we calibrate the demand block so that it matches the available evidence on consumer spending responses to income gains (as taken from Fagereng et al., 2021), thus also replicating the predictions of richer HANK models about fiscal transfers (along the lines of Auclert et al., 2024); doing so requires generalizing our model to feature three distinct types of consumers. Second, we pin down the parameters of the supply block so that it matches the relevant evidence about the slope and backward-lookingness of the Phillips curve, as inferred from the response of inflation to monetary shocks (following Romer and Romer, 2004; Barnichon and Mesters, 2020; Aruoba and Drechsel, 2024).[21] Third, we set tax rates, total government debt, and average debt maturity to ensure consistency with pre-2020 U.S. data, following Angeletos et al. (2025). We then choose household type steady-state wealth holdings to obtain a moderate average MPC out of steady-state wealth holdings; specifically, since most wealth in our economy is held by relatively low-MPC consumers, the MPC out of an increase in wealth proportional to steady-state wealth holdings is only 6%, vs. an economy-wide average quarterly MPC of around 27%.

Parameter values are displayed in Table 1. Taken together, our calibration choices imply that our model is broadly consistent with empirical evidence on the effects of *transitory* changes in interest rates and taxes. We then rely on the structure of the model to populate the entirety of the causal effect matrices $\{\Theta_{x,m}, \Theta_{x,f}\}$. Appendix B.1 provides further computational details.

The first two steps of our approach are "orthogonal complements" in the following sense: the first step uses *no* theory but encapsulates the actual business cycle in the data; conversely, the second step uses a specific model (disciplined with the relevant empirical evidence) to give us the causal effects of policy, but takes *no* stance on the shocks buffeting the economy. These two steps are furthermore "sufficient statistics" for computing the behavior of the economy under *any* policy rules—a point that, as shown in McKay and Wolf (2023) and Caravello et al. (2025), extends well beyond the specific context of our exercise here. It now just remains to evaluate counterfactual outcomes under our particular assumptions on the central bank objective.[22]

[21] For monetary policy, a 100 basis point transitory increase in the nominal interest rate lowers output by around 0.7 per cent and inflation by slightly above 0.1 per cent, broadly consistent with the literature review in Caravello et al. (2025, Figure 2). For fiscal transfers, we note that the direct effect of one-off transfers on spending is given by the first column of the overall intertemporal MPC matrix (Auclert et al., 2024). That column is matched to the evidence in Fagereng et al. (2021), exactly as in Angeletos et al. (2024, Figure 4, bottom panel).

[22] Given the generality of the identification results in McKay and Wolf (2023) and Caravello et al. (2025), one may con-

Parameter	Description	Value	Target
Demand Block			
χ_i	Population shares	$\{0.218, 0.629, 0.153\}$	Fagereng et al. (2021)
ω_i	Survival rates	$\{0.972, 0.833, 0\}$	Fagereng et al. (2021)
A_i^{ss}/A^{ss}	Wealth shares	$\{0.8, 0.2, 0\}$	MPC out of wealth changes
σ	EIS	1	Standard
φ	Frisch elasticity	1	Standard
β	Discount factor	0.998	Annual real rate
Supply Block			
κ	Slope of NKPC	0.02	Romer and Romer (2004); Aruoba and Drechsel (2024)
ξ	Backward-lookingness	0.29	Barnichon and Mesters (2020)
Policy			
τ_y	Tax rate	0.33	Average Labor Tax
D^{ss}/Y^{ss}	Gov't debt level	1.79	Av'g domestic debt
δ	Gov't debt maturity	0.95	Av'g debt maturity

Table 1: Quantitative model, calibration.

3. *Optimal monetary policy.* The final ingredient is the monetary policy objective: given the weights $\{\lambda_\pi, \lambda_y, \lambda_i\}$ that the central bank assigns to the volatilities of output, inflation, and interest rates, we can compute optimal monetary policy and thus evaluate the central bank loss for different values of τ_d. Our choices of parameter values again follow the Federal Reserve Tealbook (2016), exactly as in prior sections.[23]

All in all, our three-step approach transparently shows how different pieces of evidence, theory, and priors on central bank objectives are combined to answer our question of interest. In our view, this transparency of identification is the main appeal of our proposed approach. Finally, we stress that this transparency also goes hand-in-hand with a sense of robustness: it follows from the identification result that any alternative approach to quantification that delivers different results would need to disagree either in terms of unconditional second moments, policy causal effects, or on the central

template a purely empirical evaluation of our policy counterfactuals of interest, taking not just second moments but also policy causal effects from the data. Such a strategy is, unfortunately, not practical here, for two reasons. First, empirical evidence on the causal effects of (distortionary) fiscal adjustments is scant. Second, for our analysis, it is essential that the counterfactual policy rules of interest are implemented exactly and not approximately, precluding the "approximate counterfactuals" approach of McKay and Wolf (2023).

[23]Specifically, we again consider equal weights on (annualized) inflation, interest rates, and unemployment; with an Okun's law coefficient of 0.5 this corresponds to $\lambda_i = \lambda_\pi = 16$ and $\lambda_y = 0.25$.

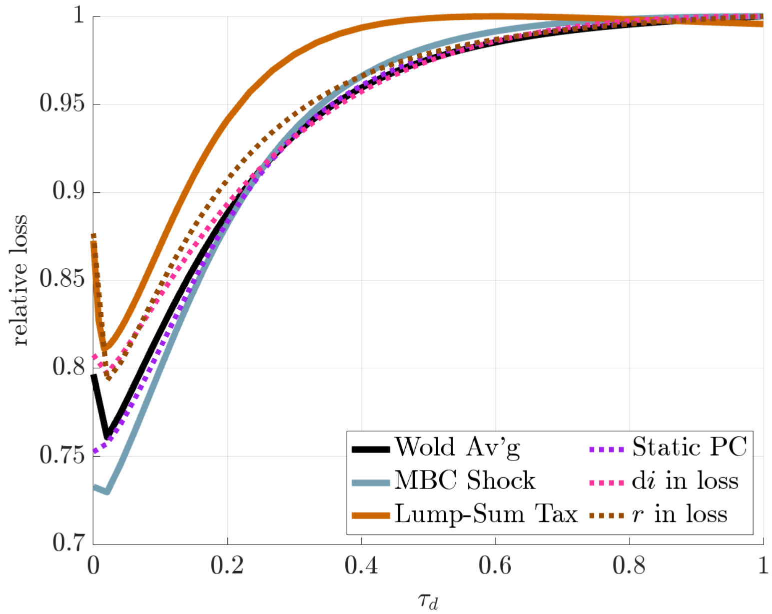

Figure 9: Central bank losses $\mathscr{L}_{CB}$ under optimal monetary policy in the quantitative model, with aggregate stochasticity driven by the estimated Wold representation (black solid), by only the "main business-cycle shock" (blue solid), or by the Wold representation but with policy causal effects from a model with lump-sum fiscal adjustments (orange solid). Dotted lines show robustness to a static Phillips curve (purple) and to alternative loss specifications featuring the change in nominal interest rates (pink) or the level of real rates (brown).

bank objective. Since we take second moments straight from the data, derive policy causal effects from a model disciplined by relevant empirical evidence, and consider an empirically relevant central bank loss, we expect the conclusions reported in the sequel to be robust.

6.3 Quantitative results

We now show the results of the quantitative strategy outlined above. Our findings are reported in Figure 9, which shows the central bank loss $\mathscr{L}_{CB}$ as a function of the fiscal adjustment speed $\tau_d \in [0,1]$ (on the x-axis), for several different experiments and model specifications. For all those exercises we normalize the peak loss over $\tau_d \in [0,1]$ to 1, so the y-axis always gives the relative loss.

The main takeaway of the figure is that the central bank would indeed welcome slow fiscal adjustment or in fact even fiscal inaction. Our headline experiment is shown as the black line, where our two sufficient statistics and the central bank loss are specified exactly as discussed in the previous section—measured second moments for the Wold decomposition, our calibrated headline model for policy causal effects, and the benchmark equal-weights central bank objective function. We see that the loss is monotone in τ_d across almost the entire unit interval, and furthermore that the loss associated with slow or absent fiscal adjustment is materially smaller than that with fast adjustment (note the y-axis), with slow adjustment lowering the central bank loss—and thus average volatilities of macro aggregates—by around 20 per cent. The smallest loss is achieved for $\tau_d \approx 0.02$, corresponding to a half life of government debt somewhat below ten years.

Further analysis and robustness. The solid blue and orange lines provide further insights into where our headline finding is coming from. First, to construct the blue line, we do not consider the full Wold representation, but instead only a single "shock"—a rotation of Wold innovations identified exactly like the "main business-cycle shock" in Angeletos et al. (2020). That shock looks like a conventional demand shock, and so itself delivers an upward slope, as expected in light of our theory. Since the overall data are also driven by various other (non-demand) shocks, the upward slope here is in fact more pronounced than its unconditional analogue (in black); that said, given that the main business-cycle shock is a dominant source of macroeconomic fluctuations, we would expect the black and blue lines to be rather close, and that is indeed what we see. Next, the orange line plots the overall loss if instead we consider an alternative model variant with lump-sum (rather than distortionary) fiscal adjustment. Since now supply shocks optimally call for fast fiscal adjustment, the orange line lies somewhat above the black line; but with demand-type shocks overall dominating, we would expect even the lump-sum fiscal adjustment loss to still be mostly upward-sloping in τ_d, and again that is what we see.[24] Taken together, these two experiments reveal cleanly that our overall quantitative results are driven by the mechanism distilled in Section 4 for demand shocks, with the distortionary tax channel only providing moderate further amplification.

The dashed lines in Figure 9 highlight some further robustness. For those lines we change either the model used to compute policy causal effects (to a static Phillips curve, in line with our previous theoretical analysis) or the central bank loss function (to feature either real rates or changes in nominal rates). We see that none of these modifications really change the overall picture: the central bank loss remains largely monotone in τ_d, with material loss reductions associated with slow adjustment.

Summary. The analysis of this section has allowed us to evaluate the practical relevance of our earlier theoretical conclusions. Since household marginal propensities to consume are high, delays in fiscal adjustment are meaningfully stabilizing; and since aggregate fluctuations are dominated by demand-type disturbances, such endogenous stabilization through fiscal inaction is welcome, and then only reinforced further by the endogenous reduction in distortionary tax hikes. Our headline

[24] The dips in the loss close to but above $\tau_d = 0$ are related to the fact that now we allow for interest rates to also feed back to the government budget. If we allowed for such feedback in our baseline analytical model, then equilibrium determinacy under the textbook dual mandate implicit targeting rule (as in Woodford, 2003a) would require $\tau_d > 1 - \beta$. A smaller τ_d thus now induces very persistent fluctuations (truncated only by long-horizon eventual fiscal adjustment, see Appendix B.1). This effect is what we see at the boundary here.

finding—that central banks may welcome slow fiscal adjustment, or even fiscal inaction, over the business cycle—is thus not just a theoretical possibility, but indeed a robust feature of empirically relevant equilibrium models, driven by our two "sufficient statistics."

7 Conclusions

Does fiscal inaction help or hurt a central bank? While the conventional wisdom holds that fast fiscal adjustment is desirable (to avoid "fiscal dominance"), we have argued both theoretically and quantitatively that slow or even absent fiscal adjustment may aid the central bank in achieving its objectives. The simple intuition is that, in structural models with non-Ricardian households, slowing down the pace of fiscal consolidation following budgetary shortfalls boosts the macro-economy. As long as such stabilization is desirable—e.g., because the economy is in a demand-driven recession, or because tax distortions should be smoothed out and reduced—fiscal inaction will provide monetary support.

Two obvious but important qualifiers for our results are the following. First, fiscal inaction is desirable following *non-fiscal* disturbances. A fiscal authority that itself is a source of macroeconomic volatility of course remains undesirable. Second, our results—like the entire New Keynesian framework upon which they are based—apply only to short-run fluctuations, and not to steady-state long-run effects. A fiscal authority that systematically runs large deficits, or that systematically distorts private activity, can have further detrimental effects not covered by our analysis. An important practical question is therefore what kind of fiscal frameworks can harness the advantages of fiscal inaction discussed here without subjecting the economy to broader fiscal imprudence.

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Appendices for:
Fiscal inaction as monetary support

This Appendix contains further material for the article "Fiscal inaction as monetary support." We provide: (i) supplementary details for our theoretical analysis in Sections 2 - 5; (ii) a complete model description, the empirical exercise, and additional analysis for our quantitative investigations in Section 6; and (iii) all proofs.

Any references to equations, figures, tables, assumptions, propositions, lemmas, or sections that are not preceded by "A."—"C." refer to the main article.

A Supplementary details for the theoretical analysis

Appendix A.1 provides further details for the headline environment of Section 2 (with lump-sum fiscal adjustments), while Appendix A.2 does the same for the environment of Section 5 (with distortionary adjustments). We next extend our positive results to generic budgetary shortfalls in Appendix A.3, and our normative conclusions to productivity shocks in Appendix A.4. Finally Appendix A.5 briefly presents the model calibration for our illustrative simulations.

Throughout we log-linearize around a deterministic steady state in which inflation is zero ($\Pi^{ss} = 1$), real allocations are given by their flexible-price counterparts (e.g., Y^{ss} equals flexible-price output), and the real debt burden is constant at some given level $D^{ss} \geq 0$. As discussed further below, our assumptions on annuities and on the social fund ensure that $R^{ss} = \frac{1}{\beta} > 1$, and that steady-state taxes satisfy $T^{ss} = (1-\beta)D^{ss}$. While we will throughout focus on the empirically relevant scenario with $D^{ss} > 0$, we wish to also accommodate $D^{ss} = 0$, so we let $d_t \equiv (D_t - D^{ss})\,/\,Y^{ss}$, $t_t \equiv (T_t - T^{ss})\,/\,Y^{ss}$, and $a_{i,t} = \left(A_{i,t} - A^{ss}\right)/\,Y^{ss}$—i.e., we measure fiscal variables (and thus also household wealth) in terms of absolute deviations (rather than log-deviations) from steady state, scaled by steady-state output. Otherwise, lowercase variables denote (log-)deviations from the steady state.

A.1 Environment with lump-sum fiscal adjustments

We proceed as in Section 2: first aggregate demand, then supply, and then policy.

Aggregate demand. The household block follows from Angeletos et al. (2024, 2025), which is restated here for completeness. The economy is populated by a unit continuum of households. A household survives from one period to the next with probability $\omega \in (0,1)$ and is replaced by a new one whenever it dies. Households have standard separable preferences regarding consumption and labor, and do not consider the utility of future households that replace them. The expected utility of any (alive) household i in period $t \in \{0, 1, \ldots\}$ is hence

$$\mathbb{E}_t \left[\sum_{k=0}^{\infty} (\beta\omega)^k \, e^{\sum_{s=0}^{k-1} \nu_{t+s}} \left[\frac{C_{i,t+k}^{1-\frac{1}{\sigma}} - 1}{1-\frac{1}{\sigma}} - \iota \frac{L_{i,t+k}^{1+\frac{1}{\varphi}}}{1+\frac{1}{\varphi}} \right] \right], \tag{A.1}$$

where $C_{i,t+k}$ and $L_{i,t+k}$ denote household i's consumption and labor supply in period $t+k$ (conditional on survival), β is the steady-state household discount factor, and ν_t is the discount-rate shock.

Households can save and borrow through an actuarially fair, risk-free, real annuity, backed by government bonds. Conditional on survival, households receive a real return R_t/ω, where R_t is the real rate of interest rate between period t and $t+1$. Households furthermore receive labor income and dividend income $W_t L_{i,t}$ and $Q_{i,t}$ (both in real terms), and pay taxes. The real tax payment $T_{i,t}$

depends on both the individual's income and aggregate fiscal conditions:

$$T_{i,t} = \tau_y Y_{i,t} + \bar{T} + \tau_d \left(D_t - D^{ss}\right) + \frac{D^{ss}}{(R^{ss})^2}\left(R_t - R^{ss}\right), \tag{A.2}$$

where $Y_{i,t} \equiv W_t L_{i,t} + Q_{i,t}$ is the household's total real income, $\tau_y \in (0,1]$ is the proportional tax rate on their income, $\bar{T} = T^{ss} - \tau_y Y^{ss}$ is set to guarantee budget balance at steady state, $\tau_d \in [0,1)$ is a scalar that parameterizes the speed of fiscal adjustment, and the last term captures the automatic offset of the budgetary effects of interest rate changes. After (log-)linearization and aggregation, (A.2) becomes the tax rule (5) in the main text.

Old households make contributions to a "social fund" whose proceeds are distributed to newborn households. We use $S_{i,t}$ to denote the transfers from or contributions to the fund, with $S_{i,t} = S^{\text{new}} = D^{ss} > 0$ for newborns and $S_{i,t} = S^{\text{old}} = -\frac{1-\omega}{\omega} D^{ss} < 0$ for old households. This guarantees $(1-\omega)S^{\text{new}} + \omega S^{\text{old}} = 0$, ensuring that the fund is balanced. The fund thus ensures that all cohorts, regardless of their age, enjoy the same wealth and hence consumption in steady state. This simplifies aggregation and implies that the steady state of our model is the same as its RANK counterpart. In particular, the social fund guarantees—together with the annuities, which offset mortality risk—that the steady-state rate of interest (in the steady state around which we log-linearize) is β^{-1} (thus "$r > g$").

Putting everything together, the date-t budget constraint of household i is given as

$$A_{i,t+1} = \underbrace{\frac{R_t}{\omega}}_{\text{annuity}} \left(A_{i,t} + \underbrace{W_t L_{i,t} + Q_{i,t}}_{Y_{i,t}} - C_{i,t} - T_{i,t}\right) + S_{i,t+1}, \tag{A.3}$$

where $A_{i,t}$ denotes household i's real wealth at the beginning of date t (inclusive of social fund payments). We furthermore assume that all households receive identical shares of dividends, and abstract from heterogeneity in labor supply, with labor supply intermediated by labor unions that demand identical hours worked from all households $L_{i,t} = L_t$.[25] The unions bargain on behalf of those households, equalizing the (post-tax) real wage and the average marginal rate of substitution between consumption and labor supply; i.e., we have that

$$(1-\tau_y)W_t = \frac{\iota L_t^{\frac{1}{\varphi}}}{\int_0^1 C_{i,t}^{-\frac{1}{\sigma}} di}. \tag{A.4}$$

Together, all households receive the same income and face the same taxes, $Y_{i,t} = Y_t$ and $T_{i,t} = T_t$.

Aggregate supply. Log-linearizing (A.4),

$$\frac{1}{\varphi}\ell_t = w_t - \frac{1}{\sigma}c_t. \tag{A.5}$$

[25]This assumption simplifies the analysis by avoiding deficit-driven heterogeneity in the labor supply and income of different generations, without changing the essence of our results.

Together with market clearing ($c_t = y_t$) and technology ($y_t = \ell_t$), this pins down the equilibrium real wage as $w_t = \left(\frac{1}{\varphi} + \frac{1}{\sigma}\right) y_t$.

We now derive the static NKPC (3). Firm optimality together with full myopia—i.e., $\bar{m} = 0$ and so $M^f = 0$ in the cognitive discounting model of Gabaix (2020)—pins down the optimal reset price as a function of current real marginal costs (wages) as well as cost-push shocks,

$$p_t^* - p_t = \left(1 - \beta\theta\right) w_t + \frac{\theta}{1-\theta} u_t \tag{A.6}$$

where p_t^* is optimal reset price in period t, p_t is the price level at period t, $1-\theta \in (0,1)$ is the Calvo reset probability, and the cost-push wedge is normalized such that u_t increases π_t one-to-one in (3). We hence arrive at

$$\pi_t = \frac{1-\theta}{\theta}\left(p_t^* - p_t\right) = \frac{(1-\theta)\left(1-\beta\theta\right)\left(\frac{1}{\varphi} + \frac{1}{\sigma}\right)}{\theta} y_t + u_t \tag{A.7}$$

which is (3) in the main text with $\kappa = \frac{(1-\theta)(1-\beta\theta)\left(\frac{1}{\varphi}+\frac{1}{\sigma}\right)}{\theta} > 0$.

Fiscal policy. The government issues non-contingent, short-term, real debt, with D_t denoting the real value of public debt outstanding at the beginning of period t. In levels, the government's flow budget is

$$D_{t+1} = R_t \left(D_t - T_t\right),$$

where $T_t \equiv \int T_{i,t} di$ is real tax revenue (also, the real primary surplus) in date t. Finally we assume that the government also needs to satisfy a non-Ponzi condition: $\lim_{k\to\infty} \mathbb{E}_t \left[\frac{D_{t+k+1}}{\prod_{l=0}^{k} R_{t+l}}\right] = 0$.

Total tax revenue T_t is determined as a function of exogenous shocks and endogenous outcomes. For each household i, the tax payment $T_{i,t}$, given by (A.2), consists of two components. First, there is a proportional tax $\tau_y \in (0,1]$ on household total income. This tax is distortionary but time-invariant. Second, there is a time-varying lump-sum component, which in turn has three parts: $\tau_d \left(D_t - D^{ss}\right)$, the tax hikes used to help return government debt to steady state; $\bar{T} = T^{ss} - \tau_y Y^{ss}$, ensuring budget balance in steady state; and $\frac{D^{ss}}{(R^{ss})^2}\left(R_t - R^{ss}\right)$, offsetting the budgetary effects of any interest rate movements. Aggregating, total taxes are set as follows:

$$T_t = \tau_y Y_t + \bar{T} + \tau_d \left(D_t - D^{ss}\right) + \frac{D^{ss}}{(R^{ss})^2}\left(R_t - R^{ss}\right). \tag{A.8}$$

Log-linearizing yields (5).

A.2 Environment with distortionary fiscal adjustments

The environment is the same as the one in Section 2 and Appendix A.1, with the sole exception that fiscal adjustment now is distortionary. Specifically, this means that the proportional tax on household total income, given as

$$\tau_{y,t} = \tau_y + \tau_d \frac{D_t - D^{ss}}{Y^{ss}} = \tau_y + t_t^{\text{adj}}, \tag{A.9}$$

is now time-varying, where $t_t^{\text{adj}} = \tau_d d_t = \tau_d \frac{D_t - D^{ss}}{Y^{ss}}$. The household's total real tax payment then becomes

$$T_{i,t} = \tau_{y,t} Y_{i,t} + \bar{T} + \frac{D^{ss}}{(R^{ss})^2}\left(R_t - R^{ss}\right), \tag{A.10}$$

aggregate tax revenue is

$$T_t = \tau_{y,t} Y_t + \bar{T} + \frac{D^{ss}}{(R^{ss})^2}\left(R_t - R^{ss}\right), \tag{A.11}$$

and finally the labor supply condition changes to

$$(1-\tau_{y,t}) W_t = \frac{\iota L_t^{\frac{1}{\varphi}}}{\int_0^1 C_{i,t}^{-\frac{1}{\sigma}} di}. \tag{A.12}$$

Log-linearizing the previous conditions, we have

$$w_t = \frac{1}{\varphi}\ell_t + \frac{1}{\sigma} c_t + \frac{1}{1-\tau_y} t_t^{\text{adj}} \tag{A.13}$$

as well as

$$t_t = \tau_y y_t + t_t^{\text{adj}} + \beta \frac{D^{ss}}{Y^{ss}} r_t, \tag{A.14}$$

which is exactly the same as (5).

Combining these equations with the unchanged government budget constraint (8) and aggregate demand block (2) means that the characterization of the equilibrium outcomes $\left\{y_t, d_{t+1}, t_t\right\}_{t=0}^{\infty}$ given $\{v_t, u_t, r_t\}_{t=0}^{\infty}$ is exactly the same as in Propositions 1 and 5. Turning to the Phillips curve and thus inflation, (A.13) together with market clearing ($c_t = y_t$) and technology ($y_t = \ell_t$) pins down the real wage as $w_t = \left(\frac{1}{\varphi} + \frac{1}{\sigma}\right) y_t + \frac{1}{1-\tau_y} t_t^{\text{adj}}$. Inflation (A.7) is then given by

$$\begin{aligned} \pi_t &= \frac{(1-\theta)\left(1-\beta\theta\right)}{\theta}\left(\left(\frac{1}{\varphi} + \frac{1}{\sigma}\right) y_t + \frac{1}{1-\tau_y} t_t^{\text{adj}}\right) + u_t \\ &= \kappa y_t + \tilde{\kappa} t_t^{\text{adj}} + u_t, \end{aligned}$$

where

$$\tilde{\kappa} = \frac{(1-\theta)\left(1-\beta\theta\right)}{\theta} \frac{1}{1-\tau_y} = \kappa \frac{1}{\left(\frac{1}{\varphi} + \frac{1}{\sigma}\right)\left(1-\tau_y\right)},$$

which microfounds (12).

A.3 Extension to generic budgetary shortfalls

In the main text, we focused on how τ_d affects the impulse responses of output and fiscal adjustments to particular demand and supply shocks. Zooming out, we note that nothing in those discussions really hinged on *why* there was a budgetary shortfall in the first place—we only leveraged the simple idea that postponing any required amount of tax hikes endogenously stimulates the economy and raises fiscal revenue, thus endogenously lessening the actually (in equilibrium) needed fiscal adjustments. This suggests that our "dynamic automatic stabilizer" logic should actually extend to generic budgetary shortfalls. We here confirm this conjecture through the following exercise. We will establish that, if the government along an equilibrium faces a budgetary shortfall at some horizon $t = H$ (in the sense of $d_H > 0$), then delaying period-H fiscal adjustment invariably raises output in all periods relative to the original equilibrium, regardless of the history of shocks that lead to $d_H > 0$.

Formally, we suppose that the fiscal rule is just as considered in the main text (for a baseline τ_d), but then, for some date H, the fiscal adjustment coefficient changes to $\tau_{d,H}$, i.e., the rule (5) is, for $t = H$, replaced by

$$t_H = \tau_y y_H + \tau_{d,H} d_H + \beta \frac{D^{ss}}{Y^{ss}} r_H. \tag{A.15}$$

We then ask how changes in $\tau_{d,H}$ away from τ_d affect the economy. This thought experiment is ideal as it allows us to cleanly isolate the causal effects of tax responses to endogenous budgetary shortfalls at arbitrary horizons H. We arrive at the following characterization of the effects of $\tau_{d,H}$.

Proposition A.1. *Suppose that $\omega < 1$ and that the fiscal authority follows the rule (5) at all dates $t \neq H$ and the rule (A.15) at date $t = H$. Furthermore suppose that the paths of real interest rates $\{r_t\}_{t=0}^{\infty}$ and aggregate shocks $\{v_t, u_t\}_{t=0}^{\infty}$ are such that, for $\tau_{d,H} = \tau_d$, the date-H value of government debt is strictly positive, i.e., $d_H > 0$. Then the equilibrium path of output satisfies*

$$\left.\frac{\partial y_t}{\partial \tau_{d,H}}\right|_{\tau_{d,H}=\tau_d} < 0 \quad \forall t \geq 0. \tag{A.16}$$

Proposition A.1 formalizes the above intuition: whatever the reason for a fiscal budgetary shortfall, and whatever the horizon of that shortfall, delaying the subsequent fiscal adjustment boosts output (and thereby also inflation). In addition to substantiating economic intuition, this result will also prove useful for our quantitative explorations in Section 6, where we allow for inflation and interest rates to also effect budgetary shortfalls (or surpluses), and thus d_t. By Proposition A.1, failing to respond to such shortfalls with fast fiscal adjustment will necessarily be stimulative, and of course *vice versa* for budgetary surpluses.

A.4 Productivity shocks

In this appendix we provide a brief discussion of an alternative model variant in which supply shocks take the form of textbook productivity shocks. We let y_t^* denote the natural level of output (defined exactly as in Galí, 2008), and write the stochastic process for productivity shocks directly in terms of y_t^*. Analogously writing $\hat{y}_t \equiv y_t - y_t^*$ for the output *gap*, our model's equations change as follows: first, the demand relation becomes (we shut down the demand shock $v_t = 0$ for clarity)

$$\hat{y}_t = -\sigma r_t + \frac{\left(1-\beta\omega\right)(1-\omega)}{\omega} d_{t+1} + \mathbb{E}_t\left[\hat{y}_{t+1} + y_{t+1}^* - y_t^*\right], \tag{A.17}$$

where now $\mathbb{E}_t\left[y_{t+1}^* - y_t^*\right]$ appears as a demand wedge; the supply block is

$$\pi_t = \kappa\hat{y}_t + \beta\mathbb{E}_t\left[\pi_{t+1}\right], \tag{A.18}$$

with inflation now driven by output gap; and the law of motion of government debt becomes

$$d_{t+1} = \frac{1-\tau_d}{\beta} d_t - \frac{\tau_y}{\beta}\hat{y}_t - \frac{\tau_y}{\beta} y_t^*, \tag{A.19}$$

where we use that tax revenue is a function of *actual* output, not y_t^*.

Implications for monetary-fiscal interactions. Comparing (A.17) - (A.19) with the equilibrium system studied in the main text, we first of all see that, if the central bank objective still features the actual level of output y_t, then productivity shocks behave exactly like cost-push shocks: the demand block in terms of y_t is unchanged; productivity shocks appear as a wedge in (A.18), just like cost-push shocks; and the fiscal block (A.19) is again unchanged.

Matters change, however, if the central bank objective features the output gap, $\hat{y}_t$. In that case, it follows from (A.17) - (A.19) that technology shocks will be isomorphic to a combination of a demand shock (a wedge in (A.17)) and fiscal deficit shock (a wedge in (A.19)). Importantly for our purposes, however, such a combination of shocks will still favor fast fiscal adjustment, exactly as in our treatment of (cost-push) supply shocks. To see this, consider a contractionary productivity shock and suppose that real rates are not raised sufficiently to track the increase in the natural rates of interest because of $\lambda_r > 0$, so $\hat{y}_t, \pi_t > 0$. Since $y_t < 0$, fiscal revenue decreases, and fast fiscal adjustment is desirable: it induces immediate tax hikes, decreasing y_t and bringing $\hat{y}_t$ and π_t close to zero. It follows that our conclusions about cost-push supply shocks also extend to this section's alternative treatment of productivity supply shocks.

A.5 Illustrative calibrations

We here collect details for the model calibrations used in illustrative simulations in Sections 3 - 5.

Section 3. We begin with the private sector. On the consumer side we set $\beta = 0.99^{\frac{1}{4}}$ for an annual steady-state interest rate of 1 per cent, and $\omega = \beta^{-1} \times 0.7$ for a quarterly MPC of 30 per cent, ensuring that the non-Ricardian effects at the heart of our theory are prominent. We furthermore set $\sigma = 1$ for an elasticity of intertemporal substitution of 1. We assume that households are subject to a reduced-form demand disturbance υ_t that follows an AR(1) process with persistence 0.9. Finally, nominal rigidities on the firm side are such that the overall resulting slope of the NKPC is $\kappa = 0.3$.

Next, turning to policy, we assume $\tau_y = \frac{1}{3}$ for an empirically relevant strength of the usual static automatic stabilizer, and $D^{ss} = 1.79$, matching the total amount of domestically, privately held U.S. government debt (see also the discussion in Angeletos et al., 2025). The fiscal adjustment coefficient τ_d is varied as our main experiment of interest, and throughout we set $H = 300$ as the horizon after which the fiscal authority adjusts to perfectly stabilize real debt, if necessary, consistent with the equilibrium refinement discussed in our earlier work, Angeletos et al. (2025). Monetary policy in all exercises just fixes the real rate of interest.

Section 4. The private sector is parameterized exactly as in Section 3, and now subject to both demand and supply shocks that follow AR(1) processes with persistence 0.9. For the strength of automatic stabilizers we consider the same baseline value as above ($\tau_y = \frac{1}{3}$), but also report results for $\tau_y = 1$ as a counterfactually strong automatic stabilizer. Finally, for the monetary authority, our assumptions on the objective function (6) follow the Federal Reserve Tealbook (2016, as well as previous Tealbooks), imposing equal weights. Since the Federal Reserve's mandate is specified in terms of unemployment and not output, we use a simple Okun's law coefficient of $\frac{1}{2}$ to translate to output space; annualizing interest rates and inflation, this gives $\lambda_r = \lambda_\pi = 16$ and $\lambda_y = 0.25$.

Section 5. We consider the exact same model parameterization as for Sections 3 - 4, with the only change being the addition of the distortionary tax term in the NKPC (12). We see $\tilde{\kappa} = 3 \times \kappa = 0.9$, which is large enough to illustrate the possibility of a switch in the supply shock loss function slope. This value, unlike that considered in our quantitative exercise, is not directly disciplined through the NKPC's microfoundations—the analysis is purely designed to illustrate Proposition 7.

B Details for the quantitative analysis

Appendices B.1 - B.2 elaborate further on how we recover the required "sufficient statistics": first policy causal effects, and then the Wold representation of the relevant time series data. Appendix B.3 provides some additional details on how we map those sufficient statistics into our counterfactual.

B.1 Policy causal effects

The first sufficient statistic are the causal effects of monetary and fiscal shocks, $\{\Theta_{x,m}, \Theta_{x,f}\}$. To compute these objects, we first close the model with a pair of determinacy-inducing policy rules; by McKay and Wolf (2023), the particular choice of those rules is irrelevant. We set monetary policy as

$$r_t = \phi y_t \tag{B.1}$$

with $\phi = 0.2$ and fiscal policy as

$$t_t^{\text{adj}} = \tau_d d_t \tag{B.2}$$

with $\tau_d = 0.1$. We then compute impulse responses to shocks to (B.1) and (B.2) at all horizons, truncating at $T = 500$. We store those impulse responses as the columns of the desired matrices $\{\Theta_{x,m}, \Theta_{x,f}\}$.

As in our quantitative explorations in Sections 3 - 5, we assume that, after horizon $H = 300$, the fiscal authority adjusts to perfectly stabilize real debt, if necessary, again motivated by the equilibrium refinement discussed in our earlier work, Angeletos et al. (2025).

B.2 Second moments

We wish to estimate the Wold representation of four aggregate time series: output, inflation, the monetary policy rate, and real government debt. These series are constructed as follows, with series names referring to FRED mnemonics. All series are quarterly.

- *Output.* We take log output per capita from FRED (`A939RX0Q048SBEA`). We then transform the series to stationarity following Hamilton (2018).
- *Inflation.* We compute the log-differenced GDP deflator (`GDPDEF`), without further transformations, corresponding to quarterly inflation.
- *Federal funds rate.* We obtain the series `FEDFUNDS` and divide by four, for the quarterly nominal rate of interest.
- *Real government debt.* We take nominal federal debt (`GFDEBTN`), and then deflate using the GDP deflator (`GDPDEF`). We transform the series to stationarity following Hamilton (2018).

Our sample begins in 1981:Q1 and ends just before Covid-19, in 2019:Q4. We estimate the Wold representation using a reduced-form VAR, including a constant and deterministic time trend. Consistent with the recommendations of Montiel Olea et al. (2024) we consider a relatively large number of lags, $p = 8$. All results are reported for OLS point estimates. For the main business-cycle shock analysis we proceed exactly as in Angeletos et al. (2020), maximizing the shock's contribution to business-cycle fluctuations in output, and again restricting attention to OLS point estimates.

B.3 Policy counterfactual computation

We here give a high-level overview of how we map the two "sufficient statistics" into the counterfactual central bank loss $\mathscr{L}(\tau_d)$, with detailed formulas provided in the proof of Proposition 8.

The argument proceeds in three steps. First, note that the monetary policy shock causal effects $\Theta_{x,m}$ are defined given the initial (and arbitrary) fiscal rule (B.2). Using the effects of policy shocks to that fiscal rule, $\Theta_{x,f}$, we can evaluate how monetary shocks would counterfactually propagate if the fiscal feedback rule were instead given by the hypothesized particular counterfactual fiscal rule (21), denoted $\Theta_{x,m}^{\tau_d}$. Second, we next seek to find an implicit targeting rule that minimizes the hypothesized central bank loss function (19). Since $\Theta_{x,m}^{\tau_d}$ provides a full characterization of how monetary policy can shape the macro-economy given the assumed fiscal backdrop (21), it immediately pins down that desired targeting rule, by Proposition 2 of McKay and Wolf (2023). And third, given this monetary rule (and given the assumed fiscal rule (21)), we can leverage Proposition 1 in Caravello et al. to turn the actual Wold representation (22) into a counterfactual Wold representation $\tilde{\Psi}(L)$, and from here evaluate all desired counterfactual statistics, including in particular $\mathscr{L}(\tau_d)$.

C Proofs

C.1 Proof of Lemma 1

From (2), (4), and (5), we have, for all $t \geq 0$,

$$y_t = \frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}(1-\tau_d)}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} d_t + \frac{1}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} y_{t+1} - \frac{\sigma}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}(r_t + v_t) \tag{C.1}$$

$$d_{t+1} = \frac{1}{\beta}\left((1-\tau_d) d_t - \tau_y y_t\right). \tag{C.2}$$

As a result,

$$\begin{pmatrix} d_{t+1} \\ y_{t+1} \end{pmatrix} = \begin{pmatrix} \frac{1-\tau_d}{\beta} & -\frac{\tau_y}{\beta} \\ -\frac{(1-\beta\omega)(1-\omega)(1-\tau_d)}{\beta\omega} & 1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y \end{pmatrix} \begin{pmatrix} d_t \\ y_t \end{pmatrix} + \begin{pmatrix} 0 \\ \sigma(r_t + v_t) \end{pmatrix} \tag{C.3}$$

Note that $\tau_y \in (0,1]$ and $\tau_d \in [0,1)$. The two eigenvalues of the system are given by the solutions of

$$\lambda^2 - \lambda\left(\frac{1}{\beta}(1-\tau_d) + 1 + \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)\right) + \frac{1}{\beta}(1-\tau_d) = 0,$$

with

$$\begin{aligned}
\lambda_1 &= \frac{\left(\frac{1}{\beta}(1-\tau_d) + 1 + \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)\right) + \sqrt{\left(1 + \frac{1}{\beta}(1-\tau_d) + \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)\right)^2 - 4\frac{1}{\beta}(1-\tau_d)}}{2} \\
&= \frac{\left(\frac{1}{\beta}(1-\tau_d) + 1 + \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)\right) + \sqrt{\left(1 - \frac{1}{\beta}(1-\tau_d) - \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)\right)^2 + 4\frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)}}{2} \\
&> \frac{\left(\frac{1}{\beta}(1-\tau_d) + 1 + \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)\right) + \left|1 - \frac{1}{\beta}(1-\tau_d) - \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)\right|}{2} \geq 1
\end{aligned} \tag{C.4}$$

and

$$\begin{aligned}
\lambda_2 &= \frac{\left(\frac{1}{\beta}(1-\tau_d) + 1 + \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)\right) - \sqrt{\left(1 + \frac{1}{\beta}(1-\tau_d) + \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)\right)^2 - 4\frac{1}{\beta}(1-\tau_d)}}{2} \\
&= \frac{\left(\frac{1}{\beta}(1-\tau_d) + 1 + \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)\right) - \sqrt{\left(1 - \frac{1}{\beta}(1-\tau_d) - \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)\right)^2 + 4\frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)}}{2} \\
&< \frac{\left(\frac{1}{\beta}(1-\tau_d) + 1 + \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega)\right) - \left|\frac{1}{\beta}(1-\tau_d) + \frac{1-\beta\omega}{\beta\omega}\tau_y(1-\omega) - 1\right|}{2} \leq 1,
\end{aligned} \tag{C.5}$$

with $\lambda_2 > 0$ too since $\lambda_1\lambda_2 = \frac{1}{\beta}(1-\tau_d) > 0$. Now let $(1, \chi_2)'$ denote the eigenvectors associated with $\lambda_2 \in [0,1)$. We then have

$$\lambda_2 = \frac{1}{\beta}\left(1 - \tau_d - \tau_y\chi_2\right) \quad \text{and} \quad \chi_2 = \frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}(1-\tau_d)}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y - \lambda_2} > 0. \tag{C.6}$$

Because $\lambda_1 > 1$, and $\lambda_2 \in (0,1)$, we know that there is unique bounded solution of (C.3) based on Blanchard and Kahn (1980). We guess and verify that such a solution takes the form, for all $t \geq 0$, of

$$y_t = \chi d_t - \sigma \sum_{k=0}^{\infty} \chi_v^{k+1} (v_{t+k} + r_{t+k}) \tag{C.7}$$

$$d_{t+1} = \rho_d d_t + \frac{\tau_y \sigma}{\beta} \sum_{k \geq 0} \chi_v^{k+1} (r_{t+k} + v_{t+k}) \tag{C.8}$$

where χ, ρ_d, and χ_v are given by

$$\chi = \chi_2 > 0 \quad , \rho_d = \lambda_2 \in (0,1), \quad \text{and} \quad \chi_v = \frac{1}{1 + \frac{\tau_y}{\beta}\left(\chi + \frac{(1-\beta\omega)(1-\omega)}{\omega}\right)} \in (0,1), \tag{C.9}$$

and are continuous functions of $\left(\beta, \omega, \tau_y, \tau_d\right)$. Because (C.3) is equivalent to (C.1)-(C.2), we only need to verify that (C.7)-(C.8) satisfies (C.1)-(C.2).

From (C.6), we know that $\rho_d = \frac{1}{\beta}\left(1 - \tau_d - \tau_y \chi\right)$ so (C.7)-(C.8) satisfies (C.2). To verify (C.1), we start from its right-hand side and substitute y_{t+1} based on (C.7) at $t+1$ and arrive at

$$\begin{aligned} \text{right-hand side of (C.1)} = & \frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}(1-\tau_d)}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} d_t + \frac{1}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}\left(\chi d_{t+1} - \sigma \sum_{k=0}^{\infty} \chi_v^{k+1} (r_{t+1+k} + v_{t+1+k})\right) \\ & - \frac{\sigma}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} (r_t + v_t). \end{aligned}$$

We then substitute d_{t+1} based (C.8) and arrive at

$$\begin{aligned} & \text{right-hand side of (C.1)} \\ = & \left[\frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}(1-\tau_d)}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} + \frac{\chi \rho_d}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}\right] d_t + \frac{\sigma}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}\left[\chi\frac{\tau_y}{\beta} - \frac{1}{\chi_v}\right] \sum_{k=0}^{\infty} \chi_v^{k+1} (r_{t+k} + v_{t+k}). \end{aligned}$$

From (C.6) and (C.9), we know that

$$\chi = \frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}(1-\tau_d)}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} + \frac{\chi \rho_d}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}$$

$$-\sigma = \frac{\sigma}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}\left(\chi\frac{\tau_y}{\beta} - \frac{1}{\chi_v}\right).$$

As a result, the right-hand side of (C.1) equals its left-hand side given (C.7)-(C.8). This finishes the proof that (C.7)-(C.8) are indeed the unique bounded solution of (C.3).

Given (C.7)-(C.8), we can then find π_t from (3) and t_t from the fiscal rule (5) and verify that the entire equilibrium path $\{y_t, \pi_t, d_{t+1}, t_t, r_t\}_{t=0}^{\infty}$ satisfies Definition 1. This proves the existence and uniqueness of the equilibrium.

From (C.8) and $d_0 = 0$, we have

$$d_t = \frac{\tau_y \sigma}{\beta} \sum_{u=0}^{t-1} \rho_d^{t-1-u} \sum_{k\geq 0} \chi_v^{k+1} \left(r_{u+k} + v_{u+k}\right).$$

Substituting into (C.7) and collecting coefficients of r_s (or v_s) yields that y_t takes the form of (7) with

$$\mathscr{Y}_{t,s} = \frac{\chi \tau_y \sigma}{\beta} \sum_{u=0}^{\min\{s,t-1\}} \rho_d^{t-1-u} \chi_v^{s-u+1} - \sigma \mathbf{1}\{s \geq t\} \chi_v^{s-t+1} \quad \forall t, s \geq 0, \tag{C.10}$$

which is a continuous function of $\left(\beta, \omega, \tau_y, \tau_d\right)$. This concludes the proof of Lemma 1. Furthermore, when $0 \leq s < t$,

$$\mathscr{Y}_{t,s} = \frac{\chi \tau_y \sigma}{\beta} \sum_{u=0}^{s} \rho_d^{t-1-u} \chi_v^{s-u+1} = \frac{\chi \tau_y \sigma \chi_v}{\beta\left(1-\rho_d \chi_v\right)} \rho_d^{t-s-1} \left[1 - \left(\rho_d \chi_v\right)^{s+1}\right]. \tag{C.11}$$

When $0 \leq t \leq s$,

$$\mathscr{Y}_{t,s} = \sigma \chi_v^{s-t+1} \left(\frac{\chi \tau_y \chi_v}{\beta\left(1-\rho_d \chi_v\right)} \left(1 - \left(\rho_d \chi_v\right)^t\right) - 1 \right), \tag{C.12}$$

where $1 - \rho_d \chi_v \in (0,1)$.

C.2 Proof of Proposition 1

From (C.5) and (C.9), we know

$$\rho_d = \lambda_2 = f(a,b) \equiv \frac{a+b+1-\sqrt{(a+b-1)^2 + 4b}}{2} \in (0,1) \tag{C.13}$$

where $a = \frac{1}{\beta}\left(1-\tau_d\right) > 0$ and $b = \frac{1-\beta\omega}{\beta\omega} \tau_y (1-\omega) > 0$. Since $\frac{\partial f}{\partial a} = \frac{1}{2} - \frac{(a+b-1)}{2\sqrt{(a+b-1)^2+4b}} > 0$, we know that $\frac{\partial \rho_d}{\partial \tau_d} < 0$ for $\tau_d \in [0,1)$. From (C.6) and (C.9), we then know

$$\chi = \frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\left(1-\tau_d\right)}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y - \rho_d}.$$

Because its numerator has a negative partial derivative with respect to τ_d and its denominator has positive partial derivative with respect to τ_d, we have $\frac{\partial \chi}{\partial \tau_d} < 0$ for $\tau_d \in [0,1)$. From (C.9), we also know

$$\chi_v = \frac{1}{1 + \frac{\tau_y}{\beta}\left(\chi + \frac{(1-\beta\omega)(1-\omega)}{\omega}\right)}$$

and $\frac{\partial \chi_v}{\partial \tau_d} > 0$ for $\tau_d \in [0,1)$. We now prove that $\frac{\partial \mathscr{Y}_{t,s}}{\partial \tau_d} < 0$ for $\tau_d \in [0,1)$.

- **Case 1.** When $0 \leq s < t$, we can re-write (C.11) as

$$\mathscr{Y}_{t,s} = \sigma\left(1-\chi_v\right)\rho_d^{t-s} \sum_{j=0}^{s} \left(\rho_d \chi_v\right)^j, \tag{C.14}$$

where $\rho_d \chi_v \in (0,1)$ and we use (C.6) and (C.9) to substitute

$$\frac{\chi \tau_y \chi_v}{\beta(1-\chi_v)} = \frac{\chi}{\chi + \frac{(1-\beta\omega)(1-\omega)}{\omega}} = \rho_d, \tag{C.15}$$

because (C.6) and (C.9) imply

$$\chi = \frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\left(\beta\rho_d + \tau_y \chi\right)}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y - \rho_d} = \frac{(1-\beta\omega)(1-\omega)\rho_d}{\omega(1-\rho_d)}.$$

Treating ρ_d and χ_v as independent arguments, we compute

$$\frac{\partial \mathscr{Y}_{t,s}}{\partial \rho_d} = \sigma(1-\chi_v)\left[(t-s)\rho_d^{t-s-1}\sum_{j=0}^{s}(\rho_d\chi_v)^j + \rho_d^{t-s}\sum_{j=1}^{s} j(\rho_d\chi_v)^{j-1}\chi_v\right] > 0 \tag{C.16}$$

$$\begin{aligned}\frac{\partial \mathscr{Y}_{t,s}}{\partial \chi_v} &= \sigma\rho_d^{t-s}\left[-\sum_{j=0}^{s}(\rho_d\chi_v)^j + (1-\chi_v)\sum_{j=1}^{s} j(\rho_d\chi_v)^{j-1}\rho_d\right] \\ &< \sigma\rho_d^{t-s}\left[-\sum_{j=0}^{s}(\rho_d\chi_v)^j + (1-\rho_d\chi_v)\sum_{j=1}^{s} j(\rho_d\chi_v)^{j-1}\right] \\ &= -\sigma\rho_d^{t-s}(s+1)(\rho_d\chi_v)^s < 0.\end{aligned} \tag{C.17}$$

By the chain rule,

$$\frac{\partial \mathscr{Y}_{t,s}}{\partial \tau_d} = \frac{\partial \mathscr{Y}_{t,s}}{\partial \rho_d}\frac{\partial \rho_d}{\partial \tau_d} + \frac{\partial \mathscr{Y}_{t,s}}{\partial \chi_v}\frac{\partial \chi_v}{\partial \tau_d} < 0.$$

- **Case 2.** When $0 \le t \le s$, we can again use (C.15) to re-write (C.12) as

$$\begin{aligned}\mathscr{Y}_{t,s} &= \sigma\chi_v^{s-t+1}\left(\rho_d(1-\chi_v)\sum_{j=0}^{t-1}(\rho_d\chi_v)^j - 1\right) \quad \forall t \ge 1 \\ \mathscr{Y}_{0,s} &= -\sigma\chi_v^{s+1}.\end{aligned}$$

Treating ρ_d and χ_v as independent arguments, we compute, for $t \ge 1$,

$$\frac{\partial \mathscr{Y}_{t,s}}{\partial \rho_d} = \sigma\chi_v^{s-t+1}\left[(1-\chi_v)\sum_{j=0}^{t-1}(\rho_d\chi_v)^j + \rho_d(1-\chi_v)\sum_{j=1}^{t-1} j(\rho_d\chi_v)^{j-1}\chi_v\right] > 0 \tag{C.18}$$

$$\begin{aligned}\frac{\partial \mathscr{Y}_{t,s}}{\partial \chi_v} &= \sigma(s-t+1)\chi_v^{s-t}\left(\rho_d(1-\chi_v)\sum_{j=0}^{t-1}(\rho_d\chi_v)^j - 1\right) + \\ &+ \sigma\chi_v^{s-t+1}\left[-\rho_d\sum_{j=0}^{t-1}(\rho_d\chi_v)^j + \rho_d^2(1-\chi_v)\sum_{j=1}^{t-1} j(\rho_d\chi_v)^{j-1}\right].\end{aligned} \tag{C.19}$$

Using the fact that $\rho_d(1-\chi_v) < 1-\rho_d\chi_v < 1$ and

$$(1-\rho_d\chi_v)\sum_{j=1}^{t-1} j(\rho_d\chi_v)^{j-1} = \sum_{j=0}^{t-2}(\rho_d\chi_v)^j - (t-1)(\rho_d\chi_v)^{t-1}.$$

we have

$$\frac{\partial \mathscr{Y}_{t,s}}{\partial \chi_v} < -\sigma(s-t+1)\chi_v^{s-t}\left(\rho_d\chi_v\right)^t + \sigma\chi_v^{s-t+1}\left[-\rho_d\sum_{j=0}^{t-1}\left(\rho_d\chi_v\right)^j + \rho_d\left(\sum_{j=0}^{t-2}\left(\rho_d\chi_v\right)^j - (t-1)\left(\rho_d\chi_v\right)^{t-1}\right)\right]$$

$$= -\sigma(s+1)\chi_v^{s-t}\left(\rho_d\chi_v\right)^t < 0 \quad \forall t \geq 1.$$

Moreover, $\frac{\partial \mathscr{Y}_{0,s}}{\partial \rho_d} = 0$ and $\frac{\partial \mathscr{Y}_{0,s}}{\partial \chi_v} = -\sigma(s+1)\chi_v^s < 0$. Together, by the chain rule,

$$\frac{\partial \mathscr{Y}_{t,s}}{\partial \tau_d} = \frac{\partial \mathscr{Y}_{t,s}}{\partial \rho_d}\frac{\partial \rho_d}{\partial \tau_d} + \frac{\partial \mathscr{Y}_{t,s}}{\partial \chi_v}\frac{\partial \chi_v}{\partial \tau_d} < 0 \quad \forall t \geq 0. \tag{C.20}$$

This finishes the proof of part a).

For part b), the fact that

$$\frac{\partial}{\partial \tau_d}\sum_{t=0}^{\infty}\beta^t\mathscr{Y}_{t,s} < 0$$

and thus that $\sum_{t=0}^{\infty}\beta^t\mathscr{Y}_{t,s}$ decreases with $\tau_d \in [0,1)$ follows from part a). To prove that $\sum_{t=0}^{\infty}\beta^t\mathscr{Y}_{t,s}$ converges to zero as $\tau_d \to 0$, we first prove that $\sum_{t=0}^{\infty}\beta^t\mathscr{Y}_{t,s}$ is continuous for all $s \geq 0$. To this end note that

$$\sum_{t=0}^{\infty}\beta^t\mathscr{Y}_{t,s} = \sum_{t=0}^{s}\beta^t\mathscr{Y}_{t,s} + \sum_{t=s+1}^{\infty}\beta^t\mathscr{Y}_{t,s}.$$

The first term of the right-hand is continuous in $\tau_d \in [0,1)$ because $\mathscr{Y}_{t,s}$ is continuous in $\tau_d \in [0,1)$ based on Lemma 1. Based on (C.14), the second term of the right-hand is given by

$$\sum_{t=s+1}^{\infty}\beta^t\mathscr{Y}_{t,s} = \sigma\left(1-\chi_v\right)\frac{\rho_d\beta^{s+1}}{1-\beta\rho_d}\sum_{j=0}^{s}\left(\rho_d\chi_v\right)^j,$$

which is also continuous in $\tau_d \in [0,1)$ because χ_v and ρ_d are continuous in $\tau_d \in [0,1)$ from Lemma 1.

When $\tau_d = 0$, we know that, in any bounded equilibrium according to Definition 1,

$$\sum_{t=0}^{\infty}\beta^t t_t^{\text{adj}} = \tau_d\sum_{t=0}^{\infty}\beta^t d_t = 0.$$

From (8), we then know that

$$\sum_{t=0}^{\infty}\beta^t y_t = 0$$

for arbitrary bounded $\{v_s, r_s\}_{s=0}^{\infty}$. From (7), we then know that

$$\sum_{t=0}^{\infty}\beta^t\mathscr{Y}_{t,s} = 0$$

for all $s \geq 0$. This completes the argument.

C.3 Proof of Proposition 2

Let $h = \{u_t, v_t\}_{t=0}^{\infty}$ denote the realized aggregate shock and $J\left(\{r_t(h)\}_{t=0}^{\infty}, h, \tau_d\right)$ denote the ex post central bank loss in the equilibrium characterized in Lemma 1 given h and $\{r_t(h)\}_{t=0}^{\infty}$. The ex ante central bank loss $\mathscr{L}_{CB}$ is then given by

$$\begin{aligned}
\mathscr{L}_{CB} &= \mathbb{E}\left[\min_{\{r_t(h)\}_{t=0}^{\infty}} J\left(\{r_t(h)\}_{t=0}^{\infty}, h, \tau_d\right)\right] = \mathbb{E}\left[J\left(\left\{r_t^*(h)\right\}_{t=0}^{\infty}, h, \tau_d\right)\right] \\
&= \frac{1}{2}\mathbb{E}\left[\sum_{t=0}^{\infty}\beta^t\left\{\lambda_\pi\left(\pi_t^*(h)\right)^2 + \lambda_y\left(y_t^*(h)\right)^2 + \lambda_r\left(r_t^*(h)^2\right\}\right],
\end{aligned}$$

where, from (7) and (9), we have

$$y_t^*(h) = \sum_{s=0}^{\infty}\mathscr{Y}_{t,s}\left(v_s + r_s^*(h)\right) \quad \text{and} \quad \pi_t^*(h) = \sum_{s=0}^{\infty}\kappa\mathscr{Y}_{t,s}\left(v_s + r_s^*(h)\right) + u_t.$$

Given the boundedness of $\{u_t, v_t\}_{t=0}^{\infty}$ and Lemma 1, one can then apply the envelope theorem

$$\begin{aligned}
\frac{\partial\mathscr{L}_{CB}}{\partial\tau_d} &= \mathbb{E}\left[\frac{\partial J\left(\left\{r_t^*(h)\right\}_{t=0}^{\infty}, h, \tau_d\right)}{\partial\tau_d}\right] \\
&= \mathbb{E}\left[\sum_{t=0}^{\infty}\beta^t\left\{\left(\lambda_\pi\kappa\pi_t^*(h) + \lambda_y y_t^*(h)\right)\left(\sum_{s=0}^{\infty}\frac{\partial\mathscr{Y}_{t,s}}{\partial\tau_d}\left(v_s + r_s^*(h)\right)\right)\right\}\right],
\end{aligned}$$

which proves the Proposition.

C.4 Proof of Proposition 3

Consider the case that the demand shock is fully transitory: $v_0 \neq 0$ and $v_t = 0$ for all $t \geq 1$ and $u_t = 0$ for all $t \geq 0$. Moreover, the monetary and fiscal authority together frictionlessly implement perfect stabilization of the economy after $t = 2$, i.e., $y_t = \pi_t = r_t = d_{t+1} = 0$ for all $t \geq 2$. For example, this can be uniquely implemented by a rule

$$t_t = d_t + \beta\frac{D^{ss}}{Y^{ss}}r_t \quad \text{and} \quad r_t = \phi y_t \quad \forall t \geq 2,$$

where $\phi > 0$. Fiscal policy still takes the form of (5) for $t = 0, 1$. In this case, the equilibrium dynamics in (2)-(5) can be summarized by

$$
\begin{aligned}
y_0 &= -\sigma\left(r_0 - \frac{(1-\beta\omega)(1-\omega)}{\sigma\omega} d_1\right) + y_1 - \sigma v_0 \\
y_1 &= -\sigma\left(r_1 - \frac{(1-\beta\omega)(1-\omega)}{\sigma\omega} d_2\right) \\
\pi_0 &= \kappa y_0 \\
\pi_1 &= \kappa y_1 \\
d_2 &= \frac{1-\tau_d}{\beta} d_1 - \frac{\tau_y}{\beta} y_1 \\
d_1 &= -\frac{\tau_y}{\beta} y_0,
\end{aligned}
$$

which implies

$$
y_0 = \sigma \frac{-(v_0 + r_0)\left(1 + \frac{\Omega\tau_y}{\beta}\right) - r_1}{\left(1 + \frac{\Omega\tau_y}{\beta}\right)^2 + \frac{\Omega(1-\tau_d)\tau_y}{\beta^2}} \quad \text{and} \quad y_1 = \sigma \frac{\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}(v_0 + r_0) - r_1\left(1 + \frac{\Omega\tau_y}{\beta}\right)}{\left(1 + \frac{\Omega\tau_y}{\beta}\right)^2 + \frac{\Omega(1-\tau_d)\tau_y}{\beta^2}}, \tag{C.21}
$$

where $\Omega = \frac{(1-\beta\omega)(1-\omega)}{\omega}$. The central bank's ex post problem can be written as

$$
\min_{r_0, r_1} \frac{1}{2}\left(\lambda y_0^2 + r_0^2 + \beta\lambda y_1^2 + r_1^2\right) \quad \text{s.t.} \quad \text{(C.21)},
$$

where $\lambda \equiv (\lambda_y + \lambda_\pi \kappa^2)/\lambda_r$. The first order conditions for the optimal r_0^* and r_1^* imply

$$
0 = r_0 + \lambda y_0^* \frac{\partial y_0^*}{\partial r_0} + \beta\lambda y_1^* \frac{\partial y_1^*}{\partial r_0} \quad \text{and} \quad 0 = \frac{\partial \mathscr{L}}{\partial r_1} = r_1 + \lambda y_0^* \frac{\partial y_0^*}{\partial r_1} + \beta\lambda y_1^* \frac{\partial y_1^*}{\partial r_1}.
$$

Substituting the derivatives based on (C.21) and rearranging gives the targeting relations.

$$
\begin{aligned}
r_0^* &= \frac{\lambda\sigma}{\left(1 + \frac{\Omega\tau_y}{\beta}\right)^2 + \frac{\Omega(1-\tau_d)\tau_y}{\beta^2}} \left[\left(1 + \frac{\Omega\tau_y}{\beta}\right) y_0^* - \frac{\Omega(1-\tau_d)\tau_y}{\beta} y_1^*\right] \\
r_1^* &= \frac{\lambda\sigma}{\left(1 + \frac{\Omega\tau_y}{\beta}\right)^2 + \frac{\Omega(1-\tau_d)\tau_y}{\beta^2}} \left[y_0^* + \beta\left(1 + \frac{\Omega\tau_y}{\beta}\right) y_1^*\right].
\end{aligned}
$$

Together with (C.21), we have

$$r_0^* = -\frac{\lambda\sigma^2\Big[(1+\frac{\Omega\tau_y}{\beta})^2+\beta\Big(\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}\Big)^2+\beta\lambda\sigma^2\Big]}{\mathscr{D}(\tau_d)}v_0$$

$$r_1^* = -\frac{(1+\frac{\Omega\tau_y}{\beta})\lambda\sigma^2\Big[1-\frac{\Omega(1-\tau_d)\tau_y}{\beta}\Big]}{\mathscr{D}(\tau_d)}v_0$$

$$y_0^* = -\frac{\sigma(1+\frac{\Omega\tau_y}{\beta})\Big[(1+\frac{\Omega\tau_y}{\beta})^2+\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}+\beta\lambda\sigma^2\Big]}{\mathscr{D}(\tau_d)}v_0$$

$$y_1^* = \frac{\sigma\Big[\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}\Big((1+\frac{\Omega\tau_y}{\beta})^2+\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}\Big)+\lambda\sigma^2\Big]}{\mathscr{D}(\tau_d)}v_0,$$

where

$$\mathscr{D}(\tau_d) = (1+\frac{\Omega\tau_y}{\beta})^4+2(1+\frac{\Omega\tau_y}{\beta})^2\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}+(1+\beta)\lambda\sigma^2(1+\frac{\Omega\tau_y}{\beta})^2+\big(1+\beta\lambda\sigma^2\big)\big(\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}\big)^2+\beta\lambda^2\sigma^4+\lambda\sigma^2>0.$$

As a result, the central bank's ex ante loss is given by

$$\begin{aligned}\mathscr{L}_{CB} &= \lambda_r\mathbb{E}\left[\frac{1}{2}\left(\lambda\left(y_0^*\right)^2+\left(r_0^*\right)^2+\beta\lambda\left(y_1^*\right)^2+\left(r_1^*\right)^2\right)\right]\\ &= \frac{(\lambda_y+\lambda_\pi\kappa^2)\sigma^2\Big[\big(1+\frac{\Omega\tau_y}{\beta}\big)^2+\beta\big(\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}\big)^2+\beta\lambda\sigma^2\Big]}{2\mathscr{D}(\tau_d)}\mathbb{E}\left[v_0^2\right]\\ \frac{\partial\mathscr{L}_{CB}}{\partial\tau_d} &= \frac{\Omega\tau_y(\lambda_y+\lambda_\pi\kappa^2)\sigma^2\big(1+\frac{\Omega\tau_y}{\beta}\big)^2\Big[1-\frac{\Omega(1-\tau_d)\tau_y}{\beta}\Big]\Big[\big(1+\frac{\Omega\tau_y}{\beta}\big)^2+\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}+\beta\lambda\sigma^2\Big]}{\beta^2\mathscr{D}^2(\tau_d)}\mathbb{E}\left[v_0^2\right],\end{aligned}$$

which means that

$$\frac{\partial\mathscr{L}_{CB}}{\partial\tau_d}>0 \Longleftrightarrow \frac{\beta\omega}{(1-\beta\omega)(1-\omega)}>(1-\tau_d)\tau_y,$$

which implies Proposition 3.

C.5 Proof of Proposition 4

Consider the case that the supply shock is fully transitory: $u_0\neq 0$ and $u_t=0$ for all $t\geq 1$ and $v_t=0$ for all $t\geq 0$. Moreover, the monetary and fiscal authority together frictionlessly implement perfect stabilization of the economy after $t=2$, i.e., $y_t=\pi_t=r_t=d_{t+1}=0$ for all $t\geq 2$. For example, this can be uniquely implemented by a rule

$$t_t = d_t+\beta\frac{D^{ss}}{Y^{ss}}r_t \quad \text{and} \quad r_t=\phi y_t \quad \forall t\geq 2,$$

where $\phi > 0$. Fiscal policy still takes the form of (5) for $t = 0,1$. In this case, the equilibrium dynamics in (2)-(5) can be summarized by

$$y_0 = -\sigma\left(r_0 - \frac{\left(1-\beta\omega\right)(1-\omega)}{\sigma\omega}d_1\right) + y_1$$

$$y_1 = -\sigma\left(r_1 - \frac{\left(1-\beta\omega\right)(1-\omega)}{\sigma\omega}d_2\right)$$

$$\pi_0 = \kappa y_0 + u_0 \tag{C.22}$$

$$\pi_1 = \kappa y_1 \tag{C.23}$$

$$d_2 = \frac{1-\tau_d}{\beta}d_1 - \frac{\tau_y}{\beta}y_1$$

$$d_1 = -\frac{\tau_y}{\beta}y_0,$$

which implies

$$y_0 = \sigma\frac{-r_0\left(1+\frac{\Omega\tau_y}{\beta}\right) - r_1}{\left(1+\frac{\Omega\tau_y}{\beta}\right)^2 + \frac{\Omega(1-\tau_d)\tau_y}{\beta^2}} \quad \text{and} \quad y_1 = \sigma\frac{\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}r_0 - r_1\left(1+\frac{\Omega\tau_y}{\beta}\right)}{\left(1+\frac{\Omega\tau_y}{\beta}\right)^2 + \frac{\Omega(1-\tau_d)\tau_y}{\beta^2}}, \tag{C.24}$$

where $\Omega = \frac{(1-\beta\omega)(1-\omega)}{\omega}$. The central bank's (ex post) problem can be written as

$$\min_{r_0,r_1} \frac{1}{2}\left(\lambda_\pi\pi_0^2 + \lambda_y y_0^2 + \lambda_r r_0^2 + \beta\left(\lambda_\pi\pi_1^2 + \lambda_y y_1^2 + \lambda_r r_1^2\right)\right) \quad \text{s.t.} \quad (\text{C.22}) - (\text{C.24}).$$

The first order conditions for the optimal r_0^* and r_1^* imply

$$0 = \lambda_r r_0^* + \left(\lambda_\pi\kappa\pi_0^* + \lambda_y y_0^*\right)\frac{\partial y_0^*}{\partial r_0} + \beta\left(\lambda_\pi\kappa\pi_1^* + \lambda_y y_1^*\right)\frac{\partial y_1^*}{\partial r_0}$$

$$0 = \lambda_r r_1^* + \left(\lambda_\pi\kappa\pi_0^* + \lambda_y y_0^*\right)\frac{\partial y_0^*}{\partial r_1} + \beta\left(\lambda_\pi\kappa\pi_1^* + \lambda_y y_1^*\right)\frac{\partial y_1^*}{\partial r_1}.$$

Substituting (C.22), (C.23), the derivatives based on (C.24), and rearranging gives the targeting relations

$$r_0^* = \frac{\sigma}{\lambda_r}\frac{\left(1+\frac{\Omega\tau_y}{\beta}\right)\left((\lambda_\pi\kappa^2+\lambda_y)y_0^* + \lambda_\pi\kappa u_0\right) - \frac{\Omega(1-\tau_d)\tau_y}{\beta}(\lambda_\pi\kappa^2+\lambda_y)y_1^*}{\left(1+\frac{\Omega\tau_y}{\beta}\right)^2 + \frac{\Omega(1-\tau_d)\tau_y}{\beta^2}}$$

$$r_1^* = \frac{\sigma}{\lambda_r}\frac{(\lambda_\pi\kappa^2+\lambda_y)y_0^* + \lambda_\pi\kappa u_0 + \beta\left(1+\frac{\Omega\tau_y}{\beta}\right)(\lambda_\pi\kappa^2+\lambda_y)y_1^*}{\left(1+\frac{\Omega\tau_y}{\beta}\right)^2 + \frac{\Omega(1-\tau_d)\tau_y}{\beta^2}}.$$

Together with (C.24), we have

$$r_0^* = \frac{\lambda_\pi \kappa(\beta+\Omega\tau_y)\left[(\lambda_\pi\kappa^2+\lambda_y)+\frac{\lambda_r}{\sigma^2}\left(1+\frac{2\Omega\tau_y}{\beta}+\frac{\Omega^2\tau_y^2+\Omega(1-\tau_d)\tau_y}{\beta^2}\right)\right]}{\sigma\mathscr{G}(\tau_d)}u_0$$

$$r_1^* = \frac{\lambda_\pi \kappa\left[\frac{\Omega(1-\tau_d)\tau_y}{\beta}(\lambda_\pi\kappa^2+\lambda_y)+\frac{\lambda_r}{\sigma^2}\left(1+\frac{2\Omega\tau_y}{\beta}+\frac{\Omega^2\tau_y^2+\Omega(1-\tau_d)\tau_y}{\beta^2}\right)\right]}{\sigma\mathscr{G}(\tau_d)}u_0$$

$$y_0^* = -\lambda_\pi\kappa\frac{\beta(\lambda_\pi\kappa^2+\lambda_y)+\frac{\lambda_r}{\sigma^2}\left(1+\beta\left(1+\frac{\Omega\tau_y}{\beta}\right)^2\right)}{\mathscr{G}(\tau_d)}u_0$$

$$y_1^* = -\frac{\kappa\lambda_\pi\lambda_r\left(1+\frac{\Omega\tau_d\tau_y}{\beta}-\frac{\Omega^2(1-\tau_d)\tau_y^2}{\beta^2}\right)}{\sigma^2\mathscr{G}(\tau_d)}u_0$$

$$\pi_0^* = \left(1-\lambda_\pi\kappa^2\frac{\beta(\lambda_\pi\kappa^2+\lambda_y)+\frac{\lambda_r}{\sigma^2}\left(1+\beta\left(1+\frac{\Omega\tau_y}{\beta}\right)^2\right)}{\mathscr{G}(\tau_d)}\right)u_0$$

$$\pi_1^* = \frac{\frac{\lambda_\pi\lambda_r\kappa^2}{\sigma^2}\left(1+\frac{\Omega\tau_y}{\beta}\right)\left(-1+\frac{\Omega(1-\tau_d)\tau_y}{\beta}\right)}{\mathscr{G}(\tau_d)}u_0,$$

where

$$\mathscr{G}(\tau_d) = \beta(\lambda_\pi\kappa^2+\lambda_y)^2+\frac{\lambda_r}{\sigma^2}(\lambda_\pi\kappa^2+\lambda_y)\left(1+2\beta\left(1+\frac{\Omega\tau_y}{\beta}\right)^2+\frac{\Omega^2(1-\tau_d)^2\tau_y^2}{\beta^2}\right)$$
$$+\left(\frac{\lambda_r}{\sigma^2}\right)^2\left[\beta\left(1+\frac{\Omega\tau_y}{\beta}\right)^4+2\left(1+\frac{\Omega\tau_y}{\beta}\right)^2\left(\frac{\Omega(1-\tau_d)\tau_y}{\beta}\right)+\frac{\Omega^2(1-\tau_d)^2\tau_y^2}{\beta^3}\right]>0.$$

As a result, the ex ante central bank loss is

$$\mathscr{L}_{CB} = \frac{1}{2}\left[\lambda_\pi-\frac{(\lambda_\pi\kappa)^2\left(\beta(\lambda_\pi\kappa^2+\lambda_y)+\frac{\lambda_r}{\sigma^2}\left(1+\beta\left(1+\frac{\Omega\tau_y}{\beta}\right)^2\right)\right)}{\mathscr{G}(\tau_d)}\right]\mathbb{E}\left[u_0^2\right]$$

$$\frac{\partial\mathscr{L}_{CB}}{\partial\tau_d} = -(\lambda_\pi\kappa)^2\frac{\frac{\lambda_r}{\sigma^2}\frac{\Omega\tau_y}{\beta}\left(\beta(\lambda_\pi\kappa^2+\lambda_y)+\frac{\lambda_r}{\sigma^2}\left(1+\beta\left(1+\frac{\Omega\tau_y}{\beta}\right)^2\right)\right)\left(\frac{\lambda_r}{\sigma^2}\left(1+\frac{\Omega\tau_y}{\beta}\right)^2+\Omega(1-\tau_d)\tau_y\left(\frac{\lambda_\pi\kappa^2+\lambda_y}{\beta}+\frac{\lambda_r}{\sigma^2\beta^2}\right)\right)}{\left(\mathscr{G}(\tau_d)\right)^2}\mathbb{E}\left[u_0^2\right].$$

which implies Proposition 4 as $\lambda_r > 0$.

C.6 Proof of Lemma 2

From (4), (5), and $d_0 = 0$, we know that

$$t_t^{\text{adj}} = \tau_d d_t = -\tau_d\frac{\tau_y}{\beta}\sum_{k=1}^{t}\left(\frac{1-\tau_d}{\beta}\right)^{k-1}y_{t-k} \quad \forall t\geq 1.$$

Moreover, $t_0^{\text{adj}} = 0$. Together with Lemma 1, we know that (13) holds with

$$\mathscr{T}_{t,s} = -\sum_{k=1}^{t} \mathscr{B}_k \mathscr{Y}_{t-k,s} \quad \forall t \geq 1, s \geq 0, \tag{C.25}$$

and $\mathscr{T}_{0,s} = 0$ for all $s \geq 0$ with

$$\mathscr{B}_k = \tau_d \frac{\tau_y}{\beta} \left(\frac{1-\tau_d}{\beta} \right)^{k-1} \qquad \forall k \geq 1. \tag{C.26}$$

C.7 Proof of Proposition 5

From (C.26),

$$\sum_{k=1}^{K} \beta^k \mathscr{B}_k = \tau_y \left(1 - (1-\tau_d)^K\right) \quad \forall K \geq 1.$$

It follows that

$$\frac{\partial}{\partial \tau_d} \sum_{k=1}^{K} \beta^k \mathscr{B}_k = K \tau_y (1-\tau_d)^{K-1}.$$

As a result, for any $\tau_d \in [0,1)$, $\frac{\partial}{\partial \tau_d} \sum_{k=1}^{K} \beta^k \mathscr{B}_k > 0$ for all finite $K \geq 1$. Moreover, for any $\tau_d \in (0,1)$, $\sum_{k=1}^{\infty} \beta^k \mathscr{B}_k = \tau_y$. This proves part a) of the proposition.

To prove part b), first note that, for any $\tau_d \in (0,1)$,

$$\begin{aligned}
\sum_{t=0}^{\infty} \beta^t \mathscr{T}_{t,s} &= -\sum_{t=1}^{\infty} \beta^t \sum_{k=1}^{t} \mathscr{B}_k \mathscr{Y}_{t-k,s} \\
&= -\left(\sum_{k=1}^{\infty} \beta^k \mathscr{B}_k \right) \left(\sum_{t=0}^{\infty} \beta^t \mathscr{Y}_{t,s} \right) \\
&= -\tau_y \sum_{t=0}^{\infty} \beta^t \mathscr{Y}_{t,s}.
\end{aligned}$$

When $\tau_d = 0$, we also have that

$$\sum_{t=0}^{\infty} \beta^t \mathscr{T}_{t,s} = 0 = -\tau_y \sum_{t=0}^{\infty} \beta^t \mathscr{Y}_{t,s},$$

where we use that $\sum_{t=0}^{\infty} \beta^t \mathscr{Y}_{t,s} = 0$ from Proposition 1. The fact that $\frac{\partial}{\partial \tau_d} \sum_{t=0}^{\infty} \beta^t \mathscr{Y}_{t,s} < 0$ for $\tau_d \in [0,1)$ from Proposition 1 then implies that $\frac{\partial}{\partial \tau_d} \sum_{t=0}^{\infty} \beta^t \mathscr{T}_{t,s} > 0$ for $\tau_d \in [0,1)$.

We now prove that, for each impulse horizon $t \geq 0$ and news horizon $s \geq 0$, the fiscal adjustment impulse response $\mathscr{T}_{t,s}$ converges to zero as $\tau_d \to 0$. For a given $\tau_y \in (0,1]$,we have

$$\begin{aligned}
&0 < \rho_d \chi_v < \chi_v < \frac{1}{1 + \frac{\tau_y}{\beta} \frac{(1-\beta\omega)(1-\omega)}{\omega}} < 1 \quad \forall \tau_d \in [0,1). \\
&0 < \rho_d \leq \bar{\rho}_d < 1 \quad \forall \tau_d \in [0,1),
\end{aligned}$$

where $\bar{\rho}_d$ is the value of ρ_d when $\tau_d = 0$. From (C.11) and (C.12), we know that $\mathscr{Y}_{t,s}$ is uniformly bounded, that is, there exists a $M_y > 0$ such that

$$\left|\mathscr{Y}_{t,s}\right| \le M_y \quad \forall t,s \ge 0, \tau_d \in [0,1).$$

From (C.26), we know that $\mathscr{B}_k$ converges to zero as $\tau_d \to 0$ for each $k \ge 1$. As a result, from (C.25), for each impulse horizon $t \ge 0$ and news horizon $s \ge 0$, the fiscal adjustment impulse response $\mathscr{T}_{t,s}$ converges to zero as $\tau_d \to 0$.

We now prove the uniform convergence for all $t \ge 0$ given a news horizon $s \ge 0$. We first note that, for all $t \ge s+1$, (C.8) and the fact that $t_t^{\text{adj}} = \tau_d d_t$ together imply

$$\mathscr{T}_{t+1,s} = \rho_d \mathscr{T}_{t,s}. \tag{C.27}$$

Furthermore, from Lemma 1 and Proposition 1 we know that (C.27) together with $\mathscr{T}_{t,s}$ converging to zero as $\tau_d \to 0$ for all $0 \le t \le s+1$ imply the uniform convergence of $\mathscr{T}_{t,s}$ for all $t \ge 0$ as $\tau_d \to 0$.

C.8 Proof of Proposition 6

Let $h = \{u_t, v_t\}_{t=0}^{\infty}$ denote the realized aggregate shock and $J\left(\{r_t(h)\}_{t=0}^{\infty}, h, \tau_d\right)$ denote the ex post central bank loss in the equilibrium characterized given h and $\{r_t(h)\}_{t=0}^{\infty}$ under the Phillips curve (12). The ex ante central bank loss $\mathscr{L}_{CB}$ is then given by

$$\begin{aligned}\mathscr{L}_{CB} &= \mathbb{E}\left[\min_{\{r_t(h)\}_{t=0}^{\infty}} J\left(\{r_t(h)\}_{t=0}^{\infty}, h, \tau_d\right)\right] = \mathbb{E}\left[J\left(\{r_t^*(h)\}_{t=0}^{\infty}, h, \tau_d\right)\right] \\ &= \frac{1}{2}\mathbb{E}\left[\sum_{t=0}^{\infty}\beta^t\left\{\lambda_\pi\left(\pi_t^*(h)\right)^2 + \lambda_y\left(y_t^*(h)\right)^2 + \lambda_r\left(r_t^*(h)\right)^2\right\}\right],\end{aligned}$$

where, from (7) and (15), we have

$$y_t^*(h) = \sum_{s=0}^{\infty}\mathscr{Y}_{t,s}\left(v_s + r_s^*(h)\right) \quad \text{and} \quad \pi_t^*(h) = \sum_{s=0}^{\infty}\left(\kappa\mathscr{Y}_{t,s} + \tilde{\kappa}\mathscr{T}_{t,s}\right)\left(v_s + r_s^*(h)\right) + u_t.$$

Given the boundedness of $\{u_t, v_t\}_{t=0}^{\infty}$ and Lemma (1), one can then apply the envelope theorem, giving

$$\begin{aligned}\frac{\partial\mathscr{L}_{CB}}{\partial\tau_d} &= \mathbb{E}\left[\frac{\partial J\left(\{r_t^*(h)\}_{t=0}^{\infty}, h, \tau_d\right)}{\partial\tau_d}\right] \\ &= \mathbb{E}\left[\sum_{t=0}^{\infty}\beta^t\left\{\left(\lambda_\pi\kappa\pi_t^*(h) + \lambda_y y_t^*(h)\right)\left(\sum_{s=0}^{\infty}\frac{\partial\mathscr{Y}_{t,s}}{\partial\tau_d}\left(v_s + r_s^*(h)\right)\right)\right\}\right] \\ &+ \mathbb{E}\left[\sum_{t=0}^{\infty}\beta^t\left\{\lambda_\pi\tilde{\kappa}\pi_t^*(h)\left(\sum_{s=0}^{\infty}\frac{\partial\mathscr{T}_{t,s}}{\partial\tau_d}\left(v_s + r_s^*(h)\right)\right)\right\}\right].\end{aligned}$$

This proves the proposition.

C.9 Proof of Proposition 7

Consider the case that the supply shock is fully transitory: $u_0 \neq 0$ and $u_t = 0$ for all $t \geq 1$ and $v_t = 0$ for all $t \geq 0$. Moreover, the monetary and fiscal authority together perfectly stabilize output and smooth taxes after two periods (i.e., $y_t = 0$, $t_t^{\text{adj}} = (1-\beta)d_2$, $r_t = \frac{(1-\beta\omega)(1-\omega)}{\sigma\omega}d_2$, and $d_t = d_2$, for all $t \geq 2$). For example, this can be uniquely implemented by a rule

$$t_t = \underbrace{\left(1-\beta\right)d_t}_{t_t^{\text{adj}}} + \beta\frac{D^{ss}}{Y^{ss}}r_t \quad \text{and} \quad r_t = \frac{\left(1-\beta\omega\right)\left(1-\omega\right)}{\sigma\omega}d_t + \phi y_t \quad \forall t \geq 2,$$

where $\phi > 0$. Fiscal policy still takes the form of (5) for $t = 0, 1$.

In this case, the equilibrium dynamics in (2)-(5) can be summarized by

$$y_0 = -\sigma\left(r_0 - \frac{\left(1-\beta\omega\right)\left(1-\omega\right)}{\sigma\omega}d_1\right) + y_1$$

$$y_1 = -\sigma\left(r_1 - \frac{\left(1-\beta\omega\right)\left(1-\omega\right)}{\sigma\omega}d_2\right)$$

$$\pi_0 = \kappa y_0 + u_0$$

$$\pi_1 = \kappa y_1 - \tilde{\kappa}\tau_d\frac{\tau_y}{\beta}y_0$$

$$d_1 = -\frac{\tau_y}{\beta}y_0$$

$$d_t = d_2 = \frac{1-\tau_d}{\beta}d_1 - \frac{\tau_y}{\beta}y_1 \quad \forall t \geq 2$$

$$\pi_t = \pi_2 = \tilde{\kappa}\left(1-\beta\right)d_2 \quad \forall t \geq 2$$

$$r_t = r_2 = \frac{\left(1-\beta\omega\right)\left(1-\omega\right)}{\sigma\omega}d_2 \quad \forall t \geq 2$$

which implies

$$y_0 = \sigma \frac{-r_0\left(1+\frac{\Omega\tau_y}{\beta}\right)-r_1}{\left(1+\frac{\Omega\tau_y}{\beta}\right)^2+\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}} \quad \text{and} \quad y_1 = \sigma \frac{\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}r_0 - r_1\left(1+\frac{\Omega\tau_y}{\beta}\right)}{\left(1+\frac{\Omega\tau_y}{\beta}\right)^2+\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}} \tag{C.28}$$

$$\pi_0 = \sigma\kappa \frac{-r_0\left(1+\frac{\Omega\tau_y}{\beta}\right)-r_1}{\left(1+\frac{\Omega\tau_y}{\beta}\right)^2+\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}} + u_0 \quad \text{and} \quad \pi_1 = \sigma \frac{\kappa\left(\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}r_0 - \left(1+\frac{\Omega\tau_y}{\beta}\right)r_1\right) + \tilde{\kappa}\tau_d\frac{\tau_y}{\beta}\left(\left(1+\frac{\Omega\tau_y}{\beta}\right)r_0 + r_1\right)}{\left(1+\frac{\Omega\tau_y}{\beta}\right)^2+\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}} \tag{C.29}$$

$$\pi_2 = \tilde{\kappa}(1-\beta)\sigma\frac{\tau_y}{\beta^2}\frac{(1-\tau_d)r_0 + \left(\Omega\tau_y+\beta+1-\tau_d\right)r_1}{\left(1+\frac{\Omega\tau_y}{\beta}\right)^2+\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}} \quad \text{and} \quad r_2 = \Omega\frac{\tau_y}{\beta^2}\frac{(1-\tau_d)r_0 + \left(\Omega\tau_y+\beta+1-\tau_d\right)r_1}{\left(1+\frac{\Omega\tau_y}{\beta}\right)^2+\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}}, \tag{C.30}$$

where $\Omega = \frac{(1-\beta\omega)(1-\omega)}{\omega}$. The central bank's (ex post) problem can be written as

$$\min_{r_0,r_1}\frac{1}{2}\left(\lambda_\pi\pi_0^2+\lambda_y y_0^2+\lambda_r r_0^2+\beta\left(\lambda_\pi\pi_1^2+\lambda_y y_1^2+\lambda_r r_1^2\right)+\lambda_\pi\frac{\beta^2}{1-\beta}\pi_2^2+\lambda_r\frac{\beta^2}{1-\beta}r_2^2\right) \quad \text{s.t.} \quad (\text{C.28})-(\text{C.30}).$$

The first order conditions for the optimal r_0^* and r_1^* imply

$$0 = \lambda_\pi\pi_0^*\frac{\partial\pi_0^*}{\partial r_0}+\lambda_y y_0^*\frac{\partial y_0^*}{\partial r_0}+\lambda_r r_0^*+\beta\left(\lambda_\pi\pi_1^*\frac{\partial\pi_1^*}{\partial r_0}+\lambda_y y_1^*\frac{\partial y_1^*}{\partial r_0}\right)+\lambda_\pi\frac{\beta^2}{1-\beta}\pi_2^*\frac{\partial\pi_2^*}{\partial r_0}+\lambda_r\frac{\beta^2}{1-\beta}r_2^*\frac{\partial r_2^*}{\partial r_0}$$

$$0 = \lambda_\pi\pi_0^*\frac{\partial\pi_0^*}{\partial r_1}+\lambda_y y_0^*\frac{\partial y_0^*}{\partial r_1}+\lambda_r r_1^*+\beta\left(\lambda_\pi\pi_1^*\frac{\partial\pi_1^*}{\partial r_1}+\lambda_y y_1^*\frac{\partial y_1^*}{\partial r_1}\right)+\lambda_\pi\frac{\beta^2}{1-\beta}\pi_2^*\frac{\partial\pi_2^*}{\partial r_1}+\lambda_r\frac{\beta^2}{1-\beta}r_2^*\frac{\partial r_2^*}{\partial r_1}.$$

Together with (C.24)–(C.30), we have

$$H_{00}(\tau_d)y_0^* + H_{01}(\tau_d)y_1^* + \lambda_\pi\kappa u_0 = 0$$

$$H_{01}(\tau_d)y_0^* + H_{11}y_1^* = 0,$$

where

$$H_{00}(\tau_d) = \lambda_\pi \kappa^2 + \lambda_y + \frac{\lambda_r}{\sigma^2}\left(1+\frac{\Omega\tau_y}{\beta}\right)^2 + \lambda_\pi\tilde{\kappa}^2\frac{\tau_d^2\tau_y^2}{\beta} + \frac{\lambda_r}{\sigma^2}\Omega^2\frac{(1-\tau_d)^2\tau_y^2}{\beta^3}$$
$$+ \lambda_\pi\tilde{\kappa}^2(1-\beta)\frac{(1-\tau_d)^2\tau_y^2}{\beta^2} + \frac{\lambda_r}{\sigma^2}\frac{(1-\beta\omega)^2(1-\omega)^2}{\omega^2}\frac{(1-\tau_d)^2\tau_y^2}{\beta^2(1-\beta)} > 0$$
$$H_{01}(\tau_d) = -\frac{\lambda_r}{\sigma^2}\left(1+\frac{\Omega\tau_y}{\beta}\right) - \lambda_\pi\kappa\tilde{\kappa}\tau_d\tau_y + \frac{\lambda_r}{\sigma^2}\frac{\Omega(1-\tau_d)\tau_y}{\beta}\left(1+\frac{\Omega\tau_y}{\beta}\right)$$
$$+ \lambda_\pi\tilde{\kappa}^2(1-\beta)\frac{(1-\tau_d)\tau_y^2}{\beta} + \frac{\lambda_r}{\sigma^2}\frac{(1-\beta\omega)^2(1-\omega)^2}{\omega^2}\frac{(1-\tau_d)\tau_y^2}{\beta(1-\beta)}$$
$$H_{11} = \frac{\lambda_r}{\sigma^2} + \beta\lambda_\pi\kappa^2 + \beta\lambda_y + \frac{\beta\lambda_r}{\sigma^2}\left(1+\frac{\Omega\tau_y}{\beta}\right)^2$$
$$+ \lambda_\pi\tilde{\kappa}^2(1-\beta)\tau_y^2 + \frac{\lambda_r}{\sigma^2}\frac{(1-\beta\omega)^2(1-\omega)^2}{\omega^2}\frac{\tau_y^2}{1-\beta} > 0$$

and

$$H_{00}(\tau_d)H_{11} - H_{01}(\tau_d)^2 > 0.$$

This implies

$$y_0^* = -\lambda_\pi\kappa\frac{H_{11}}{H_{00}(\tau_d)H_{11} - H_{01}(\tau_d)^2}u_0$$
$$y_1^* = \lambda_\pi\kappa\frac{H_{01}(\tau_d)}{H_{00}(\tau_d)H_{11} - H_{01}(\tau_d)^2}u_0$$
$$r_0^* = \frac{\lambda_\pi\kappa}{\sigma}\frac{\left(1+\frac{\Omega\tau_y}{\beta}\right)H_{11} + H_{01}(\tau_d)}{H_{00}(\tau_d)H_{11} - H_{01}(\tau_d)^2}u_0$$
$$r_1^* = \frac{\lambda_\pi\kappa}{\sigma}\frac{\frac{\Omega(1-\tau_d)\tau_y}{\beta^2}H_{11} - \left(1+\frac{\Omega\tau_y}{\beta}\right)H_{01}(\tau_d)}{H_{00}(\tau_d)H_{11} - H_{01}(\tau_d)^2}u_0$$
$$\pi_0^* = \left(1 - \lambda_\pi\kappa^2\frac{H_{11}}{H_{00}(\tau_d)H_{11} - H_{01}(\tau_d)^2}\right)u_0$$
$$\pi_1^* = \lambda_\pi\kappa\frac{\kappa H_{01}(\tau_d) + \tilde{\kappa}\tau_d\frac{\tau_y}{\beta}H_{11}}{H_{00}(\tau_d)H_{11} - H_{01}(\tau_d)^2}u_0$$
$$\pi_2^* = -\lambda_\pi\kappa\tilde{\kappa}(1-\beta)\frac{\frac{\tau_y}{\beta}H_{01}(\tau_d) - \frac{(1-\tau_d)\tau_y}{\beta^2}H_{11}}{H_{00}(\tau_d)H_{11} - H_{01}(\tau_d)^2}u_0$$
$$r_2^* = -\lambda_\pi\kappa\frac{(1-\beta\omega)(1-\omega)}{\sigma\omega}\frac{\frac{\tau_y}{\beta}H_{01}(\tau_d) - \frac{(1-\tau_d)\tau_y}{\beta^2}H_{11}}{H_{00}(\tau_d)H_{11} - H_{01}(\tau_d)^2}u_0.$$

As a result, the ex ante central bank loss is

$$\mathscr{L}_{CB} = \frac{1}{2}\lambda_\pi - \frac{1}{2}\lambda_\pi^2\kappa^2\frac{H_{11}}{H_{00}(\tau_d)H_{11} - H_{01}(\tau_d)^2}\mathbb{E}\left[u_0^2\right].$$

Recall that our objective is to prove that, if $\tilde{\kappa}$ is sufficiently large, then $\mathscr{L}_{CB}$ is increasing in τ_d over

$[0,1]$. This is evidently equivalently to proving that

$$V(\tau_d) \equiv H_{00}(\tau_d) H_{11} - H_{01}(\tau_d)^2$$

is increasing in $\tau_d \in [0,1]$. To this end note that we can write the derivative of this object with respect to τ_d as a polynomial in $\tilde{\kappa}$ of degree ≤ 4:

$$\frac{\partial V(\tau_d)}{\partial \tau_d} = c_4(\tau_d)\tilde{\kappa}^4 + c_3(\tau_d)\tilde{\kappa}^3 + c_2(\tau_d)\tilde{\kappa}^2 + c_1(\tau_d)\tilde{\kappa} + c_0(\tau_d),$$

with $\{c_l(\tau_d)\}_{l=0}^4$ continuous in $[0,1]$,

$$c_4(\tau_d) = 2\lambda_\pi^2 \tau_d \tau_y^4 \frac{1-\beta}{\beta}, \tag{C.31}$$

and

$$c_3(0) = 2\lambda_\pi^2 \kappa \frac{1-\beta}{\beta} \tau_y^3. \tag{C.32}$$

Thus, $c_4(\tau_d) > 0$ for $\tau_d \in (0,1]$, $c_4(0) = 0$, and $c_3(0) > 0$. Hence, there exists $\delta > 0$ such that $c_3(\tau_d)$ is uniformly bounded below by a positive constant for all $\tau_d \in [0,\delta]$. All lower-order coefficients are again uniformly bounded. Thus, there exists $\tilde{\kappa}_1$ such that, for all $\tau_d \in [0,\delta]$ and all $\tilde{\kappa} \geq \tilde{\kappa}_1$, the positive $\tilde{\kappa}^3$-term dominates all lower-order terms. Noting that the $\tilde{\kappa}^4$-term is also always non-negative, we can conclude that $\frac{\partial V(\tau_d)}{\partial \tau_d} > 0$.

Moreover, on $[\delta,1]$, $c_4(\tau_d)$ is uniformly bounded below by a positive constant (since $\tau_d \geq \delta > 0$), and all lower-order coefficients are uniformly bounded on this compact set; therefore there exists $\tilde{\kappa}_2$ such that for all $\tau_d \in [\delta,1]$ and all $\tilde{\kappa} \geq \tilde{\kappa}_2$, the positive $\tilde{\kappa}^4$-term dominates and $\frac{\partial V(\tau_d)}{\partial \tau_d} > 0$. This proves that if $\tilde{\kappa} \geq \max\{\tilde{\kappa}_1, \tilde{\kappa}_2\}$, then $\mathscr{L}_{CB}$ increases in τ_d over $[0,1]$.

C.10 Proof of Proposition 8

The proof is constructive, showing how to map the two "sufficient statistics" into the object of interest. It leverages the identification results of McKay and Wolf (2023, Propositions 1 and 2) and Caravello et al. (2025, Proposition 1). We note that these propositions can be applied since the linearized model environment of Section 6 falls into the general model class considered in those papers.

We begin by recovering monetary policy shock causal effects under the hypothesized fiscal policy rule (21), indexed by its fiscal adjustment coefficient τ_d; we denote those adjusted monetary policy shock impulse responses by $\{\Theta_{y,m}^{\tau_d}, \Theta_{\pi,m}^{\tau_d}, \Theta_{i,m}^{\tau_d}, \Theta_{d,m}^{\tau_d}\}$. By Proposition 1 of McKay and Wolf (2023), we can recover those adjusted monetary shock impulse responses as a function of the two baseline policy shock causal effects $\{\Theta_{y,f}, \Theta_{\pi,f}, \Theta_{i,f}, \Theta_{d,f}\}$ and $\{\Theta_{y,m}, \Theta_{\pi,m}, \Theta_{i,m}, \Theta_{d,m}\}$. Next, given those policy shock causal effects and given the assumed central bank loss function (19), we can, by Proposition 2 of McKay and Wolf (2023), recover the central bank's optimal implicit targeting rule as

$$\mathscr{A}_y^m \hat{\boldsymbol{y}} + \mathscr{A}_\pi^m \hat{\boldsymbol{\pi}} + \mathscr{A}_i^m \hat{\boldsymbol{i}} = 0, \tag{C.33}$$

where

$$\mathscr{A}_y^m = \lambda_y (\Theta_{y,m}^{\tau_d})' W, \;\; \mathscr{A}_\pi^m = \lambda_\pi (\Theta_{\pi,m}^{\tau_d})' W, \;\; \mathscr{A}_i^m = \lambda_i (\Theta_{i,m}^{\tau_d})' W,$$

and $W = \text{diag}(1, \beta, \beta^2, \dots)$. This completes the first step of the proof: we now know the counterfactual fiscal policy rule (21) (by assumption) and the associated optimal monetary policy rule (C.33) (by the preceding construction).

To construct $\mathscr{L}(\tau_d)$, it remains to construct the economy's counterfactual second-moment properties under the pair of rules (21) - (C.33). To this end we leverage Proposition 1 of Caravello et al. (2025) together with the assumption that the Wold representation of x_t in the baseline stochastic economy is known and invertible. We let e_i denote the ith Wold innovation and $\hat{\boldsymbol{x}}(e_i)$ denote the corresponding Wold impulse response paths. We can then construct the counterfactual propagation of this Wold innovation as the impulse responses to u_i together with impulse responses to artificial fiscal and monetary shocks $\{\boldsymbol{\nu}_f, \boldsymbol{\nu}_m\}$ that solve the pair of equations

$$\mathscr{A}_y^f \left(\hat{\boldsymbol{y}}(e_i) + \Theta_{y,f}\boldsymbol{\nu}_f + \Theta_{y,m}\boldsymbol{\nu}_m\right) + \mathscr{A}_\pi^f \left(\hat{\boldsymbol{\pi}}(e_i) + \Theta_{\pi,f}\boldsymbol{\nu}_f + \Theta_{\pi,m}\boldsymbol{\nu}_m\right) \\ + \mathscr{A}_i^f \left(\hat{\boldsymbol{i}}(e_i) + \Theta_{i,f}\boldsymbol{\nu}_f + \Theta_{i,m}\boldsymbol{\nu}_m\right) + \mathscr{A}_d^f \left(\hat{\boldsymbol{d}}(e_i) + \Theta_{d,f}\boldsymbol{\nu}_f + \Theta_{d,m}\boldsymbol{\nu}_m\right) = 0$$

and

$$\mathscr{A}_y^m \left(\hat{\boldsymbol{y}}(e_i) + \Theta_{y,f}\boldsymbol{\nu}_f + \Theta_{y,m}\boldsymbol{\nu}_m\right) + \mathscr{A}_\pi^m \left(\hat{\boldsymbol{\pi}}(e_i) + \Theta_{\pi,f}\boldsymbol{\nu}_f + \Theta_{\pi,m}\boldsymbol{\nu}_m\right) + \mathscr{A}_i^m \left(\hat{\boldsymbol{i}}(e_i) + \Theta_{i,f}\boldsymbol{\nu}_f + \Theta_{i,m}\boldsymbol{\nu}_m\right) = 0$$

where the fiscal rule coefficients $\{\mathscr{A}_y^f, \mathscr{A}_\pi^f, \mathscr{A}_i^f, \mathscr{A}_d^f\}$ give the mapping of output, nominal rates, and inflation into government debt under the hypothesized fiscal rule (20) - (21). Now stack these impulse responses to get a counterfactual Wold representation $\{\tilde{\Psi}_\ell\}_{\ell=0}^\infty$ of x, and use this Wold representation to compute the associated central banker loss. By Proposition 1 of Caravello et al. (2025), this construction will correctly recover $\mathscr{L}(\tau_d)$.

C.11 Proof of Proposition A.1

We seek to characterize

$$\left.\frac{\partial \boldsymbol{y}}{\partial \tau_{d,H}}\right|_{\tau_{d,H}=\tau_d}$$

where we use boldface to denote the impulse response path of output. To this end we begin with a preparatory lemma, characterizing impulse responses to *shocks* to the baseline fiscal rule (5).

Lemma C.1. *Consider the model of Section 2, but with the adjusted fiscal rule*

$$t_t = \tau_y y_t + \tau_d (d_t + \epsilon_t) + \beta \frac{D^{ss}}{Y^{ss}} r_t - \epsilon_t \quad \forall t \geq 0, \tag{C.34}$$

where ϵ_t is a date-t fiscal deficit shock, and we assume that $\{\epsilon_t\}_{t=0}^{\infty}$ is bounded. There still exists a unique equilibrium. The equilibrium path of output satisfies

$$y_t = \sum_{s=0}^{\infty} \left(\mathscr{Y}_{t,s}(v_s + r_s) + \mathscr{Y}^{\epsilon}_{t,s} \epsilon_s \right) \quad \forall t \geq 0, \tag{C.35}$$

where $\mathscr{Y}_{t,s}$ is the same as in Lemma 1 and $\mathscr{Y}^{\epsilon}_{t,s}$ is the date-t output impulse response to a one-off date-0 news shock about date-s deficit. It satisfies

$$\mathscr{Y}^{\epsilon}_{t,s} > 0, \quad \forall t, s \geq 0.$$

Proof. Because of linearity, the fact that $\mathscr{Y}_{t,s}$ is the same as in Lemma 1 follows from setting $\epsilon_s = 0$ for all $s \geq 0$. To study $\mathscr{Y}^{\epsilon}_{t,s}$, one can let $v_s = r_s = 0$ for all $s \geq 0$. In this case, from (2), (4), and (C.34), we have, for all $t \geq 0$,

$$\begin{aligned} y_t &= \frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}(1-\tau_d)}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}(d_t + \epsilon_t) + \frac{1}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} y_{t+1} && \text{(C.36)} \\ d_{t+1} &= \frac{1-\tau_d}{\beta}(d_t + \epsilon_t) - \frac{\tau_y}{\beta} y_t, && \text{(C.37)} \end{aligned}$$

with $d_0 = 0$. The system has the same eigenvalues as in Lemma 1, $\lambda_1 > 1$, and $\lambda_2 \in (0,1)$, so we know that there is unique bounded solution of (C.36) and (C.37) based on Blanchard and Kahn (1980). We guess and verify that such a solution takes the form of, for all $t \geq 0$,

$$\begin{aligned} y_t &= \chi d_t + \chi \sum_{k=0}^{\infty} \chi_v^k \epsilon_{t+k} && \text{(C.38)} \\ d_{t+1} &= \rho_d d_t + \frac{1-\tau_d}{\beta}\epsilon_t - \frac{\tau_y \chi}{\beta} \sum_{k \geq 0} \chi_v^k \epsilon_{t+k}, && \text{(C.39)} \end{aligned}$$

where χ, ρ_d, and χ_v are still given by (C.6) and (C.9). From (C.6), we know that $\rho_d = \frac{1}{\beta}\left(1 - \tau_d - \tau_y \chi\right)$ so (C.38)-(C.39) satisfies (C.37). To verify (C.36), we start from its right-hand side and substitute y_{t+1} based on (C.38) at $t+1$ and arrive at

$$\text{right-hand side of (C.36)} = \frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}(1-\tau_d)}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}(d_t + \epsilon_t) + \frac{1}{1 + \frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}\left(\chi d_{t+1} + \chi \sum_{k=0}^{\infty} \chi_v^k \epsilon_{t+1+k}\right).$$

We then substitute d_{t+1} based on (C.39) and arrive at

$$\begin{aligned}\text{right-hand side of(C.36)} &= \left[\frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}(1-\tau_d)}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} + \frac{\chi\rho_d}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}\right] d_t \\ &+ \left[\frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}(1-\tau_d)}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} + \frac{\chi\left(\frac{1-\tau_d}{\beta}-\chi\frac{\tau_y}{\beta}\right)}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}\right]\epsilon_t \\ &+ \frac{\chi}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}\left[\frac{1}{\chi_v}-\chi\frac{\tau_y}{\beta}\right]\sum_{k=1}^{\infty}\chi_v^k\epsilon_{t+k}.\end{aligned}$$

From (C.6) and (C.9), we know that

$$\begin{aligned}\chi &= \frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}(1-\tau_d)}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} + \frac{\chi\rho_d}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} \\ &= \frac{\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}(1-\tau_d)}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} + \frac{\chi\left(\frac{1-\tau_d}{\beta}-\chi\frac{\tau_y}{\beta}\right)}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y} \\ &= \frac{\chi}{1+\frac{(1-\beta\omega)(1-\omega)}{\beta\omega}\tau_y}\left(\frac{1}{\chi_v}-\chi\frac{\tau_y}{\beta}\right).\end{aligned}$$

As a result, the right-hand side of (C.36) equals its left-hand side given by (C.38)-(C.39). This verifies that (C.38)-(C.39) are indeed the unique bounded solution of (C.36)-(C.8). We can then find π_t from (3) and t_t from the fiscal rule (C.34) and verify that the entire equilibrium path $\{y_t, \pi_t, d_{t+1}, t_t\}_{t=0}^{\infty}$ satisfies the equilibrium definition. This proves the existence and uniqueness of the equilibrium.

From (C.39) and $d_0 = 0$,we have

$$d_t = \sum_{u=0}^{t-1}\rho_d^{t-1-u}\left[\frac{1-\tau_d}{\beta}\epsilon_u - \frac{\tau_y\chi}{\beta}\sum_{k\geq 0}\chi_v^k\epsilon_{u+k}\right].$$

Substituting into (C.38) and collecting coefficients of ϵ_s yields that y_t takes the form of (C.35) with

$$\mathscr{Y}^{\epsilon}_{t,s} = \chi\sum_{u=0}^{t-1}\rho_d^{t-1-u}\left[\frac{1-\tau_d}{\beta}\mathbf{1}_{\{u=s\}} - \frac{\tau_y\chi}{\beta}\chi_v^{s-u}\mathbf{1}_{\{u\leq s\}}\right] + \chi\chi_v^{s-t}\mathbf{1}_{\{t\leq s\}} \quad \forall t,s\geq 0, \tag{C.40}$$

which is a continuous function of $(\beta, \omega, \tau_y, \tau_d)$. Furthermore, together with (C.15), when $0 \leq s < t$,

$$\begin{aligned}\mathscr{Y}^{\epsilon}_{t,s} &= \chi\rho_d^{t-s-1}\left[\rho_d - \frac{\tau_y\chi}{\beta}\sum_{j=1}^{s}(\rho_d\chi_v)^j\right] \\ &= \chi\rho_d^{t-s}\frac{\chi_v(1-\rho_d)+(1-\chi_v)(\rho_d\chi_v)^{s+1}}{\chi_v(1-\rho_d\chi_v)} > 0,\end{aligned}$$

because $\rho_d, \chi_v \in (0,1)$ and $\chi > 0$. When $0 \le t \le s$, again together with (C.15), we have

$$\begin{aligned}
\mathscr{Y}^{\epsilon}_{t,s} &= \chi\chi_v^{s-t}\left[1 - \frac{\tau_y \chi}{\beta}\chi_v \sum_{j=0}^{t-1}\left(\rho_d \chi_v\right)^j\right] && \text{(C.41)}\\
&= \chi\chi_v^{s-t}\frac{1-\rho_d+\rho_d(1-\chi_v)(\rho_d\chi_v)^t}{1-\rho_d\chi_v} > 0 && \text{(C.42)}
\end{aligned}$$

because $\rho_d, \chi_v \in (0,1)$ and $\chi > 0$. □

Given Lemma C.1, the proof of Proposition A.1 is straightforward, and most easily completed using sequence-space notation. Written in that way, the equilibrium path of fiscal adjustments under the baseline fiscal rule (5) satisfies

$$\boldsymbol{t}^{\text{adj}} = \mathscr{T}_y \boldsymbol{y} \tag{C.43}$$

where

$$\mathscr{T}_y = \tau_y \times \underbrace{\begin{pmatrix} 0 & 0 & 0 & \dots \\ -\frac{\tau_d}{\beta} & 0 & 0 & \dots \\ -\frac{\tau_d}{\beta}\left(\frac{1-\tau_d}{\beta}\right) & -\frac{\tau_d}{\beta} & 0 & \dots \\ -\frac{\tau_d}{\beta}\left(\frac{1-\tau_d}{\beta}\right)^2 & -\frac{\tau_d}{\beta}\left(\frac{1-\tau_d}{\beta}\right) & -\frac{\tau_d}{\beta} & \dots \\ \vdots & \vdots & \vdots & \ddots \end{pmatrix}}_{\equiv \mathscr{T}} \tag{C.44}$$

We now contemplate a change of the policy rule to (A.15), and write fiscal adjustments under that alternative rule as

$$\boldsymbol{t}^{\text{adj}} = \mathscr{T}_y(\tau_{d,H})\boldsymbol{y} \tag{C.45}$$

with $\mathscr{T}_y(\tau_d) = \mathscr{T}_y$ and $\mathscr{T}(\tau_d) = \mathscr{T}$, as defined in (C.44). For future reference it will furthermore be useful to analogously write $\mathscr{Y}^{x}_{t,s}(\tau_{d,H})$ as the impulse response of output to deficit shocks under this alternative rule, where again $\mathscr{Y}^{x}_{t,s}(\tau_d) = \mathscr{Y}^{x}_{t,s}$. Now note that, by McKay and Wolf (2023, Proposition 1), the equilibrium paths of output under the two rules, $\boldsymbol{y}$ and $\boldsymbol{y}(\tau_{d,H})$, are tied together as

$$\boldsymbol{y} = \boldsymbol{y}(\tau_{d,H}) + \mathscr{Y}^{x}(\tau_{d,H})\underbrace{\left(I + \mathscr{T}(\tau_{d,H})\right)^{-1}}_{\text{pseudoinverse}}\underbrace{\left(\mathscr{T}_y - \mathscr{T}_y(\tau_{d,H})\right)\boldsymbol{y}}_{\text{zero net present value}} \tag{C.46}$$

where the logic of the last two terms is that we find a deficit shock that induces the same (zero net present value) excess demand wedge as the contemplated change in fiscal rule. It thus follows that

$$\frac{\partial \boldsymbol{y}}{\partial \tau_{d,H}} = \mathscr{Y}^{x} \times \underbrace{(I+\mathscr{T})^{-1}\frac{\partial \mathscr{T}_y}{\partial \tau_{d,H}}\boldsymbol{y}}_{\equiv \frac{\partial \epsilon}{\partial \tau_{d,H}}}$$

In words, we have re-written the effect on the equilibrium path of output as the product of two terms: a sequence of fiscal deficit shocks that maps the old into the new rule (second term), premultiplied by the causal effects of fiscal shocks on output. Our assumptions on the alternative fiscal rule (A.15) imply that[26]

$$\frac{\partial \epsilon_t}{\partial \tau_{d,H}} = \begin{cases} 0 & \text{if } t \neq H \\ -\frac{1}{1-\tau_d} d_H & \text{if } t = H \end{cases}$$

Since $d_H > 0$ by assumption, and $\mathscr{Y}^x_{t,s} > 0$ for all (t, s) by Lemma C.1, the desired conclusion follows.

[26]Let $\boldsymbol{\omega} \equiv \frac{\partial \mathscr{T}_y}{\partial \tau_{d,H}} \boldsymbol{y}$. Our assumptions on the fiscal rule (A.15) imply that

$$\frac{\partial \omega_t}{\partial \tau_{d,H}} = \begin{cases} 0 & \text{if } t < H \\ d_H & \text{if } t = H \\ -\frac{\tau_d}{\beta} \left(\frac{1-\tau_d}{\beta}\right)^{t-H-1} d_H & \text{if } t > H \end{cases}$$

Pre-multiplying this sequence by $(I + \mathscr{T})^{-1}$ delivers the claimed path of the fiscal wedge $\boldsymbol{\epsilon}$.