The Long and Short of Financing Government Spending

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Research question: does it matter how the US government finances its spending shocks?

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2. We explore a theory that can rationalize this.
   - Short bonds provide liquidity services to cover spending shocks
   - STF leads to an increase in consumption
3. What is the optimal debt portfolio?
   - Short bonds imply *larger multiplier* but long bonds *fiscal hedging*
   - Finding: (Relatively) stable quantity of short-term debt, long-term debt used to finance shocks

Empirical Analysis: Proxy VAR

Want to estimate:

$$AY_t = \sum_{i=1}^{p} C_i Y_{t-i} + \varepsilon_t \tag{1}$$

or equivalently:

$$Y_t = \sum_{i=1}^{p} \delta_i Y_{t-i} + B\epsilon_t \tag{2}$$

where $B = A^{-1}$, $\delta_i = A^{-1}C_i$ and let $u_t = B\varepsilon_t$.
Use covariance restrictions to identify B. Let m_t be the vector of proxy (defense news) variables. Identification conditions are:

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

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

where $\varepsilon_{g,t}$ is spending shocks and $\varepsilon_{x,t}$ are other shocks.

Empirical Analysis: Proxy VAR

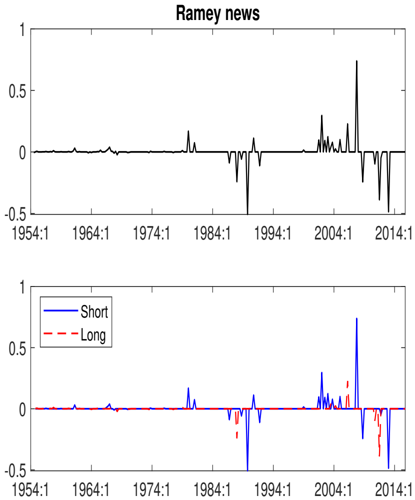
To disentangle STF spending shocks from LTF shocks we define
$m_t = \begin{bmatrix} m_{s,t} \\ m_{l,t} \end{bmatrix}$ with

$$\begin{aligned} m_t = \quad & m_{S,t}, \quad if \quad \widehat{\frac{b_{S,t}}{b_{L_t}}} \quad increases \\ m_t = \quad & m_{L,t}, \quad if \quad \widehat{\frac{b_{S,t}}{b_{L_t}}} \quad decreases, \end{aligned}$$

where $\widehat{\frac{b_{S,t}}{b_{L_t}}}$ denotes the ratio of short-term debt to long-term debt.

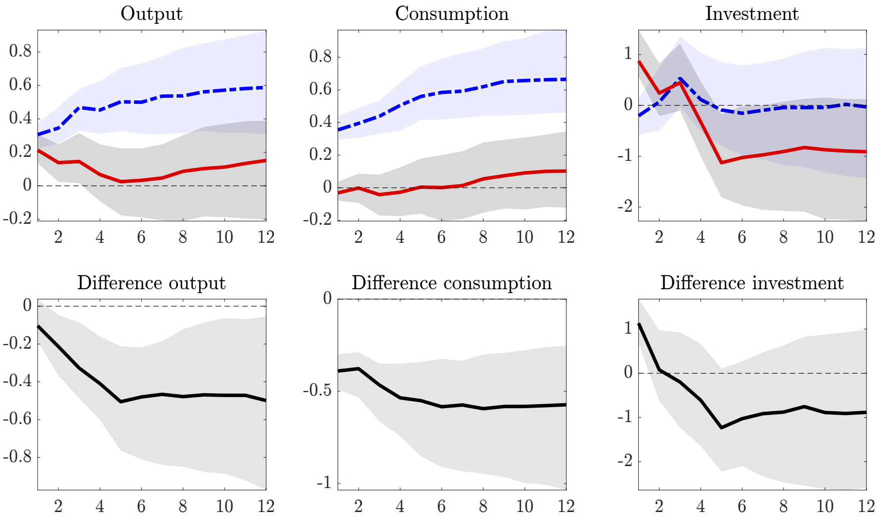
Identified fiscal shocks

Ramey and Zubairy (2018) military spending news, scaled by trend GDP



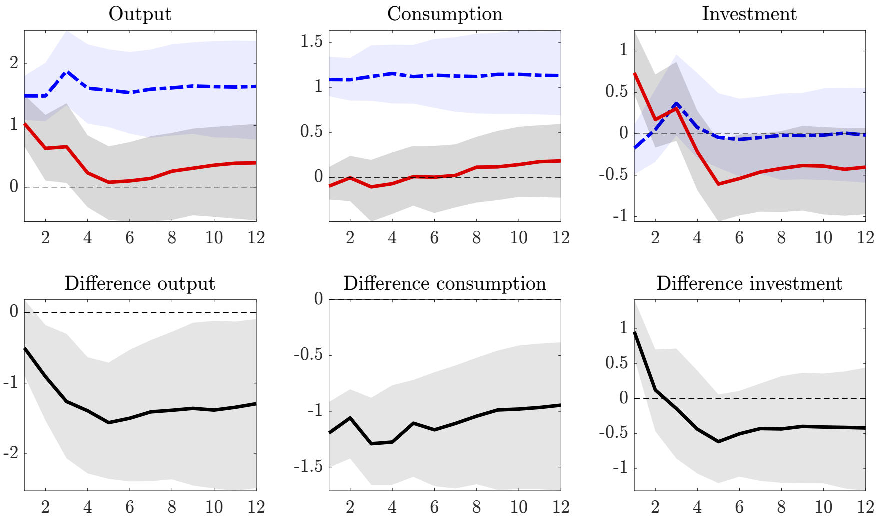
Baseline Results: Proxy VAR

Impulse responses to spending shock (blue=G with short debt; red=G with long debt)



Baseline Results: Proxy VAR

Cumulative multipliers (blue=G with short debt; red=G with long debt)

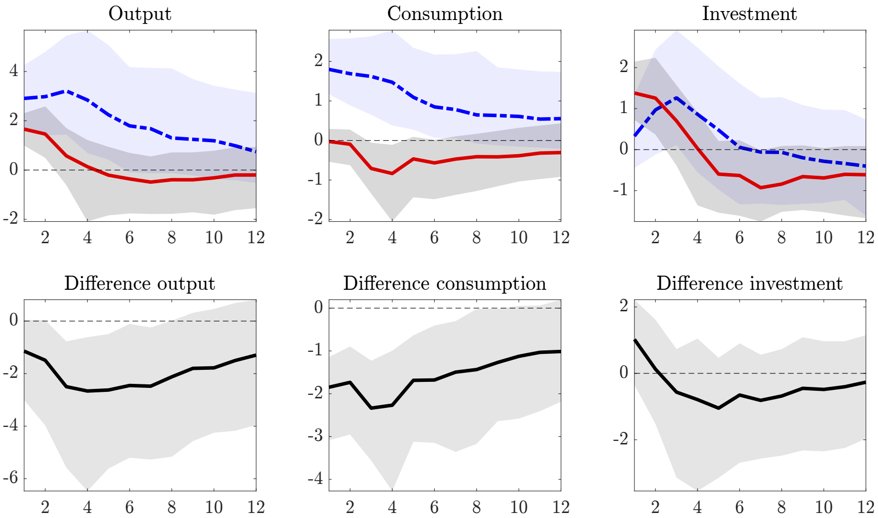


Robustness

- Possible biases...
  1. Endogeneity of Treasury's decision to finance short or long.
     - STF when yield curve (YC) is upward sloping, LTF when downward sloping. (But downward sloping YCs predict recessions...). **Treatment:** add short and long rates (level and slope of the YC)
     - LTF usually more in high debt periods (when distortionary taxes are more likely to rise, or political controversy about how to manage/finance debt).
       Treatment: Run the estimates using high and low debt samples.
  2. Shocks are of a different nature and thus affect the macroeconomy differently. (e.g. A STF shock may put more upward pressure on wages, when the government is hiring in certain sectors...)
     Treatment: add wages, interest rates...
  3. Monetary Policy response. Different for STF and LTF, also different post/pre 1980s and post 2008.
     Treatment: Add short term interest rates, split sample post/pre 1980s, drop the Great recession observations.

Robustness

Cumulative multipliers: All variables (blue=G with short debt; red=G with long debt)



Empirical Analysis: Local Projections.

Consider now the following framework,

$$Y_{t+h} = I_{t-1}\left[a_{A,h} + \beta_{A.h}\varepsilon_t + \psi_{A,h}(L)X_{t-1} + \right] \\ + (1 - I_{t-1})\left[a_{B,h} + \beta_{B,h}\varepsilon_t + \psi_{B,h}(L)X_{t-1}\right] + qtrend + u_{t+h}$$

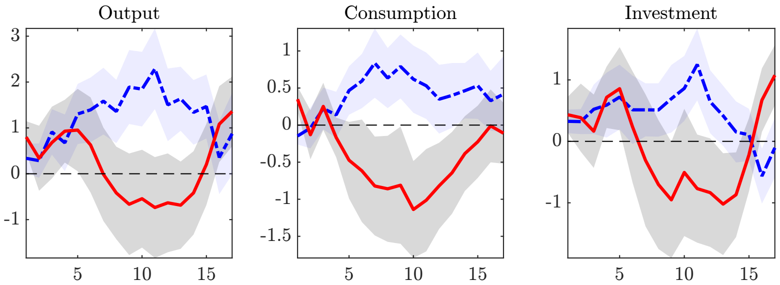
Y is output, consumption, investment, h is the horizon. X is a vector of control variables (including lags of output, consumption investment to control for serial auto-correlation), $\psi_{A,h}(L)$ is polynomial in the lag operator, and ε is the shock.

Moreover, $I_{t-1} = 1$ when the ratio of short over long debt increased between periods $t-2$ and $t-1$, and $I_{t-1} = 0$ otherwise.[1]

[1](Note we also experimented with I_t and with $\frac{1}{4}(I_{t-1} + I_t + I_{t+1} + I_{t+2})$ it didn't make a difference).

Results: Local Projections

IRFS, news instrument (blue=G with short debt; red=G with long debt)



Theoretical model

- Idea from finance: Short bonds function like money, they provide liquidity services.
- Greenwood, Hanson and Stein (JF, 2015) document the 'money premium' of T-Bills).

  (Note: Short debt provides short term liquidity/safety. Long-term Treasuries offer 'long term liquidity,' absolute certainty of ultimate repayment, subject to repricing/inflation risk).

Theoretical model

- Incomplete Markets+ (temporarily) heterogeneous agents. (Based on Hagedorn (2018) and Diamond and Dybvig (1983)).

- Agents' utility:

$$u(C_t^i) + \theta v(c_t^i) - \chi \frac{{h_t}^{i,1+\gamma}}{1+\gamma} \tag{3}$$

- Agents decide (at the beggining of period) C_t^i and a portfolio of short and long bonds.
- Short bonds can be used to finance c_t^i. We have:

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

where $b_{t,S}^i$ is the real value of debt purchased by household h; Agents will hold short term debt for the services that it provides + return properties. Long bonds (perpetuities with decaying coupons) are only held for return properties.

Theoretical model

- Agents that have low θ are unconstrained. They will set (optimally)

$$U'(C_t^i) = \theta v'(c_t^i)$$

  In contrast, agents that have high θ are constrained. They consume $c_t^i = b_{t,S}^i$.
- Cutoff θ satisfies: $U'(C_t^i) = \widetilde{\theta}_t v'(b_{t,S}^i)$
- All agents are part of a family. Excess short bonds are given to the family, so that agents will not differ in any state variable in the beginning of next period. We can thus drop i...

$$q_{t,S}u'(C_t^i) = F(\widetilde{\theta}_t)\beta E_t \frac{u'(C_{t+1}^i)}{\pi_{t+1}} + \int_{\widetilde{\theta}_t}^{\infty} \theta v'(b_{t,S}^i) dF_\theta \tag{4}$$

prices short term debt.

$$q_{t,L}u'(C_t^i) = \beta E_t \frac{u'(C_{t+1}^i)}{\pi_{t+1}}(1 + \delta q_{t+1,L}) \tag{5}$$

prices the long term bond.

$$\chi \frac{h_t^\gamma}{U'(C_t)} = w_t(1 - \tau_t) \tag{6}$$

is the labour supply condition.

Phillips curve, Resource constraint, GBC

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

$$C_t + \int_{\widetilde{\theta}_t}^{\infty} b_{S,t} dF_\theta + \int_0^{\widetilde{\theta}_t} \theta C_t dF_\theta + G_t + \frac{\lambda}{2}(\pi_t - 1)^2 = Y_t = H_t$$

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

+ Monetary/Fiscal Policy...

- Assume lump sum taxes, log-log utility and consider a log-linear approximation of the model. The short bond Euler equation is:

$$\frac{\overline{q}_S}{\overline{C}}\hat{q}_{t,S} + F_{\overline{\widetilde{\theta}}}\frac{\beta}{\overline{C}}E_t\hat{\pi}_{t+1} + F_{\overline{\widetilde{\theta}}}\frac{\beta}{\overline{C}}\hat{C}_{t+1} = \underbrace{\left(\frac{\overline{q}_S}{\overline{C}} + (1-\beta)\frac{1}{\overline{C}}f_{\overline{\widetilde{\theta}}}\overline{\widetilde{\theta}}\right)}_{\alpha_1}\hat{C}_t$$

$$-\underbrace{\left((1-\beta)\frac{1}{\overline{C}}f_{\overline{\widetilde{\theta}}}\overline{\widetilde{\theta}} + \frac{1}{\overline{b}_S}\int_{\overline{\widetilde{\theta}}}^{\infty}\theta dF_{\theta}\right)}_{\alpha_2}\hat{b}_{t,S}$$

where $\alpha_1, \alpha_2 > 0$.
Let us first assume that monetary policy sets the path of the nominal interest rate so that $\frac{\overline{q}_S}{\overline{C}}\hat{q}_{t,S} + F_{\overline{\widetilde{\theta}}}\frac{\beta}{\overline{C}}E_t\hat{\pi}_{t+1} = 0$.

Fiscal Multipliers: Simple Analytics

- then

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

- Lets also assume that $\hat{b}_{t,S} = \varrho \hat{G}_t$ is sufficient to determine the response of the share to the spending shock. STF sets $\varrho > 0$, LTF $\varrho < 0$.

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

where $\kappa_1 > 0$

The impact multiplier is:

$$m_0 = \frac{\overline{Y} d\hat{Y}_0}{\overline{G} d\hat{G}_0} = 1 + \frac{1}{\overline{G}} \left[\frac{\alpha_2}{\alpha_1} \frac{\overline{C}(1 + \int_0^{\bar{\tilde{\theta}}} \theta dF_\theta)}{1 - F_{\bar{\tilde{\theta}}} \frac{\beta}{\alpha_1 \overline{C}} \rho_G} + \overline{b}_S (1 - F_{\bar{\tilde{\theta}}}) \right] \varrho \qquad (7)$$

Fiscal Multipliers: Simple Analytics

- The same can be shown with a Taylor rule:

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

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

where $\alpha_3 < 1$

Fiscal Multipliers: A calibrated model.

$$\hat{s}_t^{\text{Short/Long}} = \varrho \hat{G}_t \quad (8)$$

where s is the share of short (defined as debt of maturity less than one year) over long.

$$\hat{s}_t^{\text{Short/Long}} = \varrho \hat{G}_t$$

Baseline rule for lump sum taxes.

$$\hat{T}_t = \phi_T \hat{D}_{t-1} \quad (9)$$

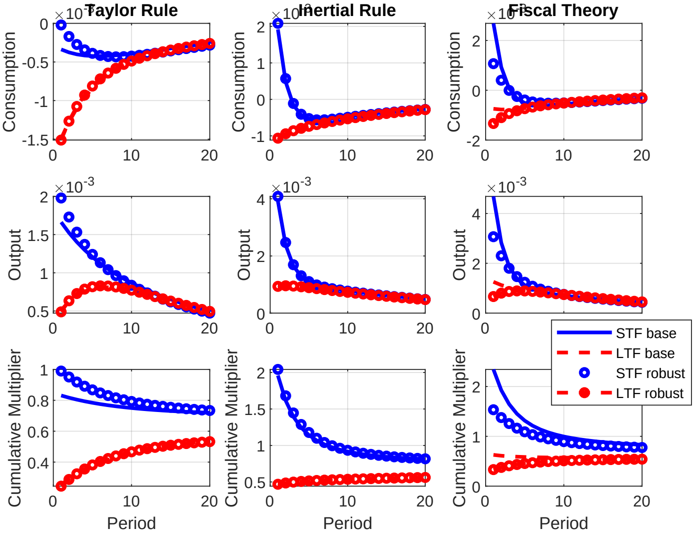
+Monetary policy follows a simple inflation targeting rule.

Fiscal Multipliers: A calibrated model.

Most of the calibration is standard. What is worth noting is the following:

1. We calibrate the steady state share of short over long as in the data (12.5%) .
2. We calibrate the short term return to be 1 percent per annum + the term spread is also 1 percent.
3. We set $\varrho = 0.6$. (For proxy VAR, short term financing was identified in periods where the average increase in the share of 0.6 percent and the spending shock is 1 percent).
4. F is log normal. The variance of F is so that the model matches the evidence presented in Greenwood et al (2015) (an increase in T-Bill ratio to GDP reduces the 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.

Fiscal Multipliers:



Optimal Policy

The Problem: Finance short or long?

- With distortionary taxes a higher multiplier will translate to lower fiscal deficits in times of high expenditures. This will enable the government to better smooth tax distortions across time.
- Short term yields are lower, and therefore issuing short bonds lowers the overall costs of servicing debt and hence lowers also the average level of taxes.
- However, an increase in the spending level leads to a drop in long bond prices (when consumption is crowded out) . Thus, a government that issues long term debt, benefits from *fiscal insurance* and can smooth taxes through time.

Optimal Policy

- We solve a Ramsey optimal fiscal/debt policy program. The benevolent government chooses sequences $\{\pi, Y, \theta, \tau, q_S, q_L, b_L, b_S, \widetilde{\theta}, C\}$ to maximise household welfare subject to a set of constraints which are sufficient for a competitive equilibrium.

  The first order conditions:

$$E_t G\left(\widetilde{Y}_{t+1}, \widetilde{X}_t, \widetilde{X}_{t-1}\widetilde{Y}_t, \widetilde{\psi}_t, \widetilde{\psi}_{t-1}, \{\underline{M}_j, \overline{M}_j\}_{j=S,L}\right) = 0 \qquad (10)$$

  where $\{\underline{M}_j, \overline{M}_j\}_{j=S,L}$ are ad hoc debt limits (e.g. Faraglia et al (2019), Lustig et al (2008)).

Optimal Policy

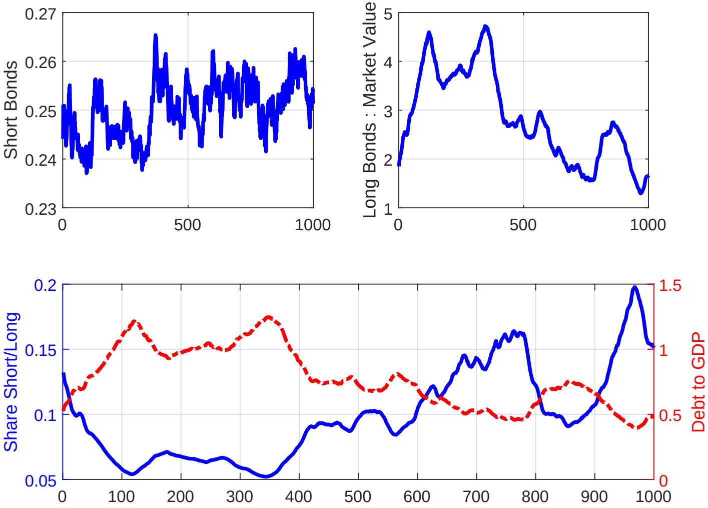
- Problem: Solving the system

$$E_t G\left(\widetilde{Y}_{t+1}, \widetilde{X}_t, \widetilde{X}_{t-1} \widetilde{Y}_t, \widetilde{\psi}_t, \widetilde{\psi}_{t-1}, \left\{\underline{M}_j, \overline{M}_j\right\}_{j=S,L}\right) = 0$$

in general produces multiple stationary points (as in e.g. Angeletos et al (2022)).

- To find the global optimum our numerical algorithm, weds stochastic PEA with value function iteration. + Use of debt limits to rule out some of the solutions.

Optimal Policy: Simulations



Optimal Policy: Share short over long

Table: Share (market value) of short over long bonds

	Data	Model
Mean share	0.124	0.099
Auto-correlation	0.89	0.99
Standard deviation	0.024	0.020
Correlation with debt-GDP	-0.43	-0.94

Conclusions

Financing spending shocks short term implies a larger spending multiplier. We explained this through the lenses of a simple model in which short bonds function like money, the provide liquidity to the economy. We explored the optimal policy implications of the model, showing that financing short term is not optimal.

Conclusions

Thanks for listening!