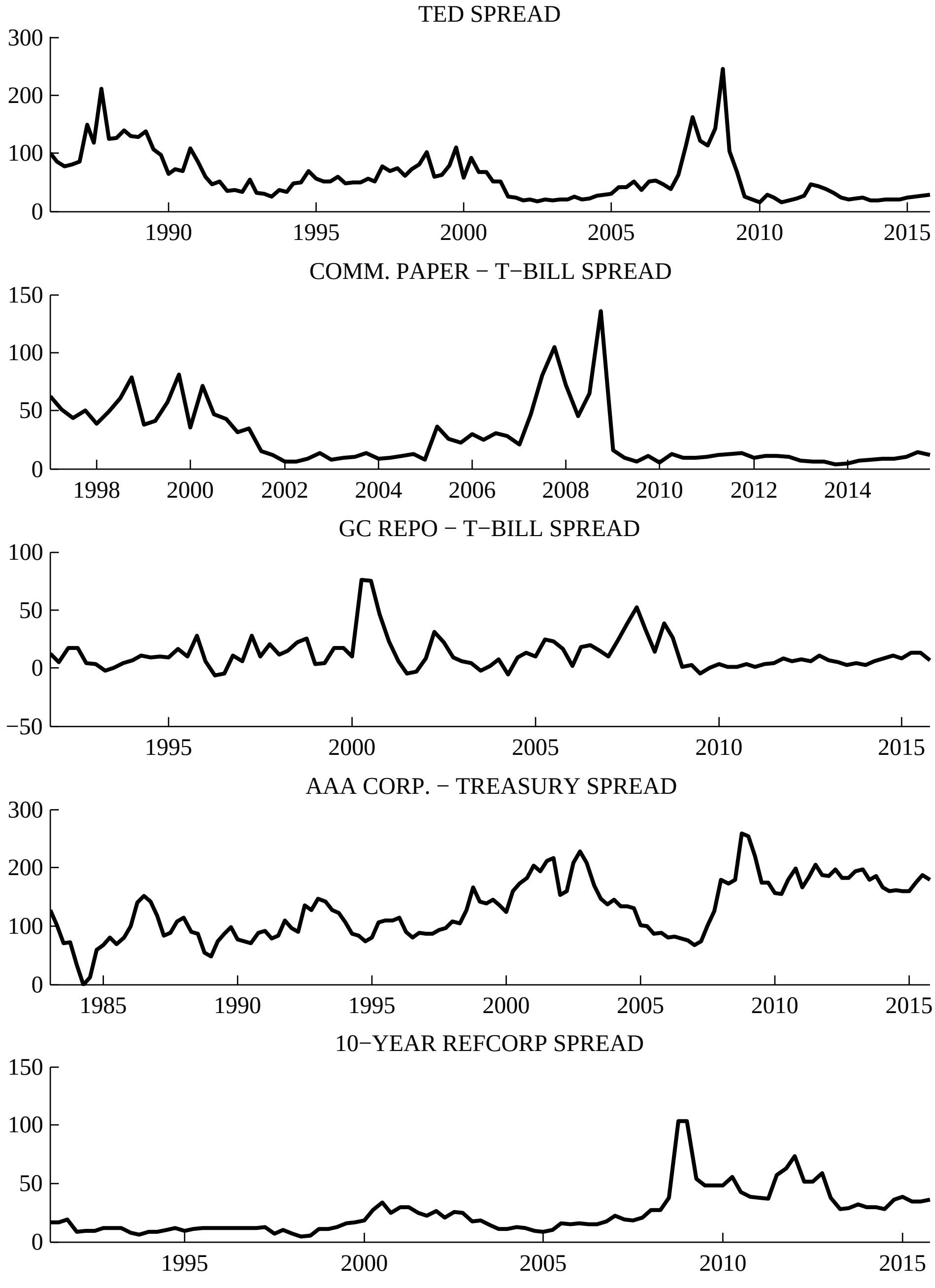
Online Appendix to
'Fiscal Multipliers and Monetary Policy: Reconciling Theory and Evidence'
by C. Bredemeier, F. Juessen, and A. Schabert

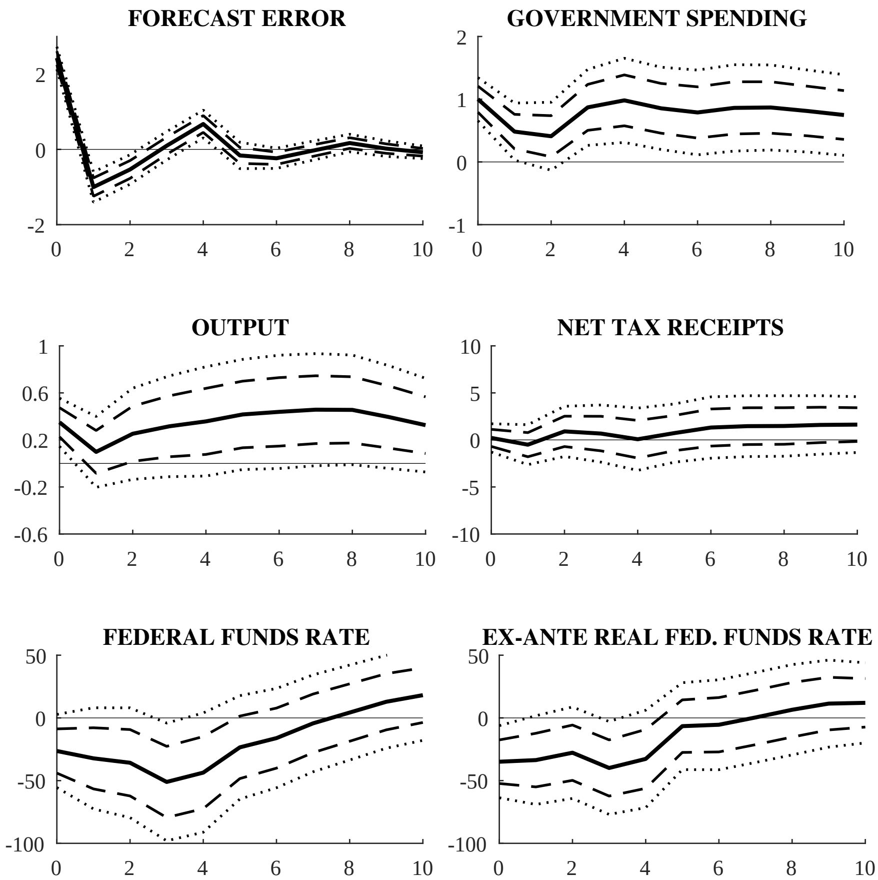
Additional empirical results

Figure A1: Time series of interest rate spreads analyzed in Section 3.3.



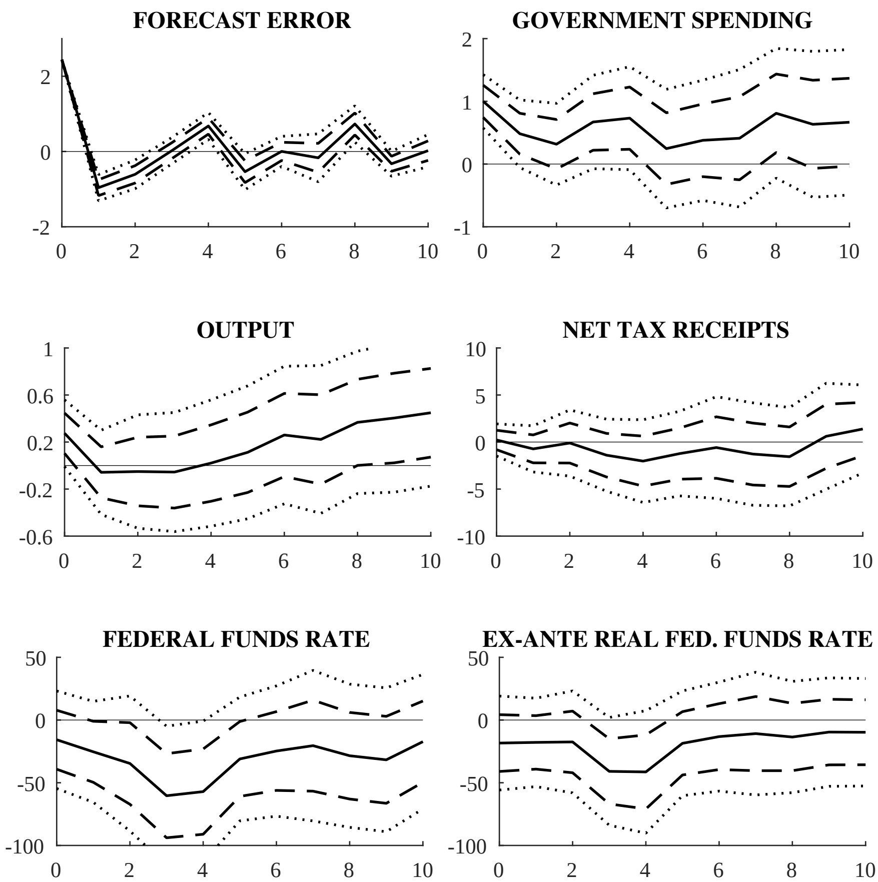
Notes: Spreads shown in basis points.

Figure A2: Responses to government spending shocks identified through forecast errors (sample period 1979Q4-2008Q3).



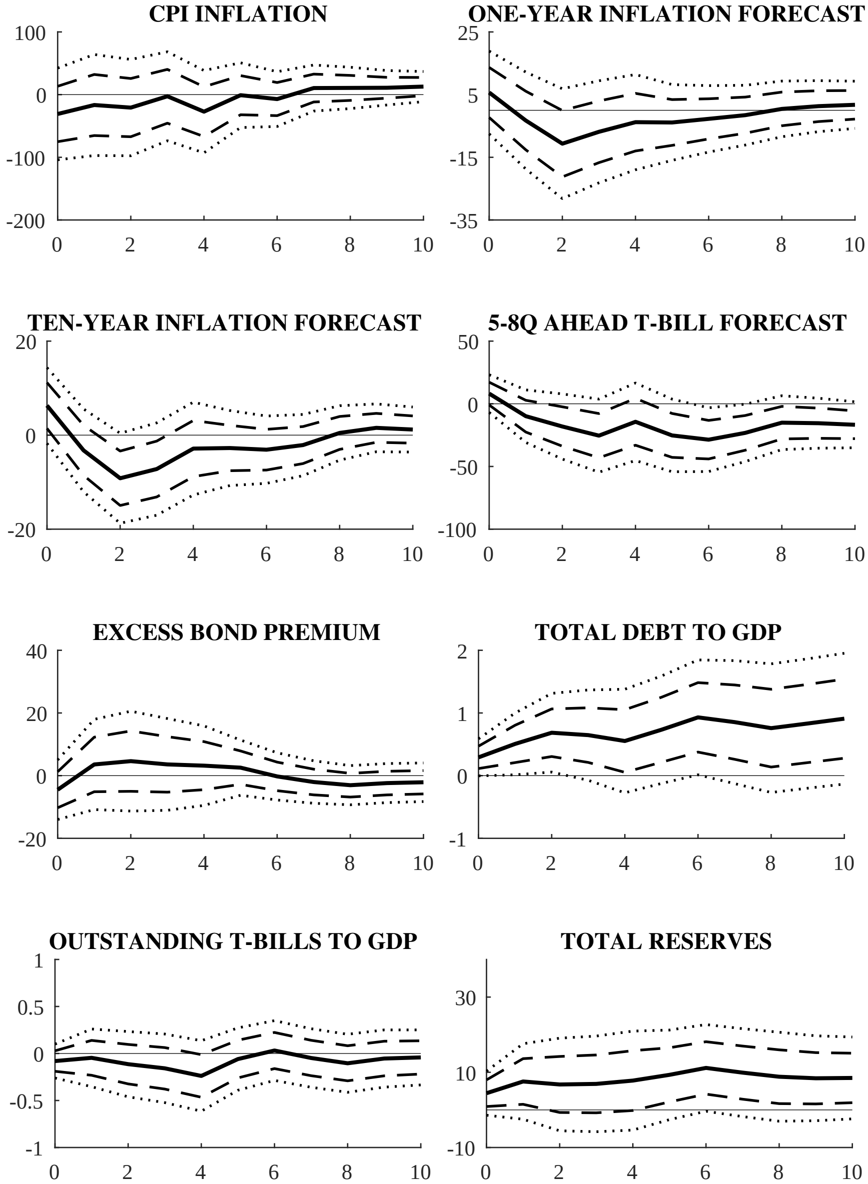
Notes: Identification based on forecast errors from the Survey of Professional Forecasters (Ramey, 2011). VAR includes forecast error, government spending, real GDP, net tax receipts, and the federal funds rate. Bottom-right panel: real federal funds rate replaces nominal federal funds rate in VAR. Sample period 1979Q4-2008Q3. Responses in percent, nominal and real federal funds rate in basis points. Dotted (dashed) lines show 68% (90%) confidence bands. Horizontal axes show quarters.

Figure A3: Local projections: Responses to government spending shocks identified through forecast errors.



Notes: Impulse responses estimated through local projections. Identification based on forecast errors from the Survey of Professional Forecasters (Ramey, 2011). The endogenous variable at horizon $t+h$ is regressed on a constant, a linear-quadratic trend, the shock variable, i.e., the forecast error, at time t and a conditioning set that includes two lags of government spending, real gdp per capita, net tax receipts, the federal funds rate, as well as, for the responses of the forecast error, the forecast error. Sample period 1979Q4-2015Q4. Dotted lines (dashed lines) show 68% (90%) confidence bands based on Newey-West (1987) standard errors. Horizontal axes show quarters.

Figure A4: Responses of further variables to positive government spending shocks identified through forecast errors.



Notes: Identification based on forecast errors from the Survey of Professional Forecasters (Ramey, 2011). VAR includes forecast error, government spending, real GDP, net tax receipts, the federal funds rate, and the respective variable shown in the figure. Sample period 1979Q4-2015Q4 for inflation, inflation forecast, excess bond premium, debt to GDP, and total reserves, 1981Q4-2015Q4 for 5-8 Quarter ahead T-bill rate forecast, 1983Q1-2013Q2 for T-bill to GDP. Dotted (dashed) lines show 68% (90%) confidence bands. Horizontal axes show quarters.

Additional material to model analysis

Definition 4 *A rational expectations equilibrium of the model with endogenous capital formation, credit goods, and habit persistence is a set of sequences* $\{c_t,\ \overline{c}_t,\ y_t,\ n_t,\ x_t,\ k_t,\ w_t,\ q_t,\ \lambda_t,\ m_t^R,\ m_t,\ b_t,\ b_t^T,\ mc_t,\ Z_{1,t},\ Z_{2,t},\ Z_t,\ s_t,\ \pi_t,\ R_t^{IS}\}_{t=0}^{\infty}$ *satisfying (25)-(30), (34)-(38),*

$$\lambda_t = u_{\overline{c},t}, \tag{65}$$
$$1/R_t^{IS} = \beta E_t \left[\xi_{t+1} u_{c,t+1} / \left(\xi_t u_{c,t} \pi_{t+1}\right)\right], \tag{66}$$
$$w_t = mc_t \alpha n_t^{\alpha-1} k_{t-1}^{1-\alpha}, \tag{67}$$
$$\lambda_t = \beta E_t \left[\xi_{t+1} u_{c,t+1} / \pi_{t+1}\right], \tag{68}$$
$$1 = q_t \left[\Lambda_t + \left(x_t/x_{t-1}\right)\Lambda_t'\right] - E_t \beta \left[\left(\lambda_{t+1}/\lambda_t\right) q_{t+1} \left(x_{t+1}/x_t\right)^2 \Lambda_{t+1}'\right], \tag{69}$$
$$q_t = \beta E_t \left[\left(\lambda_{t+1}/\lambda_t\right)\left((1-\alpha) mc_{t+1} \left(y_{t+1}/k_t\right) + (1-\delta) q_{t+1}\right)\right], \tag{70}$$
$$y_t = n_t^{\alpha} k_{t-1}^{1-\alpha} / s_t, \tag{71}$$
$$y_t = c_t + \overline{c}_t + x_t + g_t, \tag{72}$$
$$k_t = (1-\delta) k_{t-1} + x_t \Lambda_t, \tag{73}$$

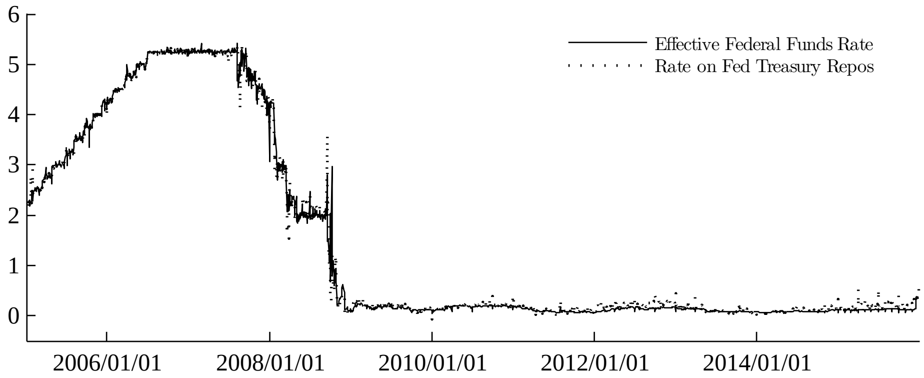
(where $u_{\overline{c},t} = \gamma(\overline{c}_t - h\overline{c}_{t-1})^{-\sigma}$, $u_{c,t} = (c_t - hc_{t-1})^{-\sigma}$, $\Lambda_t = 1 - \zeta\frac{1}{2}(x_t/x_{t-1} - 1)^2$*), the transversality conditions, a monetary policy satisfying (24),* $\Omega > 0$, $\pi \geq \beta$, *given sequence* $\{\widetilde{y}_t\}_{t=0}^{\infty}$ *(see below), a fiscal policy* $g_t = \rho g_{t-1} + (1-\rho) g + \varepsilon_{g,t}$ *and* $\Gamma \geq 1$*, a process* $\xi_t = \rho_\xi \xi_{t-1} + (1-\rho_\xi) + \varepsilon_{\xi,t}$*, random sequences* $\{\varepsilon_{g,t}, \varepsilon_{\xi,t}\}_{t=0}^{\infty}$ *and initial values* $M_{-1} > 0$, $B_{-1} > 0$, $B_{-1}^T > 0$, $k_{-1} > 0$, $x_{-1} > 0$, $s_{-1} \geq 1$, $c_{-1} > 0$ *and* $\overline{c}_{-1} > 0$.

Given a rational expectations equilibrium as summarized in Definition 4, the equilibrium sequences $\{R_t,\ R_t^D,\ R_{t+1}^q,\ R_t^L = R_t^A\}_{t=0}^{\infty}$ can be determined by (43), (44),

$$R_t = E_t[\xi_{t+1} u_{c,t+1} \pi_{t+1}^{-1}] / [E_t \left(R_{t+1}^m\right)^{-1} \xi_{t+1} u_{c,t+1} \pi_{t+1}^{-1}], \tag{74}$$
$$\lambda_t / R_t^D = \beta E_t[(\xi_{t+1} u_{c,t+1} + (1-\mu)\lambda_{t+1})/\pi_{t+1}]. \tag{75}$$

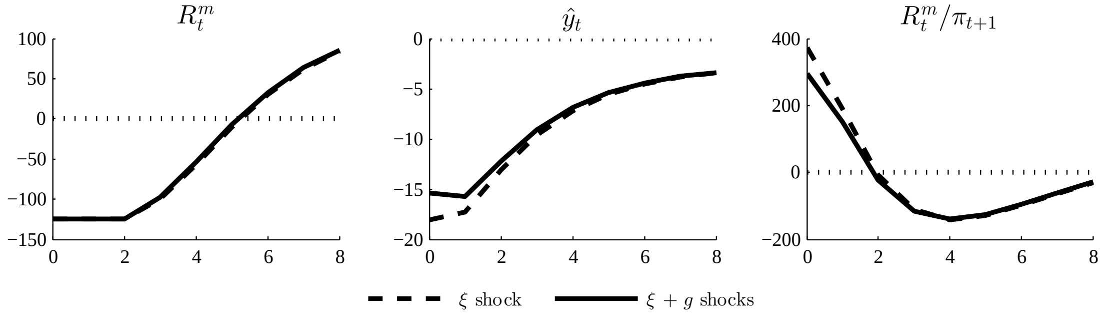
To identify the efficient output level $\widetilde{y}_t$, one has to jointly solve for the sequences $\{\widetilde{y}_t, \widetilde{n}_t, \widetilde{c}_t, \widetilde{k}_t, \widetilde{x}_t, \widetilde{q}_t\}_{t=0}^{\infty}$ satisfying $\theta \widetilde{n}_t^{1+\sigma_n} = \widetilde{u}_{ct} \alpha \widetilde{y}_t$, $\widetilde{y}_t = \widetilde{n}_t^{\alpha} \widetilde{k}_{t-1}^{1-\alpha}$, $\widetilde{y}_t = \widetilde{c}_t + \widetilde{x}_t$, $\widetilde{k}_t = (1-\delta)\widetilde{k}_{t-1} + \widetilde{x}_t \Lambda\left(\widetilde{x}_t/\widetilde{x}_{t-1}\right)$, $1 = \widetilde{q}_t \left[\Lambda\left(\widetilde{x}_t/\widetilde{x}_{t-1}\right) + \left(\widetilde{x}_t/\widetilde{x}_{t-1}\right)\Lambda'\left(\widetilde{x}_t/\widetilde{x}_{t-1}\right)\right] - E_t\beta\left[\xi_{t+1}\widetilde{u}_{c,t+1}(\xi_t \widetilde{u}_{c,t})^{-1} \widetilde{q}_{t+1}\left(\widetilde{x}_{t+1}/\widetilde{x}_t\right)^2 \Lambda'\left(\widetilde{x}_{t+1}/\widetilde{x}_t\right)\right]$, and $\widetilde{q}_t = \beta E_t[\xi_{t+1}\widetilde{u}_{c,t+1}(\xi_t \widetilde{u}_{c,t})^{-1}((1-\alpha)(\widetilde{y}_{t+1}/\widetilde{k}_t) + (1-\delta)\widetilde{q}_{t+1})]$, where $\widetilde{u}_{c,t} = (\widetilde{c}_t - h\widetilde{c}_{t-1})^{-\sigma}$, given $\{\xi_t\}_{t=0}^{\infty}$, $\widetilde{x}_{-1} > 0$ and $\widetilde{k}_{-1} > 0$.

Figure A5: Federal funds rate and treasury repo rate.



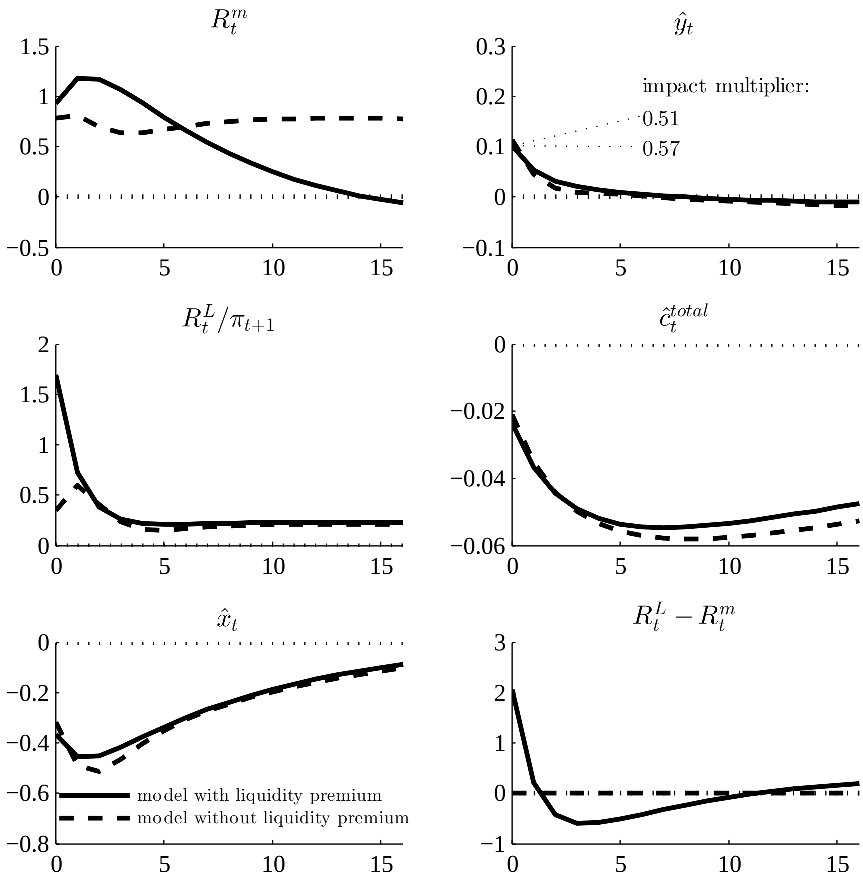
Notes: Data source for rate on Fed Treasury Repos: DTCC GCF Repo Index. Mean spread is 0.995 bp.

Figure A6: Paths of the nominal and real policy rate as well as output in our ZLB experiment analyzed in Section 5.2.3.



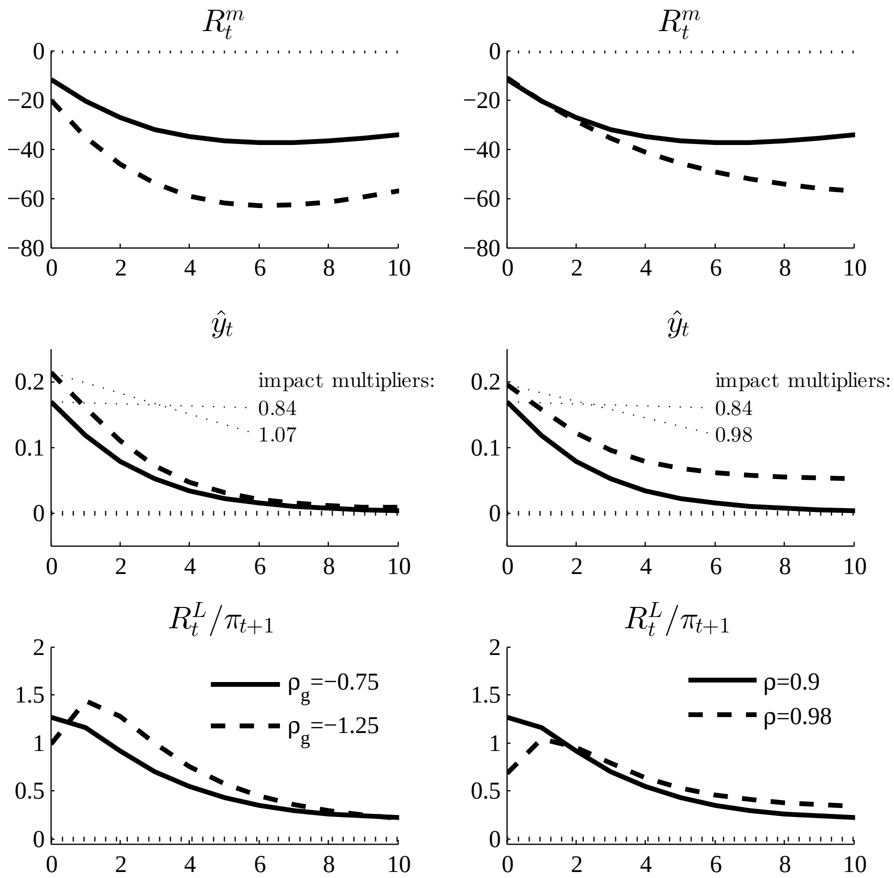
Notes: Smallest ξ shock that drives the economy to the ZLB for three periods (auto-correlation set to 0.8). g shock amounting to 5% of steady-state GDP in order to ensure visibility of the effects of fiscal policy. Absolute deviations of R_t^m and R_t^m/π_{t+1} from steady state in basis points. Relative deviation of y_t from steady state in percent.

Figure A7: Responses to a 1% government spending shock when the monetary policy rate counterfactually rises, achieved through a standard Taylor-rule ($\rho_g = 0$), for a model version with (solid line) and without liquidity premium (dashed line)



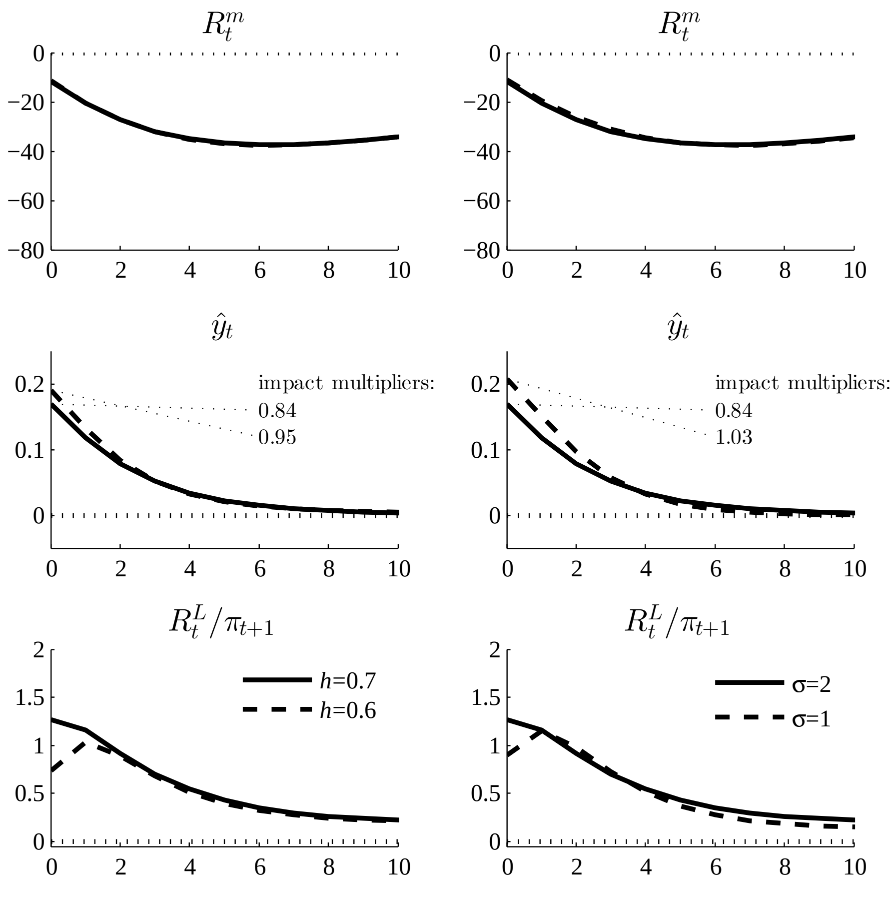
Notes: Relative responses of y_t, c_t^{total}, and x_t in percent. Absolute responses of R_t^m/π_{t+1}, R_t^L/π_{t+1}, $R_t^L - R_t$ in basis points.

Figure A8: Responses to a positive 1% government spending shock for the model version with positive liquidity premium: baseline calibration and variations in ρ_g (left column) and ρ (right column).



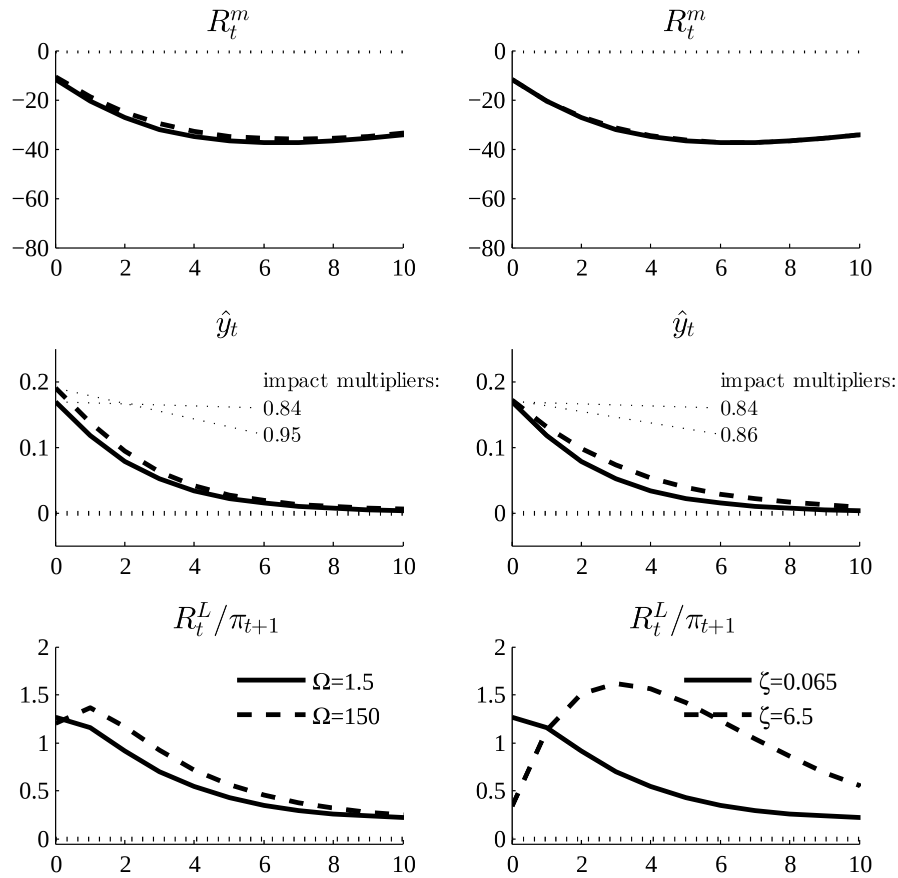
Notes: Absolute responses of R_t^m and R_t^L/π_{t+1} in basis points. Relative responses of y_t in percent.

Figure A9: Responses to a positive 1% government spending shock for the model version with positive liquidity premium: baseline calibration and variations in h (left column) and σ (right column).



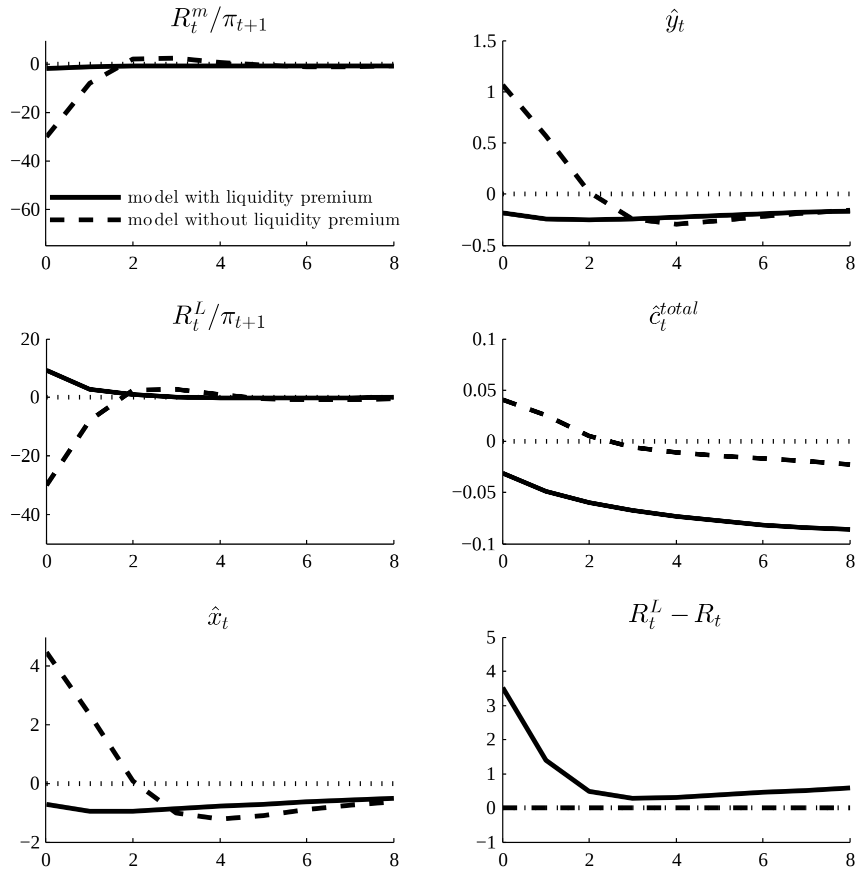
Notes: Absolute responses of R_t^m and R_t^L/π_{t+1} in basis points. Relative responses of y_t in percent.

Figure A10: Responses to a positive 1% government spending shock for the model version with positive liquidity premium: baseline calibration and variations in Ω (left column) and ζ (right column).



Notes: Absolute responses of R_t^m and R_t^L/π_{t+1} in basis points. Relative responses of y_t in percent.

Figure A11: Net effects of a positive 1 pp increase in a labor income tax rate (mean 0.2, autocorrelation 0.9) at the ZLB.



Notes: Relative responses of y_t, g_t, c_t, $\bar{c}_t$, x_t, and k_t in percent. Absolute responses of R_t^m, R_t^m/π_{t+1}, R_t^L/π_{t+1}, $R_t^L - R_t$, and $R_t^{IS} - R_t^m$ in basis points.