# Fiscal Multipliers and the Maturity Financing of Government Spending Shocks*

Morteza Ghomi †, Jochen Mankart‡, Rigas Oikonomou§ and Romanos Priftis¶

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**Abstract**

This paper shows that debt-financed fiscal multipliers vary depending on the maturity of debt issued to finance spending. Utilizing state-dependent SVAR models and local projections for post-war US data, we show that a fiscal expansion financed with short-term debt increases output more than one financed with long-term debt. The reason for this result is that only the former leads to a significant increase in private consumption. To rationalize this finding, we construct an incomplete markets model in which households invest in long- and short-term assets. Short assets provide liquidity services; households can use them to cover sudden spending needs. An increase in the supply of these assets, through a short-term debt financed government expenditure shock, makes it easier for constrained households to meet their spending needs and crowds in private consumption. We first show this mechanism analytically in a simplified model, and then quantify it in a carefully calibrated New Keynesian model. We find that differences in fiscal multipliers across short-term and long-term financed shocks can be large. We explore how these differences are influenced by the monetary and fiscal policy rules.

**Keywords:** Spending Multiplier, Fiscal Policy, Debt Maturity, Incomplete Markets, SVAR, Local Projections.
**JEL classifications:** D52, E31, E43, E62

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†Banco de España; morteza.ghomi@bde.es

‡Deutsche Bundesbank & Narodna Banka Slovenska; jochen.mankart@nbs.sk

§UC Louvain & University of Surrey; rigas.oikonomou@uclouvain.be

¶European Central Bank; romanos.priftis@ecb.europa.eu

# 1 Introduction

A considerable literature consisting of both empirical and theoretical contributions has investigated the size of the fiscal multiplier, the increase in the dollar value of aggregate output per additional dollar of spending.[1] This research is of course immensely important since public expenditures in consumption and investment goods are a key margin that governments can use to stabilize aggregate economic activity in the face of business cycle shocks.

A recent stream of papers in this literature conditions the propagation of fiscal shocks on policy variables, showing that fiscal multipliers can vary according to the sign of the shock (e.g. Barnichon et al., 2022), to the degree of progressivity of the tax code (Ferriere and Navarro, 2025), the exchange rate regime (e.g. Born, Juessen, and Müller, 2013; Ilzetzki, Mendoza, and Végh, 2013) and according to the type of debt (external vs. internal) that governments issue to finance spending (e.g. Priftis and Zimic, 2021; Broner et al., 2022).

In this paper we advocate that an important and policy relevant determinant of the size of the multiplier is the maturity of debt being issued to finance a spending shock. Employing two widely-used macroeconometric approaches, namely state-dependent SVARs and local projections, we show that when the US government has financed its spending shocks with short maturity debt, then the size of the multiplier has been large, typically exceeding unity. In contrast, when spending was financed with long-term debt, then the fiscal multiplier was typically lower than one. Accounting for this difference in the output multipliers is the significant difference in the responses of private sector consumption to spending shocks: Financing short-term resulted in a strong crowding in of consumption, whereas long-term financing did not.

We then explore a theory that can explain these empirical patterns. At the heart of our model is the notion that short-term bonds function like money, they provide liquidity to the economy which enables agents to better cope with idiosyncratic consumption risk. We first show analytically, in a simplified New Keynesian model, that short-term financed spending shocks lead to an increase in private consumption. We then demonstrate this result in an otherwise standard New Keynesian model. Calibrated carefully to US data, our model explain a large part of the differences in the fiscal multipliers that we find in our empirical exercise.

Our empirical analysis is presented in Section 2 and relies on two complementary methods to show that multipliers indeed depend on the maturity financing of the spending shocks. Our first empirical framework is a proxy-SVAR, in which we identify shocks using the approach of Ramey and Zubairy (2018); government spending is instrumented with news about military spending. To identify the impact of the maturity choice, we condition on the movements of the ratio of short-term (maturity less than one year) to long-term debt in the US. More specifically, we extract short-term financed shocks as those occurring in periods in which the ratio increases; and analogously, long-term

[1] See Blanchard and Perotti (2002); Hall (2009); Alesina and Ardagna (2010); Mertens and Ravn (2013); Uhlig (2010); Parker (2011); Ramey (2011a,b); Auerbach and Gorodnichenko (2012); Ramey and Zubairy (2018); Barnichon, Debortoli, and Matthes (2022); Priftis and Zimic (2021); Broner, Clancy, Erce, and Martin (2022); Bouakez, Rachedi, and Santoro (2023) for examples of the empirical papers written on this topic. See below for extensive references to the theoretical work in this literature.

financed shocks are those occurring in the periods in which the ratio decreases.

Our second empirical strategy makes use of the local projection method (Jordà, 2005). Rather than identifying short and long term financed shocks through the contemporaneous changes in the ratio of short over long-term debt, we identify the maturity financing of the shocks through their interaction with ex ante value of the ratio of short over long term debt. This strategy, which follows Broner et al. (2022), exploits the fact that the share of short over long term debt is highly persistent and a good proxy for the new issues of government debt. Moreover, like Broner et al. (2022) our estimates are based on both the narrative approach to identifying spending shocks and the structural VAR approach of Blanchard and Perotti (2002).

Our results, using either the proxy-SVAR or the local projections show that short-term financed shocks yield larger fiscal multipliers due to the crowding in of private consumption. This finding is robust towards controlling for a number of relevant variables, including private sector wages, short and long-term rates (capturing the response of monetary policy and of the term premium to spending shocks), or the debt to GDP ratio in the VARs. Moreover, our results hold regardless of whether the models are estimated using post 1980s observations (when arguably US monetary policy targeted inflation more actively) or when we use data since the 1960s. Analogously, dropping the Great Recession sample makes little difference for our estimates. We consistently obtain a multiplier that exceeds unity under short-term financing and a much more moderate value under long-term financing.

These findings show the importance of the choice of debt maturity to finance a spending shock and thus highlight an important policy related channel for the transmission of fiscal spending (which to our knowledge has been overlooked by the existing literature). In Sections 3 and 4 of the paper we turn to theory in order to investigate a model that can rationalize these new empirical findings.

Our model is an incomplete markets economy where households that are heterogeneous in terms of their spending needs, choose to save in a long and a short-term asset. Short-term bonds provide 'liquidity services' enabling households to finance *urgent consumption needs* subject to a 'bonds in advance constraint' that sets the maximum expenditure equal to the real value of the short-term asset. Long-term bonds provide no 'liquidity services'. Therefore, in equilibrium, the return on short-term bonds is lower than the return on long-term bonds, reflecting the money-like services that short bonds provide to the private sector. The model is otherwise a standard New Keynesian economy, featuring monopolistic competition and sticky prices, and a government that issues debt and levies taxes. Spending is exogenous and is assumed to follow a random process, as is common in many New Keynesian models. Moreover, to keep our model tractable, we abstract from investment (in private and public capital). The empirical analysis of Section 2 did not show a robustly significant effect of maturity on investment; private consumption was found to be a consistently important margin.

In Section 4 we investigate the fiscal multipliers in this model. Our baseline is an economy in which monetary policy is set according to a rule targeting inflation and the lagged nominal interest rate and fiscal policy follows an ad hoc rule which adjusts the tax rate to the lagged value of debt. A spending shock which is financed through short-term debt, leads to a multiplier that is considerably above one and to a crowding in of consumption. In contrast, a long-term financed shock predicts a strong crowding out of consumption and a multiplier of around 0.5.

This stark difference between the two modes of financing can be traced to the Euler equation that prices the short-term asset in the model. The supply of short-term debt appears like a standard demand shock in the Euler equation. When the government increases the quantity of this debt, it engineers a demand expansion. Aggregate consumption increases through two channels: the immediate impact of alleviating the financial friction today, but also through an inter-temporal effect, through inducing households to save less anticipating that future constraints become less likely to bind. In contrast, a long-term financed shock may lead to a lower real value of short bonds in the economy, and thus reverse the effect on consumption. To build this intuition we leverage a simple version of the model that we can solve analytically.

Though assuming an inertial monetary policy rule magnifies the differences between short and long-term financed shocks, these differences persist under a standard Taylor rule. To the extent that monetary policy does not forcibly eliminate the demand shock, i.e. through a stochastic intercept that tracks the real rate of interest, we continue finding a significant gap between the two modes of financing spending shocks. In Section 5, we show that the differences persist also in a scenario in which taxes are constant through time and monetary policy responds only weakly to inflation (see e.g. Leeper (1991), passive monetary/ active fiscal regime). In this fiscally dominated equilibrium, the gap in the fiscal multipliers is as large as in our baseline scenario with the inertial rule. Under active fiscal policies, demand shocks do not only impact inflation through the Euler equation but are also filtered through the government budget constraint, adding considerable volatility to macroeconomic variables (e.g. Bianchi and Ilut, 2017).

This paper is related to several strands of literature. First, our empirical finding that the financing of spending shocks with short or long bonds matters for the fiscal multiplier cannot be explained through standard macroeconomic asset pricing models, where bond yields purely reflect intertemporal substitution of consumption. Our theoretical model therefore is inspired by a recent literature in finance and macroeconomics considering models where the relative supply of short versus long maturity bonds affects interest rates (see, e.g. Vayanos and Vila, 2021; Greenwood and Vayanos, 2014; Greenwood, Hanson, and Stein, 2015; Guibaud, Nosbusch, and Vayanos, 2013; Chen, Cúrdia, and Ferrero, 2012).

From this line of work our paper is most closely related to Greenwood et al. (2015), who document that short-term US Treasury debt provides liquidity services to the private sector, over and above the services that long bonds may provide. The authors provide empirical evidence for this, and set up a formal model in which short bonds enter the utility function, which gives rise to a money-like demand function for this asset. As Greenwood et al. (2015), we assume that only short bonds provide liquidity, whereas households invest in long-term assets for their return properties. Though Greenwood et al. (2015) set up a 3-period model with exogenous interest rate shocks, we use a fully fledged New Keynesian model with infinitely lived agents and focus on spending shocks.

Second, from the vast empirical literature estimating the size of the fiscal multiplier, our paper is (methodologically) closely related to Priftis and Zimic (2021) and Broner et al. (2022) who condition the size of the multiplier on the ratio of external vs domestic debt. Specifically, Priftis and Zimic

(2021) show that the fiscal multiplier is larger when spending is financed with external debt, using a proxy SVAR where the financing is identified through the contemporaneous movement in the external/domestic ratio. Broner et al. (2022) (as discussed) instead use a local projection method, conditioning the spending shock on the lagged external/domestic ratio. Our empirical exercises draw heavily from these two papers, and therefore our contribution is not on the methodological side. However, though we utilize the approaches of Priftis and Zimic (2021) and Broner et al. (2022), we focus on an entirely different policy margin, investigating the impact of the maturity choice of financing spending shocks. To us, this seems a very relevant margin, and indeed particularly relevant for the US government's and the Treasury's spending and debt issuance policies.

Relatedly, our findings are relevant for a growing literature that studies the optimal composition of public debt in macroeconomic models.[2] In this work, the objective of debt issuance policy is to minimize or smooth the distortions caused by financing government deficits, which can arise from either taxes or inflation. A common finding is that governments can fulfill this objective when they issue long-term debt and save in short-term assets, as this enables to fully exploit the negative covariance between long bond prices and deficits.[3] The empirical finding of our paper adds a new dimension to this trade-off. Specifically, since short term financed shocks lead to a higher cumulative increase in output, they also lead to smaller deficits thus requiring smaller increases in taxes to be financed. This channel which impinges a tax smoothing benefit to short term bonds, has been overlooked by the existing literature. Testing whether it is a significant margin, however, requires to explicitly solve for the Ramsey policy equilibrium with optimal taxes and debt portfolios. This is a difficult task computationally. In a companion paper (Mankart, Priftis, and Oikonomou, 2024) we use the tractable model that we propose here as a good laboratory to study optimal policy.

Finally, our paper is related to the vast literature that investigates the propagation of fiscal shocks in macroeconomic models (see, for example, Gali, Lopez-Salido, and Valles, 2007; Woodford, 2011; Christiano, Eichenbaum, and Rebelo, 2011; Bilbiie, 2011; Hagedorn, 2018; Hagedorn, Manovskii, and Mitman, 2019; Auclert, Bardóczy, and Rognlie, 2023; Rannenberg, 2021; Bayer, Born, and Luetticke, 2023; Ferriere, Grübener, Navarro, and Vardishvili, 2021).

Closest to ours are papers that study the fiscal multiplier within the context of models in which debt is net wealth; its value exceeds that of tax liabilities. One rapidly growing line of work characterizes the multiplier in quantitatively rich heterogeneous agents models with incomplete financial markets (for example, Bayer et al., 2023; Auclert and Rognlie, 2020; Hagedorn et al., 2019; Hage-

[2]See, for example, Angeletos (2002); Buera and Nicolini (2004); Debortoli, Nunes, and Yared (2017); Nosbusch (2008); Lustig, Sleet, and Yeltekin (2008); Faraglia, Marcet, and Scott (2010); Faraglia, Marcet, Oikonomou, and Scott (2016, 2019); Canzoneri, Collard, Dellas, and Diba (2016); Greenwood et al. (2015); Aparisi de Lannoy, Bhandari, Evans, Golosov, and Sargent (2022); Passadore, Nuno, Bigio, et al. (2017) among others.

[3]More precisely the seminal papers of Angeletos (2002) and Buera and Nicolini (2004) were the first to point out that optimal debt is long term. Since them, a few papers have extended the canonical real business cycle model with realistic frictions to find reasons for governments to issue short-term debt (e.g. Faraglia et al. (2019); Debortoli et al. (2017); Aparisi de Lannoy et al. (2022); Greenwood et al. (2015)). Like us, Greenwood et al. (2015) argue that short-term debt provides valuable liquidity to households. However, in contrast to the spending shocks that we focus on here, Greenwood et al. (2015) consider exogenous shocks to the real interest rates.

Finally, two recent papers that study optimal policy when government bonds provide liquidity to the private sector are Canzoneri et al. (2016) and Angeletos, Collard, and Dellas (2022).

dorn, 2018; Auclert, Rognlie, and Straub, 2024) in which government debt is valuable to households because it is an asset that can be used to accumulate precautionary savings and buffer consumption against labour income shocks. From this line of work, particularly related to our paper is Bayer et al. (2023), who emphasize the liquidity channel of fiscal policy, however, focusing on the distinction between illiquid capital and liquid government debt.

Another stream of papers takes a shortcut, considering simpler models in which government debt enters in the utility function directly (as in, e.g., Rannenberg, 2021; Caramp and Singh, 2023), or affects consumption through providing liquidity and facilitating transactions (as in, e.g., Hagedorn, 2018). The model that we consider here, belongs to this second stream of papers and it can be basically seen as an extension of Hagedorn (2018) to a two asset economy where one of the assets (short debt) provides liquidity.[4]

Related to our paper, Rannenberg (2021) has shown that the fiscal multiplier is higher in a model where government debt is an argument in household utility in an otherwise standard New Keynesian model. Our empirical evidence and theory show that short debt leads to a higher multiplier when households can arbitrage across short and long bonds and the former provide money like services.

# 2 Empirical Analysis

## 2.1 Econometric Methodology

In this section we carry out our empirical estimation of the fiscal multiplier and show its dependence on the maturity of debt being issued. We follow two separate approaches: First, we rely on a form of state-dependent estimation applied to an SVAR framework. Second, we use local projections.

### 2.1.1 Proxy-SVAR

Our first identification approach extends the proxy-SVAR framework with the appealing features of sign restriction methodology. Following Stock and Watson (2012) and Mertens and Ravn (2013), we obtain a proxy for the government spending shock, whose exogenous variation is then included in the VAR system, and which is assumed to be correlated with the structural spending shock but orthogonal to other shocks. Our choice of the proxy follows Ramey and Zubairy (2018), who derive a *defense news* series, based on movements of spending related to political and military events.

Then, to disentangle the debt-maturity financing of the (instrumented) government spending shock, we exploit variation in defense news across different periods based on the ratio of short-term debt to long-term debt. Precisely, we extract a defense news series for periods in which the ratio increases as a proxy for the short-term financed (STF) spending shock. Conversely, we use the defense news in periods in which the ratio has dropped as a proxy for long-term financing (LTF).

[4] Interestingly, some of this recent work (Hagedorn, 2018; Auclert et al., 2024) has shown that the properties of the more complicated heterogeneous agents models regarding the propagation of shocks, can be approximated by simpler models with bonds in utility.

Notably, this approach resembles the identification of domestic- and foreign-debt financed spending employed by Priftis and Zimic (2021).

Formally, our objective is to estimate the following system of equations:

$$\mathbf{A}\mathbf{Y}_t = \sum_{i=1}^{p} \mathbf{C}_i \mathbf{Y}_{t-i} + \varepsilon_t \tag{1}$$

where $\mathbf{Y}_t$ is $n \times 1$ vector of endogenous variables in quarter $t$. $\mathbf{C}_i, i = 1, ..., p$ are $n \times n$ coefficient matrices of the own- and cross-effects of the $i^{th}$ lag of the variables, and $\varepsilon_t$ is $n \times 1$ vector of orthogonal i.i.d. shocks with $E[\varepsilon_t] = 0$ and $E\left[\varepsilon_t \varepsilon_t^{'}\right] = I$. $\mathbf{A}$ is $n \times n$, matrix capturing contemporaneous interactions between the elements of $\mathbf{Y}_t$.

An equivalent representation of the above system is:

$$\mathbf{Y}_t = \sum_{i=1}^{p} \delta_i \mathbf{Y}_{t-i} + \mathbf{B}\epsilon_t \tag{2}$$

where $\mathbf{B} = \mathbf{A}^{-1}$, $\delta_i = \mathbf{A}^{-1}\mathbf{C}_i$ and let $\mathbf{u}_t = \mathbf{B}\varepsilon_t$ denote the vector of reduced form residuals. As is well known, the estimate of the covariance matrix of $\mathbf{u}_t$ provides $n(n+1)/2$ independent restrictions, less than the number required for identification of $\mathbf{B}$. As in Mertens and Ravn (2013) we use covariance restrictions from the proxy of the true (latent) exogenous variable.

Formally, let $\widetilde{p}_t$ be a $k \times 1$ vector of proxy variables satisfying $E(\widetilde{p}_t) = 0$, that are correlated with the $k$ structural shocks of interest $(\varepsilon_{g,t})$ but orthogonal to other shocks $(\varepsilon_{x,t})$. The proxy variables can be used to identify $\mathbf{B}$ provided the following conditions hold:

$$E\left[\widetilde{p}_t \varepsilon_{g,t}^{'}\right] = \Psi$$

$$E\left[\widetilde{p}_t \varepsilon_{x,t}^{'}\right] = 0$$

where $\Psi$ is non-singular $k \times k$ matrix Given these conditions hold, we can identify the elements of $\mathbf{B}$ which are relevant for the innovations in $\varepsilon_{g,t}$.[5].

In turn, disentangling STF spending shocks from LTF shocks is obtained by defining $\widetilde{p}_t = \begin{bmatrix} \widetilde{p}_{\mathrm{STF},t} \\ \widetilde{p}_{\mathrm{LTF},t} \end{bmatrix}$ with

$$\widetilde{p}_t = \widetilde{p}_{\mathrm{STF},t}, \quad if \quad R_t \quad increases$$

$$\widetilde{p}_t = \widetilde{p}_{\mathrm{LTF},t}, \quad if \quad R_t \quad decreases,$$

and where $R_t$ denotes the ratio of short-term debt to long-term debt.

Finally, estimation proceeds following the standard two-step procedure for proxy-SVARs. First, we run a two-stage least squares estimation of non-goverrnment spending residuals on the residuals of government spending using $\widetilde{p}_t$ as an instrument, and second, we impose covariance restrictions to

[5]Obviously, in our model we have $k = 1$ since we have one instrument (defense news) and $\varepsilon_{g,t}$ represents the government spending shock. $\varepsilon_{x,t}$ is non-spending shocks.

identify the relevant elements in **B**.

### 2.1.2 Fiscal multipliers

We calculate the cumulative fiscal multiplier as:

$$m_{t+h} = \frac{\sum_{q=t}^{t+h} \Delta X_q}{\sum_{q=t}^{t+h} \Delta G_q} \left(\frac{\overline{X}}{\overline{G}}\right) \tag{3}$$

$m_{t+h}$ measures the cumulative change of the endogenous variable $X$ per unit of additional government spending $G$, from the impulse at time $t$, up to the horizon $h$.[6] $\left(\frac{\overline{X}}{\overline{G}}\right)$ is the sample average of the endogenous variable over spending.

## 2.2 Empirical Results

Our benchmark estimates are based on a VAR with four variables: $Y_t = [G_t, GDP_t, C_t, I_t]$, where $G_t$ are government expenditures, $GDP_t$ is real gross domestic product, $C_t$ is private consumption, and $I_t$ is private investment. The sample consists of quarterly observations for the period 1954Q3-2015Q4.[7] The baseline specification estimates the system in (1) in log differences.[8] We employ four lags of the endogenous variables applying the HQ criterion. Along with the median estimates of the impacts of government spending shocks on output, investment and consumption, we report one standard deviation confidence bands using the procedure in Goncalves and Kilian (2004).

### 2.2.1 Short-term and long-term debt financed government spending shocks

Figures 1 and 2 plot the cumulative impulse responses and the cumulative multipliers of consumption, investment and output, following a 1% government spending shock. The top panels show these objects under STF and LTF separately, and in the bottom panels we plot the response of the differences between the two.[9] Table 1 complements the exposition reporting the point estimates of the cumulative multipliers and the confidence intervals at various horizons.

As it is evident from Figure 1, financing the spending shock with short-term debt leads to a much stronger reaction of aggregate output. Output increases on impact by more in the STF case (blue dashed line, left panel), and moreover, it continues to increase during the 12 quarters shown in the graph. The difference in terms of the median responses between short and long-term financing (blue and red lines, respectively) grows throughout this horizon and it remains statistically significant.[10]

[6] See, for example, Ilzetzki et al. (2013).

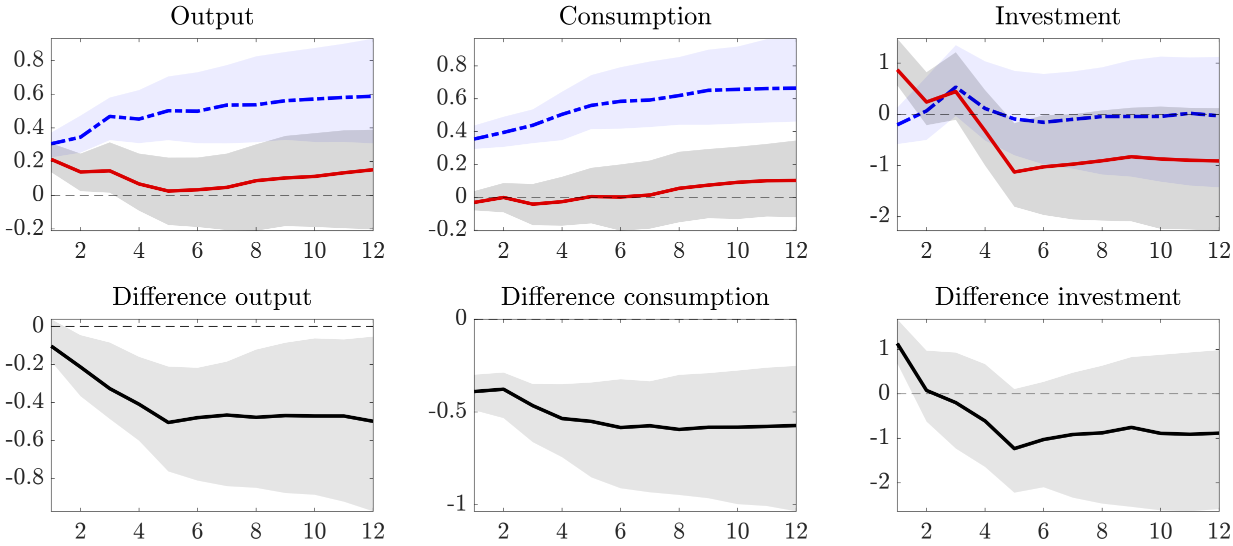
[7] Details on data sources and the construction of all variables used in this empirical section are, for brevity, provided in the online appendix.

[8] Running the model in log levels instead of differences gave us very similar results.

[9] The difference is defined as the LTF responses minus the STF responses. It has been calculated for each draw of the simulated distribution of the models that satisfy the sign restrictions.

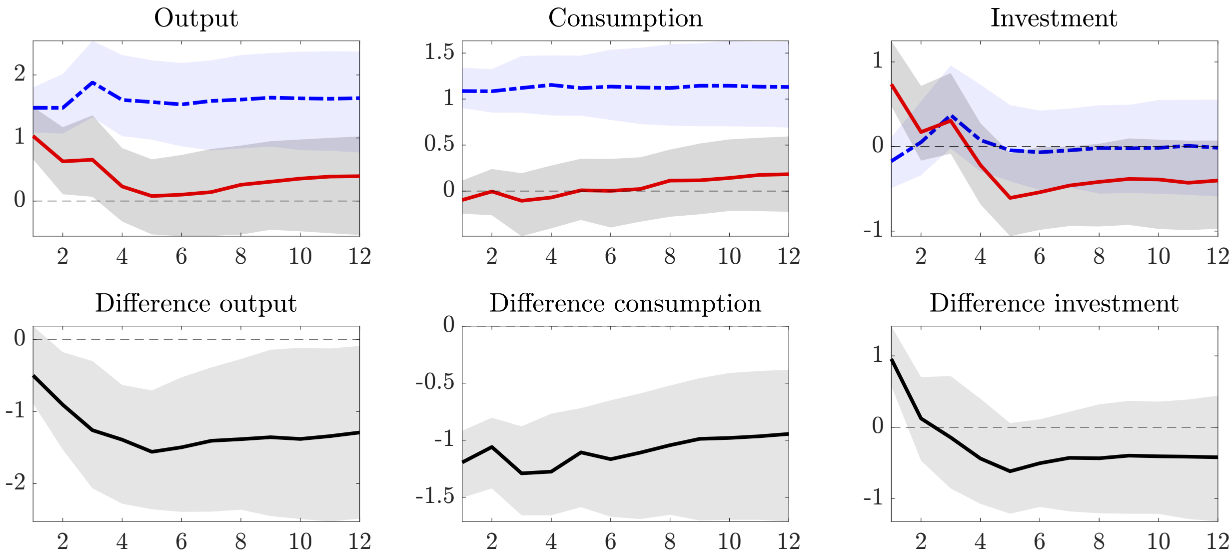
[10] In the online appendix we show the (cumulative) responses of spending following STF and LTF shocks. The paths are very similar, both in terms of the magnitude of the responses and their persistence. This indicates that the differential responses on output and consumption that we obtain under STF and LTF shocks are not driven by a different spending process. We also looked at the relation between the government consumption and investment series

Figure 1: Proxy-SVAR: Baseline specification. Cumulative impulse response functions




Notes: Top panel: Impulse response functions following a shock to short-term (blue, dash-dotted) and long-term debt-financed (red, solid) government expenditures. Lines correspond to median responses. Bottom panel: The difference in the impulse response functions between long-term and short-term debt financed government expenditures. Shaded areas correspond to confidence bands of one standard deviation.

Figure 2: Proxy-SVAR: Baseline specification. Cumulative multipliers




Notes: Top panel: Cumulative multipliers following a shock to short-term (blue, dash-dotted) and long-term debt-financed (red, solid) government expenditures. Cumulative multipliers are calculated as in equation (3). Lines correspond to median responses. Bottom panel: The difference in the cumulative multipliers between long-term and short-term debt financed government expenditures. Shaded areas correspond to confidence bands of one standard deviation.

Table 1: Proxy-SVAR: Baseline specification. Cumulative multipliers

| | *horizon* | "Long-G shock" | | "Short-G shock" | | difference | |
|---|---|---|---|---|---|---|---|
| Output | | | | | | | |
| | 1 | **1.08** | [0.68 , 1.51] | **1.48** | [1.03 , 1.86] | -0.42 | [-1.06 , 0.19] |
| | 4 | **0.42** | [-0.38 , 0.99] | **1.85** | [1.23 , 2.51] | -1.44 | [-2.70 , -0.62] |
| | 12 | **0.55** | [-0.29 , 1.11] | **1.91** | [1.12 , 2.85] | -1.42 | [-2.80 , -0.21] |
| Consumption | | | | | | | |
| | 1 | **-0.03** | [-0.28 , 0.16] | **1.16** | [0.96 , 1.40] | -1.21 | [-1.55 , -0.89] |
| | 4 | **0.00** | [-0.40 , 0.34] | **1.31** | [0.93 , 1.68] | -1.24 | [-1.98 , -0.82] |
| | 12 | **0.33** | [-0.21 , 0.62] | **1.35** | [0.85 , 1.92] | -1.08 | [-2.00 , -0.46] |
| Investment | | | | | | | |
| | 1 | **0.80** | [0.44 , 1.14] | **-0.17** | [-0.55 , 0.17] | 0.96 | [0.55 , 1.50] |
| | 4 | **-0.12** | [-0.68 , 0.41] | **0.17** | [-0.30 , 0.72] | -0.31 | [-1.34 , 0.35] |
| | 12 | **-0.33** | [-0.82 , 0.14] | **0.15** | [-0.34 , 0.78] | -0.42 | [-1.40 , 0.30] |

Notes: The table reports cumulative multipliers for output, consumption, and investment at different horizons for short-term debt-financed and long-term debt-financed government spending shocks, as well as the difference in multipliers, defined as Long-Short. Confidence bands of one standard deviation are denoted inside the brackets.

This difference can be more clearly stated in terms of the implied values of the fiscal multipliers (Figure 2 and Table 1). When spending is financed short-term, the impact multiplier is 1.48 and it remains above 1 after 12 quarters. On the other hand, if the shock is financed with long-term debt, the impact output multiplier is 1.08 but it drops to 0.42 after 4 quarters and becomes statistically insignificant.

The middle and right panels in the Figures and the middle and bottom panels in Table 1, show where the differences in the responses of output to spending derive from. Notice that the differences are clearly driven by the responses of consumption. The short-term debt-financed spending shock produces a strong crowding in of consumption (the consumption multiplier is 1.16 on impact and remains around that level throughout the horizon). However, when spending is financed with long-term debt, private consumption does not increase. In contrast to consumption, aggregate investment shows no statistically significant response to the spending shock neither under STF or LTF; the difference between the two investment responses is also found to be statistically insignificant.

This baseline exercise confirms that the way the US government finances its spending matters for the effects of the shock on the paths of aggregate consumption and output. We next build on this finding, extending our baseline, considering additional controls in estimation and running the model on different subsamples.

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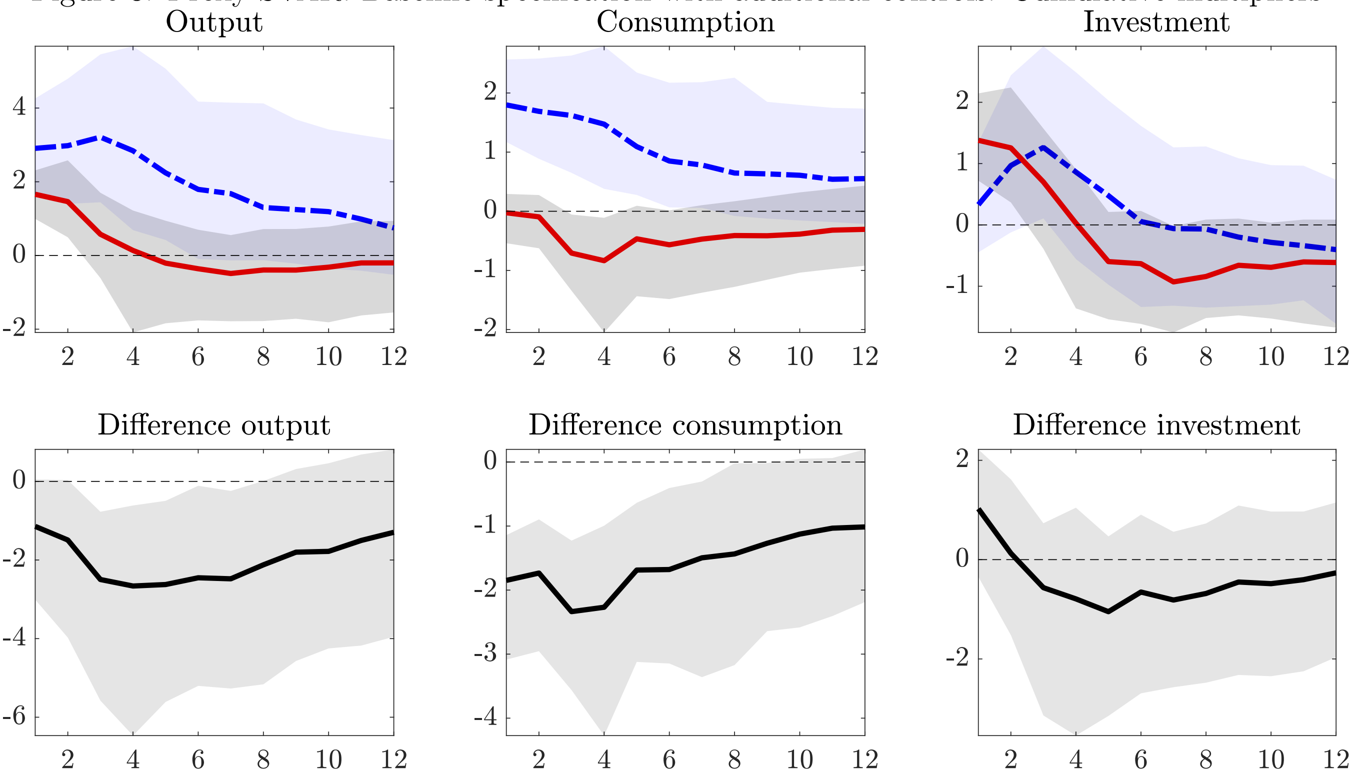
and the ratio of short over long debt. We did not find any positive correlation of the ratio of government consumption to investment with $R$, that could suggest that investment is more likely to be financed long term and consumption shocks with short term debt. In the appendix we present results from VARs using the government consumption (investment) series and show that our results go through.

We conduct several robustness exercises in this section and in the online appendix.

### 2.2.2 Extensions of the empirical model

**Adding macroeconomic variables.** We first show the robustness of our findings towards including additional macroeconomic variables in the VAR. In particular, we repeat the estimation of system (1) controlling for real wages of the private sector, the yields on short and long-term government debt, the overnight interest rate, and the GDP deflator. We do so to treat possible endogeneity issues that may have contaminated our baseline estimates, using the standard approach of adding variables to the VAR and showing that the results do not change significantly. To motivate the experiments that we conduct in this paragraph let us briefly discuss the types of biases and endogeneity issues that we believe might matter in the context of our exercise.

Figure 3: Proxy-SVAR: Baseline specification with additional controls. Cumulative multipliers




Notes: Top panel: Cumulative multipliers following a shock to short-term (blue, dash-dotted) and long-term debt-financed (red, solid) government expenditures. Cumulative multipliers are calculated as in eq. 3. Lines correspond to median responses. Bottom panel: The difference in cumulative multipliers between long-term and short-term debt financed government expenditures. Shaded areas correspond to confidence bands of one standard deviation. Controls are the term premium, real wages, overnight rate, and the GDP deflator.

First, the endogeneity of the decision of the Treasury to finance with short or long-term debt. It is well known, that debt management decisions are influenced by the interest rate costs of financing. Thus, when faced with a steeply upward sloping yield curve, debt managers are more likely to issue short-term debt, than when the yield curve is downward sloping and long-term debt becomes less costly. Moreover, downward sloping yield curves predict recessions. The lower multipliers for long-term financing could thus be reflecting that the economy is set on a recessionary path.[11] We control

[11] Arguably, the opposite could also be true, if fiscal multipliers are higher during economic recessions (see, for example, Auerbach and Gorodnichenko, 2012).

for this possibility by adding the short-term rate and the term premium in our VAR (to capture both the level and the slope of the yield curve).

Second, adding wages as well as interest rates to the VAR enables us to also control for possible differential impacts of the STF and LTF shocks on these variables which may be relevant if the shocks are of a different nature and thus affect the macroeconomy differently. For example, a STF shock may put more upward pressure on wages, when the government is hiring in certain sectors. This could then result in a larger increase in the consumption of hand to mouth households and thus in a stronger effect on aggregate output. Though our shocks have been identified using news about military spending (and both STF and LTF shocks lead to similar cumulative responses of the spending level, see appendix), showing robustness in this regard is useful. Finally, we control for the (endogenous) response of monetary policy through adding the overnight interest rate in the VAR.[12]

Figure 3 shows the cumulative multipliers we obtain when we include all of these variables together in the VAR.[13] As is evident from the Figure, the cumulative output multiplier in the case of short-term financing continues being larger; once again the difference is driven by the differential responses of private sector consumption to the spending shock, under short and long-term financing. Our previous findings thus continue to hold.

Table 2 shows a breakdown of this exercise, reporting the consumption and output multipliers from five separate VARs, when we include one variable at a time. The top panel shows the results from a VAR run with wages as an additional control, then the short-term interest rate is the additional variable in the second panel, the long-term rate in the third panel, the 'yield curve' (short rate and the term premium) in the fourth panel, and lastly, the GDP deflator in the bottom panel. We focus on the consumption and output responses, the multipliers for investment were found insignificant in most of these specifications and we left those outside the table. Moreover, to conserve space, we report the point estimates at horizons of 1, 4 and 12 quarters.

Notice that across all specifications, there are significant differences between STF and LTF, and most notably at 4 or 12 quarters after the shock has hit. Though spending multipliers can be quite large on impact also in the LTF case, i.e. in some of the models we run, very fast, 4 quarters after the shock, they drop significantly. In contrast, the multipliers in the STF case remain persistently above 1 throughout the horizon.

[12] In separate experiments in the online appendix we also considered adding taxes in the VAR. Our results did not change.

[13] The term premium has been defined as the difference between the yield of the 10 year Treasury note and the overnight rate. Our results are almost identical when we define the term premium as the difference between the 10 year and the 3 month yields.

Moreover, for brevity, the responses of the interest rates, wages and prices to the spending shock are shown in the online appendix. These responses are (by and large) what we expect them to be and in line with the theoretical model that we develop in Sections 3 and 4 of the paper. For example, a STF shock increases the short-term interest rate and reduces the term premium. In contrast, a LTF shock increases the term premium without affecting the short-term rate. Moreover, the STF shock increases the price level persistently, whereas the effect of the LTF shock on prices is nearly 0. See appendix for further details and discussion.

Table 2: Proxy-SVAR: Baseline specification with additional controls. Impact multipliers

| | | *horizon* | "LTF shock" | | "STF shock" | | difference | |
|---|---|---|---|---|---|---|---|---|
| Wages | $Y$ | 1 | **0.46** | [-0.12 , 0.93] | **1.72** | [0.96 , 2.33] | -1.24 | [-2.22 , -0.51] |
| | | 4 | **-0.64** | [-1.71 , -0.01] | **1.55** | [0.64 , 2.83] | -2.57 | [-3.88 , -0.84] |
| | | 12 | **-0.28** | [-1.30 , 0.58] | **1.47** | [0.50 , 2.65] | -1.95 | [-3.23 , -0.44] |
| | $C$ | 1 | **-0.31** | [-0.65 , -0.11] | **1.10** | [0.78 , 1.45] | -1.43 | [-1.96 , -1.09] |
| | | 4 | **-0.51** | [-1.11 , -0.18] | **0.88** | [0.37 , 1.56] | -1.53 | [-2.33 , -0.82] |
| | | 12 | **-0.10** | [-0.58 , 0.37] | **0.94** | [0.41 , 1.58] | -1.18 | [-1.66 , -0.38] |
| Short rate | $Y$ | 1 | **1.32** | [0.86 , 1.58] | **1.72** | [1.20 , 2.22] | -0.48 | [-1.12 , 0.18] |
| | | 4 | **0.59** | [-0.23 , 1.31] | **1.66** | [0.88 , 2.53] | -1.09 | [-2.26 , 0.02] |
| | | 12 | **0.40** | [-0.40 , 1.15] | **1.39** | [0.73 , 2.43] | -1.02 | [-2.56 , 0.16] |
| | $C$ | 1 | **0.23** | [0.02 , 0.45] | **1.57** | [1.26 , 1.78] | -1.31 | [-1.65 , -0.98] |
| | | 4 | **0.16** | [-0.21 , 0.50] | **1.26** | [0.92 , 1.73] | -1.13 | [-1.90 , -0.55] |
| | | 12 | **0.25** | [-0.17 , 0.65] | **1.06** | [0.61 , 1.70] | -0.86 | [-1.78 , -0.17] |
| Long rate | $Y$ | 1 | **1.26** | [0.60 , 1.88] | **1.49** | [1.00 , 2.01] | -0.22 | [-1.08 , 0.49] |
| | | 4 | **-0.83** | [-2.71 , 0.37] | **2.11** | [1.38 , 3.32] | -2.95 | [-5.30 , -1.72] |
| | | 12 | **-0.97** | [-2.39 , -0.13] | **2.20** | [1.18 , 3.43] | -3.26 | [-5.43 , -1.79] |
| | $C$ | 1 | **0.03** | [-0.30 , 0.29] | **1.45** | [1.19 , 1.78] | -1.36 | [-1.97 , -1.06] |
| | | 4 | **-1.10** | [-2.02 , -0.54] | **1.60** | [1.13 , 2.22] | -2.72 | [-3.83 , -2.02] |
| | | 12 | **-0.75** | [-1.42 , -0.25] | **1.58** | [1.00 , 2.34] | -2.37 | [-3.63 , -1.54] |
| Short rate; term premium | $Y$ | 1 | **1.79** | [1.00 , 2.58] | **1.46** | [0.99 , 1.90] | 0.36 | [-0.51 , 1.14] |
| | | 4 | **0.82** | [-0.49 , 1.80] | **1.75** | [0.93 , 2.57] | -1.05 | [-2.65 , 0.67] |
| | | 12 | **0.11** | [-1.16 , 0.96] | **1.71** | [0.99 , 2.52] | -1.57 | [-3.73 , -0.59] |
| | $C$ | 1 | **0.20** | [-0.08 , 0.52] | **1.51** | [1.28 , 1.82] | -1.38 | [-1.71 , -0.92] |
| | | 4 | **-0.27** | [-1.22 , 0.21] | **1.42** | [1.02 , 1.92] | -1.80 | [-2.91 , -1.11] |
| | | 12 | **-0.11** | [-0.95 , 0.37] | **1.34** | [0.92 , 1.92] | -1.54 | [-2.80 , -0.86] |
| GDP deflator | $Y$ | **1** | **1.12** | [0.78 , 1.54] | **2.35** | [1.84 , 2.89] | -1.08 | [-1.88 , -0.51] |
| | | **4** | **0.24** | [-0.35 , 0.87] | **2.78** | [1.90 , 3.61] | -2.54 | [-3.38 , -1.46] |
| | | **12** | **0.42** | [-0.15 , 1.30] | **2.25** | [1.35 , 3.17] | -1.73 | [-3.12 , -0.58] |
| | $C$ | **1** | **-0.02** | [-0.24 , 0.14] | **1.46** | [1.14 , 1.90] | -1.54 | [-1.93 , -1.16] |
| | | **4** | **-0.00** | [-0.36 , 0.30] | **1.59** | [1.15 , 2.14] | -1.61 | [-2.27 , -1.10] |
| | | **12** | **0.23** | [-0.09 , 0.70] | **1.29** | [0.83 , 2.05] | -1.20 | [-2.13 , -0.49] |

Notes: The table reports cumulative multipliers for $Y$ and $C$ for short-term and long-term debt-financed government spending shocks, as well as the difference in multipliers, defined as Long-Short, for different proxy-SVAR specifications. Each specification augments the system in 2.2.1 with the variables in the first column. Confidence bands of one standard deviation are denoted inside the brackets.

**Additional experiments: High vs. low debt and monetary policy regimes.**

We now conduct two additional experiments to further condition our estimates on the macroeconomic policy environment particularly focusing on the influence of the debt to GDP ratio and of the monetary policy regime.

A well-known feature of US debt management is that the Treasury has typically tilted its issuance more towards long-term debt, when the debt to GDP ratio was high (Greenwood et al., 2015).[14] At high debt levels, the response of output to a fiscal shock may be weaker if, for example, the private sector expects that distortionary taxes are more likely to increase significantly, or if high debt implies political controversies about how to manage government liabilities.

To explore whether this is a crucial dimension we re-estimated the baseline system in (1) using 'a high debt sample', that is focusing on periods where the debt to GDP ratio was above the median of the full sample of observations. Our results were unaffected. We continued to find a large difference in the fiscal multipliers of output and consumption in this sub-sample (see online appendix).

Moreover, we also run the model using only observations from the post 1980 period. It has been documented, that US monetary policy did not react strongly to inflation during the 1960s and 1970s but it satisfied the 'Taylor principle' after the early 1980s.[15] We were therefore interested to see whether this change in policy conduct has a bearing on the fiscal multiplier under STF and LTF. The online appendix shows in a graph the results that we obtained from this exercise: The difference across the two cases remains, and the consumption multiplier remains significant only in the STF scenario.

Lastly, we run our sample dropping observations from the financial crisis and the years the Fed kept the short-term nominal interest at its effective lower bound. Again we found no significant change in our estimates when we run the model with this subsample. For brevity, we show these results in the online appendix.[16]

[14]The explanation is that when overall debt rises the refinancing risk increases and debt managers face a trade off between issuing more expensive and less risky debt, long-term, or cheaper and riskier debt, short-term. In general they prefer to issue long-term debt to reduce overall refinancing risks of government portfolios.

[15]See, for example, Bianchi and Ilut (2017) for recent work on this.

[16]It is perhaps necessary to add a couple of lines to discuss what we expect (in theory) the fiscal multipliers to be like, under short-term and long-term financing in a liquidity trap. As discussed previously, we will attribute the differences in the fiscal multipliers to the money-like properties of short bonds. During a liquidity trap episode, however, the economy is 'satiated' with money (and close substitutes to money) and so we should find much smaller differences between the STF and LTF multipliers. However, other forces, besides liquidity provision, may give rise to differences in fiscal multipliers, most notably the types of forces that can rationalize why quantitative easing works in a liquidity trap (see, for example, Chen et al. (2012) and the considerable literature on QE.).

Unfortunately, the short time span of the liquidity trap episode in the US, coupled with our identification assumption for spending shocks, precludes from using the 2008-2015 observations to estimate the differences in fiscal multipliers in this regime. We thus consider only what dropping these observations does to our estimates.

## 2.3 Identifying Maturity Financing with Local Projections and Interactions.

We now explore an alternative empirical strategy to investigate the effect of financing on the propagation of spending shocks. We follow an approach similar to Broner et al. (2022) utilizing the local projection of cumulative output on cumulative spending (Jordà (2005); Ramey and Zubairy (2018)) when we interact cumulative spending with the ratio of short to long term debt.

More specifically, our empirical specification in this subsection is

$$(4)\quad \sum_{j=0}^{h} Y_{t+j} = \beta_h \widetilde{\sum_{j=0}^{h} G_{t+j}} + \gamma_h R_{t-1} \widetilde{\sum_{j=0}^{h} G_{t+j}} + \sum_{k=1}^{4} \Theta_{k,h} \mathrm{X}_{t-k} + \sum_{k=1}^{4} \Delta_{k,h} R_{t-1} \mathrm{X}_{t-k} + R_{t-1} + \mathrm{Trend}^2 + \varepsilon_{t+h}$$

where the dependent variable $Y_t$ is consumption, investment or GDP and the variable $\widetilde{\sum_{j=0}^{h} G_{t+j}}$ is an instrumented measure of the cumulative sum of government spending. As Broner et al. (2022), we obtain $\widetilde{\sum_{j=0}^{h} G_{t+j}}$ through a first stage regression of the cumulative sum $\sum_{j=0}^{h} G_{t+j}$ on the news variable and the government spending level in period $t$, controlling for the lags of macroeconomic variables (including GDP and spending).[17]

Equation (4) distinguishes between short-term and long-term financed shocks, through conditioning on the lagged value of the $R$ ratio (short over long debt). Thus, a shock that is financed through short term debt is one that has occurred in periods when the ratio $R$ is high and, opposite, a LTF shock corresponds to one which has occurred when $R$ was low. The coefficients of interest are $\beta_h$ and $\gamma_h$. Estimating these objects allows us to plot cumulative fiscal multipliers for different values of $\beta_h + \gamma_h R_{t-1}$ and interpret the resulting responses over the horizon $h$ as STF and LTF multipliers.

Note that differently from the SVAR model of the previous paragraphs, where we had obtained estimates of the multipliers by conditioning on the contemporaneous change in $R$, here we utilize the debt stocks for identification. Though relying on the stocks (rather on the changes of the ratio) may be seen as capturing different margins through which debt maturity can influence the size of the fiscal multiplier, for the case of a variable that is as persistent as the share of short-term debt is in US data, outstanding stocks are strongly correlated with new issues. Thus, the stock is a good proxy for the issuance.[18]

Furthermore, Broner et al. (2022) argue that identification based on the stock variable is likely to yield estimates that are not contaminated by potential biases (i.e. when shocks besides spending can drive new issuance). Our robustness exercises in the previous paragraph, were carried out in

[17] Thus, our first stage regression essentially pools together the news shocks and innovations to spending identified as the difference between actual value of $G$ and the value predicted by a fiscal rule implicitly identified in the VAR. In our specification, where we control for lagged output and spending levels, these innovations are essentially the Blanchard and Perotti (2002) shocks. That is, our approach is equivalent to obtaining the shocks from a separate VAR.

[18] It is well known, that the share of short term debt in the US is a highly persistent variable (see, for example, Faraglia et al., 2019). The ratio of short over long also displays a high serial autocorrelation (0.93 in our data set). Moreover, note that the high persistence of $R$ really tells us something about new issuances since a large fraction of short term debt (defined here as maturities less than one year) is redeemed in every quarter. Hence, $R$ is persistent when new shocks have been financed short term when the value of $R$ is high and vice versa.

light of this possibility. The alternative identification strategy we employ in this section will further strengthen the robustness of our findings. Finally, the control variables in $X$ include the lagged values of the main variables (output, consumption, investment and spending) as well as further controls for wages, interest rates etc (the added variables in the previous section). Trend$^2$ is a quadratic time trend.[19]

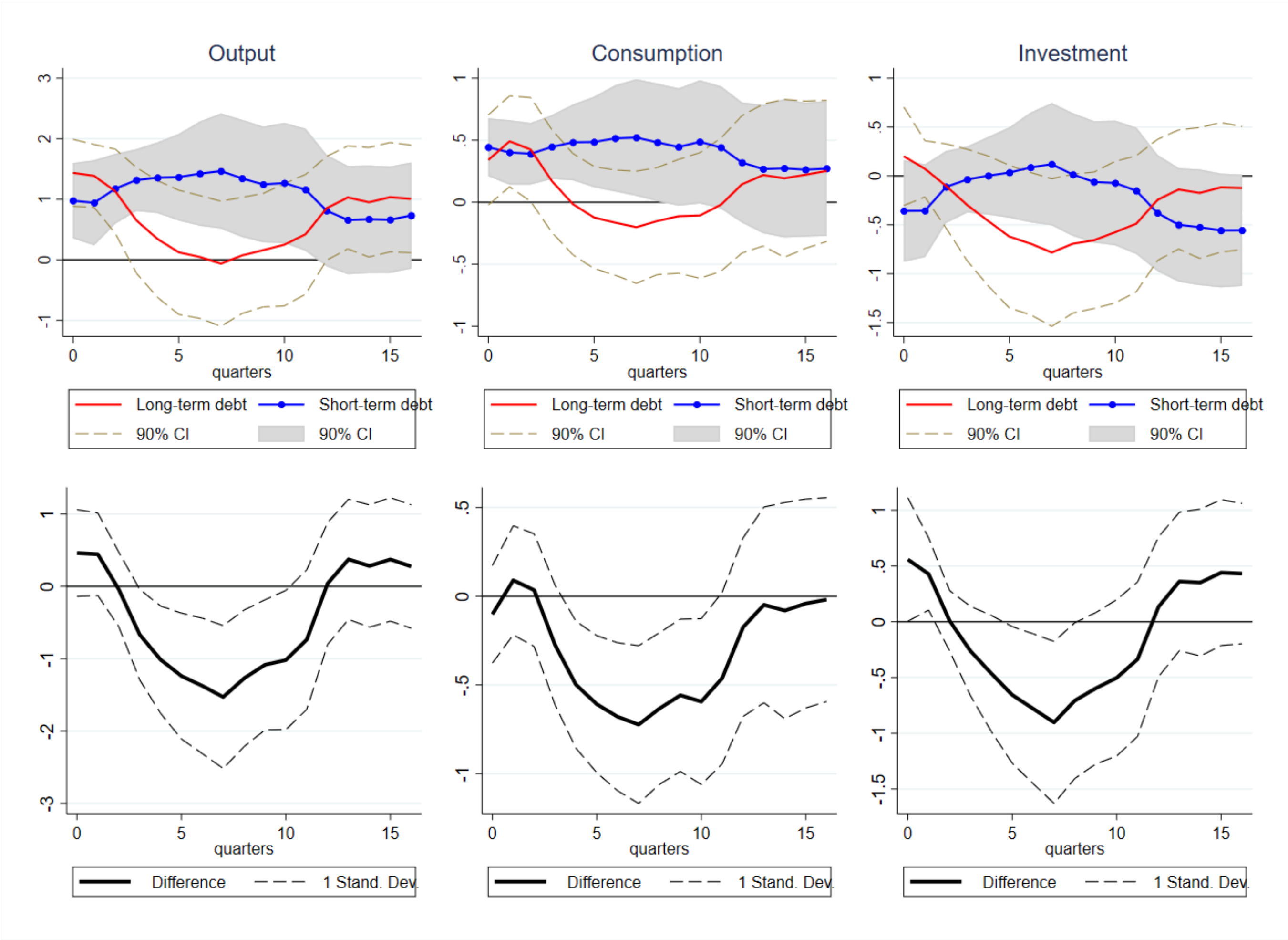



Figure 4: Cumulative multipliers of a government expenditure shock. The dotted blue lines in the top panels represent the estimated STF multipliers and the solid red line the analogous objects for LTF. The bottom panels show the difference between these two multipliers (point estimates and the corresponding one standard deviation intervals). STF and LTF are defined according to equation (4). For STF we use the 90th percentile data value of the ratio $R$, and for LTF the 10th percentile value. Standard errors have been adjusted for serial correlation and heteroscedasticity. The control variables in $X$ are the lags of consumption, output, investment and spending.

Figures 4 and 5 show the cumulative fiscal multipliers for two different values values of $\beta_h + \gamma_h R_{t-1}$. The blue lines, which represent a short term financed shock, set $R$ equal to the 90th percentile data value, whereas the red lines (LTF) to the 10th percentile value of the short to long term public debt ratio.[20]

[19]For our baseline estimates we have de-trended output, consumption, investment etc, by potential GDP which we estimated as a 6th-degree polynomial of the time-trend, following Ramey and Zubairy (2018). Our results however are not sensitive towards computing potential GDP by HP-filtering real output.

[20]This choice follows Broner et al. (2022) and can help to visualize the multipliers over a wider range for $R$. (For different percentiles one can simply interpolate since our model is basically linear in $R$.)

Consider first the results shown in Figure 4 in which $X$ does not contain additional controls (wages, interest rate spread, etc). In line with our previous estimates based on the proxy VAR, we again find that financing the spending shock short-term yields a statistically significant increase in private sector consumption, especially at medium term horizons, whereas the response in the LTF case is insignificant. The difference in the consumption multipliers is significant and translate into a sizable difference in the output multipliers.

Remarkably, in this empirical model, the investment channel also contributes to the different responses of output to spending shocks. Private sector investment responds differentially to STF and LTF shocks, there is a mild crowding out effect around one year after the shock's occurrence in the LTF case, but not for a short term financed shock. Importantly, however, consumption is a robust margin to account for the differences in the output multipliers under STF and LTF.

Our conclusion does not change when we include in the model wages, interest rates spread and prices as separate control variables. This is done in Figure 5. The differences of the cumulative multipliers are even larger now and they are statistically significant.

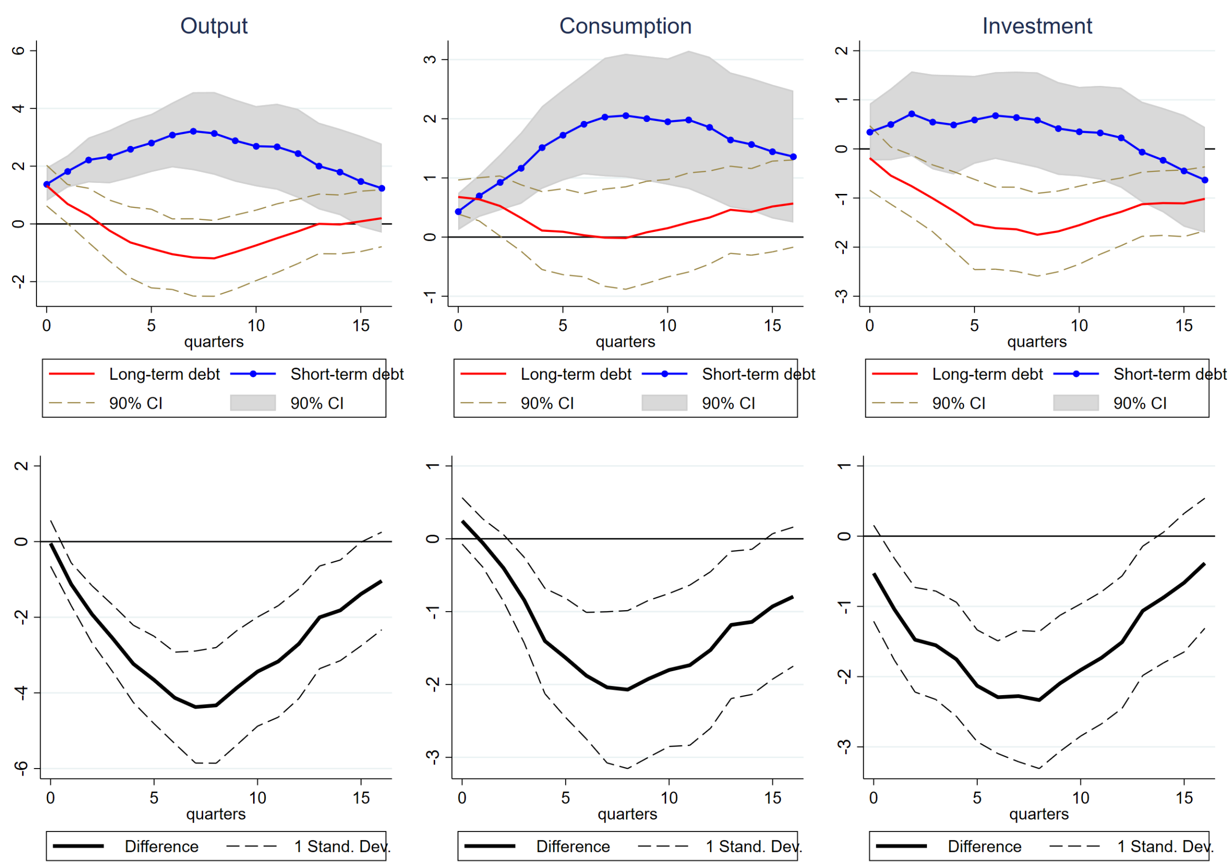



Figure 5: Cumulative multipliers of a government expenditure shock. The dotted blue lines in the top panels represent the estimated STF multipliers and the solid red line the analogous objects for LTF. The bottom panels show the difference between these two multipliers (point estimates and the corresponding one standard deviation intervals). STF and LTF are defined according to equation (4). For STF we use the 90th percentile data value of the ratio $R$, and for LTF the 10th percentile value. Standard errors have been adjusted for serial correlation and heteroscedasticity. The control variables in $X$ include the term spread and wages.

The online appendix presents several alternative specifications of this model, with a subset of the controls, dropping the observations of the Great recession and conditioning on the debt level in the economy. The results from these alternative models are very similar to what we showed here. Moreover, we separately estimated the fiscal multipliers using only government consumption as the spending series and found also in this specification, large differences in multipliers. Finally, the online appendix further extends the empirical analysis of this section drawing results from a third methodology applied to identify STF and LTF cumulative multipliers. Specifically, we used a state-dependent specification of the local projection model (as in e.g. Auerbach and Gorodnichenko, 2013; Ramey and Zubairy, 2018) which allowed to separately estimate the multipliers under STF and LTF (not forcing a linear dependence on the ratio $R$). Our results were again in line with those of the baseline specifications of the empirical model.

# 3 A model of short and long-term financing of spending shocks

## 3.1 Discussion

The empirical analysis showed that the spending multiplier is higher when the government finances its deficit by issuing short-term debt. Before presenting our formal model, we provide a general discussion to briefly outline theories that could rationalize this new fact.

The finding that debt maturity influences the spending multiplier cannot be explained by a model where bonds of different maturities are only used by investors to substitute consumption intertemporally in (almost) frictionless financial markets. In canonical representative agent models where Ricardian equivalence holds and the yield curve can be derived as a function of consumption growth and inflation, it is well known that consumption and interest rates will depend on the path of spending only, and not on how spending is financed.[21] Departing from this framework, adding elements that make relative bond supply matter for interest rates and allocations is therefore necessary to explain the fiscal multiplier.

Broadly speaking, there are two classes of models that we could consider. First, theories in which short bonds facilitate transactions and function like money (or equivalently investments in long bonds entail transaction costs (e.g. Chen et al., 2012)), thus emphasizing the liquidity attribute of short-term debt. Second, theories that emphasize the safety attribute of short debt.

The model that we develop below belongs in the first class. Our starting point is the recent work of Greenwood et al. (2015) providing empirical evidence that short bonds have money like attributes and earn a lower return than other assets, including long-term Treasuries due to their role in facilitating transactions.[22] More specifically, we will consider an economy in which agents

[21] See, for example, Greenwood and Vayanos (2014) and the irrelevance of Quantitative Easing in this class of models, shown by, for example, Curdia and Woodford (2011) building on earlier results by Wallace (1981).

[22] See also Bansal and Coleman (1996); Gorton and Metrick (2012) for a related view in which short bonds are used to back checkable deposits or collateralizing and facilitating transactions.

solve a standard consumption/savings problem, where savings can be accumulated in a short or a long-term government bond. Agents are ex post heterogeneous in terms of their spending needs and those with a high desire to consume can run down their accumulated stock of short bonds to finance consumption. Then, increasing the supply of these assets, provides additional liquidity to the economy and exerts a positive effect on private sector consumption. A spending shock financed through short-term debt results in a larger fiscal multiplier, driven by a mechanism similar to that through which money-financed fiscal shocks amplify their macroeconomic effects (see, for example, Galí, 2020).

Though our focus is on the liquidity provided by short bonds, it is also plausible that models in which agents value safer short term assets can partly explain the differences in the fiscal multipliers. To give a concrete example, consider the class of heterogeneous agents models of Huggett (1993); Aiyagari (1994), in which households value safe assets to build a stock of precautionary savings. Since short-term debt is likely a more useful asset to accumulate a buffer stock than long-term debt (agents may be unwilling to bear the repricing risk of long-term bonds[23]) an increase in the supply of short assets could increase consumption through a reduction in idiosyncratic risk.

Our view is that both the safety and liquidity channels ought to be significant, and we can see the merits of bringing these elements together in one framework. However, this would require solving a large scale heterogeneous agents model with aggregate risk, in which households can save in short term assets for precautionary purposes and in long term bonds subject to transaction costs.[24] This is a challenging task that we defer to future work. For the remainder of this paper our goal is to explore a tractable model of the liquidity channel that we can solve analytically, allowing us to transparently examine its mechanisms. We will also show that a carefully calibrated version of that model, which matches the empirical evidence of Greenwood et al. (2015), can explain a great deal of the differences in the fiscal multipliers under STF and LTF we found in Section 2.

## 3.2 The baseline model

We now present our baseline model which can be seen as an extension of the Hagedorn (2018) one liquid asset economy, to two assets (short/long government bonds) where only the short-term bond provides liquidity. We provide a brief description of the model here, focusing on the key equations. Details on derivations are relegated to the online appendix. A more detailed discussion of the frictions and the equilibrium than we offer here, can be found in Hagedorn (2018).

[23]An important risk that households have to bear when holding long-term debt is the risk of inflation. See, for example, Piazzesi, Schneider, Benigno, and Campbell (2007); Rudebusch and Swanson (2012).

[24]Presumably, motivating that long bonds are less liquid in this context, would require to consider life cycle savings, since in practice so much of long-term debt is purchased by households to finance retirement and is held in retirement accounts whereby withdrawals are subject to transaction costs.

### 3.2.1 Timing and preferences

The economy is populated by a continuum of infinitely lived, ex-ante identical agents/households. Time is discrete and each period $t$ is divided in two subperiods, $t_1, t_2$.[25]

The timing of events is as follows: In subperiod $t_1$ households make standard consumption/savings/ labour supply choices where savings can be accumulated in short and long-term assets. In subperiod 2, the generic household experiences a shock to preferences which essentially makes her desired total consumption differ from that of other households. We assume that a higher consumption need in $t_2$ can be financed by running down the quantity of short-term assets that the household has chosen in $t_1$. As in Hagedorn (2018) to keep the model tractable we also assume that households are part of a large family pooling together resources and redistributing through transfers, at the end of subperiod 2. At the start of every period all agents in the economy have the same level of wealth and therefore will end up making the same consumption/ portfolio choice decisions.

More specifically, the preferences of household $i$ (when the shocks have been revealed) are:

$$u(C_t^i) + \theta^i v(c_t^i) - \chi \frac{{h_t}^{i,1+\gamma}}{1+\gamma} \tag{5}$$

where $C_t^i$ ($c_t^i$) denotes the consumption of $i$ in sub-period $t_1$ ($t_2$). $\theta^i \in [\underline{\theta}, \infty] \sim f_\theta$ is the household-specific preference shock, a random variable that affects the relative utility derived from consumption in sub-period 2. Implicitly, a high $\theta^i$ household will face a high expenditure need in $t_2$ and therefore will desire a high consumption level $c^i$. We further assume that $\theta^i$ is an i.i.d random variable following a distribution with probability density function $f$ ($F$ denotes the cdf).[26]

Finally, $h_t^i$ denotes hours worked by $i$. Parameter $\chi$ affects the disutility of working and $\gamma$ is the inverse of the Frisch elasticity of labour supply.

### 3.2.2 Assets and asset demand

In subperiod $t_1$ the household solves a portfolio choice problem, choosing the optimal quantity of a short-term (one period) nominal bond and a long-term nominal bond. We denote by $B_{t,S}^i, B_{t,L}^i$ the nominal quantities of the short and long bonds respectively and let $b_{t,S}^i, b_{t,L}^i$ denote the real quantities (scaled by the price level $P_t$).

Long-term assets, $B_L$, are perpetuities paying coupons that decay geometrically over time (see, for example, Woodford, 2001). We let $\delta$ denote the decay factor, so that a bond pays a stream $1, \delta, \delta^2, ...$ to the investor. The price of the long-term bond in period $t$ is denoted $q_{L,t}$. The ex-post

[25] Technically, $t_1$ and $t_2$ need not represent different points in real time; they are simply used to introduce the idea that households can participate in asset markets and make savings decisions (in $t_1$) before the full vector of state variables has been revealed. In our notation below, we very frequently condense $t_1$ and $t_2$ into $t$. We distinguish between $t_1$ and $t_2$ whenever it is absolutely necessary.

[26] Note that assuming that shocks are i.i.d is necessary to rule out heterogeneity in portfolio choice decisions, when say agents experiencing a high $\theta^i$ today will likely expect a high $\theta^i$ tomorrow and have a stronger demand for short-term assets. This simplifies our derivations quite a bit. For simplicity, we drop the superscript $i$ for the theta shock from now on.

holding period return can be expressed as

$$r_{L,t+1} = \frac{1 + \delta q_{L,t+1}}{q_{L,t}}.$$

Short-term nominal bonds are purchased by households for two reasons: First, for their return (the inverse of the price $q_{S,t}$) and second for providing liquidity to finance consumption in subperiod 2. We assume that expenditures $c_t^i$ are subject to the following constraint:

$$c_t^i \leq b_{S,t}^i \tag{6}$$

and therefore a household that desires to finance a high level of expenditures may be constrained by the quantity of short-term bonds it chose in the portfolio.

It is important to note that in subperiod 2 a household has access only to her portfolio to finance $c_t^i$.[27] However, since as discussed previously, households are part of a family that pools resources when transactions have been carried out, they will have the same level of resources (wealth) at the portfolio choice stage in $t_1$ and thus will end with the same quantity of short and long-term assets in the portfolio.

### 3.2.3 Household's problem

We now define formally the household's program. The budget constraint in sub-period 1 is:

$$P_t C_t^i + q_{L,t} B_{L,t}^i + q_{S,t} B_{S,t}^i = P_t(1-\tau_t) w_t h_t^i + (1 + q_{L,t}\delta) B_{L,t-1}^i + B_{S,t-1,2}^i + Div_t P_t - T_t P_t - P_t \bar{C}_t^i \tag{7}$$

On the left hand side (LHS) we have the household's choice variables, subperiod 1 consumption $C_t^i$ and the market value of the portfolio $(B_{S,t}^i, B_{L,t}^i)$. The leading term on the right hand side (RHS) represents the household's net wage income $(1-\tau_t)w_t h_t^i$ where $w$ is the real wage rate and $\tau_t$ represents a proportional tax levied on labour income. In addition, households can be taxed in a lump-sum fashion. $T_t$ denotes the lump-sum tax.[28]

The terms $(1+q_{L,t}\delta)B_{L,t-1}^i + B_{S,t-1,2}^i$ represent the nominal pay out of long and short-term assets bought by the household in the previous period. Notice that $B_{S,t-1,2}^i$ has a subscript '2' which is used to denote that these are short bonds that remained in the household's portfolio after the transactions in subperiod 2 of period $t-1$ had been realized.

Variable $Div_t$ is used to denote income from dividends. Since ours is a New Keynesian model, there is a continuum of monopolistically competitive firms which earn profits and distribute them as dividends (see below). Households are the owners of these firms and we assume that each household

[27] As explained in Hagedorn (2018) the interpretation of the uninsurability of the expenditure shock, $\theta$, could then be a spatial one. In sub-period 2, family members are spatially separated and so the goods $c_t^i$ have to be obtained from other families in exchange for the liquid asset.

[28] We will use both lump-sum and distortionary taxes in the following sections. Though for our baseline analysis we assume lump-sum taxation, as this allows us to derive results analytically, we also consider the case of distortionary taxation and show the robustness of our findings.

owns an equal amount of shares as any other household in the economy.[29]

The term $\bar{C}_t^i$ denotes the goods the household expects to sell to other families in sub-period 2. It is important to note that $\bar{C}_t^i$ is not a choice variable for the household, and rather it is used here to ensure market clearing in the goods market.[30] It holds that:

$$E_\theta(c_t^i(\theta)) = \bar{C}_t^i, \tag{8}$$

and so the household will enter the next period with short-term bonds equal to

$$B_{S,t,2}^i = E_\theta(B_{S,t}^i - P_t(c_t^i(\theta)) + P_t\bar{C}_t^i, \tag{9}$$

We now express the household's program formally. Optimal choices solve the following value function:

(10)

$$V_t(B_{L,t-1}^i, B_{S,t-1,2}^i, \Upsilon_t) = \max_{B_{L,t}^i, B_{S,t}^i, C_t^i, c_t^i, h_t^i} \left\{ u(C_t^i) + E_\theta \theta v(c_t^i) - \chi \frac{{h_t}^{i,1+\gamma}}{1+\gamma} + \beta E_t\left[V_{t+1}(B_{L,t}^i, B_{S,t,2}^i, \Upsilon_{t+1})\right] \right\}$$

subject to constraints (7) (9) and the constraint (6) governing consumption in sub-period 2. We use state variable $\Upsilon$ to denote the vector of aggregate shocks to the economy (to be described later).

Solving the Bellman equation leads to the following optimality conditions (see online appendix): First,

$$u'(C_t^i) = \theta v'(c_t^i) \quad \text{if} \quad \theta < \widetilde{\theta}_t \tag{11a}$$

$$c_t^i = b_{t,S}^i \quad \text{if} \quad \theta \geq \widetilde{\theta}_t \tag{11b}$$

defines the optimal choice of $c^i$. When the realized value of $\theta$ is below the threshold $\widetilde{\theta}_t$ the optimal choice is unconstrained and the household sets $\theta v'(c_t^i) = u'(C_t^i)$. In contrast, if $\theta$ exceeds the threshold, then (6) is binding and trivially $c^i$ is equal to $b_{t,S}^i$. Obviously, at the threshold, we have $\widetilde{\theta}_t v'(b_{t,S}^i) = u'(C_t^i)$.

Second, the optimal choice of short-term bonds leads to :

$$q_{t,S}u'(C_t^i) = F(\widetilde{\theta}_t)\beta E_t \frac{u'(C_{t+1}^i)}{\pi_{t+1}} + \int_{\widetilde{\theta}_t}^{\infty} \theta v'(b_{t,S}^i) dF_\theta \tag{12}$$

The interpretation of (12) is the following: At the margin, the household equates the utility cost of saving in the short-term bond, $q_{t,S}u'(C_t^i)$, with the utility benefit of acquiring more of the asset.

[29] To simplify, we assume (as many papers in the literature do) that shares cannot be traded. This assumption is not restrictive however, since the households are identical at the beginning of every period, they would end up purchasing the same portfolio of stocks and bonds if we allowed them to trade. What is perhaps worth emphasizing here, is that like long-term bonds, stocks cannot be used to finance subperiod 2 consumption. This should not be controversial since in practice stocks are even less liquid than bonds.

[30] More specifically, since sub-periods $t_1$ and $t_2$ may not represent different points in real time, households cannot distinguish between customers in $t_1$ and $t_2$ and how much is sold in either subperiod is basically exogenous to households. For details see Hagedorn (2018).

The benefit has two components: On the one hand, the short-term asset provides liquidity to finance subperiod 2 consumption (this is the term $\int_{\widetilde{\theta}_t}^{\infty} \theta v'(b_{t,S}^i) dF_\theta$). On the other hand, with probability $F(\widetilde{\theta}_t)$, the preference shock is below the threshold value, and short-term bonds will be carried over to the next period. The standard asset pricing formula then applies for this asset which pays $\frac{1}{\pi_{t+1}}$ units of real income in $t+1$.

Third, the price of the long-term bond satisfies a standard Euler equation:

$$q_{t,L} u'(C_t^i) = \beta E_t \frac{u'(C_{t+1}^i)}{\pi_{t+1}} (1 + \delta q_{t+1,L}) \tag{13}$$

Finally, the optimal choice of hours gives the familiar labour supply condition:

$$\chi \frac{h_t^\gamma}{U'(C_t)} = w_t(1 - \tau_t) \tag{14}$$

### 3.2.4 Production / Government / Resource Constraints

We now describe the production side of the model and the government.

**Production.** As discussed previously, we assume, in the standard New Keynesian fashion, that a final good is produced as the aggregate of infinitely many differentiated products. Each of the products is produced under monopolistic competition by a single producer operating a technology which is linear in the labour input:

$$Y_t(j) = H_t(j)$$

The final good is then given by the following Dixit-Stiglitz aggregator

$$Y_t = \left( \int_0^1 Y_t(j)^{\frac{\eta-1}{\eta}} dj \right)^{\frac{\eta}{\eta-1}}$$

where $\eta$ governs the elasticity of substitution across the differentiated goods.

Producers of goods $Y_t(j)$ solve a standard problem, setting the price level to maximize discounted profits subject to the demand curve, and taking as given the costs of hiring labour, $w$. Moreover, we assume that price setting may involve paying a resource cost as in Rotemberg (1982). In particular,

$$\text{Cost}_t = \frac{\omega}{2} \left( \frac{P_{jt}}{P_{jt-1}} - 1 \right)^2,$$

is the cost that the firm has to bear whenever it changes the price relative to the previous period. Parameter $\omega$ governs the degree of price rigidity. A high value for this parameter implies a steep cost of adjusting prices. When $\omega = 0$ prices are perfectly flexible.

Note that the above is a standard setup (see, for example, Schmitt-Grohé and Uribe, 2004) and for brevity we will not define formally the firm's program. In this model there exists an equilibrium which is symmetric and all firms end up charging the same price and hiring the same units of labour

$h_t$. The model admits the following New Keynesian Phillips curve:

$$\pi_t(\pi_t - 1) = \frac{\eta}{\omega}(\frac{1+\eta}{\eta} - w_t)h_t + \beta E_t \frac{U'(C_{t+1})}{U'(C_t)}\pi_{t+1}(\pi_{t+1} - 1) \tag{15}$$

**Government.** We now turn to fiscal/debt policies in the economy. The government levies taxes and issues debt to finance spending $G_t$. We assume that $G_t$ is a random variable and the only source of aggregate risk in the model. The government issues debt in short and long-term bonds and, as usual, market clearing requires that the total supply of debt by the government is equated with the aggregate demand for the short and long assets by the households.

The government budget constraint can be written as:

$$q_{t,S}B^g_{t,S} + q_{t,L}B^g_{t,L} = B^g_{t-1,S} + B^g_{t-1,L}(1 + \delta q_{t,L}) + P_t(G_t - w_t\tau_t h_t - T_t) \tag{16}$$

where the superscript $g$ is used to denote the supply of bonds by the government. Using market clearing and dropping superscripts (equating demand and supply) we can express the government budget constraint in real terms as:

$$q_{t,S}b_{t,S} + q_{t,L}b_{t,L} = \frac{b_{t-1,S}}{\pi_t} + \frac{b_{t-1,L}}{\pi_t}(1 + \delta q_{t,L}) + G_t - w_t\tau_t h_t - T_t \tag{17}$$

**Resource Constraint.** Finally, putting together the household and the government budget constraints we can derive the following economy wide resource constraint:

$$C_t + \int c^i_t(\theta)dF_\theta + G_t + \frac{\omega}{2}(\pi_t - 1)^2 = h_t = Y_t \tag{18}$$

stating that total consumption by the households ($C_t + \int c^i_t(\theta)dF_\theta$) and the government ($G_t$), together with the resource costs of inflation make up for the total output produced in this economy. The latter is obviously equal to hours worked.

# 4 The Fiscal Multiplier in the Linearized Model

We now turn to studying the propagation of spending shocks in our model and to characterizing the spending multiplier under short and long-term financing. To do so, we rely on a log-linear version of the model. In addition, in order to be able to derive analytical results, we assume in this paragraph that taxes are lump-sum. Later on, we consider the case of distortionary taxes.

Let us further assume that the period utility functions $u, v$ are both log. In the online appendix we show that the Phillips curve, the resource constraint, the government budget constraint and the two bond pricing equations we previously derived can be written as:

$$\hat{\pi}_t = \frac{1+\eta}{\omega}\overline{h}(\gamma\hat{h}_t + \hat{C}_t) + \beta E_t\hat{\pi}_{t+1} \tag{19}$$

$$\overline{C}\hat{C}_t + \int_0^{\overline{\widetilde{\theta}}} \theta dF_\theta \overline{C}\hat{C}_t + \overline{\widetilde{\theta}}^2 f_{\overline{\widetilde{\theta}}} \overline{C}\hat{\widetilde{\theta}}_t + \bar{b}_S(1 - F_{\overline{\widetilde{\theta}}})\hat{b}_{t,S} - f_{\overline{\widetilde{\theta}}}\overline{\widetilde{\theta}}\bar{b}_S\hat{\widetilde{\theta}}_t + \overline{G}\hat{G}_t = \overline{Y}\hat{Y}_t \tag{20}$$

$$\overline{q}_S\bar{b}_S(\hat{q}_{t,S} + \hat{b}_{t,S}) + \overline{q}_L\bar{b}_L(\hat{q}_{t,L} + \hat{b}_{t,L}) = \overline{G}\hat{G}_t - \overline{T}\hat{T}_t + \bar{b}_S(\hat{b}_{t-1,S} - \hat{\pi}_t) + \bar{b}_L(1 + \delta\overline{q}_L)(\hat{b}_{t-1,L} - \hat{\pi}_t) + \delta\overline{q}_L\bar{b}_L\hat{q}_{t,L} \tag{21}$$

$$\frac{\overline{q}_S}{\overline{C}}(\hat{q}_{t,S} - \hat{C}_t) = -F_{\overline{\widetilde{\theta}}}\frac{\beta}{\overline{C}}E_t(\hat{C}_{t+1} + \hat{\pi}_{t+1}) + \frac{\beta}{\overline{C}} f_{\overline{\widetilde{\theta}}}\overline{\widetilde{\theta}}\hat{\widetilde{\theta}}_t - \frac{1}{\bar{b}_S}\int_{\overline{\widetilde{\theta}}}^{\infty} \theta dF_\theta \hat{b}_{t,S} - \frac{1}{\bar{b}_S}\overline{\widetilde{\theta}}^2 f_{\overline{\widetilde{\theta}}}\hat{\widetilde{\theta}}_t \tag{22}$$

$$\frac{\overline{q}_L}{\overline{C}}(\hat{q}_{t,L} - \hat{C}_t) = -\frac{\beta}{\overline{C}}(1 + \delta\overline{q}_L)E_t(\hat{C}_{t+1} + \hat{\pi}_{t+1}) + \frac{\overline{q}_L}{\overline{C}}\delta\overline{q}_L E_t\hat{q}_{t+1,L} \tag{23}$$

where hats denote that variables are expressed in log deviation from their steady state values. The threshold $\widetilde{\theta}$ satisfies $\hat{\widetilde{\theta}}_t = \hat{b}_{t,S} - \hat{C}_t$ in this log-linear model.

Equations (19) to (23) are sufficient for a competitive equilibrium when we further specify monetary and fiscal policies, setting the path of the short-term nominal interest rate and the tax schedule respectively. We next explore the fiscal multiplier in this model under various specifications of these policies.

## 4.1 Simple analytics

We first show that issuing short-term debt increases the size of the spending multiplier in an analytical version of the model. To show this, we focus on an environment where the Phillips curve, the Euler equation for short-term debt and the resource constraint (equations (19), (20) and (22)) are sufficient to determine the path of output and consumption following a spending shock. In particular, we assume that lump-sum taxes are set by the government so that the budget constraint (21) is satisfied. Then, we do not have to keep track of equation (21) and also we can dispense with equation (23), since the price $\hat{q}_{L,t}$ can be set to satisfy this equation given the path of consumption and inflation.

Recall that our empirical analysis had linked the size of the fiscal multiplier to the share of short debt over long-term debt. We assume in this paragraph that the response of the share to the spending shock is of the same sign as the response of $\hat{b}_{t,S}$, the real value of short-term bonds in $t$.[31] We consider paths $\hat{b}_{t,S} = \varrho\hat{G}_t$ where $\varrho$ is of positive value if the government finances the shock short-term (the share of short bonds then increases) and $\varrho < 0$ when the shock is financed with long-term debt (the short-term share drops).

Consider the Euler equation (22) that prices short-term debt. Substituting in the condition

[31] This is not a restrictive assumption since we assume that taxes satisfy the government budget for any path of long-term debt after the shock. We can thus always ensure that the share is of the same sign as $\hat{b}_{t,S}$.

$\hat{\bar{\bar{\theta}}}_t = \hat{b}_{t,S} - \hat{C}_t$ and rearranging we get:

(24)

$$\frac{\overline{q}_S}{\overline{C}}\hat{q}_{t,S} + F_{\bar{\bar{\theta}}}\frac{\beta}{\overline{C}}E_t\hat{\pi}_{t+1} + F_{\bar{\bar{\theta}}}\frac{\beta}{\overline{C}}\hat{C}_{t+1} = \underbrace{\left(\frac{\overline{q}_S}{\overline{C}} + (1-\beta)\frac{1}{\overline{C}}f_{\bar{\bar{\theta}}}\bar{\bar{\theta}}\right)}_{\alpha_1}\hat{C}_t - \underbrace{\left((1-\beta)\frac{1}{\overline{C}}f_{\bar{\bar{\theta}}}\bar{\bar{\theta}} + \frac{1}{\overline{b}_S}\int_{\bar{\bar{\theta}}}^{\infty}\theta dF_\theta\right)}_{\alpha_2}\hat{b}_{t,S}$$

where evidently $\alpha_1, \alpha_2 > 0$.

Let us first assume that monetary policy sets the path of the nominal interest rate so that $\frac{\overline{q}_S}{\overline{C}}\hat{q}_{t,S} + F_{\bar{\bar{\theta}}}\frac{\beta}{\overline{C}}E_t\hat{\pi}_{t+1} = 0$. Notice that under this policy, the real rate would be constant if $\frac{\overline{q}_S}{\overline{C}} = F_{\bar{\bar{\theta}}}\frac{\beta}{\overline{C}}$. This would in turn hold if short-term debt had no liquidity value to finance consumption.[32] In contrast, when short bonds generate liquidity services in subperiod 2, then $\overline{q}_S > \beta > \beta F_{\bar{\bar{\theta}}}$ and the nominal interest rate will not increase proportionally with expected inflation to keep the real interest rate constant.[33]

Under this policy, we can write (24) as:

$$F_{\bar{\bar{\theta}}}\frac{\beta}{\overline{C}}\hat{C}_{t+1} = \alpha_1\hat{C}_t - \alpha_2\hat{b}_{t,S}$$

which defines a first order difference equation in $\hat{C}$. Since $F_{\bar{\bar{\theta}}}\frac{\beta}{\overline{C}} < \alpha_1$[34] we can solve forward to obtain:

$$\hat{C}_t = \frac{\alpha_2}{\alpha_1}E_t\sum_{\bar{t}\geq 0}(F_{\bar{\bar{\theta}}}\frac{\beta}{\alpha_1\overline{C}})^{\bar{t}}\hat{b}_{t+\bar{t},S}$$

which expresses consumption in period $t$ as a function of the sequence of real short-term bonds. Using this result, it is simple to characterize the path of $\hat{C}_t$ following a shock to spending when $\hat{b}_{S,t} = \varrho\hat{G}_t$. Let us make the standard assumption, that spending follows a first order auto-regressive process with coefficient $\rho_G$. Then, considering a positive innovation to spending at date 0 we have that

$$\hat{C}_t = \rho_G^t\frac{\alpha_2}{\alpha_1}\frac{1}{1 - F_{\bar{\bar{\theta}}}\frac{\beta}{\alpha_1\overline{C}}\rho_G}\varrho\hat{G}_0, \qquad t \geq 0$$

[32] For a sufficiently large stock of short-term bonds we have that $\overline{q}_S \approx \beta$ and $F_{\bar{\bar{\theta}}} \approx 1$. We then obtain the standard 3 equation NK model in which targeting a constant real interest rate implies no consumption response to the spending shock (Woodford, 2011). Then also $\alpha_2 = 0$.

[33] A way to interpret this condition then is the following: Since $F_{\bar{\bar{\theta}}}\frac{\beta}{\overline{C}}E_t\hat{\pi}_{t+1}$ is the expected decrease of the real value of short bond holdings for households that retain their stock of short bonds after subperiod 2, monetary policy compensates these households for higher expected inflation. As we will now show, under this policy and if in addition we assume $\hat{b}_{S,t} = 0$, so that the supply of the short-term asset also does not change the payoff of holding the asset, then consumption remains constant through time.

[34] This follows from $F_{\bar{\bar{\theta}}}\frac{\beta}{\overline{C}} < F_{\bar{\bar{\theta}}}\frac{\beta}{\overline{C}} + \frac{1}{\overline{b}_S}\int_{\bar{\bar{\theta}}}^{\infty}\theta dF_\theta = \frac{\overline{q}_S}{\overline{C}} < \frac{\overline{q}_S}{\overline{C}} + (1-\beta)\frac{1}{\overline{C}}f_{\bar{\bar{\theta}}}\bar{\bar{\theta}} \equiv \alpha_1$.

Analogously, the response of total consumption (in both subperiods) can be derived as:

$$\hat{TC}_t = \kappa_1 \varrho \rho_G^t \hat{G}_0$$

where $\kappa_1 > 0$ is defined in the appendix.

Using these expressions we can derive analytically the fiscal multiplier. Define the impact multiplier as the dollar increase in output for each dollar increase in spending, or $m_0 = \frac{\overline{Y} d\hat{Y}_0}{\overline{G} d\hat{G}_0}$. We have:

$$m_0 = \frac{\overline{Y} d\hat{Y}_0}{\overline{G} d\hat{G}_0} = 1 + \frac{1}{\overline{G}} \left[ \frac{\alpha_2}{\alpha_1} \frac{\overline{C}(1 + \int_0^{\bar{\bar{\theta}}} \theta dF_\theta)}{1 - F_{\bar{\bar{\theta}}} \frac{\beta}{\alpha_1 \overline{C}} \rho_G} + \bar{b}_S (1 - F_{\bar{\bar{\theta}}}) \right] \varrho \tag{25}$$

According to (25) a key parameter for the value of $m_0$ is $\varrho$. Since the expression contained in the square brackets is positive, when the government finances spending short-term, or $\varrho > 0$, then the multiplier exceeds 1. Otherwise, assuming $\varrho < 0$ yields an impact multiplier that is less than 1.

The expression in the square brackets has two components. The second term, $\bar{b}_S(1 - F_{\bar{\bar{\theta}}})$, measures the immediate effect of relaxing the constraint for households experiencing a high preference shock. The leading term measures the inter-temporal effect of relaxing future constraints on current consumption $C$. Even if it is not likely that the constraint will bind today, the fact that it may bind in the future generates a strong incentive to accumulate savings. When the relative supply of short-term debt increases ($\varrho > 0$) this incentive becomes weaker.

As is evident from (25), the significance of these margins, and consequently the value of the multiplier, depend (besides on parameter $\varrho$) on $\alpha_1, \alpha_2, F_{\bar{\bar{\theta}}}$. influencing the elasticity of consumption with respect to $\hat{b}_{S,t}$. The more responsive is total spending to the share $\hat{b}_{S,t}$, the larger is the multiplier.

Our quantitative experiments below will discipline these parameters to match relevant moments from US data. In particular, we will discipline parameter $\varrho$, measuring the response of the share to the spending shock, drawing from our empirical analysis in Section 2. Parameters $\alpha_1, \alpha_2, F_{\bar{\bar{\theta}}}$ (their analogues in the calibrated model of the next paragraphs) will be such that the model produces a realistic response of the term spread to a change in the share of short-term bonds, consistent with the empirical evidence presented in Greenwood et al. (2015). For the moment, our interest is in verifying that the model possesses a mechanism which makes the fiscal multiplier depend on how the government finances spending shocks.

This result can also be obtained under a more plausible specification of monetary policy than what we assumed above. For example, let us consider a standard Taylor rule:

$$\hat{i}_t = \phi_\pi \hat{\pi}_t$$

To keep the algebra tractable, we assume that shocks to spending are i.i.d, or $\rho_G = 0$. Then, conjecturing a solution of the form:

$$\hat{\pi}_t = \chi_1 \hat{G}_t \qquad \hat{C}_t = \chi_2 \hat{G}_t \qquad \hat{Y}_t = \chi_3 \hat{G}_t$$

for some coefficients $\chi_1, \chi_2, \chi_3$ which satisfy the three equilibrium conditions (19), (20) and (22), we find:

$$m_0 = \alpha_3 \left[ 1 + \left( \frac{1}{\overline{\overline{G}}} \frac{\alpha_2}{\alpha_1} \frac{\overline{C}\left(1 + \int_0^{\overline{\overline{\theta}}} \theta dF_\theta \right)}{1 + \frac{1+\eta}{\omega}\frac{1}{\alpha_1}\frac{\overline{q}_S}{\overline{\overline{C}}}\phi_\pi} + \bar{b}_S(1 - F_{\overline{\overline{\theta}}}) \right) \varrho \right] \tag{26}$$

where $a_3 = a_3(\phi_\pi) < 1$ decreases in the inflation coefficient $\phi_\pi$ (see appendix).

Comparing (26) with (25) (the latter when we set $\rho_G = 0$) it is easy to see that the impact multiplier is now smaller in magnitude. As expected, when monetary policy raises the nominal rate in response to inflation (and therefore also following a positive spending shock which is typically inflationary), then the real interest rate increases, and this suppresses private consumption. In (26) this effect is visible from the leading fraction ($\alpha_3 < 1$) which measures the impact of inflation through the Phillips curve, and from the fraction in the square bracket featuring $\phi_\pi$ in the denominator, which measures the standard intertemporal substitution effect on consumption. Both fractions decrease in $\phi_\pi$.[35]

Parameter $\varrho$ continues being important. We can show that when $\varrho = 0$ (the share remains constant after the shock) then the multiplier falls short of unity (due to the crowding out of consumption). Moreover, it is possible to find sufficiently positive values of $\varrho$ for which the multiplier exceeds 1. The crowding out effect of the higher real interest rate on consumption, is compensated by the crowding in effect deriving from the larger short bond supply.

## 4.2 A calibrated model

We now calibrate the model to US data to investigate quantitatively how the spending multiplier varies with the financing of the spending shock.

The model horizon is quarterly and so we set $\beta = 0.995$. Moreover, we set $\delta = 0.96$ so that the long-term bond is of (average) maturity equal to 25 quarters. With this value we target an average debt maturity for total debt of roughly 5 years, when we set the share of short over long-term debt

[35] Note that we did not specify under which condition for $\phi_\pi$ the solution to (19), (20) and (22) is a unique stable equilibrium. It is perhaps worth to discuss this briefly.

In this model the usual condition $\phi_\pi > 1$ (i.e. the Taylor principle) does not need to hold for a unique equilibrium. Instead it is sufficient to have $\phi_\pi > \beta \frac{F_{\overline{\overline{\theta}}}}{\overline{q}_S}$ which, since $\overline{q}_S > \beta$ and $F_{\overline{\overline{\theta}}} < 1$, defines a threshold value that is strictly less than 1. Intuitively, the Euler equation (22) features 'discounting' and this enables to rule out multiple equlibria even when the Taylor principle does not hold (an analogous property obtains in the HANK model (see, for example, Bilbiie, 2025).

The reader may also wonder whether the assumption of an exogenous path of real debt, $\hat{b}_{S,t}$, is important for this property. Indeed this is so: Suppose that debt issuance is set according to a rule $\hat{b}_{S,t} + \hat{\pi}_t = \varrho \hat{G}_t$. Then, (for some parameterizations of the model) even setting $\phi_\pi = 0$ could induce determinacy of the equilibrium. The logic follows Hagedorn (2018). In this model, where the real value of debt enters the Euler equation, the price level (and hence also inflation) may be determinate even under a simple interest rate peg.

to be equal to the mean of our data sample. We also set the steady state ratio of total debt to GDP equal to 60 percent at an annual horizon.

We make the following assumptions about fiscal/monetary policies and the share of short-term debt in the model. First, we assume that taxes follow a feedback rule of the form:

$$\hat{T}_t = \phi_T \hat{D}_{t-1} \tag{27}$$

where $\hat{D}$ denotes the real face value of total debt (both long and short-term bonds).

(27) is a standard specification linking taxes to lagged debt (e.g. Leeper, 1991). In our baseline quantitative experiments below, the parameter $\phi_\tau$ is set equal to 0.01. This value is close to the threshold that defines the determinacy region in the model, when we assume that monetary policy is set according to an interest rate rule satisfying the Taylor principle. Moreover, it ensures that government debt displays a near unit root, consistent with the US data (Marcet and Scott, 2009).

Second, we assume that monetary policy follows an inertial rule of the form:

$$\hat{i}_t = \rho_i \hat{i}_{t-1} + (1 - \rho_i)\phi_\pi \hat{\pi}_t \tag{28}$$

In our baseline calibration of the model we set $\rho_i = 0.9$ and $\phi_\pi = 1.25$. However, we also experiment with alternative values for these parameters and specifications of the monetary policy rule.

Finally, we assume that the share of short-term over long-term debt follows:

$$\hat{R}_t = \varrho \hat{G}_t \tag{29}$$

We discipline the value of $\varrho$ using the empirical evidence: In the proxy VAR we identified the effects of a spending shock under short-term financing relying on observations where the average increase in $R_t$ is 0.6% and the shock is a 1% increase in government spending. Under long-term financing the share was lower by roughly 0.6% on average. We thus set $\varrho = 0.6$ as our baseline when the government finances short and $\varrho = -0.6$ in the case long-term financing.[36]

[36] $\hat{R}_t$ is defined by taking the log deviation of the ratio of the face value of short-term over long-term debt in the model. The average value of the share is 0.125 in our calibration and in the data. Note however, that since in our model short-term is one quarter debt whereas in the empirical section it is any debt of maturity less than a year, there is a difference between the model and the data. We therefore experimented with an alternative definition of the share.

In particular, consider

$$\widetilde{R}_t = \frac{b_{S,t} + b_{L,t}\frac{1-\delta^4}{1-\delta}}{b_{L,t}\frac{\delta^4}{1-\delta}}$$

to represent the share in levels. $\widetilde{R}_t$ assumes that the face value of all debt of maturity less than a year (including the coupon payments of the long-term bonds) count as short-term debt. In other words, we stripped the coupons of the long-term asset and consider the payments that are of maturity less than 4 quarters as short debt. In log deviations we obtain:

$$\hat{\widetilde{R}}_t = \frac{1}{\overline{\widetilde{R}}} \frac{\overline{b}_S}{\overline{b}_L \frac{\delta^4}{1-\delta}} \left( \hat{b}_{S,t} - \hat{b}_{L,t} \right).$$

In the online appendix we show simulations from this model, showing that our baseline results regarding the fiscal

We now describe how we chose objects $F_\theta, \overline{\overline{\theta}}, \varrho$ and $\overline{q}_S$. First, given $\overline{q}_L = \frac{\beta}{1-\beta\delta}$ in steady state, we calibrate $\overline{q}_S$ so that the term premium at the annual horizon is equal to 1 percentage point. The quarterly net rate of return on the long-term asset is $\overline{r}_L - 1 = \frac{1+\delta\overline{q}_L}{\overline{q}_L} - 1 = 0.5\%$ and the analogous short-term rate $(\frac{1}{\overline{q}_S})$ equals 0.25%.

Given $\overline{q}_S$, our principle in calibrating the distribution $F_\theta$ is the following: We assume that $F_\theta$ is log normal which leaves us with two parameters (the mean and the variance) to hit relevant targets. We calibrate the mean so that in steady state, total consumption is 80% of output which we normalize to 1. The net inflation rate is zero in the deterministic steady state.

We set the variance of $F$ so that our model produces an elasticity of the term premium with respect to the short-term debt to GDP ratio in line with the estimates of Greenwood et al. (2015). This paper reports that an increase of the ratio by 1 percent, reduces the (annualized) spread between T-bills and T-notes/bonds by 16 basis points in the case of 4 week bills and about 8 basis points for 10 week yields. Both are relevant numbers since the data counterpart for $b_S$ is all debt that is of maturity up to one quarter. We target a 2 basis points change in the spread, corresponding to our quarterly model.[37]

Finally, for the remaining model parameters we adopt standard values. $\omega$ and $\eta$ are set to 17.5 and -6 respectively, following Schmitt-Grohé and Uribe (2004). $\gamma_h$ equals 1 implying a Frisch elasticity of labour supply of the same magnitude. The persistence of the spending shock $\rho_G$ is 0.95. Moreover, as in the previous analytical subsection, we continue assuming that utility is log - log.

## 4.3 Baseline experiments

Figure 6 shows the responses of consumption (top plots), output (middle plots) and the cumulative multiplier (bottom) to a shock which increases spending by 1 percent on impact. The blue lines show the responses under short-term financing (STF) whereas the red lines are the analogous objects in the case where the government finances with long-term debt (LTF). Our baseline calibration with an inertial interest rate is shown in the middle column of the figure.

The differences between short and long-term financing are easy to spot in the figure. Financing the deficit short-term, leads to a much stronger output response due to the fact that consumption is crowded in by the shock. In contrast, under long-term financing, consumption drops significantly after the spending shock, and this translates into a weaker response of output. The multiplier under STF is equal to 2 on impact and remains above 1 until roughly period 8 in the graph. Under LTF, the impact multiplier is 0.5 and remains around that level throughout the horizon considered in the plot.

To highlight the key driving forces behind these results let us go back to the Euler equation (24).

multipliers under STF and LTF do not change and if anything the differences become larger.

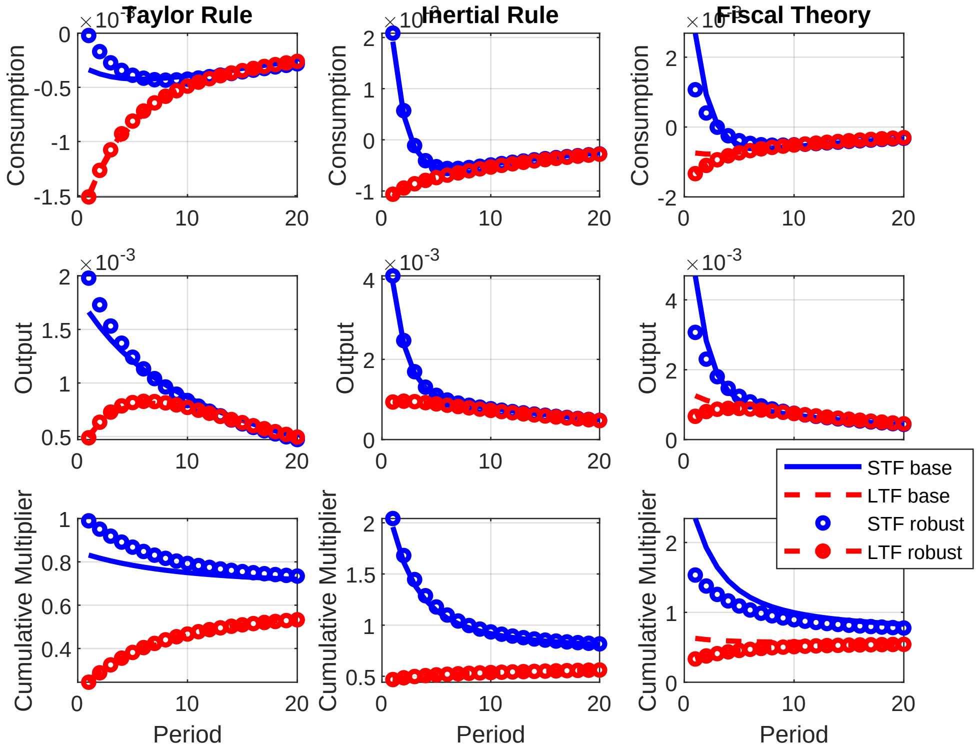
[37] To hit this target, we consider a shock to the ratio $\hat{b}_{S,t} - \hat{Y}_t$ using the baseline version of the model. Moreover, for every alternative calibration of the model that consider below, we repeat this exercise and if needed we re-calibrate the distribution $F_\theta$ to match the empirical evidence.

We can write this equation as

$$(30) \qquad \hat{i}_t = F\frac{\beta}{\bar{\bar{\theta}}\bar{q}_S}E_t\hat{\pi}_{t+1} + F\frac{\beta}{\bar{\bar{\theta}}\bar{q}_S}\hat{C}_{t+1} - \frac{\overline{C}\alpha_1}{\bar{q}_S}\hat{C}_t + \frac{\overline{C}\alpha_2}{\bar{q}_S}\hat{b}_{t,S}$$

Note that the crucial element in (30) is the last term on the RHS, $\frac{\overline{C}\alpha_2}{\bar{q}_S}\hat{b}_{t,S}$. This term acts like a standard demand shock to the Euler equation. Under short-term financing, the increase in spending is accompanied by a positive shock ($\hat{b}_{t,S}$ increases), and the opposite could happen under long financing.[38]

Figure 6: Responses to a spending shock.




*Notes: We plot the paths of consumption, output and the cumulative fiscal multiplier following a shock that increases spending by 1 percent on impact. In the middle panels we show our baseline calibration in which monetary policy sets the nominal interest rate according to $\hat{i}_t = \rho_i\hat{i}_{t-1} + (1-\rho_i)\phi_\pi\hat{\pi}_t$. The solid (blue) line and the dashed (red) assume $\phi_\pi = 1.25$ and $\rho_i = 0.9$ (the baseline calibration). Responses in blue correspond to the case where the government finances with short-term debt. Red colour graphs are for long-term financing. The graphs with circles correspond to an alternative specification of the interest rate rule, $\phi_\pi = 1$ and $\rho_i = 0.9$. The left panels assume that monetary policy follows a simple inflation targeting rule $\hat{i}_t = \phi_\pi\hat{\pi}_t$. The 'base' value is $\phi_\pi = 1.25$ and the 'robust' value is $\phi_\pi = 1$. Lastly, the right panels correspond to the case of passive monetary policy, that is coefficient $\phi_\pi$ is strictly below 1. The 'base' is $\phi_\pi = 0.5$ and 'robust' corresponds to $\phi_\pi = 0$.*

The reaction of monetary policy is key. As with any demand shock, if monetary policy tracks

[38] In the appendix we show that responses of $\hat{b}_{t,S}$ and $\hat{b}_{t,L}$ to the shocks for this baseline calibration. Indeed the LTF shock leads to a drop in the quantity of real short-term bonds, which can be mainly attributed to higher inflation, when the nominal quantity is roughly constant. Notice however, that even a drop in nominal short-term debt would not be unrealistic. Since short bonds mature after one period, a government that temporarily focuses on issuing long-term debt could see a contraction in the quantity of short bonds outstanding. In the data contractions relative to trend occur frequently.

the real interest rate, it can fully eliminate the shock from the Euler equation. This would, however, require that the term $\frac{\overline{C}\alpha_2}{\overline{q}_S}\hat{b}_{t,S}$ enter into the policy rule as a stochastic intercept. But the inertial monetary policy rule in (28) does not feature real interest rate targeting and so the supply of short-term debt has non-trivial effects on the macroeconomy.

It is also evident that parameter $\rho_i$ becomes very important in this context. Smoothing the nominal interest rate is essentially the opposite to tracking real rate fluctuations (since the latter implies a volatile process for $\hat{i}_t$) and a higher coefficient $\rho_i$ will leave extra room to the demand shock to impact the Euler equation thus amplifying the expansionary effect on private consumption.[39]

Parameter $\phi_\pi$ also exerts an influence. In principle, a stronger reaction of the nominal rate to inflation (a higher inflation coefficient) will mitigate the expansionary effect of increasing the supply of short-term debt.

## 4.4 The effects of varying the monetary policy rule

To dig deeper into how coefficients $\rho_i$ and $\phi_\pi$ affect the fiscal multipliers, in the left panels of Figure 6 we show the responses when monetary policy sets interest rates according to a standard Taylor rule, $\hat{i}_t = \phi_\pi \hat{\pi}_t$. The baseline inflation coefficient is 1.25, shown with the lines without circles in the figure. Notice that we continue finding a substantial difference in the responses of output and consumption across STF and LTF (blue and red plots, respectively). However, these differences are smaller relative to the inertial monetary policy rule. Whereas under inertial policies the STF multipliers exceeded unity and consumption was crowded in after the shock, with a simple Taylor rule, consumption is crowded out and the cumulative multiplier is never above one. Thus, parameter $\rho_i$ exerts a significant influence on the magnitudes of the multipliers, but, qualitatively speaking, the result that short-term and long-term financing induce different responses of aggregate consumption and output to fiscal shocks, is robust to the alternative rules we consider.[40]

The effects of varying parameter $\phi_\pi$ are clearly visible in the left panels. The 'base' plots correspond to the calibration setting $\phi_\pi = 1.25$ whereas the plots labeled 'robust' (marked with circles) assume $\phi_\pi = 1$. A higher inflation coefficient induces a weaker response of output and a smaller fiscal multiplier. Interestingly, however, this effect is mainly present in the STF responses. The reason

[39] Simple forward iteration on (30) yields:

$$\hat{C}_t = E_t \sum_{j\geq 0} (\frac{\beta}{\overline{C}\alpha_1} F_{\overline{\theta}})^j (-\frac{\overline{q}_S}{\overline{C}\alpha_1}\hat{i}_{t+j} + \frac{\beta}{\overline{C}\alpha_1} F_{\overline{\theta}} E_t \hat{\pi}_{t+j+1} + \frac{\overline{C}\alpha_2}{\overline{C}\alpha_1}\hat{b}_{t+j,S})$$

An STF shock will result in a persistent increase of the short bond supply and of inflation. With a smooth path of the interest rates, $\hat{i}_{t+j}$ will not strongly compensate for the increase in the RHS variables and this will result into a stronger reaction of current consumption to the shock.

[40] Obviously, the inertial policy is the most plausible scenario, since numerous DGSE studies detect considerable inertia in interest rates in the US post 1980s sample (see, for example, Bianchi and Ilut, 2017). At the same time, it is worth pointing out that our simplistic framework misses out on ingredients that have been shown to increase the value of fiscal multipliers in the baseline New Keynesian context (e.g. rule of thumb consumers as in Gali et al. (2007), or non-separabilities between consumption and leisure, as in Bilbiie (2011)). Adding these elements to the model when we assume a Taylor rule would likely increase the STF multiplier above unity. Since our goal here is not to build a quantitative model that can exactly match the data, we leave this to future work.

is that inflation after an LTF shock reacts much less, the negative demand impact of reducing the supply of short-term debt compensates for the positive demand impact of the spending shock.[41]

In the online appendix we further extend these results considering different values for coefficients $\rho_i, \phi_\pi$. Moreover, we experiment with monetary policy rules that target the output gap along with inflation and lagged interest rates. The main message is that a significant difference between the fiscal multiplier under STF and under LTF applies also in these cases.

# 5 Extensions

We now present results from three different versions of the model. First, we consider the case where monetary policy is 'passive' (e.g. Leeper, 1991). Second, we show that our findings continue to hold when instead of lump-sum taxes, the government levies distortionary taxes on labour income. Third, we study a model in which long term bonds provide partial liquidity to the private sector.

## 5.1 Unbacked fiscal deficits/ Passive monetary policy

Our baseline model focuses on a scenario in which monetary policy (implicitly) pursues an inflation stabilization goal and fiscal policy ensures the solvency of government debt through taxes. Parameter $\phi_T$ is large enough so that debt is a mean reverting process, even though it displays considerable persistence in our baseline calibration. Assuming higher values of $\phi_T$ will not change dramatically the results we showed previously.[42] However, what may significantly change the model's behavior, is to assume a low enough coefficient $\phi_T$ so that debt becomes an explosive process. In this case, fiscal deficits need to be financed by inflation and it is well understood that monetary policy needs to follow a rule that prescribes a weak response to inflation (e.g. Leeper, 1991). We now explore this scenario.

In particular, we let taxes be constant through time (i.e. $\phi_T = 0$) and also let the nominal interest rate be set according to a rule $\hat{i}_t = \phi_\pi \hat{\pi}_t$ but now coefficient $\phi_\pi$ is either 0.5 or 0 ('base' and 'robust' legends respectively). The results are shown in the right panel of Figure 6. Notice that the spending multipliers are now larger. This is to be expected: In an equilibrium where monetary policy cannot focus fully on stabilizing inflation and has to satisfy debt solvency, inflation will be pinned down by the intertemporal government budget constraint and a spending shock will not only impact the macroeconomy through the usual channels (the Euler equation and the Phillips curve) but will also be filtered through the consolidated budget. This adds more volatility, macroeconomic variables in this model are more exposed to the fiscal shock (see, for example, Leeper, Traum, and Walker, 2017).[43] The differences in the fiscal multiplier stemming from how the government finances

[41]See online appendix for the responses of inflation.

[42]Since ours is an non-Ricardian model (even with lump-sum taxes), the value of $\phi_T$ in principle will affect the behavior of debt aggregates and the multipliers. We have, however, simulated various scenarios assuming different values for $\phi_T$ and our results didn't change.

[43]An important difference between the STF and LTF shocks concerns how the intertemporal constraint of the government is impacted. Since short debt is 'cheap' in this model (its price reflects the liquidity services) the government extracts profits from liquidity provision (see Angeletos et al., 2022). These rents increase the intertemporal revenues of

spending are clearly present in this model.

## 5.2 Distortionary Taxation

Our results carry over to the case where distortionary taxes are levied on labour income at a proportional rate $\tau$. Under distortionary taxation, equations (20), (22) and (23) continue to hold, the only changes to the system of equilibrium conditions concern the government's budget constraint and the Phillips curve. In particular, the government's revenue now becomes

$$\text{Revenue} = \overline{\tau}\overline{Y}\frac{1+\eta}{\eta}\left((1+\gamma_h)\hat{Y}_t + \hat{C}_t + \frac{1}{1-\overline{\tau}}\hat{\tau}_t\right)$$

where $\overline{\tau}$ ($\hat{\tau}_t$) denote the steady state (log-deviation) of the tax rate. Thus, revenue depends also on aggregate output and on consumption, and hence of the path of these variables following a spending shock. Moreover, the Phillips curve now is:

$$\hat{\pi}_t = \frac{1+\eta}{\omega}\overline{Y}(\gamma\hat{Y}_t + \hat{C}_t + \frac{\overline{\tau}}{1-\overline{\tau}}\hat{\tau}_t) + \beta E_t\hat{\pi}_{t+1} \tag{31}$$

and therefore the path of taxes will also influence inflation in this version of the model.

In Figure 7 we repeat the exercises of the previous paragraphs assuming distortionary taxes. As is evident from the figure, the impulse responses and the cumulative multipliers are very close to the analogous objects in Figure 6. Thus, our findings continue to hold.

## 5.3 Assuming that long bonds provide partial liquidity services.

Our theoretical model explains the differential effect of financing spending shocks with short and long-term bonds, based on the presumption that short-term bonds provide money like services to the private sector. In our framework households can finance within period idiosyncratic shocks to consumption utility using short-term bonds; long bonds can only be used to transfer resources across periods. The starting point of this analysis has been the recent empirical finance literature (e.g. Greenwood et al., 2015) showing that short-term government debt provides liquidity services over and above the services that may be provided by long-term debt.

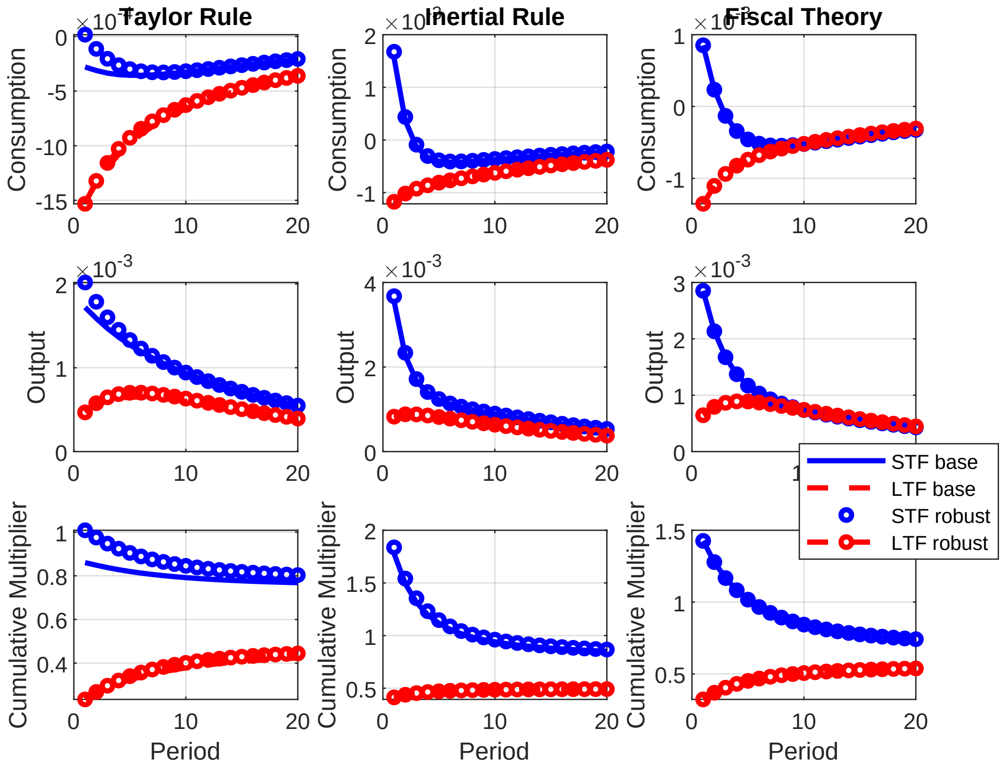
We now stress that our results do not hinge on the assumption that short bonds are the only liquid asset in the economy. In the online appendix we experiment with a version of our model in which long bonds provide *partial liquidity*. More specifically, we assume the following constraint applies to the subperiod 2 consumption of households:

$$c_t^i \leq b_{S,t}^i + \kappa b_{L,t}^i$$

where $\kappa$ is a parameter that governs the liquidity provided by long-term debt.

the government. A STF spending shock, will result in a relatively higher short bond supply and lower rents, reinforcing the drop in the intertemporal surplus of the government. For debt to be stabilized, a larger increase in inflation and output is needed, relative to the case of the LTF shock.

Figure 7: Responses to a spending shock: Distortionary taxes




*Notes: We plot the paths of consumption, output and the cumulative fiscal multiplier following a shock that increases spending by 1 percent on impact, and assuming distortionary taxation. The calibration of the monetary and fiscal rules corresponding to each of the graphs shown, is discussed in the notes of Figure 6.*

In calibrating this model we link parameter $\kappa$ to the term premium. Recall that in our baseline ($\kappa = 0$) the annual term premium is 100 basis points. In the appendix we investigate versions of our model where $\kappa > 0$ and the term premium is 75 bps and 50 bps. In each case, we recalibrate the parameters of $F_\theta$ to make our model consistent with the empirical evidence of Greenwood et al. (2015). We continue finding considerable differences in the fiscal multipliers across STF and LTF.

# 6 Conclusion

The empirical evidence presented in this paper demonstrates that the fiscal multiplier is higher when short-term debt is issued by the US Treasury. We provide a theoretical explanation for this phenomenon by incorporating financial market frictions into a model, where short-term bonds serve as a source of liquidity, enabling ex post heterogeneous households to finance a higher consumption stream. Our modeling approach aligns with a large body of literature that emphasizes the influence of bond supply on the yield curve. The model, calibrated to the US data, generates sizable differences in the fiscal multipliers induced by short-term and long-term financed spending shocks. We also study the interplay between the maturity financing and monetary/fiscal policies.

A few fruitful extensions of our work warrant consideration. First, as we discussed, heterogeneous agents models with wealth distributions, can also provide a microfoundation of the assumption that short bonds can be used to weather off idiosyncratic consumption risk. In these models households may prefer to accumulate precautionary savings in short bonds, due to their safety or to avoid paying the transaction costs that can plausibly be applied to long term assets. These models could also serve as a laboratory for studying the propagation of spending shocks under various maturity financing arrangements.

Solving such large-scale models incorporating heterogeneous agents, when long-term bonds are realistically risky assets is obviously not a straightforward task. In this paper we explored a simpler model with limited heterogeneity, emphasizing the liquidity attribute of short term debt. Besides being able to derive analytical insights from this model, we also envisage using it to study optimal policy. A growing literature on optimal debt maturity in macroeconomic models, when optimizing governments use the debt portfolios to insure against fiscal shocks. A novel insight that our paper brings to this literature is that the propagation mechanism of spending shocks may be different according to the maturity financing.

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