Fiscal foresight and the effects of government spending: It's all in the monetary-fiscal mix*

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March 26, 2021

Abstract

Announcements of future government spending have different effects on activity depending on the monetary-fiscal policy mix: They are contractionary in the monetary regime but expansionary in the fiscal regime. This result contrasts with the expansionary nature of government spending at implementation in both regimes. Anticipation effects can therefore help empirically distinguish between the two regimes. Data support this theoretical result, reconciling conflicting results in the empirical literature that disappear once conditioning on the policy regime. These results suggest that it could be (un)wise to anticipate future fiscal policies, depending on the regime in place.

Keywords: Monetary policy and fiscal policy interactions, Government spending, Fiscal foresight, Non-fundamentalness.

JEL classification: E52, E62, E63.

*We thank Luca Gambetti and Eric Leeper for their valuable comments.

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1 Introduction

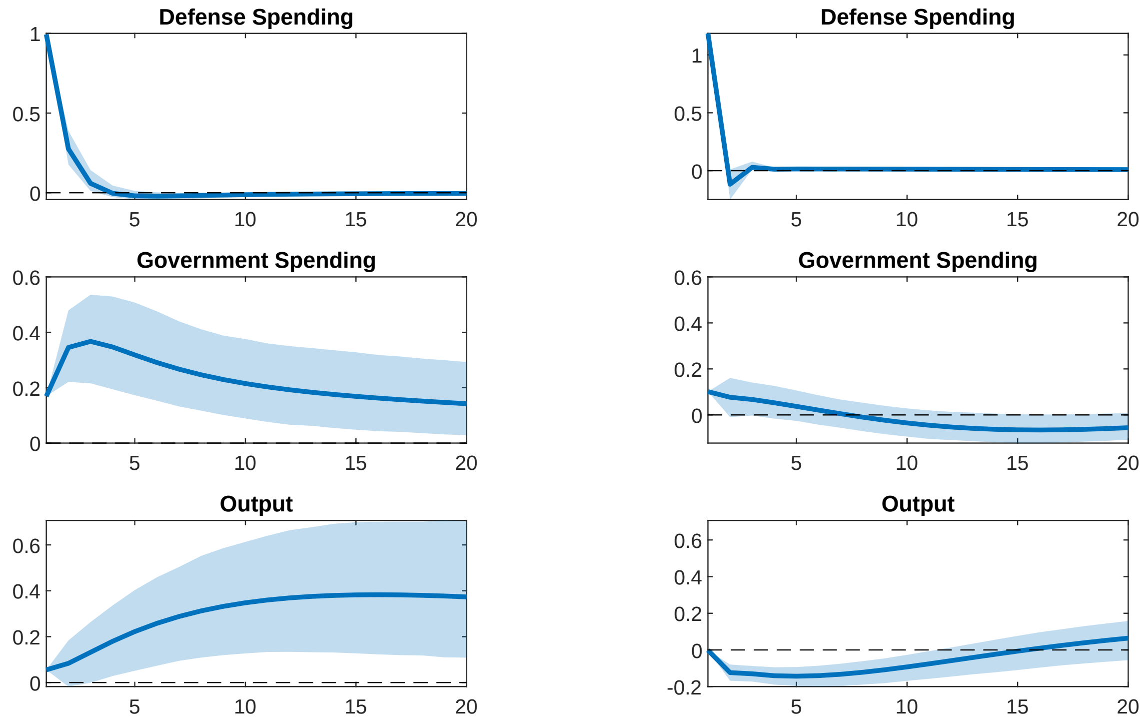
Governments frequently signal their intentions of future fiscal policies, with immediate effects on economic activity. Indeed, all changes in fiscal policy come with an implementation lag and are thus pre-announced.[1] The presence of lags between the announcement of a fiscal change and its implementation generates expectation effects that affect the economy at the time of both the announcement and implementation. The seminal contribution by Ramey (2011) shows that government spending innovations recovered by standard VAR identification methods à la Blanchard and Perotti (2002) are predictable and are therefore likely to have been anticipated by agents. Using a long post-WWII sample period, she shows that the impulse responses from a VAR that takes fiscal foresight into account result in increasing output but decreasing consumption and real wages in response to a positive government spending shock. While this result is consistent with standard neoclassical DSGE models, it differs from the results from standard VARs that do not take fiscal foresight into account. [2] We replicate the analysis in Ramey (2011) but, rather than using a large sample, we consider two sub-periods: the Great Inflation (1960q1-1979q2) and the Great Moderation (1984q1-2007q2). To capture anticipated shocks, we use Ramey's (2011) "defense news" variable that reflects changes in the expected present value of government spending in response to military events. Figure 1 shows the impulse response functions to a shock to this variable in a small VAR that also includes government spending and GDP.[3] In contrast to the results from the longer sample period, output seems to respond in opposite ways in the two different samples: it increases in the Great Inflation period while it decreases in the Great Moderation period.

How can we reconcile these findings? We propose the following theoretical explanation. During the Great Inflation, the rise in output after an anticipated positive shock to government

[1] In particular, changes in fiscal policy are subject to two lags: an inside lag, due to the political discussion between the initial proposal of a new fiscal measure and its approval; and an outside lag between the legislative approval and its actual implementation.

[2] Following the contribution by Blanchard and Perotti (2002), several papers (see Ramey, 2019, for a survey) using standard VAR identification find that a government spending shock increases consumption, hours and real wages. This contrasts with standard neoclassical DSGE theoretical models, in which the same shock leads to a decrease in consumption and an increase in the labor supply, due to Ricardian behavior. The New Keynesian literature has, therefore, developed models in which consumption spending crowds in - rather than out - aggregate private consumption. In Galí et al. (2007), for example, this crowding in is accomplished via a strong response of the real wage to the fiscal shock, which boosts consumption of hand-to-mouth non-Ricardian agents. The extent of the robustness of the theoretical result in Galí et al. (2007) is discussed in, e.g., Colciago (2011); Furlanetto (2011); Furlanetto and Seneca (2009).

[3] Following closely Ramey (2011), we identify the fiscal shock through a Choleski decomposition with the defense news variable ordered first. The VAR also includes the three-month T-bill and the Barro-Redlick average marginal income tax rate that, for the sake of brevity, we omit in the following figures.



(a) Great Inflation (1960q1-1979q2)

(b) Great Moderation (1984q1-2007q2)

Figure 1: Impulse responses to a defense spending shock.

Notes: Impulse response functions to the defence spending shock in a five-variable VAR with one lag, including, in this order, defence news, real government spending, real GDP, the marginal tax rate (not shown) and the three-month interest rate (not shown). The (anticipated) shock is the first one of the Cholesky decomposition. The left hand side reports results for the Great Inflation period, the right hand side for the Great Moderation period. Each panel reports point estimates and a 68% confidence region.

expenditure is consistent with the behavior of agents who expect positive wealth effects following an unbacked fiscal expansion. And viceversa, the decrease in output in the Great Moderation is consistent with an anticipated fiscally-backed increase in government expenditure. Indeed, our two samples match two well-defined regimes that the empirical literature on monetary and fiscal policy interaction generally identifies as, respectively, a fiscally-led (F regime) and a monetary-led regime (regime M) (see Bianchi and Melosi, 2017, 2014; Bianchi, 2012; Chung et al., 2007).[4,5] This new evidence suggests that the effects of anticipated government spending shocks depend crucially on the prevailing monetary/fiscal policy mix. In this paper we contribute to both the

[4]In the language of Leeper (1991), the monetary regime assumes an active monetary policy, that is, the adherence to the Taylor principle, and a passive fiscal policy. In this regime fiscal expansions are always backed by future fiscal surpluses and Ricardian equivalence holds. On the contrary, the fiscal regime assumes a passive monetary policy and an active fiscal policy: here, fiscal expansions are unbacked, which generate wealth effects.

[5]While there is wide consensus on considering the Great Moderation as a monetary regime, the Great Inflation regime is more debated. Papers hinging on the assumptions of constantly passive fiscal policy detect, in the Great Inflation period, a double passive (hence indeterminate) regime (see Lubik and Schorfheide, 2004; Davig and Leeper, 2007b). Once considering the possible switch of fiscal policy, the pre-Volcker era is found to be consistent with a fiscally led regime (see even Sims, 2011; Davig and Leeper, 2007a, 2011), in which the increasing inflation is due to lack of fiscal discipline.

theoretical and empirical literature, and propose a way to reconcile the conflicting empirical results by looking at the policy mix in place.

As for the theoretical part, we extend the work by Beck-Friis and Willems (2017), who analytically derive the unanticipated fiscal multipliers in both the monetary and the fiscal regime in a simple New Keynesian model, to *anticipated* changes in government expenditures. We provide analytical insights on the economic intuition. Two points are worth noting. First, while the empirical literature convincingly shows that it is crucial to distinguish between anticipated and unanticipated government spending shocks, the vast majority of the theoretical literature looks only at the reaction to contemporaneous unanticipated shock to fiscal spending, and does not analyze the problem of fiscal foresight, that is, the reaction to anticipated shocks. Second, most of the theoretical literature focuses exclusively on the "standard" New Keynesian M regime. Under standard calibration, our simple New Keynesian model shows that both an unanticipated (see Beck-Friis and Willems, 2017) and a previously anticipated government spending shock increase output in both the M and F regimes at implementation. However, fiscal foresight leads government spending shocks to have very different effects in the two regimes during the anticipation period. In regime M, an anticipated fiscally backed increase in government expenditure is contractionary, i.e., it decreases output and consumption. In regime F, under unbacked fiscal expansions, in contrast, the same shock is expansionary, as it increases private consumption through the expectation of positive wealth effects. As a result, we cannot distinguish the two regimes from the output behaviour after the shock implementation, but we can once we consider fiscal foresight during the anticipation period. We then check whether our theoretical results still hold in the medium scale DSGE model of Smets and Wouters (2007). This exercise shows that anticipated shocks lead output to increase in regime F and to decrease in regime M, closely replicating the empirical evidence in Figure 1.

We then deepen the empirical analysis whose findings corroborate the theoretical implications. First, consumption, investment, wages and hours responses to anticipated government spending shocks in the Smets and Wouters (2007) DSGE model all increase in regime F while decrease in regime M, during the anticipation period. We extend the VAR in Figure 1 to include these variables and obtain VAR impulse responses that mimic their behavior of those in the DSGE model. Consistent with the theory, unanticipated shocks are always expansionary in the two regimes/subsamples. Second, the different responses across the two regimes hold when we use other measures of anticipated shocks proposed in the literature as Ramey and Shapiro

(1998) and Forni and Gambetti (2016). Third, employing the Blanchard and Perotti's (2002) standard identification scheme, we find again that the effects of government spending shocks are expansionary in F and contractionary in M, as VARs that use measure of anticipated shocks also find. Surprisingly, the difference between Blanchard and Perotti (2002) and Ramey (2011) disappears when we condition the estimates on the monetary-fiscal policy mix, suggesting that the crucial feature is not the timing but rather the monetary-fiscal policy mix. Fourth, this surprising result calls for a reassessment of the Ramey's (2011) interpretation of the standard VAR shocks, when they are estimated contingent on a specific regime in place.

Fiscal foresight poses a challenge to VAR analysis. As shown by Leeper et al. (2013), if the VAR does not contain enough information about future variables anticipated by agents, the variables do not have a VAR representation in the structural shocks. As a result, the identified shocks may be "non-fundamental", that is, they may not correspond to the true structural shocks and the resulting impulse responses could be misleading. Our approach allows us to compare the results from different identification procedures and to draw some useful insights on (non?)-fundamentalness issues when two well-defined regimes are considered. Following Ramey (2011), we perform Granger causality tests on the VAR shocks. When we estimate the VAR conditional on the monetary-fiscal regime in place, we find no evidence that shocks could have been forecasted. In other words, they are fundamental. As a result, it seems that fundamentalness arises not because of the fiscal foresight problem, but because of the mispecification of a linear VAR across two different regimes, featuring two different impulse responses and hence implying two different VAR structures.

This paper is related to at least three strands of the literature. First, the literature that identifies the effect on the economy of news shocks to fiscal policy. Some find that fiscal news shocks account for a large share of the business cycle volatility (e.g. see Schmitt-Grohé and Uribe, 2012; Born et al., 2013). Others either use single tax events to demonstrate the importance of fiscal foresight (e.g. Parker, 1999; House and Shapiro, 2006) or use several methods to identify fiscal news shocks in VAR models (see Fisher and Peters, 2010; Ramey, 2011; Mertens and Ravn, 2012; Ricco, 2015; Forni and Gambetti, 2016; Ben Zeev and Pappa, 2017). Although the empirical evidence makes clear that fiscal foresight matters for economic conditions, surprisingly little work has been done in the theoretical literature to study the mechanisms whereby fiscal news shocks propagate to economic activity. This paper sheds lights on how these mechanisms work under different monetary-fiscal mixes. crucially, while all these papers find that, at least qualitatively, anticipated government spending shocks increase output, we show that both theoretically and empirically this result is conditional on being in regime F, while the opposite occurs in regime M. Second, this paper adds to the large literature on fiscal multipliers (e.g. see Aiyagari et al., 1992; Baxter and King, 1993; Christiano et al., 2011; Woodford, 2011; Leeper et al., 2017; Auerbach and Gorodnichenko, 2012; Caggiano et al., 2015; Ramey and Zubairy, 2018). Third, it deals with non-fundamentalness problems that usually plagues VARs and employs some fundamentalness tests proposed in the literature (e.g. see, among the others, Ramey, 2011; Leeper et al., 2013; Forni and Gambetti, 2014, 2016; Ellahie and Ricco, 2017).

The paper proceeds as follows. Section 2 outlines the model. Section 3 derives the announcement multipliers in the monetary and fiscal regimes and discusses the channels through which fiscal news shocks propagate to economic activity. The same section contains the calibration of both our simple model and of a larger model to check the validity of the theoretical results. Section 4 includes the empirical evidence and some fundamentalness tests. Section 6 concludes.

2 Theory

2.1 An Analytical Model

In this Section, we consider a small-scale New Keynesian model to provide analytical results and basic intuitions on the effects of anticipated government spending in the fiscal and monetary regimes. We extend the work in Beck-Friis and Willems (2017) to include anticipated shocks to government spending. The model is standard and features infinite-lived households, no capital, wasteful government spending and sticky prices à la Calvo, whereby each firm can reset its price in each period with probability $(1-\theta)$. The log-linearized model is given by the following equations:[6]

$$\hat{y}_t - \alpha_1 \tilde{g}_t = \mathbb{E}_t \hat{y}_{t+1} - \alpha_1 \mathbb{E}_t \tilde{g}_{t+1} - \alpha_2 [\hat{\imath}_t - \mathbb{E}_t \hat{\pi}_{t+1}], \tag{1}$$

$$\hat{\pi}_t = \beta \mathbb{E}_t [\hat{\pi}_{t+1}] + \kappa \alpha_3 \hat{y}_t - \kappa \alpha_4 \tilde{g}_t, \tag{2}$$

$$\hat{\imath}_t = \phi \hat{\pi}_t, \tag{3}$$

$$\tilde{\tau}_t = \psi \tilde{b}_{t-1} + \varepsilon_t^{\tau}, \tag{4}$$

[6]See Appendix A for the details of this standard model. Throughout the paper, variables without a time-subscript denote steady-state values, variables with a hat indicate log-deviations from this steady state (i.e. $\hat{x}_t = (x_t - x)/x$), and variables with a tilde express steady-state deviations as a fraction of steady-state output (i.e. $\tilde{x}_t = (x_t - x)/y$).

$$\tilde{b}_t = \frac{1}{\beta}\tilde{b}_{t-1} - \frac{1}{\beta}(\tilde{\tau}_t - \tilde{g}_t) - \frac{1}{\beta}\frac{b}{y}\hat{\pi}_t + \frac{b}{y}\hat{\imath}_t, \tag{5}$$

$$\tilde{g}_t = \rho\tilde{g}_{t-1} + \varepsilon^g_t. \tag{6}$$

y_t refers to output, g_t to real government spending, i_t to the nominal interest rate, π_t to inflation, b_t to real government debt, and τ_t to real lump-sum taxation. Variables ε^τ_t and ε^g_t are mean zero i.i.d taxation and government spending shocks, respectively. Equation (1) is the Euler equation, where the parameters $\{\alpha_i\}_{i=1}^4$ are convolutions that depend on the properties of the utility function $U(c_t, n_t)$, where c is consumption and n are hours worked (see Appendix A). Equation (2) is the New Keynesian Phillips Curve, where $\beta \in [0, 1)$ is the household's subjective discount factor and $\kappa \equiv (1-\theta)(1-\beta\theta)/\theta$. Both equations account for the impact of government spending. Equation (3) and (4) describe, respectively, the very simple monetary and fiscal policy rules. The central bank reacts to current-period inflation, according to the parameter $\phi \geq 0$, while, as in Leeper (1991), the fiscal authority adjusts lump-sum taxes to the deviation of lagged real debt according to the parameter $\psi \geq 0$. Equation (5) is the government's flow budget identity. Finally, equation (6) assumes a simple AR(1) process for the evolution of government spending, with an autoregressive parameter $\rho \in [0, 1)$.

As is well-known and established by Leeper (1991), the system has a unique, bounded solution under two regimes: (i) the "monetary regime" in which the central bank actively adjusts the policy rate to inflation, $\phi > 1$, in which fiscal policy passively adjusts taxes to deviation of lagged real debt, $\psi > (1-\beta)$; (ii) the "fiscal regime" where the central bank passively adjusts the policy rate to inflation, $\phi < 1$, while fiscal policy actively adjusts taxes to deviation of lagged real debt, $\psi < (1-\beta)$.

2.2 Government spending multipliers

The government spending multiplier on output (y) and inflation (π) at horizons $j, k \geq 0$ are:[7]

$$GSM^y(j,k) \equiv \mathbb{E}_t \frac{\partial \hat{y}_{t+k}}{\partial \varepsilon^g_{t+j}}, \tag{7}$$

$$GSM^\pi(j,k) \equiv \mathbb{E}_t \frac{\partial \hat{\pi}_{t+k}}{\partial \varepsilon^g_{t+j}}. \tag{8}$$

[7] We define the multipliers on inflation as the inflationary response to a fiscal shock as a fraction of steady state output. This ensures that the multipliers on inflation do not depend on the model's steady state level of output.

The multipliers measure the expected effect on economic activity in period $t+k$ from a fiscal shock announced in period t but implemented in period $t+j$. When a fiscal shock is implemented without any anticipation, $j=0$, (7) and (8) collapse to the *unanticipated multipliers* analyzed in Beck-Friis and Willems (2017), and we can distinguish the impact multipliers, when $j=k=0$, and the tail multipliers, when $j=0$ and $k>0$. When $j>0$, instead, (7) and (8) define *anticipated multipliers*. When $j>0$ and $k=0$, they capture the immediate effects on output and inflation of an announcement (or anticipation by the agents) of a future government spending change after j periods. In the remainder of this section, we derive expressions for these objects under both the monetary and fiscal regime. To provide the intuition, we build on the results and the analytical insights in Beck-Friis and Willems (2017) for the unanticipated multipliers.

2.2.1 Monetary regime

Unanticipated multipliers. In the monetary regime, the impact unanticipated multipliers of government spending are positive for both output and inflation:

$$GSM_M^y(0,0) = \frac{\alpha_1(1-\rho)(1-\beta\rho)+\kappa\alpha_2\alpha_4(\phi-\rho)}{(1-\rho)(1-\beta\rho)+\kappa\alpha_2\alpha_3(\phi-\rho)} > 0, \tag{9}$$

$$GSM_M^\pi(0,0) = \frac{(1-\rho)\kappa(\alpha_1\alpha_3-\alpha_4)}{(1-\rho)(1-\beta\rho)+\kappa\alpha_2\alpha_3(\phi-\rho)} > 0, \tag{10}$$

and the tail multipliers decay by a factor of ρ:

$$GSM_M^{\{y,\pi\}}(0,k) = \rho^k \times GSM_M^{\{y,\pi\}}(0,0). \tag{11}$$

The multipliers on output are positive for two reasons, that Beck-Friis and Willems (2017) label as the "Keynesian effect." First, labor supply shifts out because of the Neo-classical/Ricardian behavior of the household, which chooses to consume less goods and to work more (or to consume less leisure) for any given real wage. Second, if prices are sticky, labor demand shifts out too, as firms are forced to lower their markup and increase production to meet the higher demand for their goods. If prices are fully flexible, however, firms merely adjust their prices, leaving labor demand unchanged. The monetary policy coefficient ϕ decreases the multipliers because the more the central bank responds to the increase in inflation, the more it counteracts the initial increase in demand, diminishing the strength of the second effect. The first effect due to the shift in labor supply, however, is unrelated to monetary policy.[8]

Anticipated multipliers. Before turning to the analytical expressions of the anticipated multipliers, it is helpful to first present the following relation:

$$GSM_M^{\{y,\pi\}}(j,k) = GSM_M^{\{y,\pi\}}(j+m, k+m), \text{ for any } m \geq 0.$$

That is, the expected effect on economic activity in period $t+k$ is independent of when the announcement of the spending shock was made. Put differently, the multipliers are history-independent: current economic activity does not depend on the past. For $k < j$, what matters is only the distance $j-k$ to the actual implementation of the shock. In particular: $GSM_M^{\{y,\pi\}}(j,j) = GSM_M^{\{y,\pi\}}(0,0)$. It follows that in this very simple model, the effect of an anticipated shock, once implemented, is equal to that of an unanticipated shock. Or, in other words, the effect on economic activity in the period in which the spending shock is implemented is independent of when in the past the spending shock was announced. This result is not surprising, and very specific to the forward-looking nature of this simple model. The only backward-looking equations in this economy are the government's flow budget identity (5) and the taxation rule (4). But in the monetary regime, the path of government debt is irrelevant for economic activity, because all debt is backed by primary surpluses. So the economy is instead completely dictated by the forward-looking Euler equation (1), Phillips curve (2) and Taylor rule (3).

The effects of news on government spending still depend linearly on the impact multipliers:

$$GSM_M^y(j,0) = p_{1,2}(j)GSM_M^\pi(0,0) + p_{1,1}(j)[GSM_M^y(0,0) - \alpha_1], \tag{12}$$

$$GSM_M^\pi(j,0) = p_{2,2}(j)GSM_M^\pi(0,0) + p_{2,1}(j)[GSM_M^y(0,0) - \alpha_1], \tag{13}$$

where the p's are given by (B32) - (B35) in the Appendix B, with $p \to 0$ as $j \to \infty$.

Consider first the effect on output and inflation in the period immediately preceding the spending shock, i.e., $j = 1$. Three competing effects come into play. The first two appear via the Euler equation (1). First, higher next-period inflation (see (10)) lowers the ex-ante real

[8]To see this, note that in the flexible-price limit where $\kappa \to \infty$, the multiplier on output, (α_4/α_3), is independent of ϕ. Moreover, price stickiness affects the impact multipliers too. If the utility function is additively separable, the stickier are prices, the larger is the impact multiplier on output and smaller is the impact multiplier on inflation.

interest rate, because, according to the Taylor rule (3), the interest rate reacts only to current inflation. This effect increases aggregate demand. Second, lower future consumption because of the Ricardian behavior depresses aggregate demand through the consumption smoothing motive.[9] With sluggish price adjustment, the net demand of these effects translates into a change in output, as firms are unable to fully adjust their prices. Sticky prices introduces a third transmission channel. Higher next-period inflation raises current inflation through the Phillips curve (2), as firms increase their prices in anticipation of a higher future demand. Higher prices, in turn, depresses output along an unchanged aggregate demand curve. The stagflationary nature of this transmission mechanism resembles the effects of a more standard cost-push shock, and grows stronger the stickier are prices.

As the system is completely forward-looking, the effects in period $t+k$ depend only on the economic conditions in period $t+k+1$. We can therefore extend the above intuition by backward induction to each period preceding the spending shock.[10]

To visualize the output multipliers in Figure 2, consider CRRA-preferences, i.e., $U(c_t, n_t) = \frac{c_t^{1-\sigma}}{1-\sigma} - \frac{n_t^{1+\xi}}{1+\xi}$, where σ is the coefficient of relative risk aversion and ξ is the inverse of the elasticity of labor supply.[11] As is well-documented in the literature, the impact multiplier on output is smaller than one with CRRA-preferences (for all calibrations), so that government spending crowds out private consumption. The blue solid line in Figure 2 displays the path of output pre and post the implementation of an increase in government spending. On impact upon announcement, the three effects described above result in a net negative demand effect that translates into lower labor demand and output. Output decreases further throughout the anticipation period. The post-implementation multipliers resemble the standard impulse response functions after an unanticipated government spending increase, with economic activity decaying by a factor of $\rho = 0.5$ in each period. This result follows as the monetary regime is

[9]This effect could actually reverse if the multiplier in output is greater than α_1 (note: $\alpha_1 = 1$ for additevely separable utility functions), in which case government spending crowds in private consumption, rather than crowding it out. Appendix A.2 shows that the marginal utility of consumption increases in response to a government spending increase if $GSM_M^y(0,0) < \alpha_1$ (and vice versa). In this case, household consumption demand decreases.

[10]Note that, if the impact multipliers on output and inflation are equal to α_1 and zero, respectively, these transmission mechanisms become impotent. In that specific case, as future inflation and private consumption remain unaffected by the spending shock, there is neither any incentive to change private consumption demand nor any reason for firms to smooth any price increase over time.

[11]Unless otherwise noted, the simulations of this simple New Keynesian model throughout the paper assume the following baseline calibration at the quarterly frequency: $\beta = 0.99$, $\theta = 0.75$, $\sigma = 1$, $\xi = 2$, $\rho = 0.5$; the steady state fraction of government spending to output $(g/y) = 1/3$; the steady state fraction of government debt to output $(b/y) = 4$. In the monetary regime, we set the monetary policy parameter (ϕ) to 1.5 and fiscal policy parameter (ψ) to 0.2. In the fiscal regime, the same policy parameters are set to 0.5 and 0, respectively.

history-independent.

The effects on inflation during the announcement period is ambiguous. On the one hand, the negative shift in demand induces a decrease in inflation. On the other hand, forward-looking price setters will start raising their prices in the periods preceding the spending shock, in anticipation of higher future inflation after the implementation. Which of the two effects prevails depends on their relative strength and hence on the calibration. Moreover, the real value of debt is affected by two opposing forces too. Assume inflation increases in the announcement period. Then, on the one hand, higher inflation erodes the real value of outstanding nominal debt, but, on the other hand, it also calls for a higher nominal interest rate (via the Taylor rule), leading to a larger fiscal deficit and more issuance of nominal debt. If the first effect dominates then the real value of debt goes in the opposite direction of inflation. Otherwise it goes in the same direction. If $\phi\beta > 1$, the second effect would tend to dominate the first, *ceteris paribus.*[12] So, in the monetary regime with a sufficiently aggressive central bank, forward guidance of fiscal policy, to the extent it is inflationary, is just as constrained by binding debt or deficit limits as conventional fiscal policy.

2.2.2 Fiscal regime

Unanticipated multipliers. Beck-Friis and Willems (2017) show that, when $\rho = 0$, the impact and tail multipliers of government spending in the fiscal regime are:

$$GSM_F^y(0,k) = GSM_M^y(0,k) + TM_F^y(0,k) - \left(\frac{b}{y}\right)(1-\beta\phi)GSM_M^\pi(0,0)TM_F^y(0,k), \tag{14}$$

$$GSM_F^\pi(0,k) = \underbrace{GSM_M^\pi(0,k)}_{\text{Keynesian Effect}} + \underbrace{TM_F^\pi(0,k) - \left(\frac{b}{y}\right)(1-\beta\phi)GSM_M^\pi(0,0)TM_F^\pi(0,k)}_{\text{Nominal Wealth Effect}}, \tag{15}$$

where TM_F^y and TM_F^π are the tax multipliers on output and inflation, respectively, in the fiscal regime.[13] The multipliers come in two parts. First, there is the standard Keynesian effect (due to labor demand and supply), also present in the monetary regime and described above. Second, the fiscal regime features a "nominal wealth effect" resulting from changes to the wealth of the private sector. The first nominal wealth term captures the direct wealth increase that the newly-issued unbacked bonds represent, which is equivalent to that of a debt-financed tax

[12] To see this, substitute the Taylor rule (3) in the government's budget identity (5) and differentiate $\tilde{b}_t$ with respect to $\hat{\pi}_t$.

[13] For an analytical expression of the impact and tail tax multiplier see Beck-Friis and Willems (2017).

cut, $TM_F^{y,\pi}$. The second nominal wealth effect term captures a "fiscal inflation tax" that results from inflation devaluing the real value of the outstanding nominal debt which is now net wealth for the households (for a detailed discussion, see Beck-Friis and Willems, 2017).

Anticipated multipliers. Contrary to the monetary regime, the fiscal regime is history-dependent, because now debt is an important state variable, determining wealth. As a result, the backward-looking nature of the government's budget identity (5) plays an important role in shaping demand. The effect on economic activity in the period when the government spending shock is implemented depends on when in the past it was announced.

The analytical expressions of the announcement multipliers are complicated objects and are omitted here (see Appendix B.2.2 for the derivation), but the intuition follows from the one above, that is, from the combination of the Keynesian effect and the nominal wealth effect. During the announcement period, the former effect is contractionary (as we explained above) while the latter effect is expansionary. Upon implementation, these two effects are both expansionary. It turns out that, during the announcement period, the nominal wealth effects dominates, meaning that in regime F the impulse response functions display two bursts of activity across time, first upon announcement and then upon implementation. Figure 2 plots the announcement multipliers under regime F. A news shock to government spending expands economic activity. With sluggish price adjustments, increased consumption demand now translates into higher labor demand: output therefore expands in the announcement period. Figure 2 shows that output rises after the fiscal shock implementation in both the monetary and fiscal regimes. In contrast, the dynamics of output during the anticipation period is opposite in the two regimes: output decreases in the monetary regime while it increases in the fiscal one.[14] According to these results, output, and eventually its components, provide a viable testable implication to discriminate between the two regimes.

In the next section, we check whether this insight from the simple NK model generalizes to more operational models such as the DSGE-model of Smets and Wouters (2007), and whether it applies also to other components of output.

[14]The behaviour of inflation does not show such a clear-cut difference between the two regimes: while under the fiscal regime inflation always increases, its response is ambiguous under the monetary regime as parameters vary.

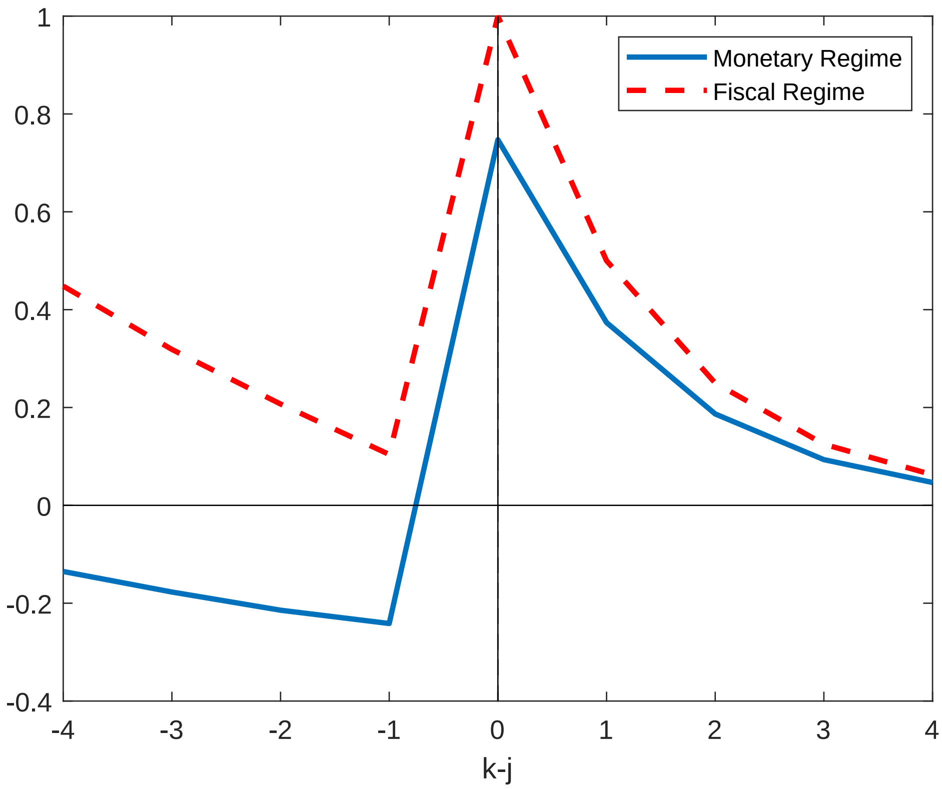


Figure 2: Output multipliers of government spending.

Notes: The graphs plot the impulse response of economic activity following a news shock to government spending. The shock is announced four ($j = 4$) quarters before it is implemented. The x-axis measures the number of periods before (-) and after (+) the spending shock is implemented. The y-axis measures the size of the multipliers, with the multiplier on debt being defined analogously as in (7)-(8).

2.3 A quantitative illustration using the Smets and Wouters (2007) model

The well-known model by Smets and Wouters (2007) includes capital together with a rich set of frictions, such as: wage and price stickiness, wage and price indexation, habit formation in consumption, investment adjustment costs, variable capital utilization, and fixed costs in production. This kind of medium-scale model has proved to successfully fit and explain most business cycle behaviour of macroeconomic data. We augment the model with a fiscal block, consisting in the policy rule for taxes (4) and the flow budget constraint (5). In addition, we replace the stochastic process for government spending to adopt the specification proposed by Ramey (2009)

$$g_t^a = 1.4g_{t-1}^a - 0.18g_{t-2}^a - 0.25g_{t-3}^a + \varepsilon_t^{ga},$$

so that government spending is fully exogenous and follows an AR(3) process that mimics the hump-shaped profile of fiscal plans.[15] As for the monetary policy rule, we maintain the original specification of Smets and Wouters (2007), which generalizes our simple Taylor rule (3).[16]

[15] To model anticipation, we assume that agents know the process for government spending j periods in advance, so that $\tilde{g}_t = \tilde{g}_{t-j}^a$. When $j = 0$, the government spending shock is unanticipated.

[16] We calibrate the model using the parameter values at the posterior mode (set Smets and Wouters, 2007, Tables 1A and 1B), except for the parameters on inflation and lagged debt of the monetary and fiscal rules (r_π

Figure 3 displays the impulse response functions to an unanticipated shock to government spending in the standard 4 model, while4 shows the responses in the same model with a 4-period anticipation. The impulse response functions confirm the main result from the previous section that one cannot identify M or F regimes by looking at unanticipated impulse responses since, except for investment, every variable rises following the unanticipated fiscal shock. In the case of anticipated shocks, however, output, consumption, investments, wages and hours decrease during the anticipation period in regime M, while they increase in regime F. As a result, we can identify the two regimes by looking at the impulse responses following an anticipated government spending shock: anticipated government spending shocks are contractionary in regime M and expansionary in regime F. In our sensitivity analysis (see Appendix C) we find that this pattern holds true for all parameters' calibration.[17]

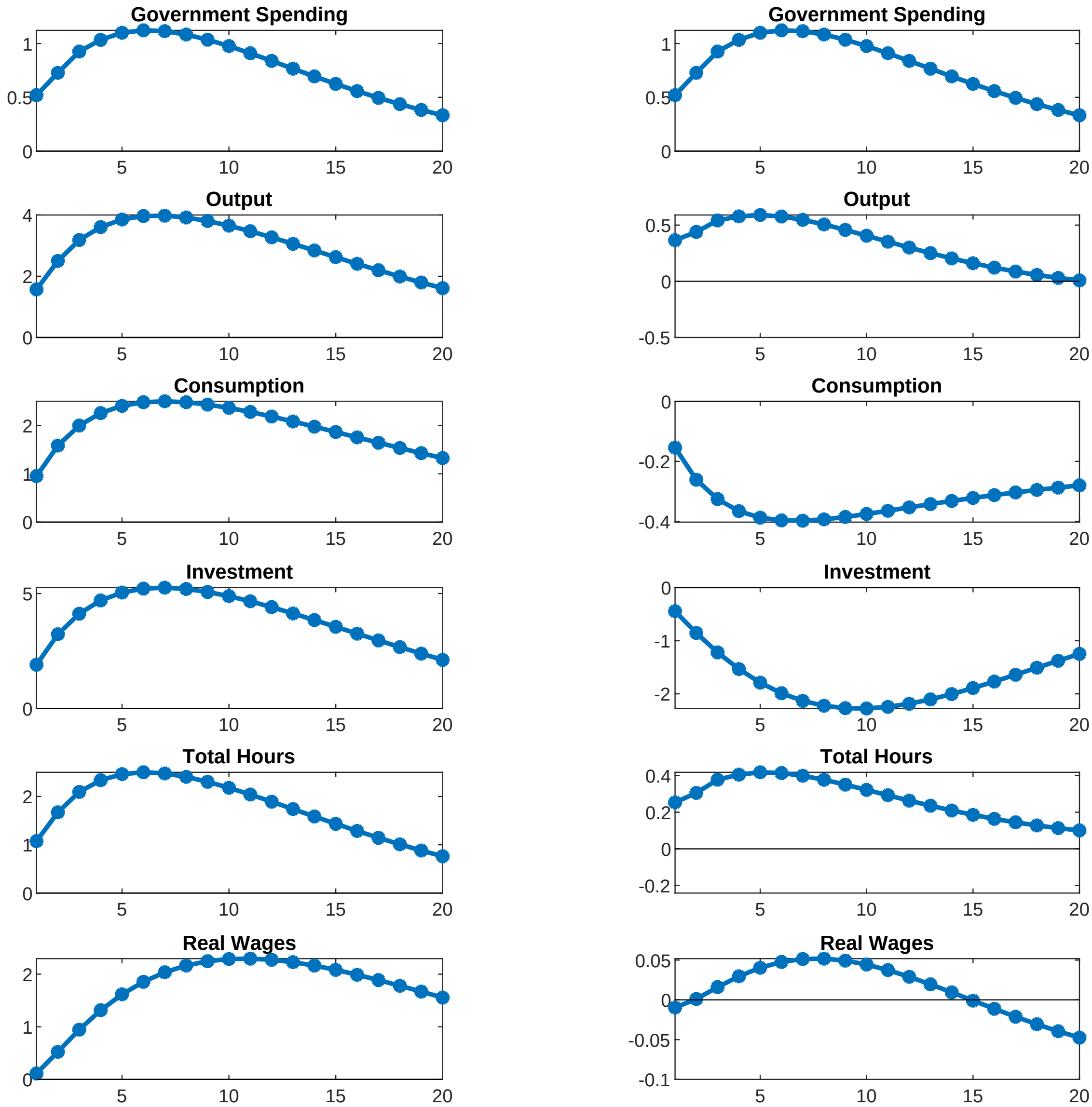
This theoretical result connects us with two important streams of literature. The first one deals with fiscal foresight and the identification of fiscal policy shocks. This literature demonstrates the importance of carefully distinguishing between anticipated and unanticipated government spending shocks (e.g., Ramey 2011). The second one is the literature on the identification of monetary-fiscal policy regimes in US economic data. Our theoretical result provides a powerful identification strategy in two directions. First, taking as given the results in the literature that identifies the historical periods of regime M and F, we can check whether the previous findings on the effects of anticipated vs. unanticipated shocks are consistent with our theoretical results. Second, taking as given the shock measures proposed by the literature on fiscal foresight, we can use our results as a tool to identify different policy regimes in the data. We proceed with these steps in the next section.

3 Empirical Evidence

Can empirical evidence help discriminate between the two ppolicy regimes on the grounds of the observed response of the variables in the anticipation period? In the above analysis, anticipated government spending shock are contractionary in regime M and expansionary in regime F, while unanticipated shocks are expansionary in both regimes. The empirical analysis in the

and γ, respectively). In particular, we set $r_\pi = 1.5$ and $\gamma = 0.2$ for the monetary regime, and $r_\pi = 0.5$ and $\gamma = 0$ for the fiscal regime.

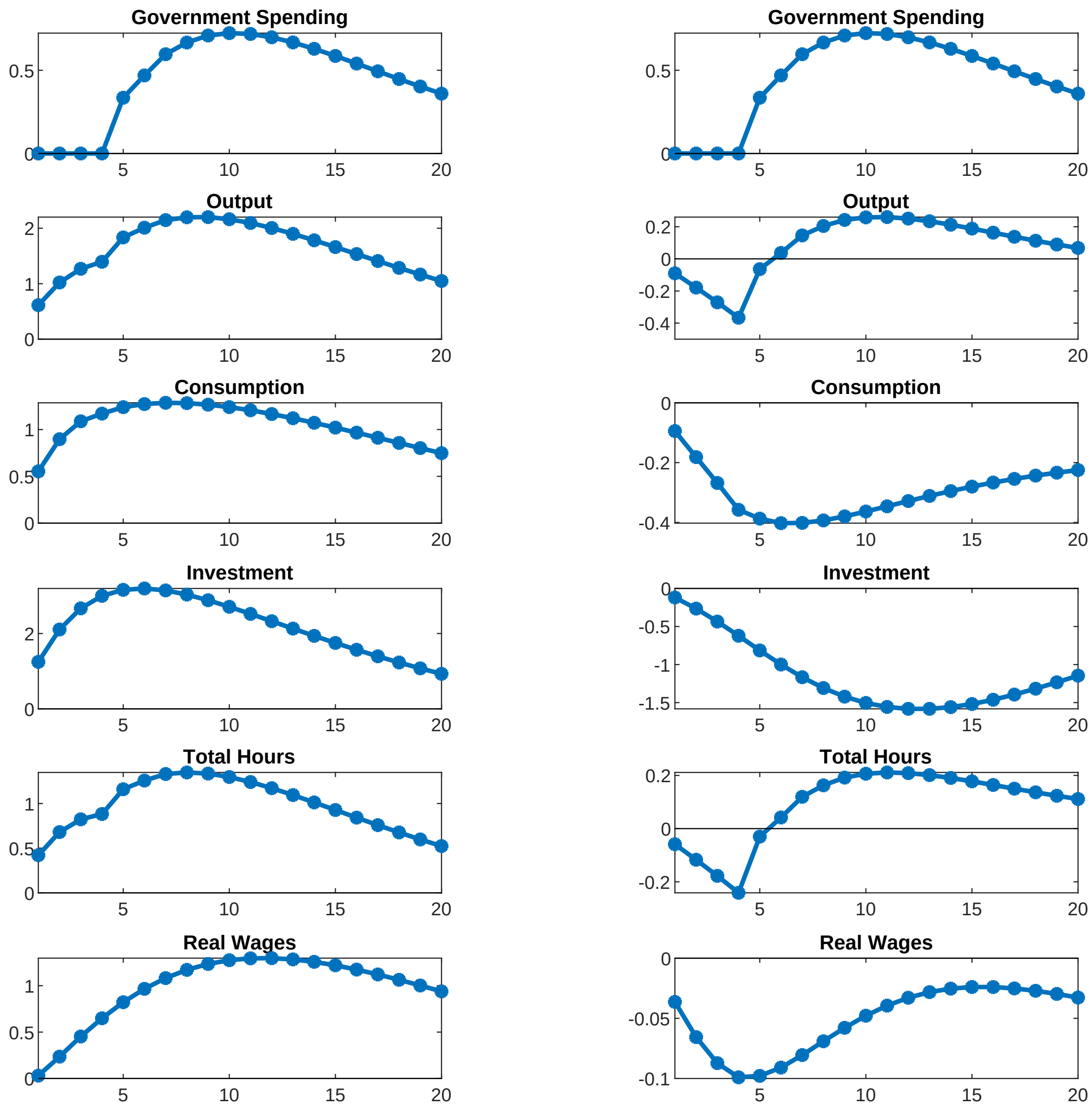
[17]This is not true for the behaviour of inflation, which does not show such a clear-cut difference among the two regimes: while under the fiscal regime inflation always increases, its response is ambiguous under the monetary regime as parameters vary.



(a) Regime F: $\varphi = 0$, $r_\pi = 0.5$

(b) Regime M: $\varphi = 0.2$, $r_\pi = 1.5$

Figure 3: Impulse responses to an unanticipated government spending shock in the Smets-Wouters (2007) model.



(a) Regime F: $\varphi = 0$, $r_\pi = 0.5$

(b) Regime M: $\varphi = 0.2$, $r_\pi = 1.5$

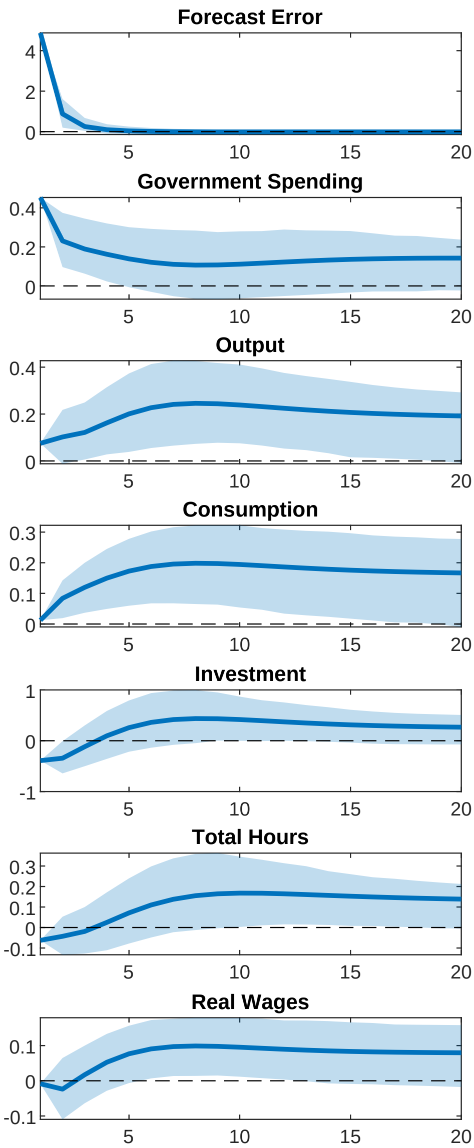
Figure 4: Impulse responses to a (four quarters) anticipated government spending shock in the Smets-Wouters (2007) model.

introduction (see Figure 1) suggests that the output response is consistent with this result. We now extend our VAR to include other variables present in the Smets and Wouters (2007) model, namely, the logarithm of government spending, GDP, non-durable and service consumption, investments, manufacturing product wages and hours.[18] We use the dataset provided by Ramey (2011). In particular, Ramey (2011) notes that the response of consumption and real wages crucially differs across identification methods, given the ability of identified fiscal shocks to capture the anticipation effect. Throughout this section, we check the impulse response to a government spending shock under the monetary and fiscal regimes. As in the Introduction, we consider the Great Inflation (1960q1-1979q2) period as the F regime and the Great Moderation one (1984q1-2007q2) as the M regime. We first check whether the data confirm the similarity of the results for unanticipated shocks under M and F and then turn to anticipated shocks.

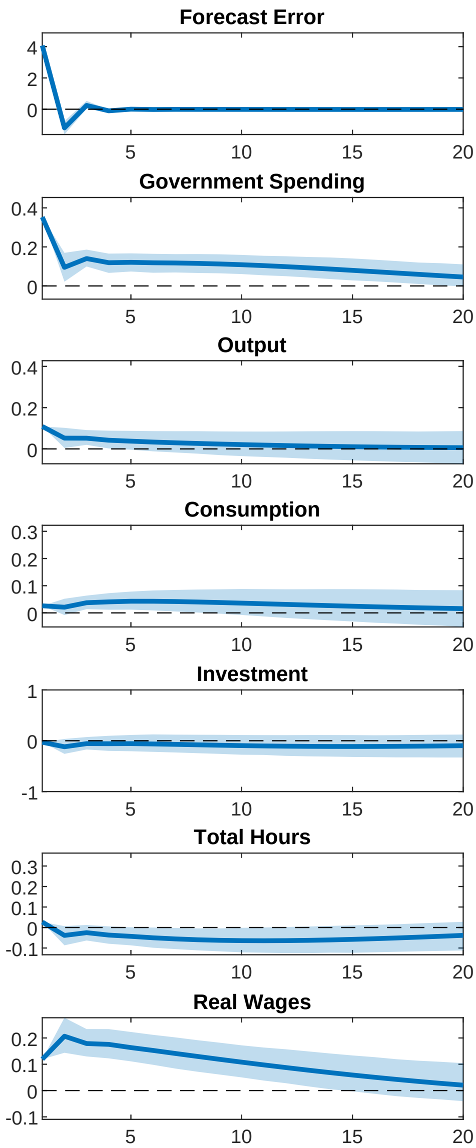
3.1 Unanticipated government spending shocks

To take into account unanticipated effects, we follow Auerbach and Gorodnichenko (2012) who, to control for expectations not already absorbed by the VAR, draw forecasts for government spending from the SPF (available since 1982) and from Greenbook forecasts prepared by the FRB staff for FOMC meetings (available from 1966 to 2004). They impose a Cholesky identification scheme with the forecast error for the growth rate of government spending ordered first and government spending ordered second. In this specification, they interpret an innovation in the forecast error as an unanticipated shock. Inserting their forecast error variable in our VAR specification and considering the two regimes (with the F regime starting from 1966) yields Figure 5. In accordance with the simulations of the Smets and Wouters (2007) model, the effects of an unanticipated shock in the two regimes do not show the clear-cut differences that we find in the Introduction, in which we instead use Ramey's (2011) measure of anticipated government spending shocks. In Figure 5, the effect of an unanticipated government spending shock is expansionary in both regimes - all the variables increase or are not significantly different from zero. Moreover, not only is there no substantial qualitative difference between the responses in the two regimes, but the VAR impulse responses also mirror the quantitative difference between the two regimes implied by the theoretical model (for example, the response of output and consumption is less pronounced and not hump-shaped in the M regime).

[18] All the VAR in this section employ one lag and include even the Barro-Redlick average marginal income tax rate whose response, to the sake of brevity, is not shown in the figures.



(a) Regime F: 1966q4-1979q2



(b) Regime M: 1984q1-2007q2

Figure 5: Impulse responses to a government spending forecast error shock.

Notes: Impulse response functions to the forecast error in a eight-variable VAR with one lag, including, in this order, the forecast error for the growth rate of government spending, real government spending, real GDP, the marginal tax rate (not shown), non-durable and service consumption, investments, wages and hours. The (unanticipated) shock is the first one of the Cholesky decomposition. Each panel reports point estimates and a 68% confidence region.

3.2 Anticipated government spending shocks

To take into account fiscal foresight, we use Ramey's (2011) set of variables in the VAR (those used to construct Figure 1), thereby using the defense news variable as measures for anticipated government spending shocks and adding the other extra variables one at a time. Figure 6 shows the resulting impulse response functions.

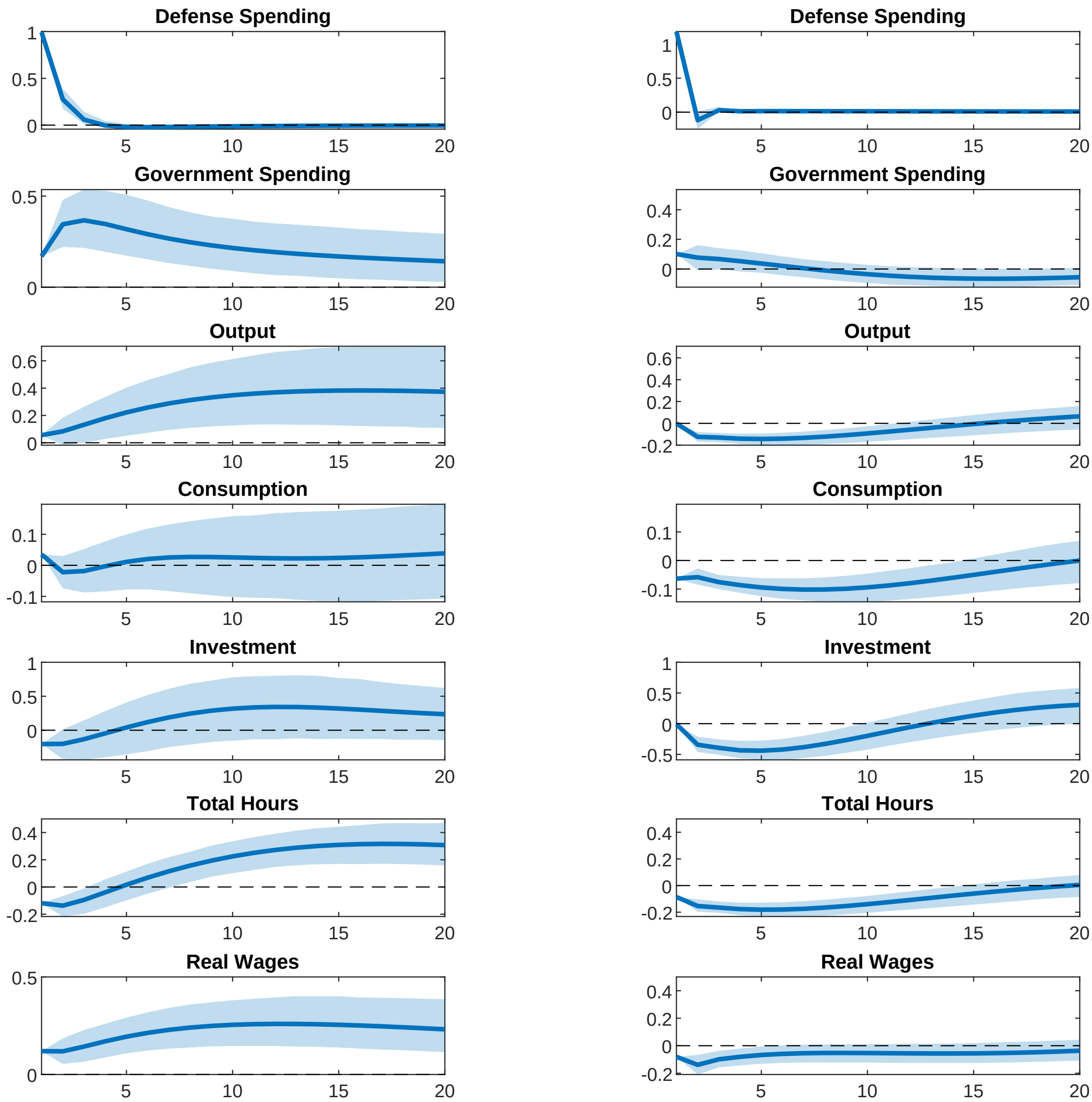
The impulse responses show that anticipated government spending shock are contractionary in regime M and expansionary in regime F. Consistent with the impulse responses from the Smets and Wouters (2007) model above, output, consumption, investment, hours and real wages show a significant reduction in the M regime and a significant increase (less so for consumption, significant only on impact, and investment) in the fiscal regime.

We interpret the evidence in Sections 3.1 and 3.2 as indicating that that the effects of government spending shocks do depend on the timing, as suggested by Ramey (2011), but above all they are contingent to the particular monetary-fiscal policy mix. More precisely, we show that the crucial importance of taking into account fiscal foresight, as stressed by Ramey (2011), depends on the monetary-fiscal regime in place. Failing to account for the monetary-fiscal mix can lead to misleading results, because anticipated government spending shocks have very different effects in the M and F regime.

3.3 Alternative procedures

As a robustness check, we now use two different specifications, one for each regime. For the F regime we adopt the Ramey and Shapiro (1998) narrative approach to identify shocks to government spending. We augment our VAR with their war dates variable, ordered first, and report the corresponding impulse responses in Figure 7, panel (a).[19] For the M regime, we follow Forni and Gambetti (2016) and use the professional forecasts of government spending to construct a variable that is affected contemporaneously by the news shock. Data for professional forecasts are available starting from the eighties, restricting this strategy's applicability to regime M. The variable we employ is the SPF expectation of future spending growth for the following four quarters, i.e. the cumulated forecast F(1,4). As Forni and Gambetti (2016), we then

[19] Ramey and Shapiro (1998) war dates are often criticized because, if one employs a sample that excludes the Korean War, the shock variable has lower explanatory power. Our two regimes exclude that war but, lacking alternatives for these years, we opted to employ this procedure for regime F. While the years corresponding to our regime M do not include any spike comparable to the Korean war in defense spending, those corresponding to our regime F include the Vietnam war where defense spending, although lower than the Korean war's one, is still noticeable.

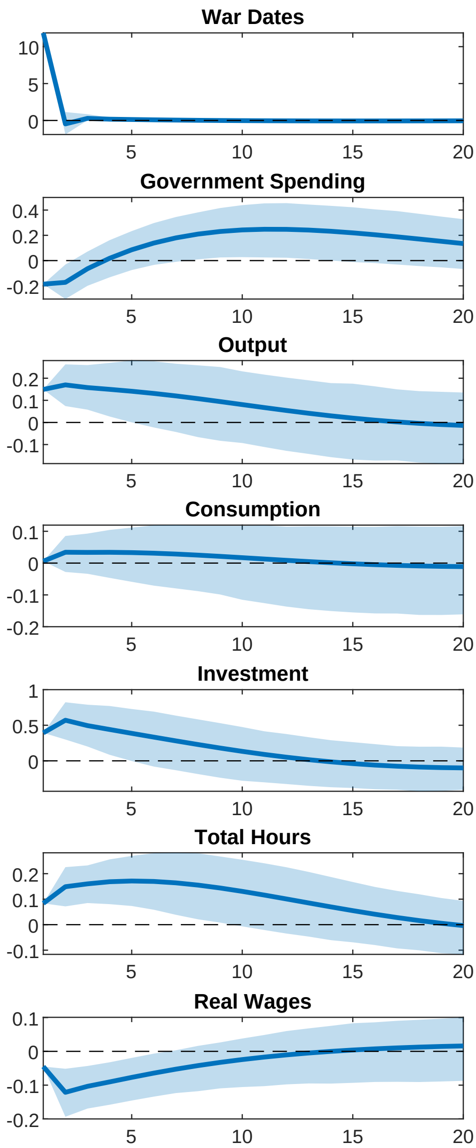


(a) Regime F: 1960q1-1979q2

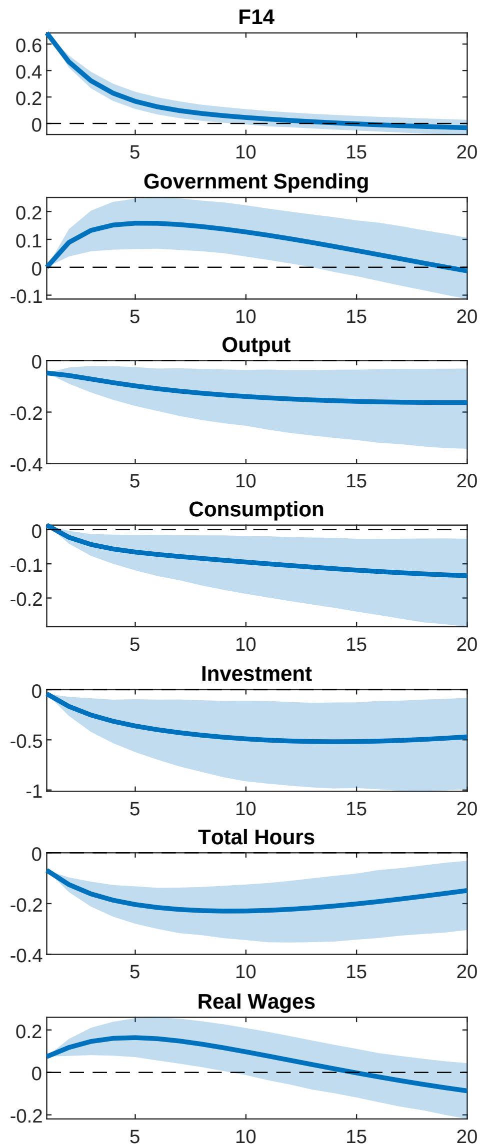
(b) Regime M: 1984q1-2007q2

Figure 6: Impulse responses to a defense spending shock, full specification.

Notes: Impulse response functions to the defence spending shock in a nine-variable VAR with one lag, including, in this order, defence news variable, real government spending, real GDP, the marginal tax rate (not shown), the three-month T-bill (not shown) and rotating, one at time, these other extra variables: non-durable and service consumption, investments, wages and hours. The (anticipated) shock is the first one of the Cholesky decomposition. Each panel reports point estimates and a 68% confidence region.



(a) Regime F: 1960q1-1979q2



(b) Regime M: 1984q1-2007q2

Figure 7: Impulse responses to a government spending shock under alternative specifications.

Notes: On the left, for the F regime, impulse response functions to Ramey and Shapiro (1998) military dates in a eight-variable VAR with one lag, including, in this order, military dates, real government spending, real GDP, the marginal tax rate (not shown), non-durable and service consumption, investments, wages and hours. The (anticipated) shock is the first one of the Cholesky decomposition. On the right, for the M regime, impulse response functions to a foresight (anticipated) spending shock in a eight-variable VAR with one lag including, in this order, real government spending, the cumulated professional forecast $F(1,4)$, real GDP, the marginal tax rate (not shown), non-durable and service consumption, investments, wages and hours. The (anticipated) shock is the second one of the Cholesky decomposition. Each panel reports point estimates and a 68% confidence region.

include this variable in the VAR, ordered second after government spending, and identify by imposing the standard Cholesky scheme. Figure 7, panel (b), shows the impulse responses to the second residual, i.e., the news shock. As the Figure shows, the different responses under the two regimes are confirmed: output, consumption, investments and hours all significantly decrease under M and increase under F (though increase in consumption is not significant in this case).

What happens if we instead run a VAR employing a standard identification?

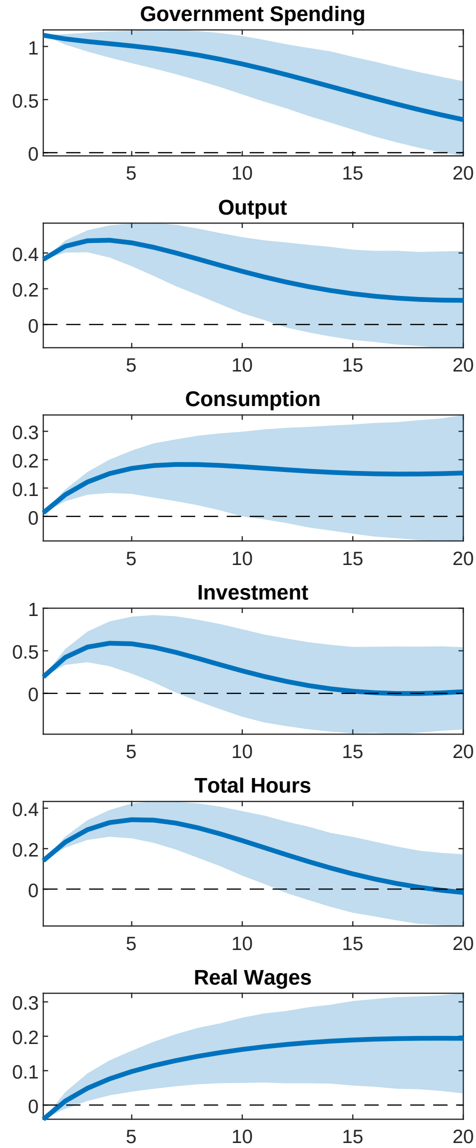
3.4 Employing a standard identification: Blanchard and Perotti (2002)

Blanchard and Perotti (2002) use a standard identification of government spending shocks, that is, a Choleski decomposition with government spending ordered before the other variables. Figure 8 shows that, with this standard identification in the VAR, output, non-durable and service consumption and investments decrease in regime M while they increase (or stay at zero) in regime F after a governement spending shock.[20]

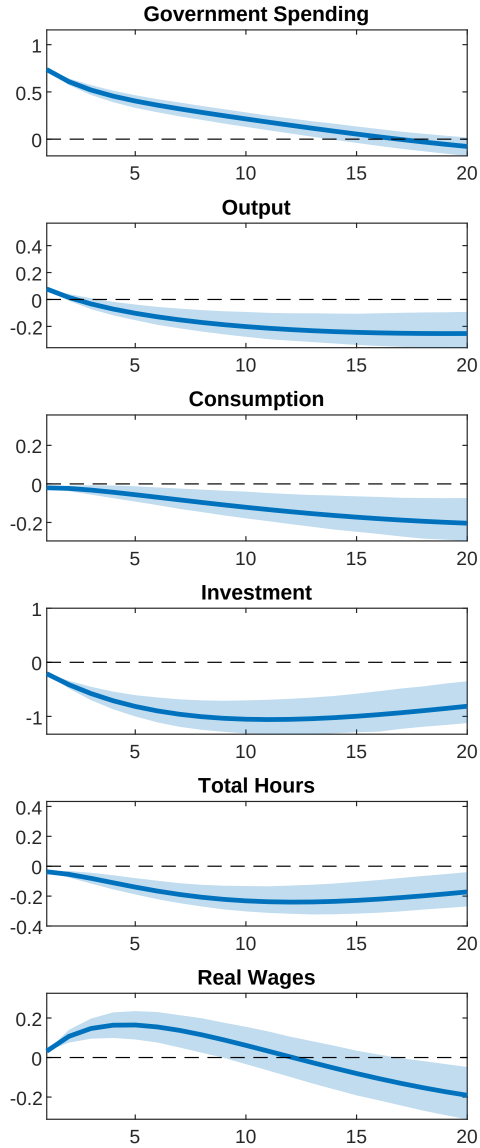
By applying the Blanchard and Perotti (2002) standard identification that does not distinguish between anticipated and unanticipated shocks, the VAR produces the same responses as in the anticipation period in the calibrated theoretical models above, and in the VARs that take fiscal foresight into account. In the fiscal regime, both anticipated and unanticipated shocks have the same effect on output, so that disentangling the two types of shocks is not necessary to conclude that fiscal shocks are expansionary. In the monetary regime, the Blanchard and Perotti (2002) identification scheme detects a fall in output following an increase in public expenditures, supporting the idea that anticipation effects represent the main transmission mechanism of fiscal shocks in the monetary regime. This is consistent with the line of reasoning in Ramey (2011). However, our results call for a different interpretation of Ramey's (2011) critique of the Blanchard and Perotti (2002) identification scheme. While, as shown by Ramey (2011), the two identifications of government spending shocks lead to two very different results using the whole post-WWII sample, the surprising finding here is that this difference disappears when the estimates are conditioned on the monetary-fiscal policy mix.[21] Therefore, irrespec-

[20] Perotti (2008) and Ellahie and Ricco (2017) find instabilities of VARs estimates across subsamples and point to the possibility that these are due to changes in the fiscal-monetary regime in place. In particular, Ellahie and Ricco (2017), dividing their sample in two subsamples, very close to ours, find that while in the Great Inflation years government spending has expansionary effects, in the Great Moderation ones they are contractionary. However, since this subsample instability seems to disappear once using large VARs, they end up attributing these instabilities to misspecification in the information set. As Lutkepohl (2014) argues, these results should be taken with caution since the use of large information techniques can distort the results.

[21] Appendix D displays the impulse responses with these two different specifications for the full post-WWII



(a) Regime F: 1960q1-1979q2



(b) Regime M: 1984q1-2007q2

Figure 8: Impulse responses to a government spending shock using the recursive identification scheme (Blanchard and Perotti, 2002).

Notes: Impulse response functions to a government spending shock in a seven-variable VAR with one lag, including, in this order, real government spending, real GDP, the marginal tax rate (not shown), non-durable and service consumption, investments, wages and hours. A government spending shock is identified as the first shock of the Choleski decomposition. The left hand side reports results for regime F, the right hand side regime M. Each panel reports point estimates and a 68% confidence region.

tive of taking fiscal foresight explicitly into account or not, the results from the VAR within each defined regime are consistent. This suggests that the crucial feature driving the results in the two identification procedure is not the timing - that is, whether the shocks capture fiscal foresight or not - but the monetary-fiscal policy mix, i.e. whether the estimation is conducted over a sample with a well-defined regime. Moreover, according to this interpretation, the Blanchard and Perotti (2002) identification scheme seems to indeed capture fiscal foresight, because the impulse response functions mimic what theory would predict for anticipated government spending shocks, once one controls for the monetary-fiscal regime in place. The fact that most of the changes in fiscal policy are part of multi-year fiscal plans announced in advance (see Alesina et al. 2019) could be one possible explanation why the Blanchard and Perotti (2002) identification scheme captures fiscal foresight.

Fiscal foresight poses a challenge to VAR analysis: under a standard identification scheme, what one identifies as a fiscal shock would be a combination of anticipated and unanticipated changes in government spending. As shown by Leeper et al. (2013), in this case, the underlying structural MA representation of the variables in the VAR is not invertible, or "non-fundamental", which leads the VAR to provide misleading results. The problem is the potential misalignment between the (richer) agents' and the (poorer) econometrician's information set, resulting from the scarce information contained in the VAR. Our analysis suggests, instead, that the problem might disappear once the estimation controls for the monetary-fiscal policy mix. In other words, the superior information the agent has with respect to the econometrician is the realization of the regime of the economy. Once one controls for the regime, shocks become fundamental. We investigate this possibility in the next section.

4 Testing for fundamentalness

Ramey's (2011) Granger causality test. Under fundamentalness, external information should not be able to forecast the VAR shocks. To check for it, we follow Ramey (2011) and run a series of Granger causality tests between the Blanchard and Perotti (2002) VAR-based government spending shocks and Ramey and Shapiro (1998) war dates and the SPF forecasts of future spending growth for one and four quarters ahead. We report the results in Table 1, respectively in Panel A and B. We consider both a large sample period (1947q1-2008q4) and

sample.

Table 1: Granger causality test

Panel A: Granger causality test using war dates

	Full sample 1947q1-2008q4	F 1960q1-1979q2	M 1984q1-2007q2
4 lags			
Do war dates Granger-cause VAR shocks?	Yes (0.0004)	No (0.5056)	No (0.5785)
Do VAR shocks Granger-cause war dates?	No (0.4938)	No (0.3803)	No (0.2415)
2 lags			
Do war dates Granger-cause VAR shocks?	Yes (0.0069)	No (0.2946)	No (0.4523)
Do VAR shocks Granger-cause war dates?	No (0.4776)	No (0.1997)	No (0.6601)

Panel B: Granger causality test using SPF forecasts

	Full sample 1968q4-2008q4	F 1968q4-1979q2	M 1984q1-2007q2
2 lags			
Do one-quarter ahead professional forecasts Granger-cause VAR shocks?	Yes (0.0667)	No (0.6320)	No (0.1711)
Do VAR shocks Granger-cause one-quarter ahead professional forecasts?	No (0.3618)	No (0.6059)	No (0.2488)
Do four-quarter ahead professional forecasts Granger-cause VAR shocks?			No (0.6577)
Do VAR shocks Granger-cause four-quarter ahead professional forecasts?			No (0.1462)

Notes: Granger-causality tests between the VAR-based government spending shocks identified with the Blanchard and Perotti (2002) scheme and, respectively, Ramey and Shapiro (1998) war dates (Panel A) and the SPF forecasts of future spending growth for one and four quarters ahead (Panel B). p-values are reported in parenthesis.

the two subperiods we identify as regimes M and F.[22] The evidence is clear: VAR shocks never Granger-cause the war dates. War dates Granger-cause the VAR shocks just if one considers the full sample but they do not if one considers each regime separately. As a result, non-fundamentalness seems to be present only in the long sample that includes our two sub-samples that we interpret as characterized by very different monetary-fiscal policy mix. As such, the VAR is mispecified because the transmission mechanism of anticipated fiscal shocks is very different in the two regimes, as our theoretical analysis shows, and thus a single linear VAR that does not distinguish among the M and F regimes can not capture this difference. On the contrary, when we consider well-defined monetary and/or fiscal regimes, there is no evidence

[22] In Panel B we adjust samples because data for the one-quarter ahead forecast start from 1968q1, while those for the four-quarter ahead forecast start later and allows just the analysis of regime M.

that VAR shocks could have been forecasted, i.e. shocks become fundamental. Our analysis suggests that in this case non-fundamentalness arises for VAR mispecification rather than from fiscal foresight.[23]

Test of orthogonality. Following Forni and Gambetti (2016), we can test for fundamentalness also by regressing the VAR-based shocks on a set of potential predictors. We report these orthogonality test in Table 2. Each row corresponds to the F tests for a regression of the estimated government spending shock, based on the standard Blanchard and Perotti (2002) scheme, against the SPF forecasts for the growth rates of government spending at a specific horizon. $f(h)$ indicates the forecast made in t for the growth rate between $t+h-1$ and $t+h$, with $h = 0, ..., 4$. In the first five rows we report one forecast at a time (in each case we include one to three lags), in the sixth row the quarterly forecast at all horizons, and in the seventh row the cumulated forecasts $F(1,4) = f(1) + \cdots + f(4)$. Since the SPF forecasts are available starting from 1981, we only focus on regime M. In all cases but one we find that the SPF forecasts have no predictive power for the VAR-based shocks. At least from an empirical standpoint, the problem of non-fundamentalness of governments spending shocks does not arise if one controls for the fiscal-monetary regime.[24]

[23] We also considered the sample (1960q1-2007q2) just covering our two regimes, both including and excluding the Volcker's disinflation years (1979q3-1983q4) and we confirm results for the whole sample period. Results are available from the authors upon request.

[24] Note that, however, even in the case where orthogonality is rejected, the consequences of non-fundamentalness do not seem so severe. Looking at the R^2 associated to the relative regressions (as the empirical diagnostic of the non-fundamentalness severity by Beaudry et al. (2019) proposes) we find they are never larger than 0.08, i.e. they explain less than the 8% of the variance of government shocks.

Table 2: Orthogonality test for the identified government spending shocks

Regime M	1 lag	2 lags	3 lags
$f(0)$	0.85	0.78	0.81
$f(1)$	0.17	0.25	0.35
$f(2)$	0.75	0.14	0.23
$f(3)$	0.99	0.93	0.04
$f(4)$	0.87	0.51	0.50
$f(0)$ to $f(4)$	0.59	0.13	0.13
$F(1,4)$	0.55	0.81	0.70

Notes: the first five rows of the table report the p-values of the F-test for the regressions of the government spending shock obtained from the 7-variable VAR on the (lagged) SPF forecasts of government spending growth, from $f(0)$ (nowcast) to $f(4)$ (four quarters ahead), taken one at a time. The sixth row corresponds to the regressions that include all the $f(h)$, for $h = 0, \ldots, 4$. The seventh row reports the regression that includes $F(1,4) = f(1) + \cdots + f(4)$.

5 Conclusions

Government spending shocks affect the economy activity not just when they are implemented but also when they are announced. In a simple analytical model, we show that the reaction of output to anticipated government spending shocks crucially depends on the predominant monetary-fiscal regime. In the monetary regime the anticipation of a government spending shock generates an immediate decrease in aggregate demand ahead of its implementation, as agents expect higher future taxes given the Ricardian nature of fiscal policy. Conversely, in a fiscal regime, the same anticipated shock is expansionary, as the increase in nominal debt generates a wealth effect that stimulates consumption. The effect of anticipated shocks contrasts with the effect of unanticipated shocks, which are expansionary in both regimes. The opposite movement of output after an anticipated shock could be exploited to identify different monetary and fiscal regimes in the data.

The empirical literature studies the impact of fiscal policy shocks mainly through two identification procedures that, however, return conflicting results when considering U.S. data for the whole post-WWII sample. Both approaches find that output increases after a positive fiscal shock, but the results differ as for the behavior of consumption and real wages. In the recursive identification à la Blanchard and Perotti (2002), consumption and wages increase, while the narrative approach à la Ramey (2011) shows that both variables decline. Ramey (2011) explains this dichotomy with the idea that the standard identification procedure misses the timing of the shocks, showing that news about government spending shocks are known to agents before their actual implementation. Her narrative approach is aimed to correctly account for these anticipation effects.

We exploit this intuition further and find that the conflicting results of the two identification procedures disappear once the estimates are conditional on the existing monetary-fiscal policy mix. This happens irrespective of explicitly accounting for fiscal foresight or not: using both identification procedures, consumption, wages, and even output increase in the a fiscal regime, while all variables decrease in the monetary regime.

If we apply the narrative identification strategy to a long sample that includes different monetary and fiscal regimes, one arguably catches some of the effects—such a reduction in consumption, compatible with a monetary regime—that can arise following pre-announced increases in public spending. However, the final results on the behavior of the variables are driven by an average of the different responses under the different regimes. Splitting the long sample to run the estimation over years characterized by a well-defined regime seems to solve the problem.

Even the non-fundamentalness problem brought about by a misalignment between the information sets of economic agents, who take into account anticipation effects, and of the econometrician, who does not, disappears once the estimation controls for the monetary-fiscal policy mix. The superior information held by the agents with respect to the econometrician seems to be the realization of the regime of the economy: once one controls for the regime, shocks become fundamental.

The different behavior of output in the two regimes in the anticipation period points to the key role that forward guidance of fiscal policy could exert. In general, fiscal forward guidance produces different effects depending on the monetary-fiscal mix in place: while it could lead to immediate wealth effects on aggregate demand under fiscal dominance, it could discourage spending in a monetary regime.

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A Model Setup

The model is the same as in Beck-Friis and Willems (2017), but we keep a general form for the utility function so that the analytical results extend to any types of preferences. We consider CRRA-preferences, as Beck-Friis and Willems (2017) in the numerical illustrations. Given the similarities, we proceed by presenting the model's linearized form.

A.1 Linearized Model

Linearized aggregate resource constraint:

$$\hat{y}_t = \left(\frac{c}{y}\right)\hat{c}_t + \tilde{g}_t. \tag{A1}$$

Linearized production function:

$$\hat{y}_t = \hat{n}_t. \tag{A2}$$

Let $U(c_t, n_t)$ be the household's per-period utility function. The Euler equation reads

$$\frac{1}{i_t} = \beta \mathbb{E}_t\left[\frac{U_c(c_{t+1}, n_{t+1})}{U_c(c_t, n_t)}\frac{1}{\pi_{t+1}}\right], \tag{A3}$$

which in linearized form becomes

$$-U_c \cdot [\hat{\imath}_t - \mathbb{E}_t\hat{\pi}_{t+1}] = U_{cc} \cdot c[\hat{c}_{t+1} - \hat{c}_t] + U_{cn} \cdot n[\hat{n}_{t+1} - \hat{n}_t],$$

where U_c, U_{cc} and U_{cn} denote the steady state values of the partial derivatives, with $U_c, -U_n > 0$ and $U_{cc}, U_{cn}, U_{nn} \leq 0$. Combining the Euler equation with the resource constraint and production function yields

$$\hat{y}_t - \alpha_1\tilde{g}_t = \mathbb{E}_t\hat{y}_{t+1} - \alpha_1\mathbb{E}_t\tilde{g}_{t+1} - \alpha_2[\hat{\imath}_t - \mathbb{E}_t\hat{\pi}_{t+1}], \tag{A4}$$

where

$$\alpha_1 = \frac{U_{cc}}{U_{cc} + U_{cn}} \in \mathbb{R}, \tag{A5}$$

$$\alpha_2 = -\frac{U_c}{y(U_{cc} + U_{cn})} \in \mathbb{R}. \tag{A6}$$

The optimal intra-temporal consumption/labour choice is

$$\frac{w_t}{p_t} = -\frac{U_n(c_t, n_t)}{U_c(c_t, n_t)}, \tag{A7}$$

which in linearized form becomes

$$\hat{w}_t - \hat{p}_t = c\left[\frac{U_{nc}}{U_n} - \frac{U_{cc}}{U_c}\right]\hat{c}_t + n\left[\frac{U_{nn}}{U_n} - \frac{U_{cn}}{U_c}\right]\hat{n}_t. \tag{A8}$$

Combining with the resource constraint and production function gives

$$\hat{w}_t - \hat{p}_t = \alpha_3\hat{y}_t - \alpha_4\tilde{g}_t, \tag{A9}$$

where

$$\alpha_3 = y\left[\frac{U_{nc} + U_{nn}}{U_n} - \frac{U_{cc} + U_{cn}}{U_c}\right] \in \mathbb{R} \tag{A10}$$

$$\alpha_4 = y\Big[\frac{U_{nc}}{U_n} - \frac{U_{cc}}{U_c}\Big] \in \mathbb{R}. \tag{A11}$$

The New Keynesian Phillips curve is:

$$\hat{\pi}_t = \beta \mathbb{E}_t[\hat{\pi}_{t+1}] + \kappa \hat{mc}_t, \tag{A12}$$

where κ is the standard measure of price rigidity. With a linear production function, real marginal cost equals the real wage. We can therefore rewrite the Phillips curve as

$$\hat{\pi}_t = \beta \mathbb{E}_t[\hat{\pi}_{t+1}] + \kappa\alpha_3 \hat{y}_t - \kappa\alpha_4 \tilde{g}_t. \tag{A13}$$

Interest rate rule:

$$\hat{i}_t = \phi\hat{\pi}_t, \quad \phi \geq 0. \tag{A14}$$

Taxation rule:

$$\tilde{\tau}_t = \psi\tilde{b}_{t-1} + \varepsilon_t^\tau, \quad \psi \geq 0, \tag{A15}$$

where ε_t^τ is an exogenous i.i.d taxation shock. Government spending process:

$$\tilde{g}_t = \rho\tilde{g}_{t-1} + \varepsilon_t^g, \tag{A16}$$

where ε_t^g is an exogenous i.i.d government spending shock.

The nominal government budget constraint is:

$$q_t B_t + p_t\tau_t = B_{t-1} + p_t g_t, \tag{A17}$$

which in real terms is:

$$q_t b_t + \tau_t - g_t = \frac{b_{t-1}}{\pi_t}, \tag{A18}$$

where $b_t \equiv B_t/p_t$ denotes real debt. The linearized government budget constraint is hence:

$$\tilde{b}_t = \frac{1}{\beta}\tilde{b}_{t-1} - \frac{1}{\beta}(\tilde{\tau}_t - \tilde{g}_t) - \frac{1}{\beta}\frac{b}{y}\hat{\pi}_t + \frac{b}{y}\hat{i}_t. \tag{A19}$$

A.2 Linearized marginal utility of consumption

By Taylor expansion of the marginal utility of consumption around the steady state, we get:

$$\begin{aligned}
\frac{\partial U_c(c_t, n_t)}{\partial \tilde{g}_t} &= \frac{\partial}{\partial \tilde{g}_t}\Big[U_c + U_{cc}(c_t - c) + U_{cn}(n_t - n)\Big], \\
&= \frac{\partial}{\partial \tilde{g}_t}\Big[U_c + y\tilde{c}_t U_{cc} + y\tilde{y}_t U_{cn}\Big], \\
&= \frac{\partial}{\partial \tilde{g}_t}\Big[U_c + y(\tilde{y}_t - \tilde{g}_t)U_{cc} + y\tilde{y}_t U_{cn}\Big], \\
&= y(U_{cc} + U_{cn})GSM_M^y(0,0) - yU_{cc}, \\
&= y(U_{cc} + U_{cn})\Big[GSM_M^y(0,0) - \alpha_1\Big],
\end{aligned}$$

where $\alpha_1 = U_{cc}/(U_{cc} + U_{cn})$ as in (A5). The marginal utility of consumption therefore increases in response to government spending if $GSM_M^y(0,0) > \alpha_1$.

B Model Solution

The economy is characterized by the following linearized equations

$$\begin{aligned}
\hat{y}_t - \alpha_1 \tilde{g}_t &= \mathbb{E}_t \hat{y}_{t+1} - \alpha_1 \mathbb{E}_t \tilde{g}_{t+1} - \alpha_2 [\hat{i}_t - \mathbb{E}_t \hat{\pi}_{t+1}], \\
\hat{\pi}_t &= \beta \mathbb{E}_t [\hat{\pi}_{t+1}] + \kappa \alpha_3 \hat{y}_t - \kappa \alpha_4 \tilde{g}_t, \\
\hat{i}_t &= \phi \hat{\pi}_t, \\
\tilde{b}_t &= \frac{1}{\beta} \tilde{b}_{t-1} - \frac{1}{\beta}(\tilde{\tau}_t - \tilde{g}_t) - \frac{1}{\beta}\frac{b}{y}\pi_t + \frac{b}{y}\hat{i}_t, \\
\tilde{\tau}_t &= \psi \tilde{b}_{t-1} + \varepsilon_t^{\tau} \\
\tilde{g}_t &= \rho \tilde{g}_{t-1} + \varepsilon_t^{g},
\end{aligned}$$

which in vector form can be written as

$$\begin{bmatrix} 1 & \alpha_2 & 0 & 0 & -\alpha_1 \\ 0 & \beta & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \mathbb{E}_t \hat{y}_{t+1} \\ \mathbb{E}_t \hat{\pi}_{t+1} \\ \tilde{b}_t \\ \tilde{\tau}_{t+1} \\ \tilde{g}_{t+1} \end{bmatrix} = \begin{bmatrix} 1 & \alpha_2 \phi & 0 & 0 & -\alpha_1 \\ -\kappa\alpha_3 & 1 & 0 & 0 & \kappa\alpha_4 \\ 0 & -\frac{1}{\beta}\frac{b}{y}(1-\beta\phi) & \frac{1}{\beta} & -\frac{1}{\beta} & \frac{1}{\beta} \\ 0 & -\psi\frac{b}{y}\frac{1}{\beta}(1-\beta\phi) & \psi\frac{1}{\beta} & -\psi\frac{1}{\beta} & \psi\frac{1}{\beta} \\ 0 & 0 & 0 & 0 & \rho \end{bmatrix} \begin{bmatrix} \hat{y}_t \\ \hat{\pi}_t \\ \tilde{b}_{t-1} \\ \tilde{\tau}_t \\ \tilde{g}_t \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ \varepsilon_{t+1}^{\tau} \\ \varepsilon_{t+1}^{g} \end{bmatrix}$$

In period t, suppose that the government announces that it will implement a non-zero government spending shock and a non-zero taxation shock in period $t+j$. That is, let $\mathbb{E}_t \varepsilon_{t+i}^{g} = \mathbb{E}_t \varepsilon_{t+i}^{\tau} = 0$ for $i \in \{0, 1, ..., j-1, j+1, j+2, ...\}$ and $\mathbb{E}_t \varepsilon_{t+j}^{g}, \mathbb{E}_t \varepsilon_{t+j}^{\tau} \neq 0$.

How do we find a solution to this system? Any innovations $\delta_{t+1}^{y}, \delta_{t+1}^{\pi}$ such that $\mathbb{E}_t \delta_{t+1}^{y} = \mathbb{E}_t \delta_{t+1}^{\pi} = 0$ satisfying the system

$$\begin{aligned}
\begin{bmatrix} \hat{y}_{t+1} \\ \hat{\pi}_{t+1} \\ \tilde{b}_t \\ \tilde{\tau}_{t+1} \\ \tilde{g}_{t+1} \end{bmatrix} &= \begin{bmatrix} 1 & -\frac{\alpha_2}{\beta} & 0 & 0 & \alpha_1 \\ 0 & \frac{1}{\beta} & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & \alpha_2 \phi & 0 & 0 & -\alpha_1 \\ -\kappa\alpha_3 & 1 & 0 & 0 & \kappa\alpha_4 \\ 0 & -\frac{1}{\beta}\frac{b}{y}(1-\beta\phi) & \frac{1}{\beta} & -\frac{1}{\beta} & \frac{1}{\beta} \\ 0 & -\psi\frac{b}{y}\frac{1}{\beta}(1-\beta\phi) & \psi\frac{1}{\beta} & -\psi\frac{1}{\beta} & \psi\frac{1}{\beta} \\ 0 & 0 & 0 & 0 & \rho \end{bmatrix} \begin{bmatrix} \hat{y}_t \\ \hat{\pi}_t \\ \tilde{b}_{t-1} \\ \tilde{\tau}_t \\ \tilde{g}_t \end{bmatrix} + \begin{bmatrix} \alpha_1 \varepsilon_{t+1}^{g} + \delta_{t+1}^{y} \\ \delta_{t+1}^{\pi} \\ 0 \\ \varepsilon_{t+1}^{\tau} \\ \varepsilon_{t+1}^{g} \end{bmatrix} \\
&= \begin{bmatrix} \frac{1}{\beta}(\beta + \alpha_2\kappa\alpha_3) & -\frac{\alpha_2}{\beta}(1-\phi\beta) & 0 & 0 & -\frac{1}{\beta}[\kappa\alpha_2\alpha_4 + \beta\alpha_1(1-\rho)] \\ -\frac{\kappa\alpha_3}{\beta} & \frac{1}{\beta} & 0 & 0 & \frac{\kappa\alpha_4}{\beta} \\ 0 & -\frac{1}{\beta}\frac{b}{y}(1-\beta\phi) & \frac{1}{\beta} & -\frac{1}{\beta} & \frac{1}{\beta} \\ 0 & -\psi\frac{b}{y}\frac{1}{\beta}(1-\beta\phi) & \psi\frac{1}{\beta} & -\psi\frac{1}{\beta} & \psi\frac{1}{\beta} \\ 0 & 0 & 0 & 0 & \rho \end{bmatrix} \begin{bmatrix} \hat{y}_t \\ \hat{\pi}_t \\ \tilde{b}_{t-1} \\ \tilde{\tau}_t \\ \tilde{g}_t \end{bmatrix} \\
&+ \begin{bmatrix} \alpha_1 \varepsilon_{t+1}^{g} + \delta_{t+1}^{y} \\ \delta_{t+1}^{\pi} \\ 0 \\ \varepsilon_{t+1}^{\tau} \\ \varepsilon_{t+1}^{g} \end{bmatrix} \\
X_{t+1} &= AX_t + \delta_{t+1},
\end{aligned}$$

form a solution. The eigenvalues and corresponding eigenvectors of A are

$$\lambda_1 = 0 \longleftrightarrow q_1 = \begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}, \qquad \lambda_2 = \rho \longleftrightarrow q_2 = \begin{bmatrix} q_{1,2} \\ q_{2,2} \\ q_{3,2} \\ q_{4,2} \\ q_{5,2} \end{bmatrix},$$

$$\lambda_3 = \frac{1}{2\beta}\left[1+\beta+\kappa\alpha_2\alpha_3 - \sqrt{(1+\beta+\kappa\alpha_2\alpha_3)^2 - 4\beta(1+\phi\kappa\alpha_2\alpha_3)}\right] \longleftrightarrow q_3 = \begin{bmatrix} (1-\beta\lambda_3)[1-\beta\lambda_3-\psi] \\ \kappa\alpha_3[1-\beta\lambda_3-\psi] \\ \kappa\alpha_3(b/y)(1-\beta\phi) \\ \psi\kappa\alpha_3(b/y)(1-\beta\phi) \\ 0 \end{bmatrix},$$

$$\lambda_4 = \frac{1}{2\beta}\left[1+\beta+\kappa\alpha_2\alpha_3 + \sqrt{(1+\beta+\kappa\alpha_2\alpha_3)^2 - 4\beta(1+\phi\kappa\alpha_2\alpha_3)}\right] \longleftrightarrow q_4 = \begin{bmatrix} (1-\beta\lambda_4)[1-\beta\lambda_4-\psi] \\ \kappa\alpha_3[1-\beta\lambda_4-\psi] \\ \kappa\alpha_3(b/y)(1-\beta\phi) \\ \psi\kappa\alpha_3(b/y)(1-\beta\phi) \\ 0 \end{bmatrix},$$

$$\lambda_5 = \frac{1}{\beta}(1-\psi) \longleftrightarrow q_5 = \begin{bmatrix} 0 \\ 0 \\ 1 \\ \psi \\ 0 \end{bmatrix},$$

where

$$\begin{aligned} q_{1,2} &\equiv \left[\alpha_1(1-\rho) + \kappa\alpha_2\alpha_4\frac{(\phi-\rho)}{(1-\rho\beta)}\right], \\ q_{2,2} &\equiv \frac{(1-\rho)\kappa(\alpha_1\alpha_3-\alpha_4)}{1-\beta\rho}, \\ q_{5,2} &\equiv \left[1-\rho+\kappa\alpha_2\alpha_3\frac{(\phi-\rho)}{(1-\rho\beta)}\right], \\ q_{3,2} &\equiv \frac{(1-\beta\phi)(b/y)q_{2,2} - q_{5,2}}{[1-\psi-\beta\rho]}, \\ q_{4,2} &\equiv \psi q_{3,2}. \end{aligned}$$

Define

$$Q \equiv [q_1 \quad q_2 \quad q_3 \quad q_4 \quad q_5], \quad \Lambda \equiv \begin{bmatrix} \lambda_1 & 0 & 0 & 0 & 0 \\ 0 & \lambda_2 & 0 & 0 & 0 \\ 0 & 0 & \lambda_3 & 0 & 0 \\ 0 & 0 & 0 & \lambda_4 & 0 \\ 0 & 0 & 0 & 0 & \lambda_5 \end{bmatrix},$$

and let $q_{i,h}$ denote the element of Q at row i and column h.

By eigendecomposition of A, we then get

$$\begin{aligned} X_t &= AX_{t-1} + \delta_t, \\ X_t &= Q\Lambda Q^{-1}X_{t-1} + \delta_t, \\ Q^{-1}X_t &= \Lambda Q^{-1}X_{t-1} + Q^{-1}\delta_t, \\ Z_t &= \Lambda Z_{t-1} + V_t, && \text{defining } Z_t \equiv Q^{-1}X_t \text{ and } V_t \equiv Q^{-1}\delta_t, \\ z_{i,t} &= \lambda_i z_{i,t-1} + v_{i,t}, && \text{for } i \in \{1,2,3,4,5\}. \end{aligned}$$

To rule out explosive solutions, for any eigenvalue λ_i that is outside the unit circle, we then need

$$\begin{aligned} &\mathbb{E}_t[z_{i,t+j}] = 0, \\ &\mathbb{E}_t[\lambda_i z_{i,t+j-1} + v_{i,t+j}] = 0, \\ &\mathbb{E}_t[\lambda_i^2 z_{i,t+j-2} + \lambda_i v_{i,t+j-1} + v_{i,t+j}] = 0, \\ &\ldots \\ &\mathbb{E}_t\Big[\lambda_i^{j+1} z_{i,t-1} + \sum_{k=0}^{j} \lambda_i^k v_{i,t+j-k}\Big] = 0, \\ &\lambda_i^j v_{i,t} + \mathbb{E}_t v_{i,t+j} = 0, \end{aligned} \tag{B20}$$

where the last line follows from $\mathbb{E}_t v_{i,t+k} = 0$ for $k \in \{1, 2, ..., j-1\}$, and that $z_{i,t-1} = 0$ as we start from steady state.

Note that $\lambda_i^j v_{i,t} + \mathbb{E}_t v_{i,t+j}$ is the i's element of column vector $\Lambda^j V_t + \mathbb{E}_t V_{t+j}$. So to find the solution, write

$$\Lambda^j V_t + \mathbb{E}_t V_{t+j} = \Lambda^j Q^{-1}\delta_t + Q^{-1}\mathbb{E}_t\delta_{t+j} \tag{B21}$$

$$Q[\Lambda^j V_t + \mathbb{E}_t V_{t+j}] = \underbrace{Q\Lambda^j Q^{-1}}_{A^j}\delta_t + \mathbb{E}_t\delta_{t+j} \tag{B22}$$

where the first equality follows by definition, and the second line follows from pre-multiplying both sides by Q. Combining (B20) with (B22) gives a system of five equations with five unknowns, two of which are δ_t^y and δ_t^π. We can then obtain the response of output and inflation by recalling that $X_t = \delta_t$, since we assume to start from the steady state where $X_{t-1} = 0$. Hence $\hat{y}_t = \alpha_1\varepsilon_t^g + \delta_t^y$ and $\hat{\pi}_t = \delta_t^\pi$. Before deriving the five equations, we first need to find an expression for $A^j = Q\Lambda^j Q^{-1}$. Inverting Q gives

$$Q^{-1}(:,1:3) = \begin{bmatrix} 0 & 0 & -\psi/(1-\psi) \\ 0 & 0 & 0 \\ q_{2,4}/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) & -q_{1,4}/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) & 0 \\ -q_{2,3}/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) & q_{1,3}/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) & 0 \\ q_{3,4}(q_{2,3}-q_{2,4})/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) & q_{3,4}(q_{1,4}-q_{1,3})/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) & 1/(1-\psi) \end{bmatrix}$$

$$Q^{-1}(:,4:5) = \begin{bmatrix} 1/(1-\psi) & 0 \\ 0 & 1/q_{5,2} \\ 0 & (q_{1,4}q_{2,2}-q_{2,4}q_{1,2})/[q_{5,2}(q_{1,3}q_{2,4}-q_{2,3}q_{1,4})] \\ 0 & (q_{2,3}q_{5,2}-q_{1,3}q_{2,2})/[q_{5,2}(q_{1,3}q_{2,4}-q_{2,3}q_{1,4})] \\ -1/(1-\psi) & -q_{3,2}/q_{5,2} - \Big[q_{3,4}[q_{1,2}(q_{2,3}-q_{2,4})+q_{2,2}(q_{1,4}-q_{1,3})]\Big]/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) \end{bmatrix}$$

which, after some algebra, gives (with $\cdot$ denoting unknown (not shown) convolutions/expressions not of interest)

$$Q\Lambda^j Q^{-1} = \begin{bmatrix} \omega_{1,1}(j) & \omega_{1,2}(j) & 0 & 0 & \cdot \\ \omega_{2,1}(j) & \omega_{2,2}(j) & 0 & 0 & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ 0 & 0 & 0 & 0 & \rho^j \end{bmatrix} \tag{B23}$$

where,

$$\omega_{1,1}(j) = \frac{\lambda_3^j q_{1,3}q_{2,4} - \lambda_4^j q_{1,4}q_{2,3}}{q_{1,3}q_{2,4}-q_{2,3}q_{1,4}}$$
$$\omega_{1,2}(j) = \frac{q_{1,3}q_{1,4}(\lambda_4^j - \lambda_3^j)}{q_{1,3}q_{2,4}-q_{2,3}q_{1,4}}$$
$$\omega_{2,1}(j) = \frac{q_{2,3}q_{2,4}(\lambda_3^j - \lambda_4^j)}{q_{1,3}q_{2,4}-q_{2,3}q_{1,4}}$$
$$\omega_{2,2}(j) = \frac{-\lambda_3^j q_{2,3}q_{1,4} + \lambda_4^j q_{2,4}q_{1,3}}{q_{1,3}q_{2,4}-q_{2,3}q_{1,4}}$$

Substituting the expressions for q's from the eigenvectors gives

$$\omega_{1,1}(j) = \frac{\lambda_3^j(1-\beta\lambda_3) - \lambda_4^j(1-\beta\lambda_4)}{\beta(\lambda_4-\lambda_3)} \tag{B24}$$
$$\omega_{1,2}(j) = \frac{(1-\beta\lambda_3)(1-\beta\lambda_4)(\lambda_4^j-\lambda_3^j)}{\kappa\alpha_3\beta(\lambda_4-\lambda_3)} \tag{B25}$$
$$\omega_{2,1}(j) = \frac{\kappa\alpha_3(\lambda_3^j-\lambda_4^j)}{\beta(\lambda_4-\lambda_3)} \tag{B26}$$
$$\omega_{2,2}(j) = \frac{\lambda_4^j(1-\beta\lambda_3) - \lambda_3^j(1-\beta\lambda_4)}{\beta(\lambda_4-\lambda_3)} \tag{B27}$$

We are now in a position to find the multipliers in the two regimes.

B.1 Monetary Regime

In the monetary regime, the two eigenvalues λ_3 and λ_4 are outside the unit circle. From (B20), we then need $\lambda_i^j v_{i,t} + \mathbb{E}_t v_{i,t+j} = 0$ for $i \in \{3, 4\}$.

B.1.1 Anticipated Multipliers

Let us start with the impact multipliers, i.e. $j = 0$, so that $v_{3,t} = v_{4,t} = 0$, as well as $z_{3,t} = z_{4,t} = 0$. We then have

$$
\begin{aligned}
\delta_t &= QV_t, \\
\begin{bmatrix} \alpha_1 \varepsilon_t^g + \delta_t^y \\ \delta_t^\pi \\ 0 \\ \varepsilon_t^\tau \\ \varepsilon_t^g \end{bmatrix} &= [q_1 \quad q_2 \quad q_3 \quad q_4 \quad q_5] \begin{bmatrix} v_{1,t} \\ v_{2,t} \\ v_{3,t} \\ v_{4,t} \\ v_{5,t} \end{bmatrix}, \\
&= \begin{bmatrix} 0 & q_{1,2} & 0 \\ 0 & q_{2,2} & 0 \\ 1 & q_{3,2} & 1 \\ 1 & q_{4,2} & \psi \\ 0 & q_{5,2} & 0 \end{bmatrix} \begin{bmatrix} v_{1,t} \\ v_{2,t} \\ v_{5,t} \end{bmatrix} = \begin{bmatrix} q_{1,2} v_{2,t} \\ q_{2,2} v_{2,t} \\ v_{1,t} + q_{3,2} v_{2,t} + v_{5,t} \\ v_{1,t} + q_{4,2} v_{2,t} + \psi v_{5,t} \\ q_{5,2} v_{2,t} \end{bmatrix}, \quad \text{as } v_{3,t} = v_{4,t} = 0,
\end{aligned}
$$

which implies that

$$
\begin{aligned}
v_{1,t} &= \frac{1}{1-\psi} \varepsilon_t^\tau, \\
v_{2,t} &= \frac{1}{q_{5,2}} \varepsilon_t^g, \\
v_{5,t} &= -\frac{1}{1-\psi} \varepsilon_t^\tau - \frac{q_{3,2}}{q_{5,2}} \varepsilon_t^g, \\
\delta_t^\pi &= q_{2,2} v_{2,t} = \frac{q_{2,2}}{q_{5,2}} \varepsilon_t^g, \\
\delta_t^y &= q_{1,2} \frac{1}{q_{5,2}} \varepsilon_t^g - \alpha_1 \varepsilon_t^g = \left(\frac{q_{1,2}}{q_{5,2}} - \alpha_1 \right) \varepsilon_t^g.
\end{aligned}
$$

Note that this gives immediately the standard impact solution for the model, because starting from steady state gives

$$
X_t = AX_{t-1} + \delta_t \Rightarrow X_t = \delta_t \Rightarrow
$$

$$
\begin{bmatrix} \hat{y}_t \\ \hat{\pi}_t \\ \tilde{b}_{t-1} \\ \tilde{\tau}_t \\ \tilde{g}_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \varepsilon_t^g + \delta_t^y \\ \delta_t^\pi \\ 0 \\ \varepsilon_t^\tau \\ \varepsilon_t^g \end{bmatrix} \Rightarrow \begin{bmatrix} \hat{y}_t \\ \hat{\pi}_t \\ \tilde{b}_{t-1} \\ \tilde{\tau}_t \\ \tilde{g}_t \end{bmatrix} = \begin{bmatrix} \frac{q_{1,2}}{q_{5,2}} \varepsilon_t^g \\ \frac{q_{2,2}}{q_{5,2}} \varepsilon_t^g \\ 0 \\ \varepsilon_t^\tau \\ \varepsilon_t^g \end{bmatrix}
$$

Alternatively, to find the impact multipliers, write

$$
X_t = QZ_t,
$$

$$
\begin{bmatrix} \hat{y}_t \\ \hat{\pi}_t \\ \tilde{b}_{t-1} \\ \tilde{\tau}_t \\ \tilde{g}_t \end{bmatrix} = [q_1 \quad q_2 \quad q_3 \quad q_4 \quad q_5] \begin{bmatrix} z_{1,t} \\ z_{2,t} \\ z_{3,t} \\ z_{4,t} \\ z_{5,t} \end{bmatrix},
$$

$$
= \begin{bmatrix} 0 & q_{1,2} & 0 \\ 0 & q_{2,2} & 0 \\ 1 & q_{3,2} & 1 \\ 1 & q_{4,2} & \psi \\ 0 & q_{5,2} & 0 \end{bmatrix} \begin{bmatrix} z_{1,t} \\ z_{2,t} \\ z_{5,t} \end{bmatrix} = \begin{bmatrix} q_{1,2}z_{2,t} \\ q_{2,2}z_{2,t} \\ z_{1,t} + q_{3,2}z_{2,t} + z_{5,t} \\ z_{1,t} + q_{4,2}z_{2,t} + \psi z_{5,t} \\ q_{5,2}v_{2,t} \end{bmatrix}, \quad \text{as } z_{3,t} = z_{4,t} = 0,
$$

where (assuming starting from steady state where $z_{i,t-1} = 0$, for $i = \{1, 2, 3, 4, 5\}$)

$$
\begin{aligned}
z_{1,t} &= v_{1,t} = \frac{1}{1-\psi}\varepsilon_t^{\tau}, \\
z_{2,t} &= v_{2,t} = \frac{1}{q_{5,2}}\varepsilon_t^{g}, \\
z_{5,t} &= v_{5,t} = -\frac{1}{1-\psi}\varepsilon_t^{\tau} - \frac{q_{3,2}}{q_{5,2}}\varepsilon_t^{g}.
\end{aligned}
$$

and for $k \in \{1, 2, ...\}$

$$
\begin{aligned}
z_{1,t+k} &= \lambda_1 z_{1,t+k-1} = 0, \\
z_{2,t+k} &= \lambda_2 z_{2,t+k-1} = \rho z_{2,t+k-1}, \\
z_{5,t+k} &= \lambda_5 z_{5,t+k-1}.
\end{aligned}
$$

The impact and tail multipliers of taxation in the monetary regime are therefore

$$
TM_M^y(0,k) \equiv \frac{\partial \hat{y}_{t+k}}{\partial \tilde{\tau}_t} = 0, \tag{B28}
$$

$$
TM_M^{\pi}(0,k) \equiv \frac{\partial \hat{\pi}_{t+k}}{\partial \tilde{\tau}_t} = 0, \tag{B29}
$$

and the impact and tail multipliers of government spending in the monetary regime are

$$
GSM_M^y(0,k) \equiv \frac{\partial \hat{y}_{t+k}}{\partial \tilde{g}_t} = \frac{\partial \hat{y}_{t+k}}{\partial \varepsilon_t^g} = \rho^k \frac{q_{1,2}}{q_{5,2}}, \tag{B30}
$$

$$
GSM_M^{\pi}(0,k) \equiv \frac{\partial \hat{\pi}_{t+k}}{\partial \tilde{g}_t} = \frac{\partial \hat{\pi}_{t+k}}{\partial \varepsilon_t^g} = \rho^k \frac{q_{2,2}}{q_{5,2}}. \tag{B31}
$$

B.1.2 Unanticipated Multipliers

We now let $j \neq 0$, so that

$$
\begin{aligned}
\delta_t &= [\delta_t^y, \delta_t^{\pi}, 0, 0, 0]', \\
\mathbb{E}_t \delta_{t+j} &= [\alpha_1 \varepsilon_{t+j}^g, 0, 0, \varepsilon_{t+j}^{\tau}, \varepsilon_{t+j}^g]'.
\end{aligned}
$$

From (B22), we then have

$$
Q[\Lambda^j V_t + \mathbb{E}_t V_{t+j}] = Q\Lambda^j Q^{-1}\delta_t + \mathbb{E}_t \delta_{t+j}
$$

$$\begin{bmatrix} 0 & q_{1,2} & 0 \\ 0 & q_{2,2} & 0 \\ 1 & q_{3,2} & 1 \\ 1 & q_{4,2} & \psi \\ 0 & q_{5,2} & 0 \end{bmatrix} \begin{bmatrix} \lambda_1^j v_{1,t} + \mathbb{E}_t v_{1,t+j} \\ \lambda_2^j v_{2,t} + \mathbb{E}_t v_{2,t+j} \\ \lambda_5^j v_{5,t} + \mathbb{E}_t v_{5,t+j} \end{bmatrix} = \begin{bmatrix} \omega_{1,1}(j) & \omega_{1,2}(j) \\ \omega_{2,1}(j) & \omega_{2,2}(j) \\ \cdot & \cdot \\ \cdot & \cdot \\ 0 & 0 \end{bmatrix} \begin{bmatrix} \delta_t^y \\ \delta_t^\pi \end{bmatrix} + \begin{bmatrix} \alpha_1 \varepsilon_{t+j}^g \\ 0 \\ 0 \\ \varepsilon_{t+j}^\tau \\ \varepsilon_{t+j}^g \end{bmatrix}$$

As before, this is a system of five equations with five unknown: $v_{1,t}, v_{2,t}, v_{5,t}, , \delta_t^y, \delta_t^\pi$. The last equation in this system gives

$$\lambda_2^j v_{2,t} + \mathbb{E}_t v_{2,t+j} = \frac{1}{q_{5,2}} \varepsilon_{t+j}^g,$$

so that the system reduces to

$$\begin{bmatrix} \omega_{1,1}(j) & \omega_{1,2}(j) \\ \omega_{2,1}(j) & \omega_{2,2}(j) \end{bmatrix} \begin{bmatrix} \delta_t^y \\ \delta_t^\pi \end{bmatrix} = \begin{bmatrix} q_{1,2}/q_{5,2} - \alpha_1 \\ q_{2,2}/q_{5,2} \end{bmatrix} \varepsilon_{t+j}^g$$

with solution

$$\begin{aligned} \begin{bmatrix} \delta_t^y \\ \delta_t^\pi \end{bmatrix} &= \frac{1}{\omega_{1,1}(j)\omega_{2,2}(j) - \omega_{1,2}(j)\omega_{2,1}(j)} \begin{bmatrix} \omega_{2,2}(j) & -\omega_{1,2}(j) \\ -\omega_{2,1}(j) & \omega_{1,1}(j) \end{bmatrix} \begin{bmatrix} q_{1,2}/q_{5,2} - \alpha_1 \\ q_{2,2}/q_{5,2} \end{bmatrix} \varepsilon_{t+j}^g \\ &= \frac{1}{(\lambda_3\lambda_4)^j} \begin{bmatrix} \omega_{2,2}(j) & -\omega_{1,2}(j) \\ -\omega_{2,1}(j) & \omega_{1,1}(j) \end{bmatrix} \begin{bmatrix} q_{1,2}/q_{5,2} - \alpha_1 \\ q_{2,2}/q_{5,2} \end{bmatrix} \varepsilon_{t+j}^g \\ &= \frac{1}{(\lambda_3\lambda_4)^j} \begin{bmatrix} \omega_{2,2}(j) & -\omega_{1,2}(j) \\ -\omega_{2,1}(j) & \omega_{1,1}(j) \end{bmatrix} \begin{bmatrix} GSM_M^y(0,0) - \alpha_1 \\ GSM_M^\pi(0,0) \end{bmatrix} \varepsilon_{t+j}^g \end{aligned}$$

We thus get

$$\begin{bmatrix} GSM_M^y(j,0) \\ GSM_M^\pi(j,0) \end{bmatrix} = \begin{bmatrix} p_{1,1}(j) & p_{1,2}(j) \\ p_{2,1}(j) & p_{2,2}(j) \end{bmatrix} \begin{bmatrix} GSM_M^y(0,0) - \alpha_1 \\ GSM_M^\pi(0,0) \end{bmatrix},$$

where,

$$p_{1,1}(j) = \frac{\lambda_4^j(1-\beta\lambda_3) - \lambda_3^j(1-\beta\lambda_4)}{(\lambda_3\lambda_4)^j\beta(\lambda_4-\lambda_3)}, \tag{B32}$$

$$p_{1,2}(j) = -\frac{(1-\beta\lambda_3)(1-\beta\lambda_4)(\lambda_4^j - \lambda_3^j)}{(\lambda_3\lambda_4)^j\kappa\alpha_3\beta(\lambda_4-\lambda_3)}, \tag{B33}$$

$$p_{2,1}(j) = -\frac{\kappa\alpha_3(\lambda_3^j - \lambda_4^j)}{(\lambda_3\lambda_4)^j\beta(\lambda_4-\lambda_3)}, \tag{B34}$$

$$p_{2,2}(j) = \frac{\lambda_3^j(1-\beta\lambda_3) - \lambda_4^j(1-\beta\lambda_4)}{(\lambda_3\lambda_4)^j\beta(\lambda_4-\lambda_3)}, \tag{B35}$$

using the expressions for ω's in (B24) - (B27).

B.2 Fiscal Regime

In the fiscal regime, two eigenvalues λ_4 and λ_5 are outside the unit circle. From (B20), we then need $\lambda_i^j v_{i,t} + \mathbb{E}_t v_{i,t+j} = 0$ for $i \in \{4, 5\}$.

B.2.1 Anticipated Multipliers

Let us start with the impact multipliers, i.e. $j = 0$, so that $v_{4,t} = v_{5,t} = 0$. We have

$$\delta_t = QV_t,$$

$$\begin{bmatrix} \alpha_1 \varepsilon_t^g + \delta_t^y \\ \delta_t^\pi \\ 0 \\ \varepsilon_t^\tau \\ \varepsilon_t^g \end{bmatrix} = \begin{bmatrix} q_1 & q_2 & q_3 & q_4 & q_5 \end{bmatrix} \begin{bmatrix} v_{1,t} \\ v_{2,t} \\ v_{3,t} \\ v_{4,t} \\ v_{5,t} \end{bmatrix},$$

$$= \begin{bmatrix} 0 & q_{1,2} & q_{1,3} \\ 0 & q_{2,2} & q_{2,3} \\ 1 & q_{3,2} & q_{3,3} \\ 1 & \psi q_{3,2} & \psi q_{3,3} \\ 0 & q_{5,2} & 0 \end{bmatrix} \begin{bmatrix} v_{1,t} \\ v_{2,t} \\ v_{3,t} \end{bmatrix}$$

which implies that

$$\begin{aligned}
v_{1,t} &= \frac{1}{1-\psi} \varepsilon_t^\tau, \\
v_{2,t} &= \frac{1}{q_{5,2}} \varepsilon_t^g, \\
v_{3,t} &= -\frac{1}{q_{3,3}} \left[\frac{1}{1-\psi} \varepsilon_t^\tau + \frac{q_{3,2}}{q_{5,2}} \varepsilon_t^g \right], \\
\delta_t^\pi &= \frac{q_{2,2}}{q_{5,2}} \varepsilon_t^g + q_{2,3} \left(\frac{\varepsilon_t^\tau}{(\psi - 1)\, q_{3,3}} - \frac{q_{3,2}}{q_{5,2} q_{3,3}} \varepsilon_t^g \right), \\
\delta_t^y &= -\alpha_1 \varepsilon_t^g + q_{1,2} v_{2,t} + q_{1,3} v_{3,t} = -\alpha_1 \varepsilon_t^g + \frac{q_{1,2}}{q_{5,2}} \varepsilon_t^g + q_{1,3} \left(\frac{\varepsilon_t^\tau}{(\psi - 1)\, q_{3,3}} - \frac{q_{3,2}}{q_{5,2} q_{3,3}} \varepsilon_t^g \right).
\end{aligned}$$

To find the impact multipliers, write

$$X_t = QZ_t,$$

$$\begin{bmatrix} \hat{y}_t \\ \hat{\pi}_t \\ \tilde{b}_{t-1} \\ \tilde{\tau}_t \\ \tilde{g}_t \end{bmatrix} = \begin{bmatrix} q_1 & q_2 & q_3 & q_4 & q_5 \end{bmatrix} \begin{bmatrix} z_{1,t} \\ z_{2,t} \\ z_{3,t} \\ z_{4,t} \\ z_{5,t} \end{bmatrix} = \begin{bmatrix} 0 & q_{1,2} & q_{1,3} \\ 0 & q_{2,2} & q_{2,3} \\ 1 & q_{3,2} & q_{3,3} \\ 1 & q_{4,2} & q_{4,3} \\ 0 & q_{5,2} & 0 \end{bmatrix} \begin{bmatrix} z_{1,t} \\ z_{2,t} \\ z_{3,t} \end{bmatrix}$$

where

$$z_{1,t} = v_{1,t} = \frac{1}{1-\psi} \varepsilon_t^\tau,$$

$$z_{2,t} = v_{2,t} = \frac{1}{q_{5,2}}\varepsilon_t^g,$$

$$z_{3,t} = v_{3,t} = -\frac{1}{q_{3,3}}\left[\frac{1}{1-\psi}\varepsilon_t^\tau + \frac{q_{3,2}}{q_{5,2}}\varepsilon_t^g\right].$$

and for $k \in \{1, 2, ...\}$

$$z_{1,t+k} = \lambda_1 z_{1,t+k-1} = 0,$$
$$z_{2,t+k} = \lambda_2 z_{2,t+k-1} = \rho z_{2,t+k-1},$$
$$z_{3,t+k} = \lambda_3 z_{3,t+k-1}.$$

Hence impact multipliers:

$$\hat{y}_t = q_{1,2}z_{2,t} + q_{1,3}z_{3,t},$$
$$\hat{\pi}_t = q_{2,2}z_{2,t} + q_{2,3}z_{3,t},$$
$$\hat{y}_t = q_{1,2}\frac{1}{q_{5,2}}\varepsilon_t^g - \frac{q_{1,3}}{q_{3,3}}\left[\frac{1}{1-\psi}\varepsilon_t^\tau + \frac{q_{3,2}}{q_{5,2}}\varepsilon_t^g\right],$$
$$\hat{\pi}_t = q_{2,2}\frac{1}{q_{5,2}}\varepsilon_t^g - \frac{q_{2,3}}{q_{3,3}}\left[\frac{1}{1-\psi}\varepsilon_t^\tau + \frac{q_{3,2}}{q_{5,2}}\varepsilon_t^g\right],$$

and tail multipliers

$$\hat{y}_{t+k} = q_{1,2}\rho^k z_{2,t} + q_{1,3}\lambda_3^k z_{3,t},$$
$$\hat{\pi}_{t+k} = q_{2,2}\rho^k z_{2,t} + q_{2,3}\lambda_3^k z_{3,t},$$
$$\hat{y}_t = q_{1,2}\frac{\rho^k}{q_{5,2}}\varepsilon_t^g - \lambda_3^k\frac{q_{1,3}}{q_{3,3}}\left[\frac{1}{1-\psi}\varepsilon_t^\tau + \frac{q_{3,2}}{q_{5,2}}\varepsilon_t^g\right],$$
$$\hat{\pi}_t = q_{2,2}\frac{\rho^k}{q_{5,2}}\varepsilon_t^g - \lambda_3^k\frac{q_{2,3}}{q_{3,3}}\left[\frac{1}{1-\psi}\varepsilon_t^\tau + \frac{q_{3,2}}{q_{5,2}}\varepsilon_t^g\right].$$

The taxation multipliers (i.e., of a tax cut) in the fiscal regime are therefore

$$TM_F^y(0,k) \equiv -\frac{\partial\hat{y}_{t+k}}{\partial\tilde{\tau}_t} = -\frac{\partial\hat{y}_{t+k}}{\partial\varepsilon_t^\tau} = \lambda_3^k\frac{q_{1,3}}{q_{3,3}(1-\psi)}, \tag{B36}$$

$$TM_F^\pi(0,k) \equiv -\frac{\partial\hat{\pi}_{t+k}}{\partial\tilde{\tau}_t} = -\frac{\partial\hat{\pi}_{t+k}}{\partial\varepsilon_t^\tau} = \lambda_3^k\frac{q_{2,3}}{q_{3,3}(1-\psi)}. \tag{B37}$$

The impact and tail multipliers of government spending in the fiscal regime are therefore

$$GSM_F^y(0,k) \equiv \frac{\partial\hat{y}_{t+k}}{\partial\tilde{g}_t} = \frac{\partial\hat{y}_{t+k}}{\partial\varepsilon_t^g} = \rho^k\frac{q_{1,2}}{q_{5,2}} - \lambda_3^k\frac{q_{1,3}}{q_{3,3}}\frac{q_{3,2}}{q_{5,2}}, \tag{B38}$$

$$GSM_F^\pi(0,k) \equiv \frac{\partial\hat{\pi}_{t+k}}{\partial\tilde{g}_t} = \frac{\partial\hat{\pi}_{t+k}}{\partial\varepsilon_t^g} = \rho^k\frac{q_{2,2}}{q_{5,2}} - \lambda_3^k\frac{q_{2,3}}{q_{3,3}}\frac{q_{3,2}}{q_{5,2}}. \tag{B39}$$

Using $GSM_M^y(0,k) = \rho^k\frac{q_{1,2}}{q_{5,2}}$ and $TM_F^y(0,k) = \lambda_3^k\frac{q_{1,3}}{q_{3,3}(1-\psi)}$, the tail multiplier for output can be expressed as:

$$GSM_F^y(0,k) = GSM_M^y(0,k) - TM_F^y(0,k)(1-\psi)\frac{q_{3,2}}{q_{5,2}},$$

then using $q_{3,2} \equiv \frac{(1-\beta\phi)(b/y)q_{2,2}-q_{5,2}}{[1-\psi-\beta\rho]}$

$$GSM_F^y(0,k) = GSM_M^y(0,k) - TM_F^y(0,k)\frac{1-\psi}{1-\psi-\beta\rho}\left[\frac{(1-\beta\phi)(b/y)q_{2,2}}{q_{5,2}} - 1\right],$$

and finally using $GSM_M^\pi(0,0) = \frac{q_{2,2}}{q_{5,2}}$

$$GSM_F^y(0,k) = GSM_M^y(0,k) + TM_F^y(0,k)\frac{1-\psi}{1-\psi-\beta\rho}\left[1-(1-\beta\phi)(b/y)GSM_M^\pi(0,0)\right]. \quad \text{(B40)}$$

When $\rho = 0$ (B40) reduces to the (14) in the main text.

Similarly, using $GSM_M^\pi(0,k) = \rho^k \frac{q_{2,2}}{q_{5,2}}$ and $TM_F^\pi(0,k) = \lambda_3^k \frac{q_{2,3}}{q_{3,3}(1-\psi)}$, the tail multiplier for inflation can be expressed as:

$$\begin{aligned} GSM_F^\pi(0,k) &= GSM_M^\pi(0,k) - TM_F^\pi(0,k)(1-\psi)\frac{q_{3,2}}{q_{5,2}} \\ &= GSM_M^\pi(0,k) - TM_F^\pi(0,k)\frac{1-\psi}{1-\psi-\beta\rho}\left[\frac{(1-\beta\phi)(b/y)q_{2,2}}{q_{5,2}} - 1\right] \\ &= GSM_M^\pi(0,k) + TM_F^\pi(0,k)\frac{1-\psi}{1-\psi-\beta\rho}\left[1-(1-\beta\phi)(b/y)GSM_M^\pi(0,0)\right] \quad \text{(B41)} \end{aligned}$$

which reduces to (15) in the main text when $\rho = 0$.

B.2.2 Unanaticipated Multipliers

To obtain the announcement multipliers, instead of using (B22), we will use (B21): $\Lambda^j V_t + \mathbb{E}_t V_{t+j} = \Lambda^j Q^{-1}\delta_t + Q^{-1}\mathbb{E}_t\delta_{t+j}$ where, as above:

$$Q^{-1}(:,1-3) = \begin{bmatrix} 0 & 0 & -\psi/(1-\psi) \\ 0 & 0 & 0 \\ q_{2,4}/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) & -q_{1,4}/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) & 0 \\ -q_{2,3}/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) & q_{1,3}/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) & 0 \\ q_{3,4}(q_{2,3}-q_{2,4})/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) & q_{3,4}(q_{1,4}-q_{1,3})/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) & 1/(1-\psi) \end{bmatrix}$$

$$Q^{-1}(:,4-5) = \begin{bmatrix} 1/(1-\psi) & 0 \\ 0 & 1/q_{5,2} \\ 0 & (q_{1,4}q_{2,2}-q_{2,4}q_{1,2})/[q_{5,2}(q_{1,3}q_{2,4}-q_{2,3}q_{1,4})] \\ 0 & (q_{2,3}q_{5,2}-q_{1,3}q_{2,2})/[q_{5,2}(q_{1,3}q_{2,4}-q_{2,3}q_{1,4})] \\ -1/(1-\psi) & -q_{3,2}/q_{5,2} - \left[q_{3,4}[q_{1,2}(q_{2,3}-q_{2,4})+q_{2,2}(q_{1,4}-q_{1,3})]\right]/(q_{1,3}q_{2,4}-q_{2,3}q_{1,4}) \end{bmatrix}$$

Now let $j \neq 0$. Here, we only consider a news shock to government spending, so that

$$\begin{aligned} \delta_t &= [\delta_t^y, \delta_t^\pi, 0, 0, 0]', \\ \mathbb{E}_t\delta_{t+j} &= [\alpha_1\varepsilon_{t+j}^g, 0, 0, 0, \varepsilon_{t+j}^g]'. \end{aligned}$$

To obtain the announcement multipliers, instead of using (B22), we will use (B21). The last two equations of (B21) give

$$\Lambda^j V_t + \mathbb{E}_t V_{t+j} = \Lambda^j Q^{-1}\delta_t + Q^{-1}\mathbb{E}_t\delta_{t+j} \Rightarrow$$

$$\begin{bmatrix} 0 \\ 0 \end{bmatrix} = \frac{1}{q_{1,3}q_{2,4}-q_{2,3}q_{1,4}}\begin{bmatrix} -\lambda_4^j q_{2,3} & \lambda_4^j q_{1,3} \\ \lambda_5^j q_{3,4}(q_{2,3}-q_{2,4}) & \lambda_5^j q_{3,4}(q_{1,4}-q_{1,3}) \end{bmatrix}\begin{bmatrix} \delta_t^y \\ \delta_t^\pi \end{bmatrix} + \begin{bmatrix} k_1 \\ k_2 \end{bmatrix}\varepsilon_{t+j}^g,$$

where

$$\begin{bmatrix} k_1 \\ k_2 \end{bmatrix} = \begin{bmatrix} -\frac{q_{2,3}\alpha_1}{q_{1,3}q_{2,4}-q_{2,3}q_{1,4}} + \frac{q_{2,3}q_{5,2}-q_{1,3}q_{2,2}}{q_{5,2}(q_{1,3}q_{2,4}-q_{2,3}q_{1,4})} \\ \frac{q_{3,4}(q_{2,3}-q_{2,4})\alpha_1}{q_{1,3}q_{2,4}-q_{2,3}q_{1,4}} - \frac{q_{3,2}}{q_{5,2}} - \frac{q_{3,4}[q_{1,2}(q_{2,3}-q_{2,4})+q_{2,2}(q_{1,4}-q_{1,3})]}{q_{1,3}q_{2,4}-q_{2,3}q_{1,4}} \end{bmatrix}.$$

Hence

$$\begin{aligned} \begin{bmatrix} \delta_t^y \\ \delta_t^\pi \end{bmatrix} &= -\frac{q_{1,3}q_{2,4}-q_{2,3}q_{1,4}}{(\lambda_4\lambda_5)^j[q_{2,3}q_{3,4}(q_{1,4}-q_{1,3})+q_{1,3}q_{3,4}(q_{2,3}-q_{2,4})]} \begin{bmatrix} \lambda_5^j q_{3,4}(q_{1,4}-q_{1,3}) & -\lambda_4^j q_{1,3} \\ -\lambda_5^j q_{3,4}(q_{2,3}-q_{2,4}) & -\lambda_4^j q_{2,3} \end{bmatrix} \begin{bmatrix} -k_1 \\ -k_2 \end{bmatrix} \varepsilon_{t+j}^g \\ &= \frac{1}{(\lambda_4\lambda_5)^j q_{3,4}} \begin{bmatrix} \lambda_5^j q_{3,4}(q_{1,4}-q_{1,3}) & -\lambda_4^j q_{1,3} \\ -\lambda_5^j q_{3,4}(q_{2,3}-q_{2,4}) & -\lambda_4^j q_{2,3} \end{bmatrix} \begin{bmatrix} k_1 \\ k_2 \end{bmatrix} \varepsilon_{t+j}^g \end{aligned} \tag{B42}$$

Again, starting from steady state and since $\varepsilon_t^g = 0$:, it follows that: $\begin{bmatrix} \hat{y}_t \\ \hat{\pi}_t \end{bmatrix} = \begin{bmatrix} \delta_t^y \\ \delta_t^\pi \end{bmatrix}$.

C Sensitivity analysis

Table 3: Sensitivity analysis: Impact government spending multipliers in the monetary regime, Smets-Wouters model

Panel A: Multipliers for different values of structural parameters

		Output multiplier			Inflation multiplier		
		$\xi = 0.50$	$\xi = 0.75$	$\xi = 0.85$	$\xi = 0.50$	$\xi = 0.75$	$\xi = 0.85$
	$\sigma_l = 0$	0.02	0.01	0.01	−0.01	0.02	0.02
$\sigma_c = 1$	$\sigma_l = 2$	−0.17	−0.22	−0.22	−0.27	0.04	0.05
	$\sigma_l = 5$	−0.23	−0.30	−0.30	−0.50	0.02	0.07
	$\sigma_l = 0$	−0.21	−0.26	−0.26	−0.42	0.03	0.07
$\sigma_c = 2$	$\sigma_l = 2$	−0.27	−0.34	−0.35	−0.69	−0.00	0.08
	$\sigma_l = 5$	−0.29	−0.38	−0.39	−0.95	−0.05	0.08
	$\sigma_l = 0$	−0.31	−0.37	−0.37	−0.96	−0.04	0.07
$\sigma_c = 5$	$\sigma_l = 2$	−0.34	−0.42	−0.42	−1.27	−0.10	0.07
	$\sigma_l = 5$	−0.36	−0.45	−0.45	−1.61	−0.18	0.06

Panel B: Multipliers for different values of the monetary policy rule parameters

		Output multiplier			Inflation multiplier		
		$r_\pi = 1.50$	$r_\pi = 2.00$	$r_\pi = 2.50$	$r_\pi = 1.50$	$r_\pi = 2.00$	$r_\pi = 2.50$
	$r_y = 0$	−0.53	−0.50	−0.46	0.12	−0.09	−0.15
$\rho = 0$	$r_y = 0.125$	−0.35	−0.34	−0.32	0.10	−0.03	−0.08
	$r_y = 0.25$	−0.26	−0.25	−0.24	0.09	−0.00	−0.04
	$r_y = 0$	−0.48	−0.47	−0.45	0.14	−0.05	−0.11
$\rho = 0.5$	$r_y = 0.125$	−0.33	−0.34	−0.33	0.12	0.00	−0.05
	$r_y = 0.25$	−0.26	−0.26	−0.26	0.11	0.02	−0.02
	$r_y = 0$	−0.26	−0.34	−0.38	0.27	0.11	0.04
$\rho = 0.9$	$r_y = 0.125$	−0.25	−0.30	−0.32	0.21	0.11	0.06
	$r_y = 0.25$	−0.23	−0.26	−0.28	0.17	0.11	0.07

Panel C: Multipliers for different lengths of the anticipation period

	$j = 0$	$j = 1$	$j = 2$	$j = 4$	$j = 6$	$j = 8$
Output multiplier	0.66	−0.48	−0.41	−0.28	−0.16	−0.06
Inflation multiplier	0.27	0.19	0.11	−0.04	−0.14	−0.19

Notes: Panel A reports the impact multiplier for different values of the elasticity of intertemporal substitution (σ_c), the elasticity of labor supply (σ_l) and the Calvo probabilities of not resetting prices and wages ($\xi = \xi_p = \xi_w$). Panel B reports the multipliers across different parametrizations of the Taylor rule: inflation coefficient (r_π), output gap coefficient (r_y) and inertia ρ, while the reaction to output changes ($r_{\Delta y}$) is kept at zero. Both Panel A and B are computed for an anticipation of four periods, while Panel C reports the multipliers for different values of j.

Table 4: Sensitivity analysis: Impact government spending multipliers in the fiscal regime, Smets-Wouters model

Panel A: Multipliers for different values of structural parameters ($j = 4$)

		Output multiplier			Inflation multiplier		
		$\xi = 0.50$	$\xi = 0.75$	$\xi = 0.85$	$\xi = 0.50$	$\xi = 0.75$	$\xi = 0.85$
	$\sigma_l = 0$	2.04	2.11	2.09	6.73	5.13	4.65
$\sigma_c = 1$	$\sigma_l = 2$	1.87	2.17	2.14	8.02	6.27	5.59
	$\sigma_l = 5$	1.77	2.23	2.30	8.91	7.06	6.45
	$\sigma_l = 0$	1.40	1.73	2.26	7.60	7.16	8.53
$\sigma_c = 2$	$\sigma_l = 2$	1.28	1.75	2.22	8.28	7.84	8.96
	$\sigma_l = 5$	1.20	1.77	2.36	8.81	8.31	9.76
	$\sigma_l = 0$	0.63	1.23	8.44	6.34	8.89	48.89
$\sigma_c = 5$	$\sigma_l = 2$	0.55	1.17	7.34	6.60	8.71	41.42
	$\sigma_l = 5$	0.50	1.12	6.69	6.82	8.57	36.43

Panel B: Multipliers for different values of the monetary policy rule parameters ($j = 4$)

		Output multiplier			Inflation multiplier		
		$r_\pi = 0$	$r_\pi = 0.5$	$r_\pi = 0.8$	$r_\pi = 0$	$r_\pi = 0.5$	$r_\pi = 0.8$
	$r_y = 0$	2.19	2.17	2.00	3.49	5.27	8.51
$\rho = 0$	$r_y = 0.125$	2.04	1.83	1.36	5.07	8.23	13.94
	$r_y = 0.25$	1.88	1.58	1.08	6.36	10.20	16.52
	$r_y = 0$	2.19	2.11	1.88	3.49	5.02	7.44
$\rho = 0.5$	$r_y = 0.125$	2.02	1.81	1.45	4.81	7.11	10.36
	$r_y = 0.25$	1.87	1.61	1.27	5.85	8.46	11.81
	$r_y = 0$	2.19	2.10	2.01	3.49	4.07	4.59
$\rho = 0.9$	$r_y = 0.125$	2.07	1.96	1.88	4.08	4.74	5.30
	$r_y = 0.25$	1.98	1.87	1.78	4.56	5.26	5.84

Panel C: Multipliers for different lengths of the anticipation period

	$j = 0$	$j = 1$	$j = 2$	$j = 4$	$j = 6$	$j = 8$
Output multiplier	3.02	1.81	1.81	1.83	1.86	1.89
Inflation multiplier	7.93	7.68	7.44	7.04	6.74	6.53

Notes: Panel A reports the impact multiplier for different values of the elasticity of intertemporal substitution (σ_c), the elasticity of labor supply (σ_l) and the Calvo probabilities of not resetting prices and wages ($\xi = \xi_p = \xi_w$). Panel B reports the multipliers across different parametrizations of the Taylor rule: inflation coefficient (r_π), output gap coefficient (r_y) and inertia ρ, while the reaction to output changes ($r_{\Delta y}$) is kept at zero. Both Panel A and B are computed for an anticipation of four periods, while Panel C reports the multipliers for different values of j.

D Full sample analysis

Ramey (2011) shows that government spending innovations recovered by standard VAR identification scheme a' la Blanchard and Perotti (2002) are predictable by agents. She constructs a series for exogenous government spending shocks to take fiscal foresight into account and shows how the two identifications procedures return very different results using the whole post-WWII sample. We here replicate this exercise for the sample 1947q1-2008q4. Figure 9 and 10 show, respectively, the impulse response functions to the Ramey (2011) defense spending shock and those to the government spending shock recovered through a standard Blanchard and Perotti (2002) identification scheme. As in Ramey (2011), we find an increase in output under both procedures but, while in 9, taking fiscal foresight into account, both consumption and the real wages decrease after a positive government spending shock, as a standard neoclassical DSGE model would prescribe, under a standard VAR identification these variables increase (see Figure 10).

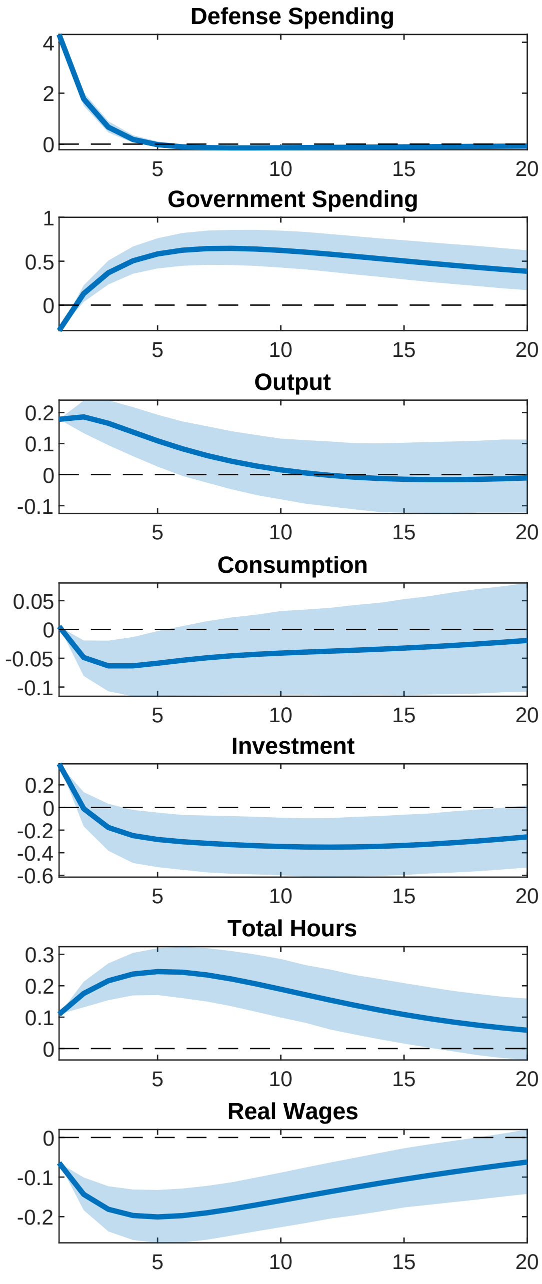

Figure 9: Impulse responses to a defense spending shock, sample 1947q1-2008q4.

Notes: Impulse response functions to the defence spending shock in a nine-variable VAR with one lag, including, in this order, defence news variable, real government spending, real GDP, the marginal tax rate (not shown), the three-month T-bill (not shown), non-durable and service consumption, investments, wages and hours. The (anticipated) shock is the first one of the Cholesky decomposition. Each panel reports point estimates and a 68% confidence region.

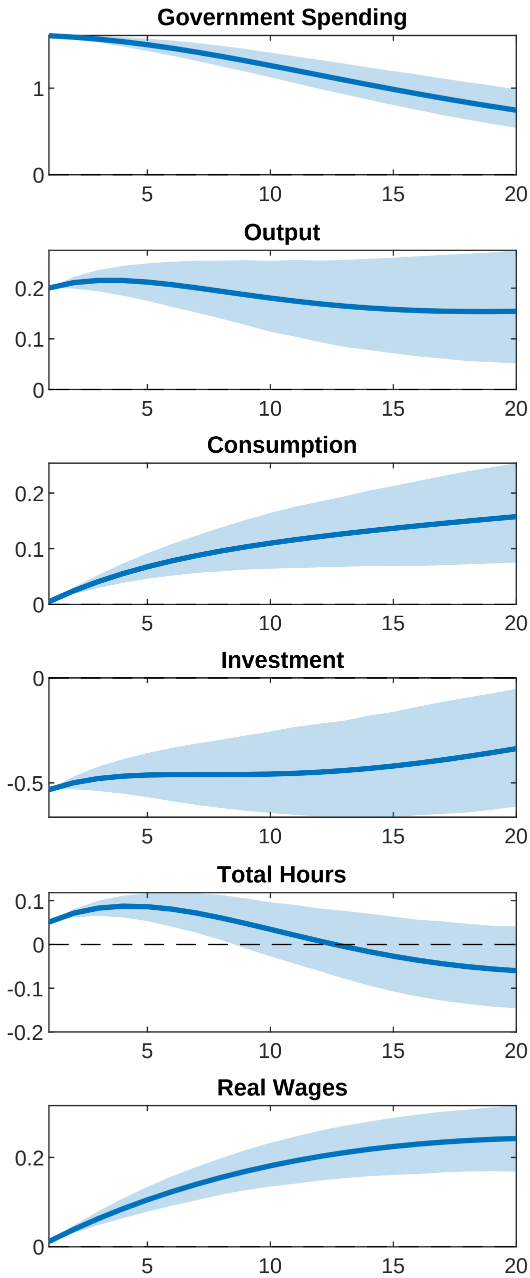

Figure 10: Impulse responses to a government spending shock using the recursive identification scheme (Blanchard and Perotti, 2002), sample 1947q1-2008q4.

Notes: Impulse response functions to a government spending shock in a seven-variable VAR with one lag, including, in this order, real government spending, real GDP, the marginal tax rate (not shown), non-durable and service consumption, investments, wages and hours. A government spending shock is identified as the first shock of the Choleski decomposition. Each panel reports point estimates and a 68% confidence region.