For Online Publication: Appendix to "Clearing Up the Fiscal Multiplier Morass"

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This appendix gathers supplementary material to Leeper, Traum, and Walker (2017).

Contents

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1 Derivation of the Log-Linearized Model

1.1 The Equilibrium System.

Since the economy features a permanent shock to technology, several variables are not stationary. In order to induce stationarity, we perform a change of variables and define: $y_t = \frac{Y_t}{A_t}$, $c_t^{*S} = \frac{C_t^{*S}}{A_t}$, $c_t^S = \frac{C_t^S}{A_t}$, $c_t^N = \frac{C_t^N}{A_t}$,$k_t = \frac{K_t}{A_t}$, $\bar{k}_t = \frac{\bar{K}_t}{A_t}$, $i_t = \frac{I_t}{A_t}$, $g_t = \frac{G_t}{A_t}$, $z_t = \frac{Z_t}{A_t}$, $b_t = \frac{P_t^B B_t}{P_t A_t}$, $w_t = \frac{W_t}{P_t A_t}$, and $\lambda_t^S = \Lambda_t^S A_t$.

1.1.1 Households

We define Λ_t^S as the Lagrange multiplier associated with the savers' budget constraint, $\Lambda_t^S q_t$ as the Lagrange multiplier associated with the capital accumulation equation, and $r_t^k \equiv R_t^k / P_t$.

Savers' FOC for consumption:

$$\lambda_t^S (1 + \tau_t^c) = \frac{u_t^b}{c_t^{*S} - \theta c_{t-1}^{*S} e^{-u_t^a}} \tag{1}$$

c^{*S} definition:

$$c_t^{*S} = c_t^S + \alpha_g g_t \tag{2}$$

Euler equation for one-period private bonds:

$$\lambda_t^S = \beta R_t E_t \frac{\lambda_{t+1}^S e^{-u_{t+1}^a}}{\pi_{t+1}} \tag{3}$$

Price relation between long and short bonds:

$$P_t^B = E_t \left(\frac{1}{R_t} (1 + \rho P_{t+1}^B) \right) \tag{4}$$

Savers' FOC for capacity utilization:

$$(1 - \tau_t^k) r_t^k = \psi'(v_t) \tag{5}$$

Savers' FOC for capital:

$$q_t = \beta E_t \frac{\lambda_{t+1}^S e^{-u_{t+1}^a}}{\lambda_t^S} \left\{ (1 - \tau_{t+1}^K) r_{t+1}^k v_{t+1} - \psi(v_{t+1}) + (1 - \delta) q_{t+1} \right\} \tag{6}$$

where q_t is Tobin's Q. Savers' FOC for investment:

$$\begin{aligned} 1 =& q_t u_t^i \left[1 - s\left(\frac{i_t e^{u_t^a}}{i_{t-1}} \right) - s'\left(\frac{i_t e^{u_t^a}}{i_{t-1}} \right) \frac{i_t e^{u_t^a}}{i_{t-1}} \right] \\ &+ \beta E_t \left[q_{t+1} \frac{\lambda_{t+1}^S e^{-u_{t+1}^a}}{\lambda_t^S} u_{t+1}^i s'\left(\frac{i_{t+1} e^{u_{t+1}^a}}{i_t} \right) \left(\frac{i_{t+1} e^{u_{t+1}^a}}{i_t} \right)^2 \right] \end{aligned} \tag{7}$$

Effective capital:

$$k_t = v_t \bar{k}_{t-1} e^{-u_t^a} \tag{8}$$

Law of motion for capital:

$$\bar{k}_t = (1-\delta) e^{-u_t^a} \bar{k}_{t-1} + u_t^i \left[1 - s\left(\frac{i_t e^{u_t^a}}{i_{t-1}} \right) \right] i_t \tag{9}$$

Nonsavers' real budget constraint:

$$(1+\tau_t^c) c_t^N = (1-\tau_t^L) w_t L_t + z_t^N \tag{10}$$

1.1.2 Wage Determination.

FOC for the optimal wage, defined as $\tilde{w}_t \equiv \tilde{W}_t/(A_t P_t)$:

$$0 = E_t \left\{ \sum_{t=0}^{\infty} (\beta\omega_w)^s \lambda_{t+s}^S \bar{L}_{t+s} \left[\tilde{w}_t \prod_{k=1}^{s} \left\{ \left(\frac{\pi_{t+k-1} e^{u_{t+k-1}^a}}{\pi e^{\gamma}} \right)^{\chi^w} \left(\frac{\pi e^{\gamma}}{\pi_{t+k} e^{u_{t+k}^a}} \right) \right\} - \frac{(1+\eta_{t+s}^w) u_{t+s}^b \bar{L}_{t+s}^{\xi}}{(1-\tau_{t+s}^L)\lambda_{t+s}^S} \right] \right\} \tag{11}$$

where

$$\bar{L}_{t+s} = \left(\tilde{w}_t \prod_{k=1}^{s} \left\{ \left(\frac{\pi_{t+k-1} e^{u_{t+k-1}^a}}{\pi e^{\gamma}} \right)^{\chi^w} \left(\frac{\pi e^{\gamma}}{\pi_{t+k} e^{u_{t+k}^a}} \right) \right\} \right)^{-\frac{1+\eta_{t+s}^w}{\eta_{t+s}^w}} L_{t+s} \tag{12}$$

Aggregate wage evolution:

$$w_t^{\frac{1}{\eta_t^w}} = (1-\omega_w) \tilde{w}_t^{\frac{1}{\eta_t^w}} + \omega_w \left[\left(\frac{\pi_{t-1} e^{u_{t-1}^a}}{\pi e^{\gamma}} \right)^{\chi_w} \left(\frac{\pi e^{\gamma}}{\pi_t e^{u_t^a}} \right) w_{t-1} \right]^{\frac{1}{\eta_t^w}} \tag{13}$$

1.1.3 Intermediate Goods Firms.

Production function:

$$y_t pd_t = k_t^{\alpha} L_t^{1-\alpha} - \Omega \tag{14}$$

where pd_t stands for price dispersion. Capital-labor ration:

$$\frac{k_t}{L_t} = \frac{w_t}{r_t^k} \frac{\alpha}{1-\alpha} \tag{15}$$

Real marginal cost ($\equiv MC_t/P_t$):

$$mc_t = (1-\alpha)^{\alpha-1} \alpha^{-\alpha} (r_t^k)^{\alpha} w_t^{1-\alpha} \tag{16}$$

Intermediate firm's FOC for price ($\tilde{p}_t \equiv \tilde{P}_t/P_t$)

$$0 = E_t \left\{ \sum_{s=0}^{\infty} (\beta\omega_p)^s \lambda_{t+s}^S \bar{y}_{t+s} \left[\tilde{p}_t \prod_{k=1}^{s} \left[\left(\frac{\pi_{t+k-1}}{\pi} \right)^{\chi^p} \left(\frac{\pi}{\pi_{t+k}} \right) \right] - (1+\eta_{t+s}^p) mc_{t+s} \right] \right\} \tag{17}$$

where

$$\bar{y}_{t+s} = \left(\tilde{p}_t \prod_{k=1}^{s} \left[\left(\frac{\pi_{t+k-1}}{\pi} \right)^{\chi^p} \left(\frac{\pi}{\pi_{t+k}} \right) \right] \right)^{-\frac{1+\eta^p_{t+s}}{\eta^p_{t+s}}} y_{t+s}$$

Aggregate price index:

$$1 = \left\{ (1-\omega_p)\tilde{p}_t^{\frac{1}{\eta^p_t}} + \omega_p \left[\left(\frac{\pi_{t-1}}{\pi} \right)^{\chi^p} \left(\frac{\pi}{\pi_t} \right) \right]^{\frac{1}{\eta^p_t}} \right\}^{\eta^p_t} \tag{18}$$

Government budget constraint:

$$b_t + \tau^K_t r^k_t k_t + \tau^L_t w_t L_t + \tau^C_t c_t = \frac{1+\rho P^B_t}{P^B_{t-1}} \frac{b_{t-1}}{\pi_t e^{u^a_t}} + g_t + z_t \tag{19}$$

$$c_t = \mu c^S_t + (1-\mu) c^N_t \tag{20}$$

Aggregate resource constraint:

$$y_t = c_t + i_t + g_t + \psi(v_t)\bar{k}_{t-1} e^{-u^a_t} \tag{21}$$

1.2 Steady state

By assumption, in the steady state $v = 1$, $s(e^\gamma) = s'(e^\gamma) = 0$, and $\pi = 1$, which implies $R = e^\gamma/\beta$. Given the average duration of government debt, defined as AD, the parameter ρ is

$$\rho = \left(1 - \frac{1}{AD}\right)\frac{1}{\beta}$$

Given these values and the steady state fiscal policy calibration, the remaining variables are defined by the system:

$$
\begin{aligned}
P^B &= \frac{\beta}{e^{\gamma} - \rho\beta}, \\
r^k &= \frac{\frac{e^{\gamma}}{\beta} - 1 + \delta}{1 - \tau^k}, \\
\psi'(1) &= r^k(1 - \tau^k), \\
mc &= \frac{1}{1 + \eta^p}, \\
w &= \left[mc(1-\alpha)^{1-\alpha}\alpha^{\alpha}(r^k)^{-\alpha}\right]^{\frac{1}{1-\alpha}}, \\
\frac{k}{L} &= \frac{w}{r^k}\frac{\alpha}{1-\alpha}, \\
\frac{\Omega}{L} &= \left(\frac{k}{L}\right)^{\alpha} - r^k\frac{k}{L} - w, \quad \text{(assuming zero profits)}, \\
\frac{y}{L} &= \left(\frac{k}{L}\right)^{\alpha} - \frac{\Omega}{L}, \\
\frac{i}{L} &= \left(1 - (1-\delta)e^{-\gamma}\right) e^{\gamma}\frac{k}{L}, \\
\frac{c}{L} &= \frac{y}{L}\left(1 - \frac{g}{y}\right) - \frac{i}{L}, \\
\frac{z}{L} &= \left[(1 - Re^{-\gamma})\frac{b}{y} - \frac{g}{y}\right]\frac{y}{L} + \tau^c\frac{c}{L} + \tau^l w + \tau^k r^k \frac{k}{L}, \\
\frac{c^n}{L} &= \frac{(1-\tau^l)w + \frac{z}{L}}{1+\tau^c}, \\
\frac{c^s}{L} &= \frac{\frac{c}{L} - \mu\frac{c^n}{L}}{1-\mu}, \\
\frac{c^{*s}}{L} &= \frac{c^s}{L} + \alpha_g\frac{g}{y}\frac{y}{L}, \\
L &= \left[\frac{w(1-\tau^l)}{(1+\tau^c)(1+\eta^w)}\frac{1}{(1-\theta e^{-\gamma})\frac{c^{*s}}{L}}\right]^{\frac{1}{\xi+1}}
\end{aligned}
$$

Given L, all level variables can be defined from the steady state ratios given above.

1.3 The Log-Linearized System

We define the log deviations of a variable X from its steady state as $\hat{X}_t = \ln X_t - \ln X$, except for the shocks to TFP and price and wage markups, where we define $\hat{u}_t^a \equiv u_t^a - \gamma$, $\hat{\eta}_t^p = \ln(1+\eta_t^p) - \ln(1+\eta^p)$, and $\hat{\eta}_t^w = \ln(1+\eta_t^w) - \ln(1+\eta^w)$. The equilibrium system in the log-linearized form consists of the following equations:

Production function:

$$\hat{y}_t = \frac{y+\Omega}{y}\left[\alpha\hat{k}_t + (1-\alpha)\hat{L}_t\right] \tag{22}$$

Capital-labor ratio:

$$\hat{r}_t^k - \hat{w}_t = \hat{L}_t - \hat{k}_t \tag{23}$$

Marginal cost:

$$\hat{mc}_t = \alpha \hat{r}_t^k + (1-\alpha)\hat{w}_t \tag{24}$$

Phillips equation:

$$\hat{\pi}_t = \frac{\beta}{1+\chi_p \beta} E_t \hat{\pi}_{t+1} + \frac{\chi_p}{1+\chi_p \beta} \hat{\pi}_{t-1} + \kappa_p \hat{mc}_t + \hat{u}_t^p$$

where $\kappa_p = [(1-\beta\omega_p)(1-\omega_p)]/[\omega_p (1+\beta\chi_p)]$, and we have normalized the price shock $\hat{u}_t^p = \kappa_p \hat{\eta}_t^p$ and directly estimate the process for $\hat{u}_t^p = \rho_p \hat{u}_{t-1}^p + \epsilon_t^p$ with $\epsilon_t^p \sim N(0, \sigma_p^2)$.

Household FOC for consumption:

$$\hat{\lambda}_t^S = \hat{u}_t^b + \hat{u}_t^a - \frac{e^\gamma}{e^\gamma - \theta}(\hat{c}_t^* + \hat{u}_t^a) + \frac{\theta}{e^\gamma - \theta}\hat{c}_{t-1}^* - \frac{\tau^C}{1+\tau^C}\hat{\tau}_t^C \tag{25}$$

Public/private consumption in utility:

$$\hat{c}_t^* = \frac{c^S}{c^S + \alpha_g g}\hat{c}_t^S + \frac{\alpha_g g}{c^S + \alpha_g g}\hat{g}_t \tag{26}$$

Euler Equation:

$$\hat{\lambda}_t^S = \hat{R}_t + E_t \hat{\lambda}_{t+1}^S - E_t \hat{\pi}_{t+1} - E_t \hat{u}_{t+1}^a \tag{27}$$

Maturity structure of debt:

$$\hat{R}_t + \hat{P}_t^B = \frac{\rho P^B}{1+\rho P^B} E_t \hat{P}_{t+1}^B = \frac{\rho}{R} E_t \hat{P}_{t+1}^B \tag{28}$$

Household FOC for capacity utilization:

$$\hat{r}_t^k - \frac{\tau^K}{1-\tau^K}\hat{\tau}_t^K = \frac{\psi}{1-\psi}\hat{v}_t \tag{29}$$

Household FOC for capital:

$$\hat{q}_t = E_t \hat{\lambda}_{t+1}^S - \hat{\lambda}_t^S - E_t \hat{u}_{t+1}^a + \beta e^{-\gamma}(1-\tau^K) r^k E_t \hat{r}_{t+1}^k - \beta e^{-\gamma} \tau^K r^k E_t \hat{\tau}_{t+1}^K + \beta e^{-\gamma}(1-\delta) E_t \hat{q}_{t+1} \tag{30}$$

Household FOC for investment:

$$\hat{i}_t + \frac{1}{1+\beta}\hat{u}_t^a - \frac{1}{(1+\beta)\, s e^{2\gamma}}\hat{q}_t - \hat{u}_t^i - \frac{\beta}{1+\beta} E_t \hat{i}_{t+1} - \frac{\beta}{1+\beta} E_t \hat{u}_{t+1}^a = \frac{1}{1+\beta}\hat{i}_{t-1} \tag{31}$$

where we have normalized the investment shock $\hat{u}_t^i = (1/[(1+\beta)se^{2\gamma}])\hat{\hat{u}}_t^i$ and directly estimate the process for $\hat{u}_t^i = \rho_i \hat{u}_{t-1}^i + \epsilon_t^i$ with $\epsilon_t^i \sim N(0, \sigma_i^2)$.

Effective capital:

$$\hat{k}_t = \hat{v}_t + \hat{\bar{k}}_{t-1} - \hat{u}_t^a \tag{32}$$

Law of motion for capital:

$$\hat{\bar{k}}_t = (1-\delta)e^{-\gamma}(\hat{\bar{k}}_{t-1} - \hat{u}^a_t) + [1-(1-\delta)e^{-\gamma}]((1+\beta)se^{2\gamma}\hat{u}^i_t + \hat{i}_t) \tag{33}$$

Nonsavers' real budget constraint:

$$\tau^C c^N \hat{\tau}^C_t + (1+\tau^C)c^N \hat{c}^N_t = (1-\tau^L)wL[\hat{w}_t + \hat{L}_t] - \tau^L wL\hat{\tau}^L_t + z\hat{z}_t \tag{34}$$

Wage equation:

$$\begin{aligned}\hat{w}_t =& \frac{1}{1+\beta}\hat{w}_{t-1} + \frac{\beta}{1+\beta}E_t\hat{w}_{t+1} - \kappa_w[\hat{w}_t - \xi\hat{L}_t - \hat{u}^b_t + \lambda^S_t - \frac{\tau^L}{1-\tau^L}\hat{\tau}^L_t] + \frac{\chi^w}{1+\beta}\hat{\pi}_{t-1} \\ &- \frac{1+\beta\chi^w}{1+\beta}\hat{\pi}_t + \frac{\beta}{1+\beta}E_t\hat{\pi}_{t+1} + \frac{\chi^w}{1+\beta}\hat{u}^a_{t-1} - \frac{1+\beta\chi^w - \rho_a\beta}{1+\beta}\hat{u}^a_t + \hat{u}^w_t\end{aligned} \tag{35}$$

where $\kappa_w \equiv [(1-\beta\omega_w)(1-\omega_w)]/[\omega_w(1+\beta)\left(1+\frac{(1+\eta^w)\xi}{\eta^w}\right)]$, and we have normalized the wage shock $\hat{u}^w_t = \kappa_w\hat{\eta}^w_t$ and directly estimate the process for $\hat{u}^w_t = \rho_w\hat{u}^w_{t-1} + \epsilon^w_t$ with $\epsilon^w_t \sim N(0,\sigma^2_w)$.

Aggregation of household consumption:

$$c\hat{c}_t = c^S(1-\mu)\hat{c}^S_t + c^N\mu\hat{c}^N_t \tag{36}$$

Aggregate resource constraint:

$$y\hat{y}_t = c\hat{c}_t + i\hat{i}_t + g\hat{g}_t + \psi'(1)k\hat{v}_t \tag{37}$$

Government budget constraint:

$$\begin{aligned}&\frac{b}{y}\hat{b}_t + \tau^K r^k\frac{k}{y}[\hat{\tau}^K_t + \hat{r}^k_t + \hat{k}_t] + \tau^L w\frac{L}{y}[\hat{\tau}^L_t + \hat{w}_t + \hat{L}_t] + \tau^C\frac{c}{y}(\hat{\tau}^C_t + \hat{c}_t) \\ &= \frac{1}{\beta}\frac{b}{y}[\hat{b}_{t-1} - \hat{\pi}_t - \hat{P}^B_{t-1} - \hat{u}^a_t] + \frac{b}{y}\frac{\rho}{e^\gamma}\hat{P}^B_t + \frac{g}{y}\hat{g}_t + \frac{z}{y}\hat{z}_t\end{aligned} \tag{38}$$

1.4 Additional Variables: Long-run real interest rate and inflation

Impulse responses in section 4 of the main paper plot results for a measure of the long run real interest rate and inflation rate. In this section we derive these variables. In what follows, for simplicity all shocks except government spending are shut down, so the derivations pertain to the long-run real interest rate following an innovation in $\hat{u}^g_t$.

The log-linearized maturity structure linkage, equation (28) implies the term structure relation

$$\hat{P}^B_t = -\sum_{j=0}^{\infty}\left(\frac{\beta\rho}{e^\gamma}\right)^j E_t\hat{R}_{t+j} \tag{39}$$

Using the consumption Euler equation (27) in equation (39) gives a measure of the long-run real interest rate

$$\hat{P}_t^B = E_t \sum_{j=0}^{\infty} \left(\frac{\beta\rho}{e^\gamma}\right)^j \left[\hat{\lambda}_{t+j+1}^S - \hat{\lambda}_{t+j}^S - \hat{\pi}_{t+j+1}\right] \tag{40}$$

in which the long-run real rate is

$$\hat{r}_t^L = -\sum_{j=0}^{\infty} \left(\frac{\beta\rho}{e^\gamma}\right)^j E_t \left[\hat{\lambda}_{t+j+1}^S - \hat{\lambda}_{t+j}^S\right] \tag{41}$$

In the special case of only one-period debt, $\rho = 0$ and the long real rate equals the short real rate: $r_t^L = E_t \left[\hat{\lambda}_t^S - \hat{\lambda}_{t+1}^S\right]$.

To derive a recursive representation for the long run real interest rate, we rewrite (40) and (41) to obtain

$$\hat{r}_t^L = -\hat{P}_t^B - \sum_{j=0}^{\infty} \left(\frac{\beta\rho}{e^\gamma}\right)^j E_t \hat{\pi}_{t+j+1} \tag{42}$$

We can rewrite this as:

$$\hat{r}_t^L = -\hat{P}_t^B - E_t\hat{\pi}_{t+1} - \left(\frac{\beta\rho}{e^\gamma}\right) \sum_{j=0}^{\infty} \left(\frac{\beta\rho}{e^\gamma}\right)^j E_t \hat{\pi}_{t+j+2} \tag{43}$$

Equation (42) one period forward is:

$$\hat{r}_{t+1}^L = -\hat{P}_{t+1}^B - \sum_{j=0}^{\infty} \left(\frac{\beta\rho}{e^\gamma}\right)^j E_t \hat{\pi}_{t+j+2} \tag{44}$$

Taking expectations to this equation gives:

$$E_t\hat{r}_{t+1}^L = -E_t\hat{P}_{t+1}^B - \sum_{j=0}^{\infty} \left(\frac{\beta\rho}{e^\gamma}\right)^j E_t \hat{\pi}_{t+j+2} \tag{45}$$

Combining equations (43) and (45), we can rewrite the equation for the interest rate recursively:

$$\hat{r}_t^L = -\hat{P}_t^B - E_t\hat{\pi}_{t+1} + \left(\frac{\beta\rho}{e^\gamma}\right) (E_t\hat{r}_{t+1}^L + E_t\hat{P}_{t+1}^B) \tag{46}$$

and from 42 we define the long-run expected inflation rate as

$$\hat{\pi}_t^L = \sum_{j=0}^{\infty} \left(\frac{\beta\rho}{e^\gamma}\right)^j E_t \hat{\pi}_{t+j+1} = -\hat{r}_t^L - \hat{P}_t^B \tag{47}$$

2 Prior-Predictive Multipliers

2.1 Multiplier Values from Prior-Predictive

Tables 1-3 provide present-value output, consumption, and investment multipliers respectively for the cases considered in section 2 of the main text. The tables list mean and 90% credible intervals for the prior multipliers across various model specifications. See section 2 of the main text for more discussion of the results. Although the prior-predictive analysis in the main text only considered results for regime M with short debt, the tables include multipliers in regime M for both short and long term government bonds.

Tables 1-3 show that in regime M, the maturity duration plays no role in determining the size of government spending multipliers in the short run, but across longer horizons, a longer maturity tends to imply higher multipliers. When all fiscal financing is lump-sum and Ricardian equivalence holds, the maturity structure is irrelevant in regime M. With distortionary fiscal financing, the maturity structure matters in regime M to the extent it affects adjustments in fiscal variables to the market value of government debt. Thus, it matters more at longer horizons when endogenous variables are responding more to fiscal financing adjustments.

Tables 4-6 present additional present-value multipliers for some model specifications not considered in the main text. In particular, the table compares multipliers from two specifications: 1) the government spending in the utility function specification (Model 4 of the main text) and 2) a specification with both nonsavers and government spending in the utility framework (referred to as Model 5 in the tables). We present results for the case in which government spending in the utility function is not restricted to be a priori a substitute or complement for private consumption. Adding nonsavers to the government spending in the utility framework raises the probabilities of larger output multipliers and positive consumption multipliers, but at the cost of slightly lowering the probability of positive investment multipliers. The joint specification does not appear to increase the range of present-value multipliers implied by the prior-predictive analysis, but rather shift the distribution of multipliers.

2.2 Joint Multiplier Probabilities from Prior-Predictive

Section 2 of the main text reports probabilities of observing a multiplier greater than a particular value for individual macroaggregates. In this section we present complementary analysis that presents joint probabilities of observing large multipliers for a set of macroaggregates. Table 7 presents the joint probability of simultaneously observing present-value output multipliers greater than one, positive present-value consumption multipliers, and positive present-value investment multipliers for the cases considered in section 2 of the main text. In addition, table 8 displays the joint probability of simultaneously observing present-value output multipliers greater than one and positive present-value consumption multipliers for the cases considered in section 2 of the main text.

Tables 7-8 make clear that regime M has great difficulty producing positive investment multipliers. In contrast, regime F tends to imply positive investment multipliers whenever there are positive consumption multipliers, as the joint probabilities in tables 7-8 are similar in regime F. Comparing the joint probabilities or output and consumption multipliers in table 8 with the probabilities of observing output multipliers greater than one (table 3 in the main text) additionally suggests large output and consumption multipliers occur together, especially in the long run. For instance, in the New Keynesian model with nonsavers, the probability of output multipliers greater than one after 10 years in 0.03 (see table 3 of the main text), which is identical to the joint probability of output multipliers greater than one and positive consumption multipliers (see table 8). Shorter-run probabilities are lower for the joint distributions (e.g. an impact probability of output greater than one of 0.58 in the New Keynesian model with nonsavers and a joint probability of 0.47 for output greater than one and positive consumption). The largest differences between joint output-consumption multipliers and output multipliers occurs in the Model 2 specification, e.g. the baseline New Keynesian model with sticky prices and wages. Although output multipliers alone have a positive probability of being positive in this case (see table 3 of the main text), the joint probabilities make clear it is impossible to observe positive consumption and investment multipliers.[1] The joint prior probability of observing an output multiplier greater than one with consumption and investment multipliers greater than zero is virtually identical from a model specification with government spending in the utility and a specification with both rule of thumb consumers and government spending in utility (see table 7). The joint prior probabilities of observing an output multiplier greater than 1 with positive consumption multipliers are slightly higher when we additionally consider nonsavers in the government spending in the utility specification.

3 Data Description

Unless otherwise noted, the following data are from the National Income and Product Accounts Tables housed at the Bureau of Economic Analysis. All data in levels are nominal values. Nominal data are converted to real values by dividing by the GDP deflator (Table 1.1.4, line 1). All fiscal variables are for the federal government only.

Consumption. Consumption, C, is defined as total personal consumption expenditures on nondurables and services (Table 1.1.5, lines 5 and 6).

Investment. Investment, I, is defined as gross private domestic investment (Table 1.1.5, line 7) and personal consumption expenditures on durables (Table 1.1.5, line 4).

Government Expenditure. Government expenditure, G, is defined as government consumption expenditure (Table 3.2, line 21) and government investment (Table 3.2, line 41).

Government Debt. Government debt, B, is the market value of privately held gross federal debt, obtained from the Federal Reserve Bank of Dallas. The quarterly values are constructed from the monthly values at the beginning of each quarter.

Hours Worked. Hours worked are constructed from the following variables:

[1] Large output multipliers in this case are an artifact of our model output definition, which includes utilization adjustment costs. With higher demand for goods from the government, firms prefer to increase the utilization rate of capital and pay an output cost to do so.

H the index for nonfarm business, all persons, average weekly hours duration, 2009 = 100, seasonally adjusted (from the Department of Labor).

Emp civilian employment for sixteen years and over, measured in thousands, seasonally adjusted (from the Department of Labor, Bureau of Labor Statistics, CE16OV). The series is transformed into an index where 2009Q3 = 100.

Hours worked are then defined as

$$N = \frac{H * Emp}{100}.$$

Wage Rate. The wage rate is defined as the index for hourly compensation for nonfarm business, all persons, 2009 = 100, seasonally adjusted (from the U.S. Department of Labor).

Inflation. The gross inflation rate is defined using the GDP deflator (Table 1.1.4, line 1).

Interest Rate. The nominal interest rate is defined as the average of daily figures of the Federal Funds Rate (from the Board of Governors of the Federal Reserve System).

Definitions of Observable Variables

The variable X is defined by making the following transformation to variable x:

$$X = \ln\left(\frac{x}{Popindex}\right) * 100 \ ,$$

where

Popindex index of Pop, constructed such that 2009Q3 = 1;

Pop Civilian noninstitutional population in thousands, ages 16 years and over, seasonally adjusted (from the Bureau of Labor Statistics).

x = consumption, investment, hours worked, government spending, and government debt. The real wage rate is defined in the same way, except that it is not divided by the total population. We convert all series, except for hours worked, inflation, and the nominal interest rate, into growth rates.

Observables are linked to model variables in the following manner:

$$\begin{bmatrix} \text{dlCons}_t \\ \text{dlInv}_t \\ \text{dlWage}_t \\ \text{dlGovSpend}_t \\ \text{dlGovDebt}_t \\ \text{lHous}_t \\ \text{lInfl}_t \\ \text{lFedFunds}_t \end{bmatrix} = \begin{bmatrix} 100e^{\gamma} \\ 100e^{\gamma} \\ 100e^{\gamma} \\ 100e^{\gamma} \\ 100e^{\gamma} \\ \bar{L} \\ \bar{\pi} \\ \bar{R} \end{bmatrix} + \begin{bmatrix} \hat{c}_t - \hat{c}_{t-1} + \hat{u}^a_t \\ \hat{i}_t - \hat{i}_{t-1} + \hat{u}^a_t \\ \hat{w}_t - \hat{w}_{t-1} + \hat{u}^a_t \\ \hat{g}_t - \hat{g}_{t-1} + \hat{u}^a_t \\ \hat{b}_t - \hat{b}_{t-1} + \hat{u}^a_t \\ \hat{L}_t \\ \hat{\pi}_t \\ \hat{R}_t \end{bmatrix} \tag{48}$$

where l and dl stand for 100 times the log and the log difference of each variable and $\bar{R} \equiv \bar{\pi} + \left(\frac{e^{\gamma}}{\beta} - 1\right) 100$. We estimate $\bar{L}$ and $\bar{\pi}$. For $\bar{L}$, we use a prior with a normal distribution with a mean of 468 and standard deviation of 5. For $\bar{\pi}$, we use a prior with a normal distribution with mean 0.75 and standard deviation of 0.25. The means and standard deviations were chosen to cover the range of sample means of the hours worked and inflation observables across the various estimated samples periods.

3.1 Calibrating Fiscal Steady State

To calibrate steady state tax rates, we first collect data on federal tax revenues:

Consumption Tax Revenues. The consumption tax revenues, T^c, include excise taxes and customs duties (Table 3.2, lines 5 and 6). The average consumption tax rate, τ^C is then

$$\frac{T^c}{C + D - T^c - ST}$$

where C is consumption of nondurables and services, D is consumption of durables, and ST is sales tax revenues (Table 3.3, line 7).

Capital and Labor Tax Revenues. Following Jones (2002), first the average personal income tax rate is computed:

$$\tau^p = \frac{IT}{W + PRI/2 + CI},$$

where IT is personal current tax revenues (Table 3.2, line 3), W is wage and salary accruals (Table 1.12 line 3), PRI is proprietors' income (Table 1.12, line 3), and CI is capital income. Capital income is defined as rental income (Table 1.12, line 12), corporate profits (Table 1.12, line 13), interest income (Table 1.12 line 18), and PRI/2.

The average labor income tax revenue, T^l, is computed as:

$$\tau^p(W + PRI/2) + CSI,$$

where CSI is contributions for government social insurance (Table 3.2, line 11). The average labor income tax rate, τ^L, is then

$$\frac{T^l}{PRI/2 + CE}$$

where CE is compensation of employees (Table 1.12, line 2). The average capital income tax revenue, T^k is calculated as:

$$\tau^p CI + CT,$$

where CT is taxes on corporate income (Table 3.2, line 7). The average capital income tax rate, τ^K, is then

$$\frac{T^k}{CI + PT}$$

where PT is property taxes (Table 3.3, line 8).

The sample mean of these consumption, labor, and capital tax rate (τ^C, τ^L, τ^K) series are used to calibrate the model. To calibrate government spending and government debt to output ratios, we calculate an output series similar to our model GDP, defined as Output = Consumption + Investment + Government Expenditure, where the series are defined above. To calibrate the government spending to output ratio, we calculate the sample mean of Government Expenditure/Output. To calibrate the market value of government debt to output ratio, we calculate the sample mean of Government Debt/Output.

4 Posterior Estimates

Tables 9-12 report the estimated posterior means, modes, and the Geweke Separated Partial Means (GSPM) test p-values[2] for regime M over our four estimated time periods: 1955q1 to 2015q2, 1955q1 to 2007q4, 1955q1 to 1979q4, and 1982q1 to 2007q4. Tables 13-16 report the same for regime F. Across all time periods and regimes, the estimates of nominal rigidities and habit formation are large. Public and private consumption are estimated to be complements, except in the subsample 1982q1–2007q4 in regime F, when the credible set for α_G encompasses zero. Although in regime M debt innovations are financed by government spending reversals in 1955q1–2014q2, 1955q1–2007q4, and 1955q1–1979q4, both transfers and public spending adjust in the 1982q1–2007q4 subsample.

Figures 1-2 plot prior versus posterior distributions for regime M while figures 3-4 plot the distributions for regime F for the 1955q1–2014q2 estimates. Figures 5-8 repeat the same prior versus posterior plots for the 1955q1–2007q4 estimates. For nearly all parameters, the posterior distribution moves away from the prior and is much tighter. Of the structural parameters, the posterior of the inverse of the Frisch elasticity, ξ, seems most similar to its prior. Similar results appear looking at the other subsample estimates (not pictured).

Figures 9-10 plot impact and 25-quarter present value multipliers in regime M (top rows) and regime F (bottom rows) from the sequential estimation. We sequentially estimate the model using a 25-year rolling window with annual steps, starting from 1955q1–1979q4 through 1989q1–2013q4. Figure 9 shows that impact multipliers are remarkably similar and exhibit the same time trends across regimes. Impact investment multipliers are slightly higher in regime F, encompassing zero in the posterior bands in the later time periods, while remaining significantly negative in regime M. Figure 10, plotting 25-quarter present value multipliers, displays more substantial differences across regimes. While the consumption multipliers continue to exhibit similar time trends across regimes, output and investment multipliers are substantially higher in regime F across all estimated time periods.

[2] The GSPM test determines whether the mean from the first 20% of the MCMC draws is identical to the mean of the final 50% of the draws. A Z-test of the hypothesis of equality of the two means is carried out and the corresponding chi-squared marginal significance is calculated (see Geweke (2005), pages 149-150, for more details). The reported p-values are based on assuming 4% tapered autocorrelation. Additionally, we plot cumulative sum of draws (CUMSUM) statistics to test convergence (not pictured).

4.1 Joint Posterior Multiplier Probabilities

Table 17 presents the posterior joint probability of simultaneously observing present-value output multipliers greater than one, positive present-value consumption multipliers, and positive present-value investment multipliers as well as the joint probability of simultaneously observing present-value output multipliers greater than one and positive present-value consumption multipliers in regime M. Table 18 repeats the same statistics for regime F. The tables present results for a range of sample periods used for estimation and show that the posteriors of both regimes M and F have difficulties in generating positive investment multipliers in combination with positive consumption and large output multipliers in the short run. Joint probabilities of large output and consumption multipliers are comparable across regimes M and F in the short-run, while at longer horizons they differ markedly, with regime F having larger probabilities than regime M across all sample periods.

4.2 RMSDs and Important Parameters

To shed light on the transmission mechanisms that underlie the estimated multipliers, we calculate a measure of root mean square deviation (RMSD) for each parameter. For each draw of the posterior parameters, $\tilde{\theta} = [\tilde{\theta}_1 \quad ... \quad \tilde{\theta}_n]'$ from the posterior distribution $p(\theta)$, we calculate multipliers $\tilde{\omega}(\tilde{\theta})$. Denote the new parameter vector by $\tilde{\theta}^i = [\tilde{\theta}_1 \quad ... \quad E[\theta_i] \quad ... \quad \tilde{\theta}_n]'$, where $E[\theta_i]$ fixes the i^{th} parameter at its posterior mean, and calculate the multipliers, $\tilde{\omega}^i(\tilde{\theta}^i)$. Repeat this for each $i = 1, 2, \ldots n$. The RMSD is the root mean square deviation between the two multipliers $\tilde{\omega}(\tilde{\theta})$ and $\tilde{\omega}^i(\tilde{\theta}^i)$: it measures how much the multiplier varies on average due to parameter i. The RMSD is largest for the parameters that are most influential for the multiplier. Table 19 displays the top five parameters by the RMSD ranking, as well as their total contribution to RMSD variation, across a range of estimated model specifications. The table displays results for output and consumption present-value multipliers on impact and after 25 quarters following a government spending shock. For a discussion of the importance of these parameters, see section 4 of the main text.

5 Model Fit

To get a sense of how well the model fits the data, we compare a set of statistics implied by the model to those in the data. Figures 11-12 plot the autocorrelations and cross-correlations for the data (solid lines) and the model (dashed lines) for the 1955q1–2014q2 estimates.[3] For the model, we report 90 percent posterior intervals implied by both parameter and small sample uncertainty.[4] Generally, the model is able to capture the autocorrelations of government spending and government debt growth and their cross-correlations with other observables. Regime F is more successful at matching the autocorrelation of debt growth, while both regimes have difficulty matching the cross-correlations of debt growth with labor, inflation, and the interest rate. Both regimes fail to capture

[3]Results for the two subsamples are similar and available from the authors on request.

[4]We sample 5,000 draws from the posterior. For each parameter draw, we generate 100 samples of the observable variables from the model with the same length as our dataset, after first discarding 500 initial observations. We compute statistics for each of these samples, for a total posterior sample of 500,000.

the contemporaneous correlation between consumption and investment growth, similar to other monetary new Keynesian models [e.g., Justiniano, Primiceri, and Tambalotti (2010)]. Figures 13-14 repeat the autocorrelation and cross-correlation plots for the 1955q1–2007q4 estimates. Results in this case are similar to the 1955q1–2014q2 estimates.

Table 20 reports the standard deviations of our eight observables, as well as the posterior 90 percent probability intervals of standard deviations from each model regime in the four estimation periods, 1955q1–2014q2, 1955q1–2007q4, 1955q1–1979q4, and 1982q1–2007q4. The model-implied standard deviations are similar across regimes. The model overpredicts the volatility of investment and wage growth, similar to monetary new Keynesian models [e.g., Justiniano, Primiceri, and Tambalotti (2010)]. In addition, the model tends to overpredict government debt growth volatility.

5.1 Alternative Specifications

Estimated DSGE models focused on fiscal policy often consider the rule-of-thumb framework [Coenen and Straub (2005), Forni, Monteforte, and Sessa (2009), Lopez-Salido and Rabanal (2006), Drautzburg and Uhlig (2015), Zubairy (2014), and Traum and Yang (2015)]. Since we use an alternative framework with government-spending-in-utility, we present here a comparison of the fit of the two frameworks and a joint specification encompassing both. Towards this end, we estimate a version of our model with non-savers by allowing $\mu > 0$ and forcing $\alpha_G = 0$. All other parameters are set as described in section 3.1 of the main text. The priors are taken from table 2 of the main text.[5] In addition, we consider a case where both μ and α_G are estimated. Table 21 reports the log marginal data densities for both regimes in the various frameworks. Log marginal data densities are calculated using Geweke's (1999) modified harmonic mean estimator with a truncation parameter of 0.5. Higher log marginal data density values imply greater fit. The government-spending-in-utility model is preferred by the data to the rule-of-thumb specification in all regimes and sample periods.[6] In addition, the model with government-spending-in-utility function is preferred to the joint specification with rule of thumb consumers and government-spending-in-utility function across all subsamples and regimes. This further supports our choice specification for estimation. Kormilitsina and Zubairy (2013) and Cantore, Levine, and Melina (2014) also find with U.S. data that the rule-of-thumb model is not preferred more than the government-spending-in-utility framework.[7]

[5] In particular, we continue to calibrate $\rho_z = 0.98$ and $\rho_{ez} = 0.8$ in the regime M specifications. To keep fiscal instruments comparable across specifications, we assume that lump-sum transfers are all to saver households, i.e. $Z_t = Z_t^S$ and $Z_t^N = 0$.

[6] Formal comparisons using log marginal data densities to compute Jeffreys' or Kass-Raftery Bayes factors give preference for the government-spending-in-utility model. See Kass and Raftery (1995) for details of these Bayes factors.

[7] Further support for the government-spending-in-utility framework is given by Lewis and Winkler (2016), which shows that a rule-of-thumb model is not consistent with firm entry dynamics following a government spending shock, whereas the government-spending-in-utility framework is.

6 Robustness of Prior-Predictive Multipliers

In this section, we expand the prior predictive analysis in the main text to more thoroughly determine how particular model features affect multipliers. This section mainly serves to document the robustness of the theoretical size of government spending multipliers.

6.1 RBC Models

Tables 22-24 report present-value output, consumption and investment multipliers for 12 versions of a real business cycle model (i.e., variations of Model 1 in the main text). In all these RBC specifications, an unexpected increase in government expenditures creates a negative wealth effect, causing agents to decrease consumption and work more. These wealth effects are reinforced by negative substitution effects. Real wages decrease as agents are more willing to work, and the rental cost of capital increases due to the rising marginal product of capital. Consumption and investment are very likely to decrease, causing output to increase by less than the increase in government consumption.

The first model variation in tables 22-24, V1 in the first rows, assumes all financing is through lump-sum transfers, so that Ricardian equivalence holds, and additionally sets the AR(1) component of the government spending shock to zero.[8] Version 2, V2 in the second rows of the tables, is similar, except that it forces high persistence in government spending ($\rho_g = 0.99$). These versions are similar to the the neoclassical models considered in the literature, e.g. Baxter and King (1993) and Aiyagari, Christiano, and Eichenbaum (1992). These two versions highlight the importance of the expected path of government spending for its transmission mechanism: qualitative differences arise in investment multipliers and quantitative differences in output and consumption multipliers. As mentioned in the main text, when government spending is perceived to be nearly permanent (or permanent), investment is likely to increase, as households are encouraged to save more. Consumption declines as households substitute consumption for investment. Looking across the 12 cases, very persistent government spending is one of the only ways to produce positive investment multipliers in a RBC model.

The next four RBC variants consider alternative debt financing scenarios (V3-V6). V3 continues to assume Ricardian equivalence holds ($\rho_Z > 0$) and additionally allows the government spending shock to have an AR(1) component ($\rho_{eg} > 0$). Instead, V4 forces debt financing to occur through government spending reversals ($\gamma_G > 0$ $\gamma_i = 0$ for $i = Z, L, K$), while V5 forces debt financing through adjustments in the labor tax ($\gamma_L > 0$ $\gamma_i = 0$ for $i = Z, G, K$). Spending reversals have been emphasized by Corsetti, Meier, and Müller (2012), while labor tax adjustments are considered in Uhlig (2010). Finally, V6 allows all fiscal instruments to respond to debt ($\gamma_i > 0$ for $i = Z, G, L, K$), as in Leeper, Plante, and Traum (2010). Comparing the multipliers in these four cases reveals that the manner in which debt is financed is important for the quantitative size of multipliers

[8] Formally, the restrictions on the model in the text are: $\psi = 1$, $\rho_{eg} = \gamma_G = \gamma_K = \gamma_L = \theta = s = \omega_w = \omega_p = \eta^w = \eta^p = \chi_w = \chi_p = \phi_\pi = \phi_y = \rho_r = \mu = \alpha_G = 0$. All other parameters are either calibrated or follow the priors described in section 2.2 of the main text.

at longer horizons. While multipliers are negative at longer horizons in all cases, distortionary financing makes multipliers more negative. Financing through increases in labor taxes or capital taxes depresses economic activity, while spending reversals undue the expansionary effects of the spending shock.

Versions V7-V10 consider how real frictions affect multipliers. V7 adds utilization to the model ($\psi > 0$), and V8 and V9 alternatively add either investment adjustment costs ($s > 0$) or consumption habits ($\theta > 0$). V10 reports multipliers when all three real frictions are present ($\psi, s, \theta > 0$) and corresponds to Model 1 in the main text. Adding variable utilization allows the capital stock to further decrease while keeping effective capital unchanged, as capital's utilization rate can be increased. This causes households to substitute investment for consumption, lowering investment multipliers (as can be seen from comparing V7 relative to V6 in table 24). Investment adjustments costs prevent large swings in investment, as they are more costly, which sharply reduces investment multipliers. Habit formation has the same effect on consumption and consumption multipliers.[9] Output multipliers are higher with investment adjustment costs, as the capital stock declines less when investment adjustments are muted. In contrast, output multipliers are smaller (relative to no frictions), with habit formation, as subdued consumption responses are accompanied by larger declines in investment and the capital stock. When all three frictions are present, output multipliers are highest, as the increase in government spending is accompanied by smaller contractions in private demand due to the frictions.

The last two versions of tables 22-24 add to the real business cycle model with real frictions either rule-of-thumb consumers ($\mu > 0$ in V11) or government-spending-in-the-utility ($\alpha_g \neq 0$ in V12). V11 demonstrates that the presence of nonsavers is not enough to generate positive consumption multipliers or output multipliers greater than one. As emphasized by Galí, López-Salido, and Vallés (2007), Furlanetto (2011), and Colciago (2011), it is the interaction of non-savers with nominal rigidities that generates such multipliers, as real wage income must rise for non-savers to consume more. Turning to V12, government-spending-in-utility generates the most diffuse distribution of multipliers at all horizons. Impact output multipliers range from negative values to values greater than one, while consumption and investment impact multipliers can be negative or positive.[10]

[9] See Monacelli and Perotti (2008) for a more detailed examination of the effect of habit formation and investment adjustment costs on multipliers in a simple RBC model.

[10] There is a long history of models with government-spending-in-utility in the literature, including (Bailey, 1971, Chapter 9), Barro (1981), Aschauer (1985), Christiano and Eichenbaum (1992), Braun (1994), McGrattan (1994), Ahmed and Yoo (1995), and Finn (1998). Some additional specifications have been proposed in the literature to generate larger multipliers in RBC models. Bilbiie (2009) shows non-separable preferences can give positive consumption multipliers but require consumption to be an inferior good. Fève, Matheron, and Sahuc (2011) shows that a model with a labor externality can give positive consumption multipliers. Ferriere and Navarro (2014) finds that consumption can increase with heterogeneous agents, indivisible labor supply, and government spending financed by increased tax progressivity.

6.2 Closed Economy New Keynesian Models

Tables 25 - 27 report present-value output, consumption and investment multipliers for ten versions of the new Keynesian model conditional on regime M.[11] Introducing nominal rigidities increases multipliers at all horizons, as Woodford (2011) shows analytically. Greater price stickiness means that more firms respond to higher government demand by increasing production rather than prices, so markups respond more strongly. Wage rigidities have a strong effect on consumption multipliers. Sticky nominal wages increase the likelihood the real wage rises (or at least has a muted decline), creating a positive substitution effect on consumption.

Non-savers ($\mu > 0$) raise output and consumption multipliers substantially, as evidenced by comparing multipliers from V2 versus V5; V3 versus V6; and V9 versus V10 in tables 25 - 26. Non-savers consume their entire income each period. When nominal wages are sticky, it is possible for real wage income to increase on impact, causing non-saver consumption to increase as well. With enough non-savers in the economy, the increase in non-saver consumption can be large enough to cause total consumption to increase on impact, leading to larger output multipliers as well. The role of non-savers has been emphasized by Galí, López-Salido, and Vallés (2007), Furlanetto (2011), and Colciago (2011).[12]

For the models generating multipliers reported in the main text, we did not allow consumption taxes to respond to government debt. We additionally consider this source of financing ($\gamma_C > 0$). Comparing the multipliers from V3 versus V4 and V6 versus V7 confirms that multipliers do not vary quantitatively with this assumption, even with the inclusion of non-savers.[13] In the main text, we also maintain that lump-sum transfers to savers and non-savers are the same. Model V8 considers an alternative where Z_t^S and Z_t^N have separate fiscal rules and parameters responding to debt (i.e., $\gamma_{Z_S}, \gamma_{Z_N}, \rho_{Z_S}, \rho_{Z_N} > 0$). Comparing multipliers from this case and model V6 confirms this assumption has negligible quantitative effect.

Tables 28 - 30 display output, consumption and investment multipliers for the same model specifications in regime F.[14] Multipliers are reported for one period debt ("short debt") and for a fixed duration of five years ("long debt"), as the maturity structure matters quantitatively in regime F. As discussed in the main text, multipliers are systematically higher in regime F compared to regime M, with notable positive probabilities for investment multipliers. But the general patterns

[11] In all specifications, government bonds are one period obligations.

[12] Alternatively, Bilbiie (2011) and Monacelli and Perotti (2008) suggest non-separability in preferences over consumption and leisure also can produce positive consumption multipliers, as can deep habits, as shown by Ravn, Schmitt-Grohé, and Uribe (2006). Devereux, Head, and Lapham (1996) show an externality in production also can give large output responses.

[13] Transfers, government spending, and capital and labor taxes also are assumed to adjust to debt innovations. If all financing is assumed through consumption taxes, consumption multipliers are affected more. Pappa, Sajedi, and Vella (2015) show the presence of tax evasion and corruption imply larger necessary adjustments in the government budget to finance increases in government spending.

[14] We omit the cases where sticky nominal wages are considered in conjunction with flexible prices. In regime F, having only sticky nominal wages affects the determinacy region and transmission mechanism of the model, which deserves independent future study. In addition, we omit the cases that allowed γ_C to vary from zero, as the priors on the fiscal debt coefficients restrict these parameters from quantitatively affecting dynamics in regime F.

across model specifications in regime F are the same as regime M.

6.3 Open Economy New Keynesian Models

Several studies have documented that open economy features affect government spending multipliers [see for instance, Karayalcin (1999), Erceg, Guerrieri, and Gust (2005), Cardi and Muller (2011), Shen and Yang (2012), Farhi and Werning (2012), Born, Juessen, and Muller (2013), and Ilzetzki, Mendoza, and Vegh (2013)]. In this section we highlight how a few, key open economy considerations affect multipliers. We do so by extending the model in the main text to a two-country framework, following Leeper, Traum, and Walker (2011). The model description, equations, and priors are given in section A. Several additional considerations are discussed in the literature and above references.

Tables 31 - 33 report present value output, consumption and investment multipliers in several open economy versions of our model.[15] For each variable, we report multipliers in a "Basic" new Keynesian model with sticky prices and wages, a version of the new Keynesian model with non-savers, and a version of the new Keynesian model with government-spending-in-utility. For each of these classes of models, we consider four open economy variations: 1) financial autarky and government spending composed of domestic goods; 2) financial autarky and government spending consisting of domestic and foreign goods; 3) financial integration and government spending composed of domestic goods; and 4) financial integration and government spending consisting of domestic and foreign goods.

In the open economy, increases in government expenditures induce substitution away from domestically-produced goods towards imported goods. Higher demand raises production costs, increasing prices of domestic goods and of domestic goods in the foreign market. Domestic households, in turn, reduce their demand for domestic production and increase demand for imports. Foreigners also reduce their demand for domestic exports. This import-substitution effect makes output multipliers smaller on average than they are in the closed economy.

Across all model structures, there are similar trends displayed in tables 31 - 33. Financial autarky produces the highest short-run output multipliers in an open economy. Because trade in goods must be balanced each period, the import substitution effect is smaller, with nominal imports constrained to equal exports. Output multipliers are smaller with international financial integration. Financial integration allows the domestic economy to run trade deficits and consume more imports, causing output to decrease more in the short run. Output multipliers also are smaller when government spending consists of traded (foreign) goods, as part of the increase in government spending goes directly to the foreign country.

[15] We only report multipliers for regime M in the open economy version; the same general patterns from open economy features hold in regime F. Results from regime F are available from the authors.

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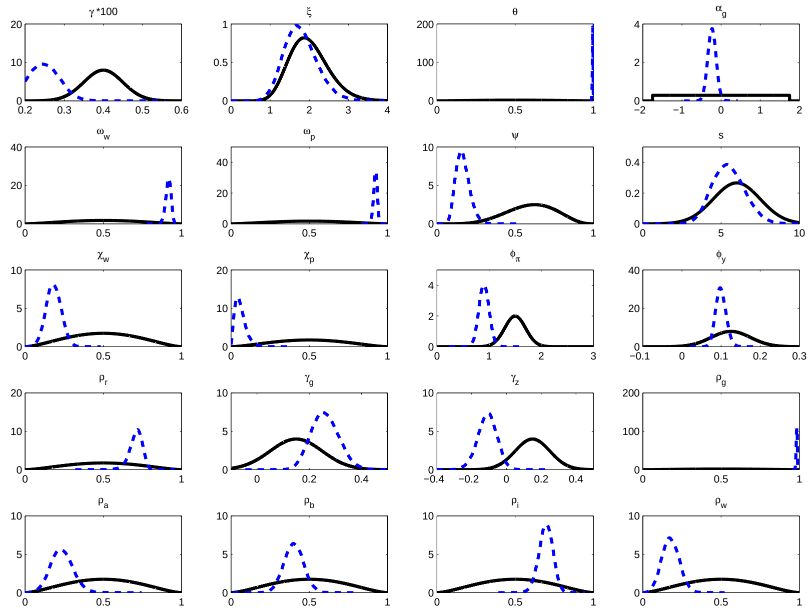

Figure 1: Prior (solid lines) versus posterior (dashed lines) distributions in regime M 1955q1–2014q2 estimates.

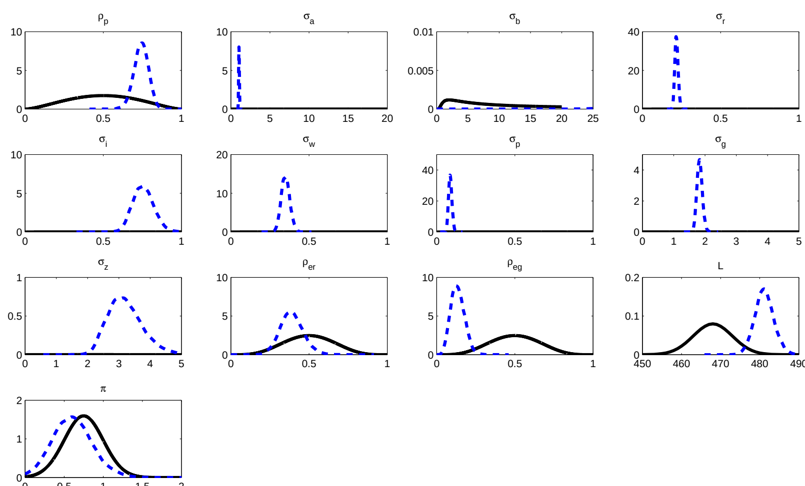

Figure 2: Prior (solid lines) versus posterior (dashed lines) distributions in regime M 1955q1–2014q2 estimates.

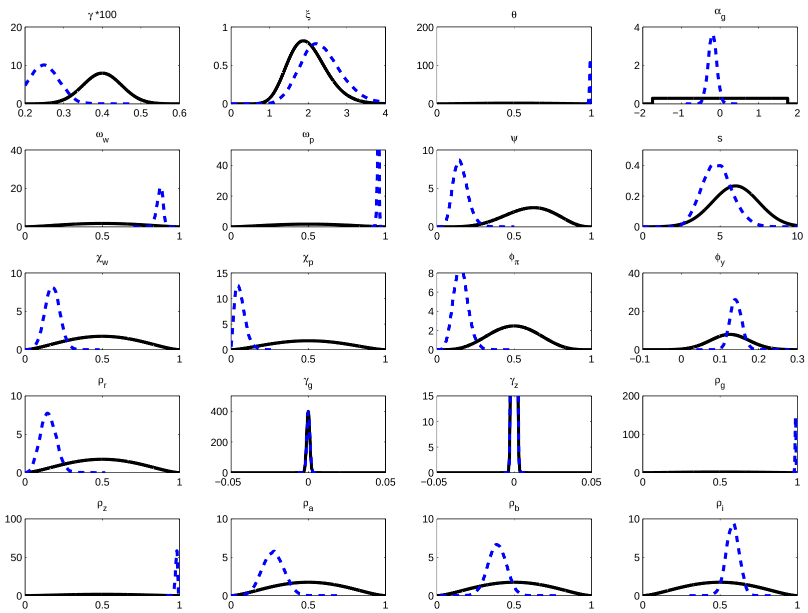

Figure 3: Prior (solid lines) versus posterior (dashed lines) distributions in regime F 1955q1–2014q2 estimates.

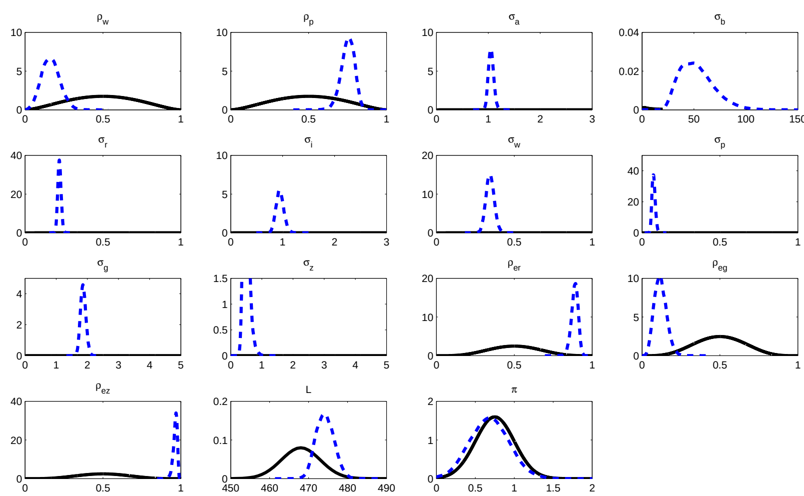

Figure 4: Prior (solid lines) versus posterior (dashed lines) distributions in regime F 1955q1–2014q2 estimates.

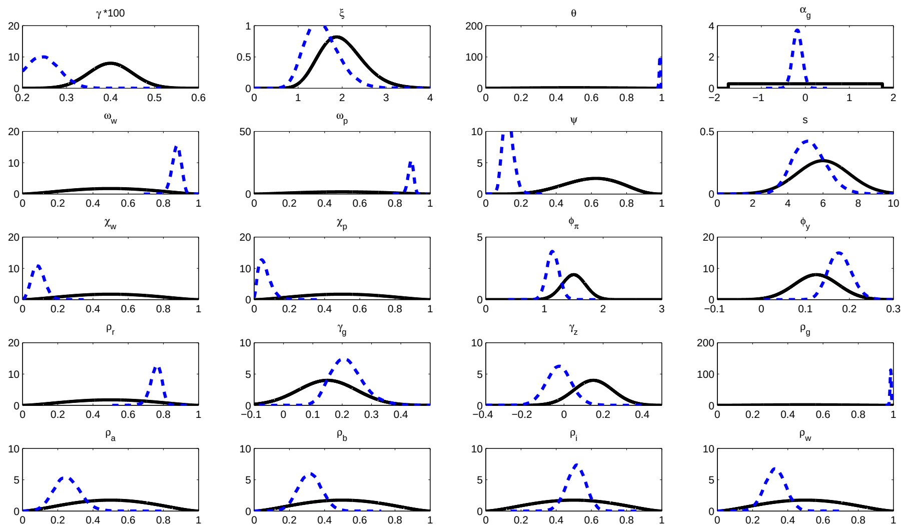

Figure 5: Prior (solid lines) versus posterior (dashed lines) distributions in regime M 1955q1–2007q4 estimates.

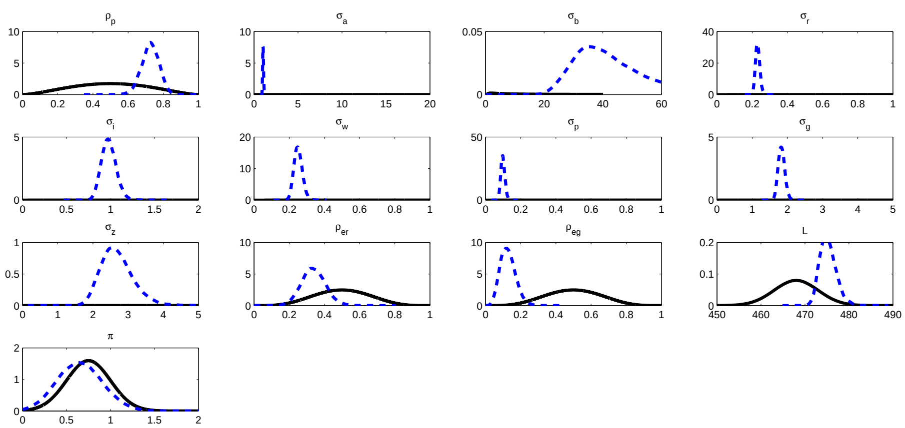

Figure 6: Prior (solid lines) versus posterior (dashed lines) distributions in regime M 1955q1–2007q4 estimates.

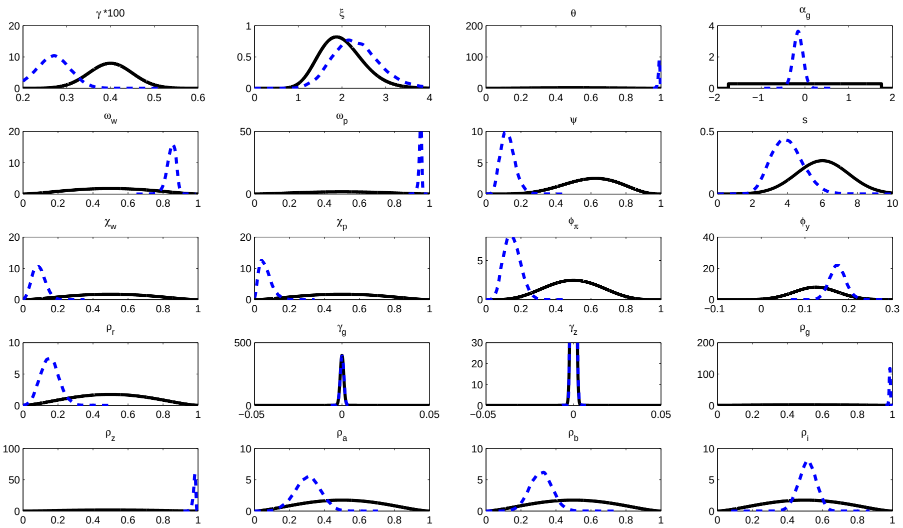

Figure 7: Prior (solid lines) versus posterior (dashed lines) distributions in regime F 1955q1–2007q4 estimates.

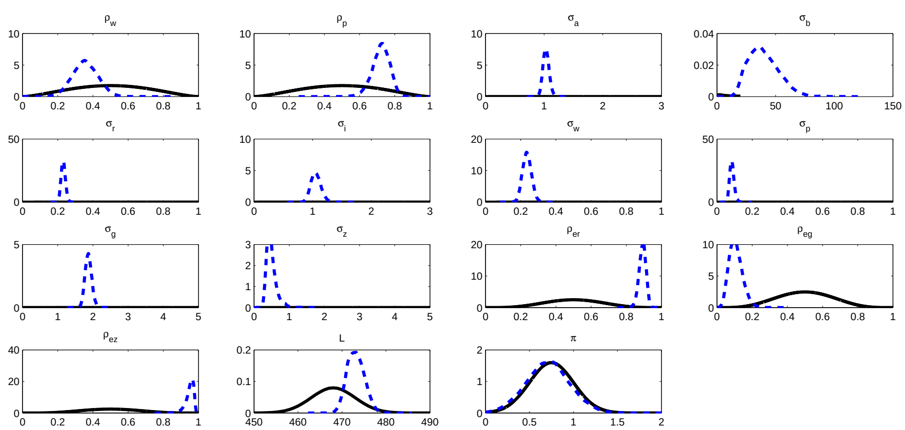

Figure 8: Prior (solid lines) versus posterior (dashed lines) distributions in regime F 1955q1–2007q4 estimates.

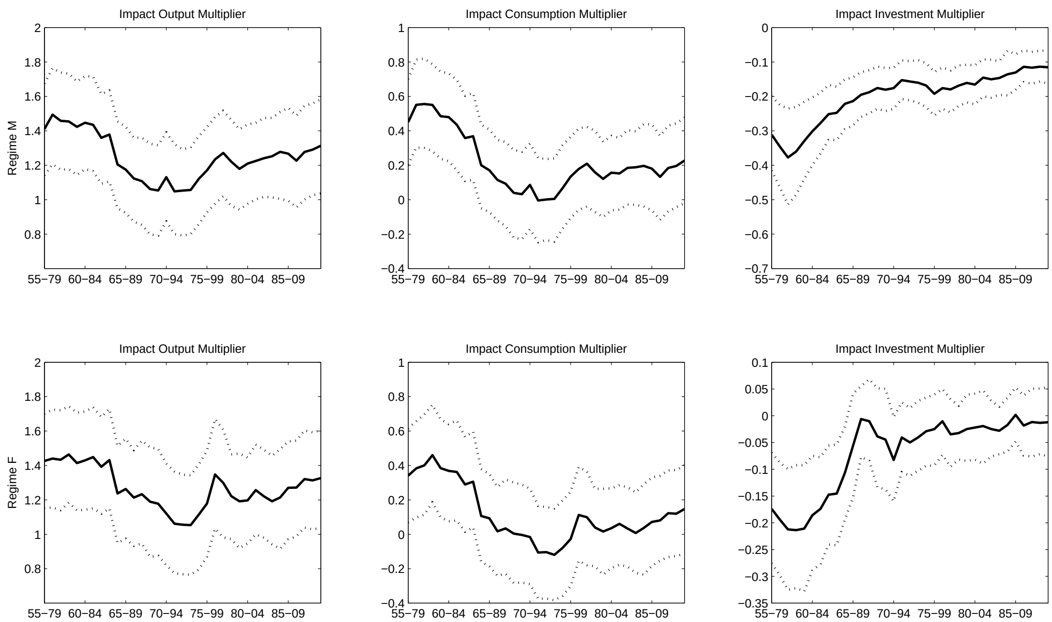

Figure 9: Sequential estimation of the impact multipliers in regime M (top row) and regime F (bottom row) using data 1955q1–1979q4 through 1989q1–2013q4. The solid lines are posterior mean values and dashed lines are 5th and 95th percentiles.

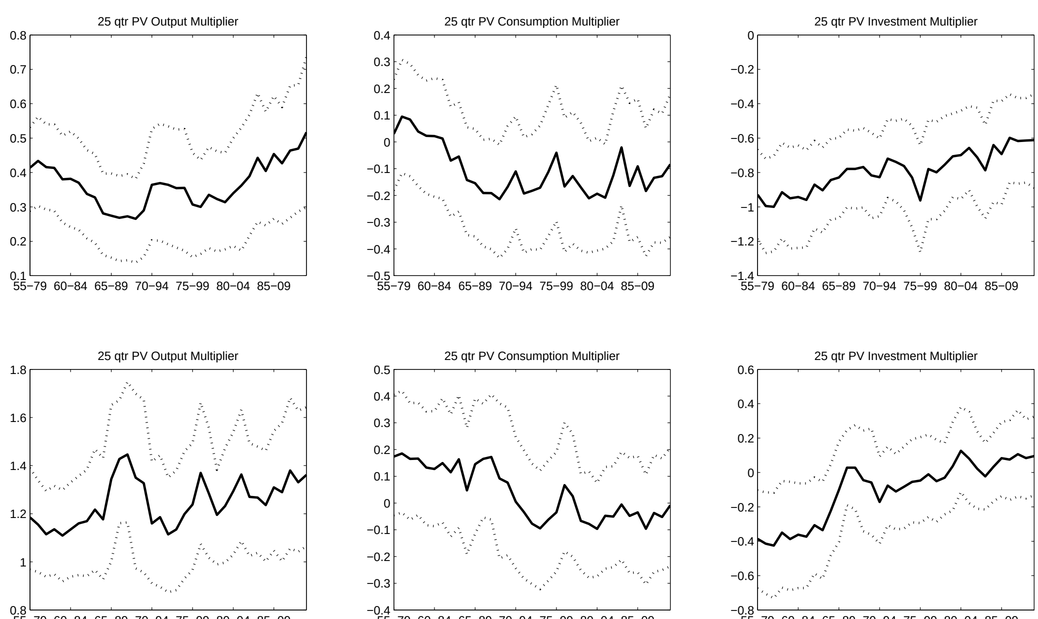

Figure 10: Sequential estimation of 25-quarter present value multipliers in regime M (top row) and regime F (bottom row) using data 1955q1–1979q4 through 1989q1–2013q4. The solid lines are posterior mean values and dashed lines are 5th and 95th percentiles.

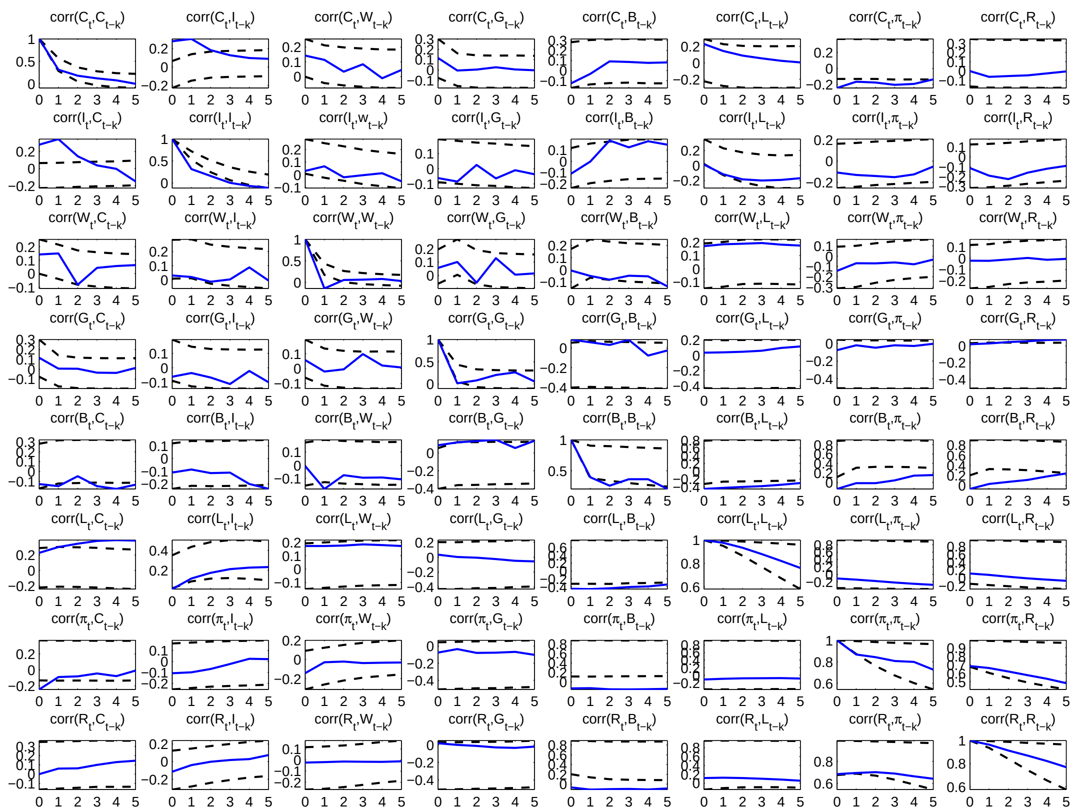

Figure 11: Autocorrelation function for regime M model over 1955q1–2014q2 estimates. Solid lines are data; dashed lines are 90 percent posterior interval from the model.

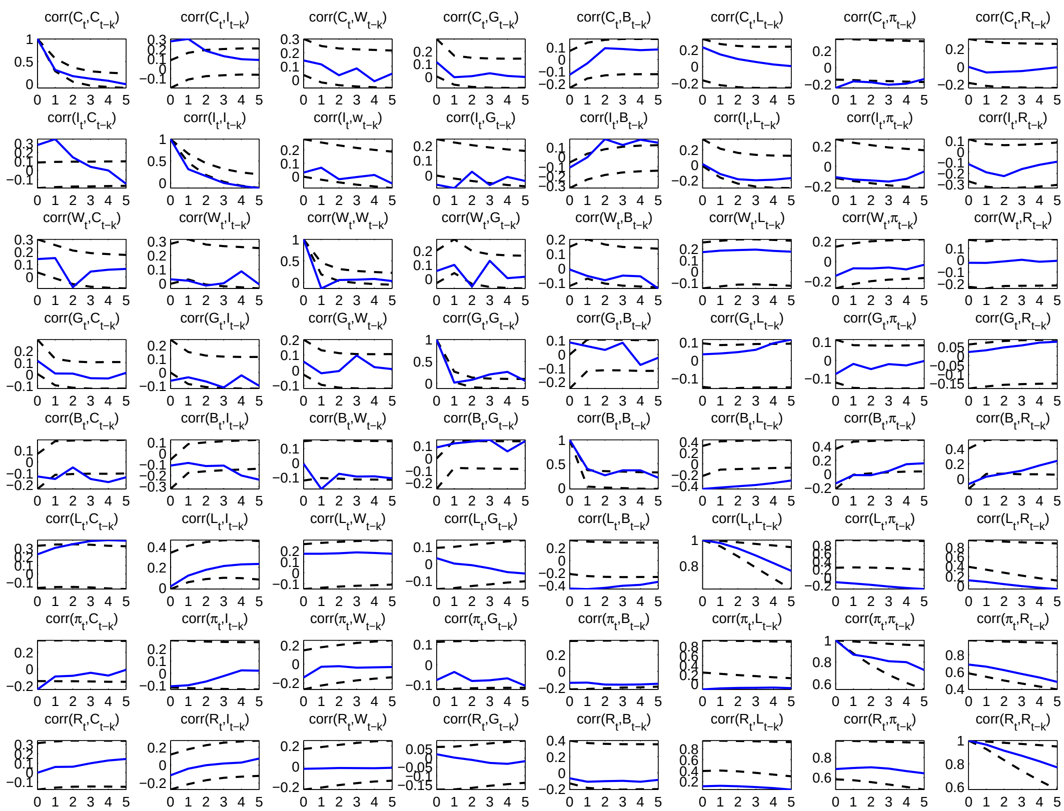

Figure 12: Autocorrelation function for regime F model over 1955q1–2014q2 estimates. Solid lines are data; dashed lines are 90 percent posterior interval from the model.

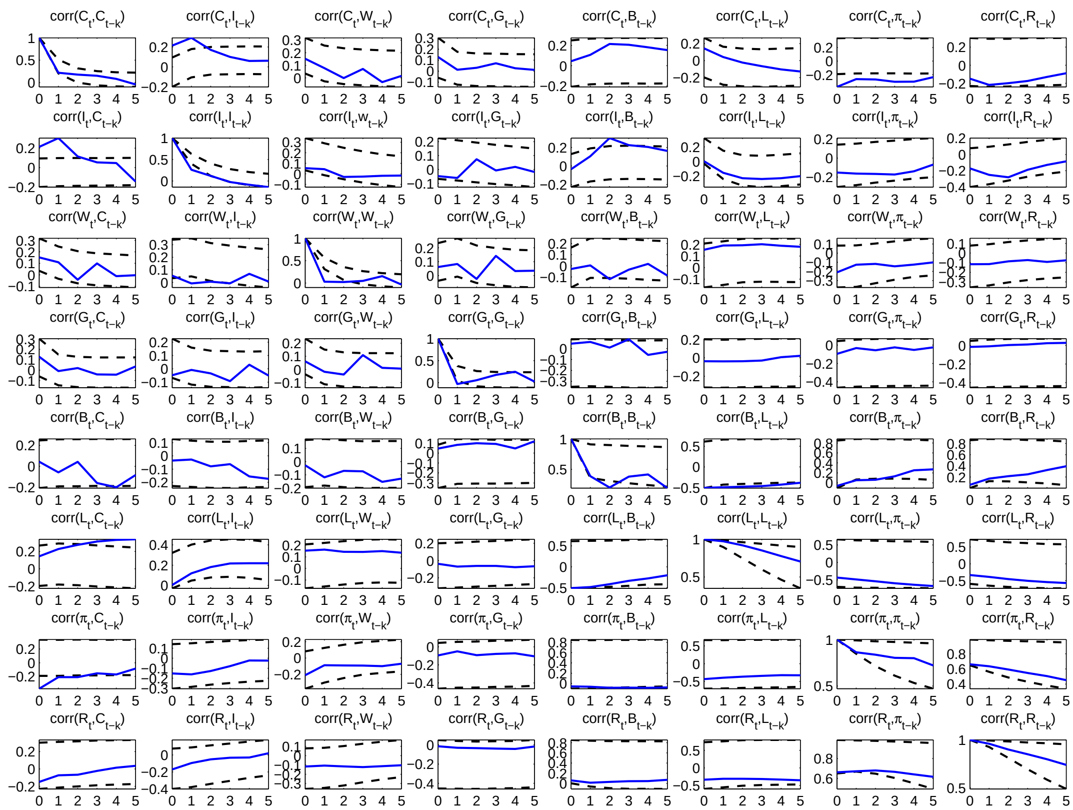

Figure 13: Autocorrelation function for regime M model over 1955q1–2007q4 estimates. Solid lines are data; dashed lines are 90 percent posterior interval from the model.

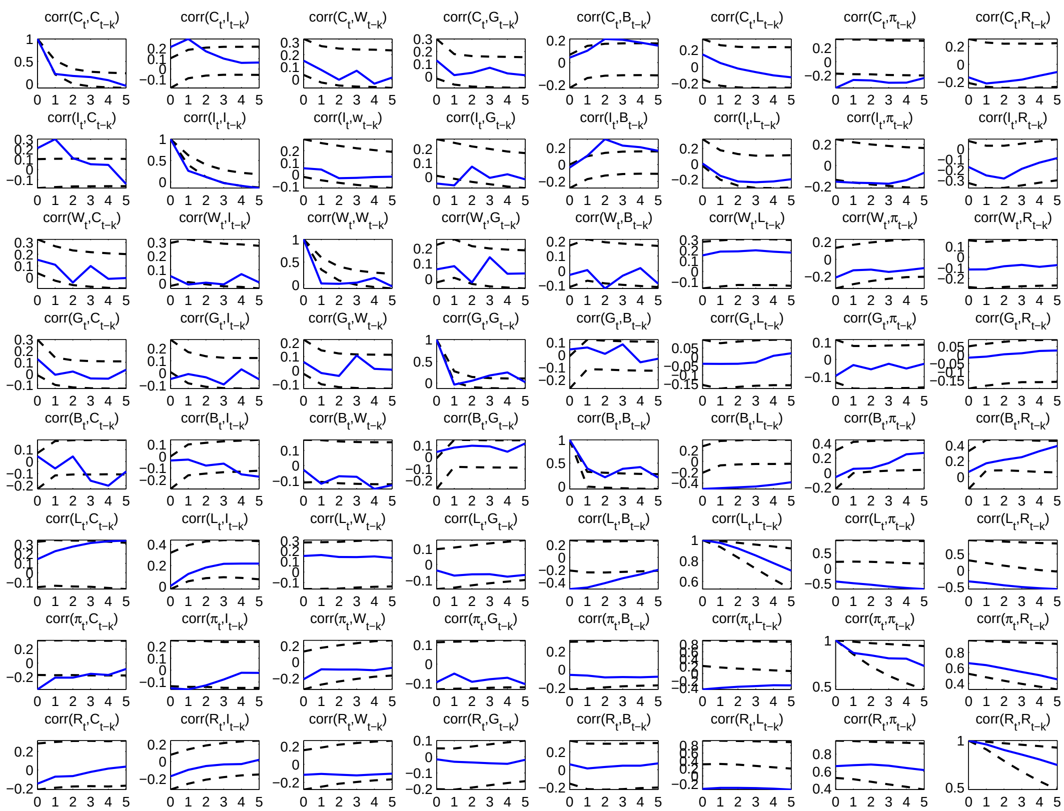

Figure 14: Autocorrelation function for regime F model over 1955q1–2007q4 estimates. Solid lines are data; dashed lines are 90 percent posterior interval from the model.

$PV \frac{\Delta Y}{\Delta G}$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Model 1:	RBC Real Frictions	0.50	0.33	0.13	-0.33	-0.78
		[0.30, 0.70]	[0.20, 0.45]	[-0.00, 0.27]	[-0.72, 0.07]	[-1.35, 0.01]
Model 2:	NK Sticky Prices & Wages					
	Regime M, short debt	0.81	0.65	0.48	0.22	0.06
		[0.55, 1.08]	[0.40, 0.91]	[0.20, 0.75]	[-0.21, 0.66]	[-0.53, 0.63]
	Regime M, long debt	0.81	0.66	0.50	0.31	0.19
		[0.55, 1.08]	[0.40, 0.91]	[0.25, 0.77]	[-0.07, 0.68]	[-0.29, 0.66]
	Regime F, short debt	1.69	1.59	1.64	1.89	2.01
		[1.05, 2.32]	[1.04, 2.07]	[0.96, 2.21]	[0.91, 2.87]	[0.90, 3.25]
	Regime F, long debt	1.32	1.19	1.13	1.22	1.27
		[0.94, 1.67]	[0.81, 1.53]	[0.65, 1.56]	[0.55, 1.83]	[0.52, 2.01]
Model 3:	NK Nonsavers					
	Regime M, short debt	1.03	0.84	0.61	0.33	0.15
		[0.65, 1.40]	[0.48, 1.19]	[0.25, 0.97]	[-0.23, 0.86]	[-0.56, 0.86]
	Regime M, long debt	1.02	0.84	0.65	0.44	0.32
		[0.65, 1.40]	[0.49, 1.18]	[0.30, 0.99]	[-0.05, 0.89]	[-0.29, 0.86]
	Regime F, short debt	1.91	1.78	1.80	2.03	2.14
		[1.24, 2.56]	[1.21, 2.31]	[1.09, 2.42]	[1.01, 3.03]	[0.97, 3.37]
	Regime F, long debt	1.53	1.36	1.27	1.33	1.37
		[1.09, 1.92]	[0.95, 1.77]	[0.75, 1.72]	[0.65, 1.98]	[0.61, 2.14]
Model 4:	NK G-in-Utility					
	Regime M, substitutes, short debt	0.10	0.06	-0.02	-0.23	-0.39
		[-0.57, 0.76]	[-0.49, 0.60]	[-0.51, 0.44]	[-0.76, 0.28]	[-0.98, 0.20]
	Regime M, substitutes, long debt	0.10	0.07	-0.01	-0.20	-0.34
		[-0.57, 0.76]	[-0.49, 0.61]	[-0.51, 0.47]	[-0.74, 0.36]	[-0.98, 0.29]
	Regime M, complements, short debt	1.56	1.29	1.02	0.72	0.54
		[0.74, 2.47]	[0.52, 2.04]	[0.32, 1.74]	[-0.13, 1.63]	[-0.54, 1.61]
	Regime M, complements, long debt	1.55	1.30	1.05	0.83	0.73
		[0.73, 2.46]	[0.54, 2.04]	[0.35, 1.73]	[0.04, 1.63]	[-0.22, 1.59]
	Regime M, complements, short debt, ss tax only	1.56	1.30	1.09	1.00	1.00
		[0.75, 2.49]	[0.54, 2.06]	[0.36, 1.79]	[0.10, 1.87]	[-0.09, 2.18]
	Regime M, complements, long debt, ss tax only	1.54	1.28	1.06	0.94	0.91
		[0.73, 2.46]	[0.55, 2.04]	[0.38, 1.75]	[0.16, 1.70]	[0.04, 1.77]
	Regime M, complements, short debt, no tax	1.63	1.35	1.13	1.10	1.19
		[0.79, 2.60]	[0.56, 2.15]	[0.35, 1.87]	[0.11, 2.07]	[-0.05, 2.49]
	Regime M, complements, long debt, no tax	1.61	1.33	1.10	1.02	1.02
		[0.77, 2.57]	[0.56, 2.12]	[0.35, 1.79]	[0.16, 1.84]	[0.03, 1.93]
	Regime F, substitutes, short debt	0.99	1.01	1.19	1.52	1.67
		[-0.35, 2.03]	[0.12, 1.77]	[0.48, 1.91]	[0.51, 2.45]	[0.59, 2.86]
	Regime F, substitutes, long debt	0.61	0.62	0.71	0.90	0.98
		[-0.40, 1.37]	[-0.09, 1.25]	[0.14, 1.28]	[0.22, 1.56]	[0.21, 1.73]
	Regime F, complements, short debt	2.43	2.22	2.13	2.30	2.40
		[1.36, 3.26]	[1.39, 2.98]	[1.27, 3.00]	[1.11, 3.44]	[1.05, 3.76]
	Regime F, complements, long debt	2.06	1.80	1.60	1.59	1.61
		[1.23, 2.85]	[1.08, 2.53]	[0.88, 2.28]	[0.75, 2.37]	[0.70, 2.48]
	Regime F, complements, short debt, ss tax only	2.44	2.23	2.14	2.31	2.40
		[1.36, 3.25]	[1.39, 2.98]	[1.28, 3.02]	[1.15, 3.51]	[1.05, 3.77]
	Regime F, complements, long debt, ss tax only	2.07	1.81	1.61	1.60	1.61
		[1.21, 2.81]	[1.08, 2.53]	[0.87, 2.27]	[0.79, 2.41]	[0.69, 2.47]
	Regime F, complements, short debt, no tax	3.30	3.30	3.75	4.78	5.29
		[1.55, 4.68]	[1.53, 4.86]	[1.11, 6.31]	[0.79, 9.30]	[0.68, 10.70]
	Regime F, complements, long debt, no tax	2.33	2.11	2.00	2.15	2.24
		[1.27, 3.15]	[1.14, 2.99]	[0.90, 3.06]	[0.70, 3.58]	[0.61, 3.87]

Table 1: Prior-predictive, present-value multipliers for output following gov. spending shock. Prior mean and 90% credible intervals [in brackets] reported.

$PV\frac{\Delta C}{\Delta G}$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Model 1:	RBC Real Frictions	-0.45	-0.53	-0.57	-0.73	-0.95
		[-0.64, -0.26]	[-0.66, -0.42]	[-0.68, -0.46]	[-0.91, -0.53]	[-1.21, -0.64]
Model 2:	NK Sticky Prices & Wages					
	Regime M, short debt	-0.22	-0.30	-0.35	-0.44	-0.55
		[-0.39, -0.03]	[-0.48, -0.13]	[-0.50, -0.19]	[-0.67, -0.21]	[-0.87, -0.24]
	Regime M, long debt	-0.22	-0.31	-0.35	-0.43	-0.52
		[-0.40, -0.03]	[-0.47, -0.13]	[-0.50, -0.20]	[-0.63, -0.23]	[-0.79, -0.26]
	Regime F, short debt	0.43	0.32	0.31	0.46	0.57
		[-0.03, 0.93]	[-0.04, 0.64]	[-0.05, 0.61]	[-0.07, 1.02]	[-0.11, 1.35]
	Regime F, long debt	0.15	0.04	0.00	0.05	0.08
		[-0.13, 0.42]	[-0.20, 0.28]	[-0.27, 0.24]	[-0.33, 0.41]	[-0.38, 0.57]
Model 3:	NK Nonsavers					
	Regime M, short debt	-0.01	-0.12	-0.20	-0.34	-0.47
		[-0.29, 0.28]	[-0.37, 0.12]	[-0.42, 0.02]	[-0.66, -0.04]	[-0.88, -0.06]
	Regime M, long debt	-0.02	-0.12	-0.19	-0.31	-0.40
		[-0.30, 0.28]	[-0.37, 0.12]	[-0.41, 0.02]	[-0.58, -0.05]	[-0.75, -0.08]
	Regime F, short debt	0.63	0.51	0.49	0.63	0.72
		[0.12, 1.13]	[0.12, 0.86]	[0.09, 0.83]	[0.07, 1.20]	[0.02, 1.51]
	Regime F, long debt	0.35	0.23	0.16	0.19	0.21
		[0.02, 0.65]	[-0.07, 0.50]	[-0.14, 0.45]	[-0.21, 0.58]	[-0.27, 0.69]
Model 4:	NK G-in-Utility					
	Regime M, substitutes, short debt	-0.90	-0.91	-0.93	-0.99	-1.07
		[-1.51, -0.27]	[-1.46, -0.38]	[-1.45, -0.43]	[-1.49, -0.48]	[-1.59, -0.56]
	Regime M, substitutes, long debt	-0.90	-0.91	-0.93	-0.98	-1.06
		[-1.52, -0.27]	[-1.46, -0.38]	[-1.43, -0.40]	[-1.48, -0.45]	[-1.59, -0.53]
	Regime M, complements, short debt	0.51	0.37	0.29	0.18	0.05
		[-0.24, 1.27]	[-0.34, 1.03]	[-0.39, 0.92]	[-0.55, 0.83]	[-0.74, 0.80]
	Regime M, complements, long debt	0.49	0.36	0.28	0.16	0.06
		[-0.27, 1.25]	[-0.34, 1.02]	[-0.38, 0.89]	[-0.50, 0.78]	[-0.63, 0.72]
	Regime M, complements, short debt, ss tax only	0.50	0.37	0.31	0.29	0.27
		[-0.23, 1.29]	[-0.34, 1.05]	[-0.37, 0.96]	[-0.46, 0.99]	[-0.56, 1.09]
	Regime M, complements, long debt, ss tax only	0.48	0.34	0.28	0.20	0.14
		[-0.25, 1.27]	[-0.35, 1.01]	[-0.39, 0.88]	[-0.43, 0.83]	[-0.56, 0.77]
	Regime M, complements, short debt, no tax	0.54	0.42	0.39	0.40	0.44
		[-0.18, 1.35]	[-0.30, 1.11]	[-0.34, 1.04]	[-0.39, 1.15]	[-0.51, 1.29]
	Regime M, complements, long debt, no tax	0.53	0.40	0.35	0.30	0.25
		[-0.20, 1.32]	[-0.31, 1.07]	[-0.35, 0.97]	[-0.42, 0.92]	[-0.47, 0.94]
	Regime F, substitutes, short debt	-0.24	-0.27	-0.22	-0.00	0.15
		[-1.35, 0.66]	[-1.02, 0.37]	[-0.82, 0.35]	[-0.67, 0.67]	[-0.63, 0.95]
	Regime F, substitutes, long debt	-0.52	-0.54	-0.52	-0.40	-0.31
		[-1.40, 0.14]	[-1.18, 0.04]	[-1.05, 0.00]	[-0.97, 0.11]	[-0.92, 0.25]
	Regime F, complements, short debt	1.13	0.95	0.89	0.98	1.04
		[0.20, 1.82]	[0.26, 1.62]	[0.25, 1.57]	[0.19, 1.77]	[0.14, 1.98]
	Regime F, complements, long debt	0.86	0.69	0.58	0.55	0.53
		[0.11, 1.55]	[0.02, 1.33]	[-0.03, 1.20]	[-0.09, 1.18]	[-0.14, 1.21]
	Regime F, complements, short debt, ss tax only	1.13	0.96	0.90	0.98	1.04
		[0.19, 1.81]	[0.28, 1.64]	[0.25, 1.58]	[0.22, 1.80]	[0.13, 1.96]
	Regime F, complements, long debt, ss tax only	0.86	0.69	0.59	0.56	0.54
		[0.11, 1.55]	[0.02, 1.34]	[-0.03, 1.21]	[-0.07, 1.20]	[-0.13, 1.21]
	Regime F, complements, short debt, no tax	1.60	1.50	1.62	2.13	2.53
		[0.28, 2.54]	[0.40, 2.44]	[0.24, 2.86]	[0.03, 4.23]	[-0.10, 5.27]
	Regime F, complements, long debt, no tax	0.98	0.84	0.78	0.83	0.87
		[0.17, 1.70]	[0.09, 1.54]	[0.02, 1.49]	[-0.09, 1.64]	[-0.17, 1.81]

Table 2: Prior-predictive, present-value multipliers for consumption following gov. spending shock. Prior mean and 90% credible intervals [in brackets] reported.

$PV\,\frac{\Delta I}{\Delta G}$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Model 1:	RBC Real Frictions	-0.10	-0.17	-0.31	-0.58	-0.79
		[-0.15, -0.04]	[-0.24, -0.10]	[-0.43, -0.20]	[-0.83, -0.31]	[-1.17, -0.32]
Model 2:	NK Sticky Prices & Wages					
	Regime M, short debt	-0.06	-0.12	-0.23	-0.38	-0.46
		[-0.11, -0.01]	[-0.19, -0.04]	[-0.35, -0.10]	[-0.61, -0.16]	[-0.75, -0.17]
	Regime M, long debt	-0.06	-0.11	-0.21	-0.32	-0.37
		[-0.10, -0.01]	[-0.18, -0.04]	[-0.32, -0.09]	[-0.51, -0.14]	[-0.60, -0.14]
	Regime F, short debt	0.07	0.09	0.15	0.26	0.29
		[-0.02, 0.15]	[-0.05, 0.20]	[-0.11, 0.38]	[-0.14, 0.69]	[-0.16, 0.74]
	Regime F, long debt	0.02	0.01	0.00	0.04	0.06
		[-0.04, 0.06]	[-0.08, 0.08]	[-0.17, 0.16]	[-0.22, 0.29]	[-0.21, 0.34]
Model 3:	NK Nonsavers					
	Regime M, short debt	-0.07	-0.14	-0.26	-0.40	-0.46
		[-0.13, -0.01]	[-0.23, -0.05]	[-0.40, -0.11]	[-0.65, -0.14]	[-0.79, -0.14]
	Regime M, long debt	-0.07	-0.13	-0.24	-0.34	-0.38
		[-0.13, -0.01]	[-0.22, -0.05]	[-0.37, -0.10]	[-0.55, -0.14]	[-0.62, -0.13]
	Regime F, short debt	0.06	0.07	0.11	0.20	0.23
		[-0.03, 0.14]	[-0.07, 0.18]	[-0.15, 0.34]	[-0.21, 0.62]	[-0.21, 0.71]
	Regime F, long debt	0.00	-0.02	-0.04	-0.02	-0.00
		[-0.05, 0.05]	[-0.12, 0.06]	[-0.22, 0.12]	[-0.27, 0.24]	[-0.27, 0.29]
Model 4:	NK G-in-Utility					
	Regime M, substitutes, short debt	-0.01	-0.03	-0.08	-0.20	-0.27
		[-0.06, 0.03]	[-0.11, 0.06]	[-0.24, 0.07]	[-0.44, 0.03]	[-0.55, 0.01]
	Regime M, substitutes, long debt	-0.01	-0.03	-0.07	-0.18	-0.24
		[-0.06, 0.03]	[-0.11, 0.06]	[-0.21, 0.07]	[-0.38, 0.02]	[-0.48, -0.02]
	Regime M, complements, short debt	-0.11	-0.22	-0.40	-0.61	-0.69
		[-0.22, -0.02]	[-0.38, -0.05]	[-0.68, -0.11]	[-1.05, -0.15]	[-1.22, -0.15]
	Regime M, complements, long debt	-0.11	-0.21	-0.37	-0.50	-0.53
		[-0.21, -0.01]	[-0.37, -0.06]	[-0.62, -0.11]	[-0.87, -0.15]	[-0.93, -0.14]
	Regime M, complements, short debt, ss tax only	-0.11	-0.21	-0.37	-0.51	-0.56
		[-0.22, -0.01]	[-0.39, -0.05]	[-0.67, -0.09]	[-1.01, -0.08]	[-1.18, -0.02]
	Regime M, complements, long debt, ss tax only	-0.11	-0.21	-0.36	-0.45	-0.47
		[-0.22, -0.02]	[-0.38, -0.05]	[-0.64, -0.10]	[-0.84, -0.09]	[-0.90, -0.09]
	Regime M, complements, short debt, no tax	-0.14	-0.26	-0.45	-0.58	-0.63
		[-0.28, -0.02]	[-0.48, -0.06]	[-0.82, -0.11]	[-1.16, -0.06]	[-1.38, 0.01]
	Regime M, complements, long debt, no tax	-0.14	-0.26	-0.44	-0.54	-0.54
		[-0.28, -0.02]	[-0.48, -0.07]	[-0.78, -0.12]	[-1.01, -0.10]	[-1.07, -0.08]
	Regime F, substitutes, short debt	0.10	0.17	0.29	0.42	0.44
		[0.00, 0.21]	[0.01, 0.31]	[0.02, 0.55]	[0.02, 0.85]	[0.00, 0.90]
	Regime F, substitutes, long debt	0.06	0.09	0.16	0.23	0.24
		[-0.01, 0.13]	[-0.03, 0.20]	[-0.05, 0.36]	[-0.08, 0.53]	[-0.08, 0.56]
	Regime F, complements, short debt	0.03	0.01	-0.00	0.07	0.11
		[-0.07, 0.12]	[-0.16, 0.16]	[-0.35, 0.31]	[-0.44, 0.60]	[-0.45, 0.68]
	Regime F, complements, long debt	-0.03	-0.09	-0.17	-0.18	-0.16
		[-0.12, 0.04]	[-0.25, 0.04]	[-0.46, 0.09]	[-0.57, 0.20]	[-0.54, 0.26]
	Regime F, complements, short debt, ss tax only	0.03	0.01	0.00	0.07	0.11
		[-0.06, 0.13]	[-0.17, 0.16]	[-0.33, 0.32]	[-0.42, 0.61]	[-0.44, 0.69]
	Regime F, complements, long debt, ss tax only	-0.03	-0.09	-0.17	-0.18	-0.16
		[-0.12, 0.04]	[-0.24, 0.05]	[-0.45, 0.09]	[-0.56, 0.20]	[-0.53, 0.26]
	Regime F, complements, short debt, no tax	0.21	0.31	0.60	1.11	1.29
		[-0.07, 0.47]	[-0.21, 0.80]	[-0.51, 1.70]	[-0.73, 3.31]	[-0.79, 3.83]
	Regime F, complements, long debt, no tax	0.00	-0.04	-0.08	-0.01	0.03
		[-0.14, 0.12]	[-0.30, 0.19]	[-0.57, 0.38]	[-0.74, 0.70]	[-0.74, 0.81]

Table 3: Prior-predictive, present-value multipliers for investment following gov. spending shock. Prior mean and 90% credible intervals [in brackets] reported.

$PV\frac{\Delta Y}{\Delta G}$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Model 4:	NK G-in-Utility					
	Regime M, unrestricted, ss tax only	0.82	0.68	0.56	0.50	0.48
		[-0.58, 2.13]	[-0.46, 1.78]	[-0.42, 1.49]	[-0.38, 1.47]	[-0.40, 1.50]
	Regime F, unrestricted, short debt, ss tax only	1.71	1.62	1.67	1.92	2.05
		[-0.02, 3.17]	[0.34, 2.87]	[0.58, 2.77]	[0.66, 3.17]	[0.69, 3.46]
	Regime F, unrestricted, long debt, ss tax only	1.35	1.22	1.17	1.25	1.30
		[-0.17, 2.72]	[0.06, 2.40]	[0.21, 2.10]	[0.30, 2.16]	[0.30, 2.23]
Model 5:	New Keynesian G-in-Utility & Nonsavers					
	Regime M, unrestricted, ss tax only	1.01	0.84	0.68	0.60	0.58
		[-0.18, 2.22]	[-0.17, 1.84]	[-0.15, 1.55]	[-0.16, 1.47]	[-0.18, 1.50]
	Regime F, unrestricted, short debt, ss tax only	1.91	1.79	1.80	2.03	2.14
		[0.34, 3.22]	[0.60, 2.91]	[0.79, 2.83]	[0.75, 3.20]	[0.75, 3.46]
	Regime F, unrestricted, long debt, ss tax only	1.54	1.38	1.28	1.34	1.38
		[0.19, 2.78]	[0.28, 2.40]	[0.39, 2.15]	[0.47, 2.25]	[0.47, 2.34]

Table 4: Prior-predictive, present-value multipliers for output following gov. spending shock. Comparison of the New Keynesian specification with government spending in the utility (G-in-Utility) to a specification with both government spending in the utility and nonsaver households. Prior mean and 90% credible intervals [in brackets] reported

$PV\frac{\Delta C}{\Delta G}$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Model 4:	NK G-in-Utility					
	Regime M, unrestricted, ss tax only	-0.21	-0.29	-0.32	-0.36	-0.40
		[-1.49, 1.07]	[-1.45, 0.84]	[-1.44, 0.71]	[-1.41, 0.65]	[-1.44, 0.59]
	Regime F, unrestricted, short debt, ss tax only	0.44	0.35	0.34	0.49	0.60
		[-1.07, 1.76]	[-0.83, 1.55]	[-0.70, 1.43]	[-0.57, 1.57]	[-0.55, 1.68]
	Regime F, unrestricted, long debt, ss tax only	0.18	0.08	0.04	0.09	0.12
		[-1.15, 1.51]	[-1.06, 1.25]	[-0.98, 1.08]	[-0.86, 1.04]	[-0.83, 1.01]
Model 5:	New Keynesian G-in-Utility & Nonsavers					
	Regime M, unrestricted, ss tax only	-0.03	-0.12	-0.18	-0.24	-0.28
		[-1.17, 1.08]	[-1.16, 0.88]	[-1.14, 0.76]	[-1.14, 0.68]	[-1.16, 0.63]
	Regime F, unrestricted, short debt, ss tax only	0.64	0.52	0.50	0.64	0.73
		[-0.77, 1.78]	[-0.53, 1.60]	[-0.44, 1.47]	[-0.36, 1.62]	[-0.35, 1.75]
	Regime F, unrestricted, long debt, ss tax only	0.36	0.24	0.18	0.21	0.23
		[-0.82, 1.54]	[-0.80, 1.26]	[-0.70, 1.12]	[-0.65, 1.08]	[-0.62, 1.08]

Table 5: Prior-predictive, present-value multipliers for consumption following gov. spending shock. Comparison of the New Keynesian specification with government spending in the utility (G-in-Utility) to a specification with both government spending in the utility and nonsaver households. Prior mean and 90% credible intervals [in brackets] reported

$PV\frac{\Delta I}{\Delta G}$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Model 4:	NK G-in-Utility					
	Regime M, unrestricted, ss tax only	-0.06	-0.11	-0.19	-0.24	-0.25
		[-0.18, 0.04]	[-0.31, 0.08]	[-0.52, 0.13]	[-0.68, 0.18]	[-0.72, 0.18]
	Regime F, unrestricted, short debt, ss tax only	0.07	0.09	0.14	0.25	0.28
		[-0.05, 0.19]	[-0.13, 0.29]	[-0.24, 0.52]	[-0.29, 0.81]	[-0.32, 0.86]
	Regime F, unrestricted, long debt, ss tax only	0.01	0.00	-0.01	0.02	0.04
		[-0.10, 0.12]	[-0.20, 0.19]	[-0.37, 0.34]	[-0.46, 0.51]	[-0.46, 0.53]
Model 5:	New Keynesian G-in-Utility & Nonsavers					
	Regime M, unrestricted, ss tax only	-0.07	-0.13	-0.22	-0.28	-0.29
		[-0.17, 0.02]	[-0.31, 0.04]	[-0.52, 0.05]	[-0.67, 0.08]	[-0.71, 0.07]
	Regime F, unrestricted, short debt, ss tax only	0.06	0.06	0.10	0.19	0.22
		[-0.06, 0.16]	[-0.14, 0.24]	[-0.26, 0.44]	[-0.33, 0.71]	[-0.31, 0.81]
	Regime F, unrestricted, long debt, ss tax only	0.00	-0.02	-0.05	-0.03	-0.01
		[-0.10, 0.09]	[-0.20, 0.15]	[-0.37, 0.26]	[-0.46, 0.40]	[-0.46, 0.43]

Table 6: Prior-predictive, present-value multipliers for investment following gov. spending shock. Comparison of the New Keynesian specification with government spending in the utility (G-in-Utility) to a specification with both government spending in the utility and nonsaver households. Prior mean and 90% credible intervals [in brackets] reported

$$\textbf{Prob}\Big(PV\tfrac{\Delta Y}{\Delta G}>1\Big)\ \textbf{\& Prob}\Big(PV\tfrac{\Delta C}{\Delta G}>0\Big)\ \textbf{\& Prob}\Big(PV\tfrac{\Delta I}{\Delta G}>0\Big)$$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Model 1:	RBC Real Frictions	0.00	0.00	0.00	0.00	0.00
Model 2:	New Keynesian Sticky Prices & Wages					
	Regime M	0.00	0.00	0.00	0.00	0.00
	Regime F, short debt	0.95	0.88	0.81	0.80	0.81
	Regime F, long debt	0.59	0.43	0.43	0.50	0.53
Model 3:	New Keynesian Nonsavers					
	Regime M	0.00	0.00	0.00	0.00	0.01
	Regime F, short debt	0.91	0.81	0.74	0.74	0.74
	Regime F, long debt	0.43	0.32	0.34	0.43	0.45
Model 4:	New Keynesian G-in-Utility					
	Regime M, substitutes	0.00	0.00	0.00	0.00	0.00
	Regime M, complements	0.00	0.00	0.00	0.00	0.01
	Regime M, complements, ss tax only	0.00	0.00	0.00	0.01	0.01
	Regime M, complements, no tax	0.00	0.00	0.00	0.01	0.02
	Regime F, substitutes, short debt	0.30	0.27	0.29	0.49	0.59
	Regime F, substitutes, long debt	0.13	0.07	0.06	0.12	0.19
	Regime F, complements, short debt	0.67	0.55	0.53	0.58	0.59
	Regime F, complements, long debt	0.19	0.13	0.14	0.22	0.26
	Regime F, complements, short debt, ss tax only	0.67	0.55	0.53	0.58	0.59
	Regime F, complements, long debt, ss tax only	0.20	0.13	0.14	0.22	0.25
	Regime F, complements, short debt, no tax	0.92	0.83	0.76	0.75	0.75
	Regime F, complements, long debt, no tax	0.43	0.35	0.36	0.43	0.44
	Regime M, unrestricted, ss tax only	0.00	0.00	0.00	0.00	0.01
	Regime F, unrestricted, short debt, ss tax only	0.49	0.41	0.42	0.54	0.59
	Regime F, unrestricted, long debt, ss tax only	0.16	0.10	0.10	0.18	0.23
Model 5:	New Keynesian G-in-Utility & Nonsavers					
	Regime M, unrestricted, ss tax only	0.00	0.00	0.00	0.00	0.01
	Regime F, unrestricted, short debt, ss tax only	0.55	0.47	0.48	0.59	0.62
	Regime F, unrestricted, long debt, ss tax only	0.18	0.11	0.11	0.21	0.26

Table 7: Joint multiplier probabilities for observing present-value output multipliers greater than one, positive consumption present-value multipliers, and positive consumption present-value multipliers jointly implied by the prior-predictive analysis.

Prob$\left(PV\frac{\Delta Y}{\Delta G} > 1\right)$ **& Prob**$\left(PV\frac{\Delta C}{\Delta G} > 0\right)$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Model 1:	RBC Real Frictions	0.00	0.00	0.00	0.00	0.00
Model 2:	New Keynesian Sticky Prices & Wages					
	Regime M	0.00	0.00	0.00	0.00	0.00
	Regime F, short debt	0.98	0.96	0.91	0.90	0.89
	Regime F, long debt	0.77	0.56	0.49	0.55	0.56
Model 3:	New Keynesian Nonsavers					
	Regime M	0.47	0.18	0.06	0.03	0.03
	Regime F, short debt	1.00	0.99	0.97	0.95	0.94
	Regime F, long debt	0.99	0.91	0.79	0.74	0.73
Model 4:	New Keynesian G-in-Utility					
	Regime M, substitutes	0.00	0.00	0.00	0.00	0.00
	Regime M, complements	0.81	0.68	0.49	0.33	0.29
	Regime M, complements, ss tax only	0.80	0.67	0.50	0.40	0.39
	Regime M, complements, no tax	0.82	0.69	0.52	0.45	0.44
	Regime F, substitutes, short debt	0.30	0.27	0.29	0.49	0.59
	Regime F, substitutes, long debt	0.13	0.07	0.06	0.13	0.19
	Regime F, complements, short debt	1.00	1.00	0.99	0.97	0.97
	Regime F, complements, long debt	0.99	0.97	0.91	0.87	0.85
	Regime F, complements, short debt, ss tax only	1.00	1.00	0.99	0.97	0.97
	Regime F, complements, long debt, ss tax only	0.99	0.97	0.91	0.87	0.85
	Regime F, complements, short debt, no tax	1.00	1.00	0.99	0.99	0.98
	Regime F, complements, long debt, no tax	1.00	0.98	0.95	0.92	0.90
	Regime M, unrestricted, ss tax only	0.40	0.33	0.25	0.20	0.20
	Regime F, unrestricted, short debt, ss tax only	0.65	0.64	0.64	0.73	0.78
	Regime F, unrestricted, long debt, ss tax only	0.57	0.53	0.49	0.50	0.52
Model 5:	New Keynesian G-in-Utility & Nonsavers					
	Regime M, unrestricted, ss tax only	0.47	0.39	0.28	0.22	0.22
	Regime F, unrestricted, short debt, ss tax only	0.74	0.74	0.76	0.83	0.85
	Regime F, unrestricted, long debt, ss tax only	0.65	0.60	0.57	0.59	0.61

Table 8: Joint multiplier probabilities for observing present-value output multipliers greater than one and positive consumption present-value multipliers implied by the prior-predictive analysis.

Parameters	Posterior				
	mean	median	5	95	Geweke χ^2 p
Preference and HHs					
ξ, inverse Frisch labor elast.	1.77	1.74	1.11	2.47	0.63
θ, habit formation	1.00	1.00	0.99	1.00	0.66
α_G, G in utility	-0.24	-0.24	-0.41	-0.07	0.02
Frictions & Production					
100γ, SS tech growth	0.25	0.25	0.18	0.31	0.21
ψ, capital utilization	0.16	0.16	0.09	0.23	0.24
s, inv adj cost	5.46	5.42	3.75	7.06	0.07
ω_p, price stickiness	0.92	0.92	0.90	0.94	0.70
ω_w, wage stickiness	0.91	0.92	0.89	0.94	0.95
χ_p, price indexation	0.06	0.05	0.01	0.11	0.53
χ_w, wage indexation	0.18	0.18	0.10	0.26	0.17
Monetary Policy					
ϕ_π, interest rate resp. to inflation	0.90	0.90	0.74	1.06	0.04
ϕ_y, interest rate resp. to output	0.10	0.10	0.08	0.12	0.70
ρ_r, lagged interest rate resp.	0.71	0.71	0.64	0.77	0.04
Fiscal Policy					
γ_G, govt cons. resp. to debt	0.26	0.26	0.17	0.34	0.65
γ_Z, transfer resp. to debt	-0.11	-0.11	-0.20	-0.02	0.56
ρ_G, lagged govt cons resp.	0.98	0.98	0.98	0.99	0.82
Shocks					
ρ_a, technology	0.23	0.23	0.12	0.34	0.96
ρ_b, preference	0.40	0.40	0.30	0.50	0.42
ρ_{em}, monetary policy	0.39	0.38	0.27	0.51	0.21
ρ_i, investment	0.69	0.70	0.62	0.77	0.30
ρ_w, wage markup	0.18	0.18	0.09	0.27	0.20
ρ_p, price markup	0.74	0.74	0.67	0.82	0.11
ρ_{eg}, govt cons	0.13	0.13	0.06	0.20	0.29
$100\sigma_a$, technology	1.05	1.04	0.96	1.12	0.58
$100\sigma_b$, preference	81.88	78.93	43.03	119.34	0.43
$100\sigma_m$, monetary policy	0.22	0.22	0.20	0.24	0.20
$100\sigma_i$, investment	0.75	0.75	0.65	0.86	0.07
$100\sigma_w$, wage markup	0.35	0.35	0.30	0.39	0.01
$100\sigma_p$, price markup	0.09	0.09	0.07	0.10	0.04
$100\sigma_G$, govt cons	1.83	1.83	1.68	1.96	0.85
$100\sigma_Z$, transfers	3.20	3.15	2.29	4.04	0.24
$\bar{L}$, mean hours obs	481.12	481.07	477.24	485.20	0.40
$\bar{\pi}$, mean inflation obs	0.60	0.59	0.17	1.01	0.10

Table 9: Posterior Estimates for Regime M over 1955q1–2014q2. Reports the posterior mean, median, 90% credible interval, and the p-value for Geweke's Separated Partial Means test. Final acceptance rate: 33%. 1,500,000 draws were made, with the first 500,000 used as a burn-in period, and one every 50 draws kept afterwards.

Parameters	Posterior				
	mean	median	5	95	Geweke χ^2 p
Preference and HHs					
ξ, inverse Frisch labor elast.	1.54	1.50	0.92	2.14	0.04
θ, habit formation	0.99	0.99	0.98	1.00	0.12
α_G, G in utility	-0.19	-0.19	-0.36	-0.02	0.83
Frictions & Production					
100γ, SS tech growth	0.24	0.24	0.18	0.31	0.21
ψ, capital utilization	0.13	0.12	0.08	0.17	0.09
s, inv adj cost	5.21	5.17	3.68	6.71	0.07
ω_p, price stickiness	0.89	0.89	0.86	0.91	0.52
ω_w, wage stickiness	0.87	0.87	0.83	0.92	0.20
χ_p, price indexation	0.06	0.05	0.01	0.11	0.75
χ_w, wage indexation	0.09	0.09	0.03	0.15	0.84
Monetary Policy					
ϕ_π, interest rate resp. to inflation	1.14	1.14	0.98	1.31	0.65
ϕ_y, interest rate resp. to output	0.18	0.18	0.13	0.22	0.28
ρ_r, lagged interest rate resp.	0.76	0.76	0.71	0.81	0.03
Fiscal Policy					
γ_G, govt cons. resp. to debt	0.21	0.21	0.13	0.30	0.76
γ_Z, transfer resp. to debt	-0.03	-0.03	-0.13	0.08	0.82
ρ_G, lagged govt cons resp.	0.98	0.98	0.98	0.99	0.85
Shocks					
ρ_a, technology	0.25	0.25	0.13	0.37	0.61
ρ_b, preference	0.31	0.31	0.21	0.42	0.08
ρ_{em}, monetary policy	0.34	0.33	0.22	0.44	0.02
ρ_i, investment	0.51	0.51	0.42	0.60	0.90
ρ_w, wage markup	0.33	0.33	0.23	0.43	0.25
ρ_p, price markup	0.72	0.73	0.65	0.81	0.52
ρ_{eg}, govt cons	0.13	0.12	0.06	0.20	0.36
$100\sigma_a$, technology	1.03	1.03	0.95	1.12	0.46
$100\sigma_b$, preference	42.66	40.20	24.22	61.48	0.05
$100\sigma_m$, monetary policy	0.23	0.23	0.21	0.25	0.09
$100\sigma_i$, investment	0.98	0.98	0.84	1.11	0.68
$100\sigma_w$, wage markup	0.25	0.25	0.21	0.29	0.61
$100\sigma_p$, price markup	0.10	0.10	0.08	0.12	0.53
$100\sigma_G$, govt cons	1.83	1.83	1.68	1.99	0.12
$100\sigma_Z$, transfers	2.68	2.63	1.92	3.36	0.01
$\bar{L}$, mean hours obs	475.20	475.03	472.24	478.07	0.05
$\bar{\pi}$, mean inflation obs	0.64	0.64	0.22	1.05	0.73

Table 10: Posterior Estimates for Regime M over 1955q1–2007q4. Reports the posterior mean, median, 90% credible interval, and the p-value for Geweke's Separated Partial Means test. Final acceptance rate: 32%. 1,500,000 draws were made, with the first 500,000 used as a burn-in period, and one every 50 draws kept afterwards.

Parameters	Posterior				
	mean	median	5	95	Geweke χ^2 p
Preference and HHs					
ξ, inverse Frisch labor elast.	1.54	1.51	0.94	2.15	0.13
θ, habit formation	0.95	0.95	0.92	0.98	0.26
α_G, G in utility	-0.56	-0.56	-0.85	-0.27	0.51
Frictions & Production					
100γ, SS tech growth	0.28	0.28	0.20	0.35	0.38
ψ, capital utilization	0.17	0.16	0.08	0.25	0.21
s, inv adj cost	4.29	4.23	2.78	5.82	0.83
ω_p, price stickiness	0.83	0.83	0.78	0.88	0.01
ω_w, wage stickiness	0.72	0.72	0.62	0.81	0.11
χ_p, price indexation	0.09	0.08	0.01	0.17	0.18
χ_w, wage indexation	0.07	0.06	0.01	0.11	0.47
Monetary Policy					
ϕ_π, interest rate resp. to inflation	1.11	1.10	0.91	1.31	0.04
ϕ_y, interest rate resp. to output	0.21	0.21	0.15	0.27	0.85
ρ_r, lagged interest rate resp.	0.76	0.77	0.69	0.84	0.07
Fiscal Policy					
γ_G, govt cons. resp. to debt	0.16	0.16	0.06	0.27	0.16
γ_Z, transfer resp. to debt	0.19	0.19	0.08	0.30	0.07
ρ_G, lagged govt cons resp.	0.98	0.99	0.97	0.99	0.37
Shocks					
ρ_a, technology	0.22	0.22	0.09	0.35	0.23
ρ_b, preference	0.18	0.18	0.06	0.30	0.61
ρ_{em}, monetary policy	0.57	0.56	0.41	0.71	0.02
ρ_i, investment	0.44	0.43	0.29	0.58	0.23
ρ_w, wage markup	0.27	0.27	0.13	0.42	0.07
ρ_p, price markup	0.69	0.70	0.56	0.82	0.01
ρ_{eg}, govt cons	0.30	0.30	0.16	0.44	0.85
$100\sigma_a$, technology	1.17	1.16	1.03	1.30	0.50
$100\sigma_b$, preference	12.03	11.08	6.22	18.00	0.11
$100\sigma_m$, monetary policy	0.23	0.23	0.19	0.26	0.97
$100\sigma_i$, investment	1.28	1.27	1.03	1.52	0.03
$100\sigma_w$, wage markup	0.23	0.23	0.18	0.27	0.14
$100\sigma_p$, price markup	0.14	0.13	0.10	0.17	0.38
$100\sigma_G$, govt cons	2.04	2.03	1.80	2.30	0.57
$100\sigma_Z$, transfers	1.90	1.85	1.29	2.54	0.52
$\bar{L}$, mean hours obs	469.81	469.67	467.31	472.28	0.03
$\bar{\pi}$, mean inflation obs	0.74	0.74	0.35	1.14	0.89

Table 11: Posterior Estimates for Regime M over 1955q1–1979q4. Reports the posterior mean, median, 90% credible interval, and the p-value for Geweke's Separated Partial Means test. Final acceptance rate: 34%. 1,500,000 draws were made, with the first 500,000 used as a burn-in period, and one every 50 draws kept afterwards.

Parameters	Posterior				
	mean	median	5	95	Geweke χ^2 p
Preference and HHs					
ξ, inverse Frisch labor elast.	1.78	1.74	1.05	2.48	0.39
θ, habit formation	0.96	0.97	0.93	0.99	0.01
α_G, G in utility	-0.24	-0.24	-0.46	-0.03	0.59
Frictions & Production					
100γ, SS tech growth	0.34	0.34	0.27	0.40	0.01
ψ, capital utilization	0.35	0.34	0.16	0.53	0.06
s, inv adj cost	7.08	7.05	5.13	9.09	0.04
ω_p, price stickiness	0.94	0.95	0.92	0.97	0.25
ω_w, wage stickiness	0.81	0.81	0.74	0.88	0.22
χ_p, price indexation	0.21	0.16	0.01	0.46	0.43
χ_w, wage indexation	0.19	0.19	0.07	0.31	0.17
Monetary Policy					
ϕ_π, interest rate resp. to inflation	1.34	1.34	1.03	1.66	0.04
ϕ_y, interest rate resp. to output	0.16	0.16	0.11	0.21	0.31
ρ_r, lagged interest rate resp.	0.79	0.80	0.73	0.85	0.01
Fiscal Policy					
γ_G, govt cons. resp. to debt	0.25	0.24	0.16	0.33	0.12
γ_Z, transfer resp. to debt	-0.06	-0.06	-0.17	0.05	0.88
ρ_G, lagged govt cons resp.	0.97	0.97	0.96	0.98	0.08
Shocks					
ρ_a, technology	0.23	0.23	0.10	0.36	0.81
ρ_b, preference	0.47	0.47	0.27	0.67	0.03
ρ_{em}, monetary policy	0.52	0.52	0.40	0.65	0.01
ρ_i, investment	0.76	0.77	0.65	0.87	0.65
ρ_w, wage markup	0.36	0.36	0.20	0.53	0.09
ρ_p, price markup	0.48	0.52	0.18	0.74	0.27
ρ_{eg}, govt cons	0.16	0.16	0.07	0.26	0.30
$100\sigma_a$, technology	0.80	0.80	0.71	0.90	0.99
$100\sigma_b$, preference	14.54	11.96	3.99	27.95	0.01
$100\sigma_m$, monetary policy	0.15	0.15	0.13	0.17	0.01
$100\sigma_i$, investment	0.44	0.44	0.35	0.53	0.01
$100\sigma_w$, wage markup	0.27	0.27	0.21	0.34	0.11
$100\sigma_p$, price markup	0.09	0.09	0.06	0.12	0.11
$100\sigma_G$, govt cons	1.63	1.63	1.44	1.82	0.97
$100\sigma_Z$, transfers	3.57	3.47	2.25	4.86	0.07
$\bar{L}$, mean hours obs	470.67	470.35	466.75	474.38	0.01
$\bar{\pi}$, mean inflation obs	0.70	0.70	0.30	1.10	0.70

Table 12: Posterior Estimates for Regime M over 1982q1–2007q4. Reports the posterior mean, median, 90% credible interval, and the p-value for Geweke's Separated Partial Means test. Final acceptance rate: 27%. 1,500,000 draws were made, with the first 500,000 used as a burn-in period, and one every 50 draws kept afterwards.

Parameters	Posterior				
	mean	median	5	95	Geweke χ^2 p
Preference and HHs					
ξ, inverse Frisch labor elast.	2.33	2.29	1.49	3.18	0.38
θ, habit formation	0.99	0.99	0.99	1.00	0.21
α_G, G in utility	-0.20	-0.20	-0.38	-0.01	0.90
Frictions & Production					
100γ, SS tech growth	0.25	0.25	0.18	0.31	0.65
ψ, capital utilization	0.15	0.15	0.07	0.23	0.84
s, inv adj cost	4.80	4.77	3.24	6.35	0.46
ω_p, price stickiness	0.95	0.95	0.94	0.96	0.54
ω_w, wage stickiness	0.87	0.87	0.84	0.90	0.08
χ_p, price indexation	0.06	0.06	0.01	0.11	0.41
χ_w, wage indexation	0.18	0.18	0.10	0.25	0.46
Monetary Policy					
ϕ_π, interest rate resp. to inflation	0.15	0.15	0.08	0.23	0.65
ϕ_y, interest rate resp. to output	0.14	0.14	0.12	0.16	0.20
ρ_r, lagged interest rate resp.	0.15	0.15	0.06	0.23	0.40
Fiscal Policy					
γ_G, govt cons. resp. to debt	0.0001	0.0001	-0.0016	0.0016	0.61
γ_Z, transfer resp. to debt	0.0000	0.0000	-0.0016	0.0017	0.65
ρ_G, lagged govt cons resp.	0.99	0.99	0.98	0.99	0.06
ρ_Z, lagged transfer resp.	0.98	0.98	0.97	0.99	0.25
Shocks					
ρ_a, technology	0.27	0.27	0.16	0.38	0.39
ρ_b, preference	0.39	0.39	0.29	0.48	0.65
ρ_{em}, monetary policy	0.89	0.89	0.85	0.92	0.40
ρ_i, investment	0.58	0.58	0.51	0.65	0.36
ρ_w, wage markup	0.16	0.16	0.07	0.26	0.66
ρ_p, price markup	0.75	0.75	0.68	0.82	0.46
ρ_{eg}, govt cons	0.12	0.12	0.06	0.18	0.51
ρ_{ez}, transfers	0.96	0.97	0.94	0.98	0.43
$100\sigma_a$, technology	1.05	1.05	0.97	1.13	0.93
$100\sigma_b$, preference	52.74	50.71	26.47	76.79	0.11
$100\sigma_m$, monetary policy	0.22	0.22	0.20	0.24	0.53
$100\sigma_i$, investment	0.95	0.94	0.83	1.07	0.34
$100\sigma_w$, wage markup	0.34	0.34	0.30	0.39	0.82
$100\sigma_p$, price markup	0.07	0.07	0.06	0.09	0.53
$100\sigma_G$, govt cons	1.86	1.86	1.72	2.00	0.50
$100\sigma_Z$, transfers	0.50	0.49	0.34	0.66	0.96
$\bar{L}$, mean hours obs	474.18	474.11	470.39	477.80	0.14
$\bar{\pi}$, mean inflation obs	0.67	0.67	0.27	1.09	0.77

Table 13: Posterior Estimates for Regime F over 1955q1–2014q2. Reports the posterior mean, median, 90% credible interval, and the p-value for Geweke's Separated Partial Means test. Final acceptance rate: 35%. 1,500,000 draws were made, with the first 500,000 used as a burn-in period, and one every 50 draws kept afterwards.

Parameters	Posterior				
	mean	median	5	95	Geweke χ^2 p
Preference and HHs					
ξ, inverse Frisch labor elast.	2.32	2.28	1.49	3.20	0.86
θ, habit formation	0.99	0.99	0.98	1.00	0.17
α_G, G in utility	-0.16	-0.16	-0.34	0.02	0.82
Frictions & Production					
100γ, SS tech growth	0.27	0.27	0.20	0.33	0.06
ψ, capital utilization	0.13	0.12	0.06	0.19	0.08
s, inv adj cost	3.97	3.92	2.47	5.36	0.86
ω_p, price stickiness	0.95	0.95	0.94	0.96	0.36
ω_w, wage stickiness	0.85	0.85	0.81	0.89	0.25
χ_p, price indexation	0.06	0.06	0.01	0.11	0.03
χ_w, wage indexation	0.09	0.09	0.03	0.15	0.06
Monetary Policy					
ϕ_π, interest rate resp. to inflation	0.15	0.15	0.08	0.23	0.07
ϕ_y, interest rate resp. to output	0.17	0.17	0.14	0.20	0.51
ρ_r, lagged interest rate resp.	0.15	0.15	0.06	0.23	0.86
Fiscal Policy					
γ_G, govt cons. resp. to debt	0.0000	0.0000	-0.0017	0.0016	0.02
γ_Z, transfer resp. to debt	0.0000	0.0000	-0.0017	0.0016	0.07
ρ_G, lagged govt cons resp.	0.98	0.98	0.98	0.99	0.31
ρ_Z, lagged transfer resp.	0.98	0.98	0.97	0.99	0.17
Shocks					
ρ_a, technology	0.30	0.30	0.19	0.42	0.73
ρ_b, preference	0.31	0.31	0.21	0.41	0.36
ρ_{em}, monetary policy	0.89	0.89	0.86	0.92	0.27
ρ_i, investment	0.51	0.51	0.43	0.60	0.90
ρ_w, wage markup	0.35	0.35	0.24	0.47	0.98
ρ_p, price markup	0.72	0.72	0.64	0.80	0.57
ρ_{eg}, govt cons	0.11	0.10	0.05	0.17	0.29
ρ_{ez}, transfers	0.95	0.95	0.92	0.98	0.21
$100\sigma_a$, technology	1.03	1.03	0.95	1.12	0.49
$100\sigma_b$, preference	39.60	38.15	19.87	59.23	0.15
$100\sigma_m$, monetary policy	0.23	0.23	0.21	0.25	0.51
$100\sigma_i$, investment	1.05	1.05	0.92	1.19	0.88
$100\sigma_w$, wage markup	0.24	0.23	0.20	0.28	0.85
$100\sigma_p$, price markup	0.08	0.08	0.06	0.10	0.67
$100\sigma_G$, govt cons	1.87	1.87	1.71	2.02	0.64
$100\sigma_Z$, transfers	0.49	0.46	0.29	0.68	0.53
$\bar{L}$, mean hours obs	473.09	473.02	470.00	476.25	0.14
$\bar{\pi}$, mean inflation obs	0.70	0.70	0.28	1.10	0.81

Table 14: Posterior Estimates for Regime F over 1955q1–2007q4. Reports the posterior mean, median, 90% credible interval, and the p-value for Geweke's Separated Partial Means test. Final acceptance rate: 32%. 1,500,000 draws were made, with the first 500,000 used as a burn-in period, and one every 50 draws kept afterwards.

Parameters	Posterior				
	mean	median	5	95	Geweke χ^2 p
Preference and HHs					
ξ, inverse Frisch labor elast.	2.25	2.21	1.40	3.09	0.09
θ, habit formation	0.96	0.96	0.94	0.99	0.16
α_G, G in utility	-0.38	-0.38	-0.67	-0.10	0.84
Frictions & Production					
100γ, SS tech growth	0.27	0.27	0.19	0.34	0.12
ψ, capital utilization	0.31	0.29	0.11	0.50	0.13
s, inv adj cost	3.47	3.40	1.92	5.03	0.08
ω_p, price stickiness	0.95	0.95	0.94	0.96	0.32
ω_w, wage stickiness	0.74	0.74	0.65	0.84	0.13
χ_p, price indexation	0.11	0.09	0.01	0.20	0.34
χ_w, wage indexation	0.06	0.06	0.01	0.11	0.90
Monetary Policy					
ϕ_π, interest rate resp. to inflation	0.19	0.18	0.08	0.29	0.24
ϕ_y, interest rate resp. to output	0.21	0.21	0.16	0.25	0.57
ρ_r, lagged interest rate resp.	0.37	0.37	0.22	0.51	0.31
Fiscal Policy					
γ_G, govt cons. resp. to debt	0.0000	0.0000	-0.0016	0.0016	0.59
γ_Z, transfer resp. to debt	0.0000	-0.0000	-0.0017	0.0016	0.47
ρ_G, lagged govt cons resp.	0.95	0.96	0.93	0.98	0.15
ρ_Z, lagged transfer resp.	0.97	0.98	0.95	0.99	0.46
Shocks					
ρ_a, technology	0.30	0.30	0.15	0.43	0.15
ρ_b, preference	0.22	0.22	0.09	0.36	0.41
ρ_{em}, monetary policy	0.87	0.88	0.79	0.95	0.15
ρ_i, investment	0.47	0.48	0.35	0.60	0.14
ρ_w, wage markup	0.20	0.19	0.06	0.33	0.38
ρ_p, price markup	0.61	0.62	0.40	0.83	0.11
ρ_{eg}, govt cons	0.29	0.28	0.14	0.42	0.73
ρ_{ez}, transfers	0.90	0.92	0.80	0.98	0.01
$100\sigma_a$, technology	1.18	1.18	1.04	1.32	0.31
$100\sigma_b$, preference	16.95	15.18	7.49	27.02	0.11
$100\sigma_m$, monetary policy	0.21	0.21	0.18	0.23	0.35
$100\sigma_i$, investment	1.30	1.30	1.08	1.53	0.01
$100\sigma_w$, wage markup	0.23	0.23	0.19	0.27	0.38
$100\sigma_p$, price markup	0.13	0.13	0.07	0.18	0.05
$100\sigma_G$, govt cons	2.05	2.04	1.79	2.30	0.17
$100\sigma_Z$, transfers	0.78	0.66	0.37	1.24	0.01
$\bar{L}$, mean hours obs	468.98	468.85	466.23	471.74	0.07
$\bar{\pi}$, mean inflation obs	0.75	0.75	0.34	1.17	0.51

Table 15: Posterior Estimates for Regime F over 1955q1–1979q4. Reports the posterior mean, median, 90% credible interval, and the p-value for Geweke's Separated Partial Means test. Final acceptance rate: 31%. 1,500,000 draws were made, with the first 500,000 used as a burn-in period, and one every 50 draws kept afterwards.

Parameters	Posterior				
	mean	median	5	95	Geweke χ^2 p
Preference and HHs					
ξ, inverse Frisch labor elast.	2.22	2.17	1.37	3.09	0.01
θ, habit formation	0.94	0.94	0.91	0.98	0.02
α_G, G in utility	-0.07	-0.07	-0.32	0.17	0.27
Frictions & Production					
100γ, SS tech growth	0.35	0.35	0.28	0.42	0.18
ψ, capital utilization	0.37	0.36	0.16	0.56	0.17
s, inv adj cost	7.21	7.18	5.25	9.13	0.04
ω_p, price stickiness	0.96	0.96	0.94	0.99	0.18
ω_w, wage stickiness	0.81	0.82	0.74	0.88	0.01
χ_p, price indexation	0.41	0.24	0.05	0.91	0.21
χ_w, wage indexation	0.20	0.19	0.07	0.32	0.48
Monetary Policy					
ϕ_π, interest rate resp. to inflation	0.33	0.31	0.12	0.54	0.31
ϕ_y, interest rate resp. to output	0.15	0.15	0.10	0.20	0.01
ρ_r, lagged interest rate resp.	0.52	0.51	0.33	0.75	0.60
Fiscal Policy					
γ_G, govt cons. resp. to debt	0.0001	0.0001	-0.0015	0.0018	0.73
γ_Z, transfer resp. to debt	-0.0000	-0.0000	-0.0017	0.0016	0.20
ρ_G, lagged govt cons resp.	0.97	0.97	0.95	0.98	0.52
ρ_Z, lagged transfer resp.	0.98	0.98	0.96	1.00	0.01
Shocks					
ρ_a, technology	0.30	0.30	0.15	0.44	0.30
ρ_b, preference	0.52	0.52	0.34	0.69	0.02
ρ_{em}, monetary policy	0.78	0.82	0.59	0.93	0.67
ρ_i, investment	0.69	0.69	0.58	0.79	0.99
ρ_w, wage markup	0.37	0.37	0.21	0.54	0.78
ρ_p, price markup	0.43	0.54	0.02	0.77	0.11
ρ_{eg}, govt cons	0.19	0.19	0.09	0.30	0.15
ρ_{ez}, transfers	0.84	0.86	0.71	0.96	0.22
$100\sigma_a$, technology	0.81	0.81	0.72	0.91	0.36
$100\sigma_b$, preference	8.49	7.77	3.90	13.20	0.02
$100\sigma_m$, monetary policy	0.15	0.15	0.13	0.17	0.99
$100\sigma_i$, investment	0.51	0.51	0.41	0.62	0.67
$100\sigma_w$, wage markup	0.26	0.26	0.20	0.32	0.19
$100\sigma_p$, price markup	0.08	0.08	0.05	0.12	0.07
$100\sigma_G$, govt cons	1.74	1.73	1.53	1.96	0.11
$100\sigma_Z$, transfers	1.35	1.22	0.38	2.32	0.17
$\bar{L}$, mean hours obs	469.89	469.85	467.65	472.08	0.02
$\bar{\pi}$, mean inflation obs	0.72	0.72	0.30	1.13	0.42

Table 16: Posterior Estimates for Regime F over 1982q1–2007q4. Reports the posterior mean, median, 90% credible interval, and the p-value for Geweke's Separated Partial Means test. Final acceptance rate: 30%. 1,500,000 draws were made, with the first 500,000 used as a burn-in period, and one every 50 draws kept afterwards.

Prob$\left(PV\frac{\Delta Y}{\Delta G} > 1\right)$ **& Prob**$\left(PV\frac{\Delta C}{\Delta G} > 0\right)$ **& Prob**$\left(PV\frac{\Delta I}{\Delta G} > 0\right)$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Prior		0.00	0.00	0.00	0.00	0.01
Posterior						
	1955q1-2014q2	0.00	0.00	0.00	0.00	0.00
	1955q1-2007q4	0.00	0.00	0.00	0.00	0.00
	1955q1-1979q4	0.00	0.00	0.00	0.00	0.00
	1982q1-2007q4	0.00	0.00	0.00	0.00	0.00

Prob$\left(PV\frac{\Delta Y}{\Delta G} > 1\right)$ **& Prob**$\left(PV\frac{\Delta C}{\Delta G} > 0\right)$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Prior		0.39	0.33	0.24	0.19	0.18
Posterior						
	1955q1-2014q2	0.99	0.94	0.18	0.02	0.03
	1955q1-2007q4	0.95	0.22	0.00	0.00	0.00
	1955q1-1979q4	0.99	0.66	0.00	0.00	0.00
	1982q1-2007q4	0.94	0.51	0.00	0.00	0.00

Prob$\left(PV\frac{\Delta C}{\Delta G} > 0\right)$ **& Prob**$\left(PV\frac{\Delta I}{\Delta G} > 0\right)$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Prior		0.00	0.00	0.00	0.00	0.01
Posterior						
	1955q1-2014q2	0.00	0.00	0.00	0.00	0.00
	1955q1-2007q4	0.00	0.00	0.00	0.00	0.00
	1955q1-1979q4	0.00	0.00	0.00	0.00	0.00
	1982q1-2007q4	0.00	0.00	0.00	0.00	0.00

Table 17: Prior versus posterior joint multipliers for Regime M. Joint multiplier probabilities for observing combinations of present-value output, consumption, and investment present-value multipliers.

Prob$\left(PV\frac{\Delta Y}{\Delta G} > 1\right)$ **& Prob**$\left(PV\frac{\Delta C}{\Delta G} > 0\right)$ **& Prob**$\left(PV\frac{\Delta I}{\Delta G} > 0\right)$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Prior		0.16	0.10	0.10	0.18	0.23
Posterior						
	1955q1-2014q2	0.39	0.40	0.45	0.58	0.70
	1955q1-2007q4	0.06	0.06	0.08	0.16	0.26
	1955q1-1979q4	0.00	0.00	0.00	0.01	0.04
	1982q1-2007q4	0.11	0.09	0.09	0.15	0.34

Prob$\left(PV\frac{\Delta Y}{\Delta G} > 1\right)$ **& Prob**$\left(PV\frac{\Delta C}{\Delta G} > 0\right)$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Prior		0.56	0.52	0.49	0.50	0.53
Posterior						
	1955q1-2014q2	0.97	0.98	0.99	1.00	1.00
	1955q1-2007q4	0.93	0.94	0.95	0.98	0.99
	1955q1-1979q4	0.98	0.96	0.81	0.86	0.86
	1982q1-2007q4	0.64	0.56	0.43	0.36	0.49

Prob$\left(PV\frac{\Delta C}{\Delta G} > 0\right)$ **& Prob**$\left(PV\frac{\Delta I}{\Delta G} > 0\right)$

		Impact	4 qtrs	10 qtrs	25 qtrs	10 years
Prior		0.16	0.10	0.10	0.18	0.23
Posterior						
	1955q1-2014q2	0.39	0.40	0.45	0.58	0.70
	1955q1-2007q4	0.06	0.06	0.08	0.16	0.26
	1955q1-1979q4	0.00	0.00	0.00	0.01	0.04
	1982q1-2007q4	0.11	0.09	0.09	0.15	0.34

Table 18: Prior versus posterior joint multipliers for Regime F. Joint multiplier probabilities for observing combinations of present-value output, consumption, and investment present-value multipliers.

RMSD for Output on Impact

Regime	Period	Rank 1	2	3	4	5	% of total
M	1955q1–2014q2	α_G	ϕ_π	γ_Z	ϕ_y	ω_w	70.9
F	1955q1–2014q2	α_G	ω_p	ρ_G	ϕ_y	ω_w	84.9
M	1955q1–2007q4	α_G	ϕ_y	ϕ_π	s	ρ_{eg}	80.1
F	1955q1–2007q4	α_G	ω_p	ρ_G	ϕ_y	ω_w	84.8
M	1955q1–1979q4	α_G	ρ_{eg}	ϕ_y	ρ_G	s	72.1
F	1955q1–1979q4	α_G	ϕ_y	ω_p	ρ_{eg}	ρ_G	73.5
M	1982q1–2007q4	α_G	ψ	ϕ_y	ρ_{eg}	ϕ_π	76.4
F	1982q1–2007q4	ω_p	α_G	χ_p	ϕ_y	ρ_G	79.9

RMSD for Consumption on Impact

Regime	Period	Rank 1	2	3	4	5	% of total
M	1955q1–2014q2	α_G	γ_Z	θ	ϕ_π	γ_G	96.2
F	1955q1–2014q2	α_G	ω_p	ρ_G	ϕ_y	θ	97.4
M	1955q1–2007q4	α_G	θ	ρ_G	ϕ_π	γ_G	84.8
F	1955q1–2007q4	α_G	ω_p	ρ_G	ϕ_y	θ	97.1
M	1955q1–1979q4	α_G	θ	ρ_G	ρ_{eg}	γ_G	88.1
F	1955q1–1979q4	α_G	θ	ω_p	ϕ_y	ρ_{eg}	93.1
M	1982q1–2007q4	α_G	θ	ρ_G	ρ_{eg}	ϕ_y	90.7
F	1982q1–2007q4	α_G	ω_p	χ_p	θ	ϕ_y	89.6

RMSD for Output after 25 qtrs

Regime	Period	Rank 1	2	3	4	5	% of total
M	1955q1–2014q2	ϕ_π	γ_Z	α_G	ϕ_y	γ_G	62.6
F	1955q1–2014q2	ω_p	ρ_G	ϕ_y	ω_w	ϕ_π	80.5
M	1955q1–2007q4	ϕ_π	α_G	γ_Z	ϕ_y	s	68.2
F	1955q1–2007q4	ω_p	ρ_G	ϕ_y	ω_w	ϕ_π	81.3
M	1955q1–1979q4	α_G	ϕ_y	ϕ_π	ω_w	ρ_G	53.1
F	1955q1–1979q4	ω_p	ϕ_y	α_G	ρ_G	ϕ_π	67.2
M	1982q1–2007q4	ϕ_π	ρ_G	α_G	ϕ_y	ω_p	61.9
F	1982q1–2007q4	ω_p	χ_p	ϕ_π	ϕ_y	ρ_G	84.0

RMSD for Consumption after 25 qtrs

Regime	Period	Rank 1	2	3	4	5	% of total
M	1955q1–2014q2	α_G	γ_Z	ϕ_π	θ	γ_G	80.3
F	1955q1–2014q2	α_G	ω_p	ρ_G	ϕ_y	θ	83.8
M	1955q1–2007q4	α_G	θ	ρ_G	γ_G	ϕ_π	77.8
F	1955q1–2007q4	α_G	ω_p	ϕ_y	ρ_G	θ	82.6
M	1955q1–1979q4	α_G	θ	ρ_G	ψ	γ_G	80.6
F	1955q1–1979q4	α_G	θ	ω_p	ψ	ϕ_y	81.3
M	1982q1–2007q4	θ	α_G	ρ_G	ψ	ϕ_π	80.3
F	1982q1–2007q4	ω_p	α_G	χ_p	ϕ_π	ϕ_y	84.6

Table 19: Root mean square deviations for estimated models. The five most influential parameters for multipliers according to the RMSD criterion that the text describes. Right column reports the total percentage contribution of those parameters to variation in the multiplier.

	Series							
	Cons. growth	Inv. growth	Wage growth	Govt Spend. growth	Govt Debt growth	Hours Worked	Inflation	Interest Rate
1955q1–2014q2								
Data	0.53	3.27	0.71	1.86	2.99	3.57	0.57	0.88
Regime M	[0.50, 0.66]	[3.64, 4.84]	[0.84, 1.05]	[1.96, 2.61]	[3.40, 7.74]	[2.63, 8.68]	[0.55, 1.94]	[0.61, 2.14]
Regime F	[0.51, 0.67]	[3.59, 4.68]	[0.84, 1.06]	[1.96, 2.39]	[3.16, 4.09]	[2.83, 7.31]	[0.58, 1.70]	[0.60, 1.70]
1955q1–2007q4								
Data	0.50	3.24	0.61	1.87	2.74	2.72	0.58	0.82
Regime M	[0.47, 0.62]	[3.25, 4.25]	[0.74, 0.95]	[1.93, 2.52]	[3.14, 7.40]	[1.68, 4.27]	[0.49, 1.93]	[0.59, 2.11]
Regime F	[0.48, 0.63]	[3.39, 4.45]	[0.75, 0.98]	[1.95, 2.41]	[2.94, 3.74]	[2.23, 5.45]	[0.51, 1.45]	[0.57, 1.50]
1955q1–1979q4								
Data	0.53	3.82	0.50	2.00	2.49	2.68	0.66	0.67
Regime M	[0.53, 0.78]	[3.30, 4.80]	[0.64, 0.93]	[2.05, 2.89]	[2.81, 5.30]	[1.53, 3.04]	[0.44, 1.40]	[0.51, 1.53]
Regime F	[0.52, 0.77]	[3.42, 4.94]	[0.62, 0.91]	[2.06, 2.89]	[2.72, 3.74]	[1.74, 3.97]	[0.43, 1.05]	[0.47, 1.13]
1982q1–2007q4								
Data	0.42	2.23	0.70	1.73	2.79	2.66	0.26	0.69
Regime M	[0.39, 0.64]	[2.22, 3.57]	[0.72, 1.05]	[1.60, 2.34]	[2.67, 6.95]	[1.54, 4.20]	[0.28, 0.98]	[0.40, 1.23]
Regime F	[0.42, 0.68]	[2.17, 3.35]	[0.73, 1.06]	[1.66, 2.30]	[2.42, 3.44]	[1.64, 4.30]	[0.33, 1.03]	[0.40, 1.11]

Table 20: Standard deviations implied by the data, as well as 90 posterior credible intervals accounting for parameter and small sample uncertainty from the model.

	Log Marginal Data Density											
	1955q1–2014q2			**1955q1–2007q4**			**1955q1–1979q4**			**1982q1–2007q4**		
	RoT	Gutil	RoT & Gutil	RoT	Gutil	RoT & Gutil	RoT	Gutil	RoT & Gutil	RoT	Gutil	RoT & Gutil
Regime M	-2563	-2557	-2565	-2217	-2211	-2218	-1128	-1121	-1127	-963	-957	-963
Regime F	-2554	-2549	-2555	-2227	-2222	-2229	-1129	-1125	-1129	-973	-969	-976

Table 21: Log marginal data densities. "RoT" denotes the rule-of-thumb specification while "Gutil" denotes the government spending-in-the-utility framework. "RoT & Gutil" denotes a specification with both rule-of-thumb consumers and government-spending-in-the-utility.

RBC Versions: $PV\frac{\Delta Y}{\Delta G}$

	Impact	4 quart.	10 quart.	25 quart.	10 years
V1: Lump-Sum Z Finance, no AR(1) term ($\rho_{eg}=0$)	0.05	-0.02	-0.15	-0.34	-0.42
	[0.02, 0.09]	[-0.08, 0.04]	[-0.24, -0.05]	[-0.46, -0.22]	[-0.55, -0.29]
V2: Lump-Sum Z Finance, $\rho_g = 0.99$, no AR(1) term ($\rho_{eg}=0$)	0.30	0.31	0.31	0.31	0.31
	[0.22, 0.39]	[0.22, 0.40]	[0.21, 0.40]	[0.21, 0.41]	[0.20, 0.42]
V3: Lump-Sum Z Finance	0.11	0.04	-0.08	-0.27	-0.35
	[0.03, 0.19]	[-0.05, 0.11]	[-0.20, 0.03]	[-0.42, -0.13]	[-0.50, -0.20]
V4: Gov. Spending Finance	0.09	0.00	-0.17	-0.65	-1.21
	[0.02, 0.15]	[-0.07, 0.08]	[-0.31, -0.04]	[-0.97, -0.33]	[-1.86, -0.56]
V5: Labor Tax Finance	0.12	0.04	-0.12	-0.42	-0.59
	[0.03, 0.20]	[-0.05, 0.12]	[-0.25, 0.01]	[-0.60, -0.24]	[-0.80, -0.40]
V6: All Finance	0.09	-0.00	-0.21	-0.70	-1.05
	[0.02, 0.16]	[-0.08, 0.08]	[-0.36, -0.06]	[-1.03, -0.38]	[-1.52, -0.56]
V7: All Finance, variable utilization	0.09	0.02	-0.15	-0.58	-0.88
	[0.02, 0.17]	[-0.06, 0.09]	[-0.31, -0.01]	[-0.89, -0.23]	[-1.33, -0.40]
V8: All Finance, inv. costs	0.27	0.23	0.11	-0.27	-0.57
	[0.20, 0.34]	[0.17, 0.30]	[0.02, 0.19]	[-0.47, -0.03]	[-0.93, -0.18]
V9: All Finance, cons. habit	0.09	-0.00	-0.22	-0.73	-1.10
	[0.02, 0.17]	[-0.08, 0.07]	[-0.37, -0.07]	[-1.06, -0.41]	[-1.58, -0.60]
V10: All Finance, Real Frictions	0.50	0.33	0.13	-0.32	-1.15
	[0.31, 0.71]	[0.20, 0.45]	[-0.01, 0.27]	[-0.70, 0.10]	[-1.32, 0.05]
V11: All Finance, Frictions & Nonsavers	0.63	0.41	0.13	-0.49	-0.91
	[0.38, 0.88]	[0.25, 0.57]	[-0.03, 0.32]	[-1.01, 0.11]	[-2.07, 0.05]
V12: All Finance, Frictions & G in utility	0.54	0.36	0.14	-0.46	-1.17
	[-0.35, 1.42]	[-0.25, 0.96]	[-0.24, 0.56]	[-1.00, 0.26]	[-2.34, 0.24]

Table 22: Multipliers for output following gov. spending shock. Prior mean and 90 percent credible intervals [in brackets].

RBC Versions: $PV\frac{\Delta C}{\Delta G}$

	Impact	4 quart.	10 quart.	25 quart.	10 years
V1: Lump-Sum Z Finance, no AR(1) term ($\rho_{eg} = 0$)	-0.13	-0.23	-0.43	-0.72	-0.83
	[-0.20, -0.06]	[-0.27, -0.20]	[-0.45, -0.41]	[-0.76, -0.67]	[-0.88, -0.77]
V2: Lump-Sum Z Finance, $\rho_g = 0.99$,	-0.71	-0.71	-0.71	-0.70	-0.70
no AR(1) term ($\rho_{eg} = 0$)	[-0.76, -0.67]	[-0.76, -0.67]	[-0.76, -0.66]	[-0.77, -0.64]	[-0.77, -0.63]
V3: Lump-Sum Finance	-0.25	-0.27	-0.42	-0.70	-0.81
	[-0.43, -0.08]	[-0.35, -0.20]	[-0.44, -0.39]	[-0.75, -0.65]	[-0.87, -0.75]
V4: Gov. Spending Finance	-0.20	-0.21	-0.35	-0.69	-0.94
	[-0.35, -0.06]	[-0.29, -0.15]	[-0.38, -0.32]	[-0.74, -0.63]	[-1.09, -0.80]
V5: Labor Tax Finance	-0.27	-0.29	-0.46	-0.81	-0.99
	[-0.47, -0.09]	[-0.37, -0.22]	[-0.48, -0.43]	[-0.87, -0.74]	[-1.08, -0.90]
V6: All Finance	-0.20	-0.21	-0.36	-0.73	-0.97
	[-0.36, -0.06]	[-0.30, -0.13]	[-0.44, -0.29]	[-0.86, -0.61]	[-1.14, -0.80]
V7: All Finance, variable utilization	-0.18	-0.19	-0.32	-0.66	-0.89
	[-0.31, -0.05]	[-0.27, -0.11]	[-0.40, -0.25]	[-0.78, -0.53]	[-1.05, -0.73]
V8: All Finance, inv. costs	-0.64	-0.60	-0.56	-0.71	-0.90
	[-0.71, -0.57]	[-0.67, -0.53]	[-0.65, -0.48]	[-0.86, -0.56]	[-1.10, -0.69]
V9: All Finance, cons. habit	-0.11	-0.16	-0.33	-0.71	-0.98
	[-0.20, -0.01]	[-0.25, -0.07]	[-0.42, -0.24]	[-0.85, -0.59]	[-1.15, -0.80]
V10: All Finance, Real Frictions	-0.45	-0.53	-0.57	-0.73	-0.93
	[-0.64, -0.26]	[-0.66, -0.42]	[-0.68, -0.46]	[-0.92, -0.53]	[-1.22, -0.64]
V11: All Finance, Frictions & Nonsavers	-0.31	-0.42	-0.51	-0.81	-1.05
	[-0.55, -0.07]	[-0.59, -0.26]	[-0.66, -0.34]	[-1.14, -0.46]	[-1.67, -0.57]
V12: All Finance, Frictions & G in utility	-0.41	-0.49	-0.53	-0.67	-1.04
	[-1.35, 0.52]	[-1.29, 0.30]	[-1.28, 0.24]	[-1.29, 0.01]	[-1.39, -0.15]

Table 23: Multipliers for consumption following gov. spending shock. Prior mean and 90 percent credible intervals [in brackets].

RBC Versions: $PV\frac{\Delta I}{\Delta G}$

	Impact	4 quart.	10 quart.	25 quart.	10 years
V1: Lump-Sum Z Finance, no AR(1) term ($\rho_{eg}=0$)	-0.82	-0.79	-0.72	-0.63	-0.59
	[-0.92, -0.71]	[-0.87, -0.68]	[-0.80, -0.63]	[-0.70, -0.54]	[-0.67, -0.50]
V2: Lump-Sum Z Finance, $\rho_g=0.99$,	0.02	0.02	0.02	0.01	0.01
no AR(1) term ($\rho_{eg}=0$)	[-0.03, 0.06]	[-0.03, 0.06]	[-0.03, 0.06]	[-0.02, 0.05]	[-0.02, 0.05]
V3: Lump-Sum Z Finance	-0.64	-0.70	-0.66	-0.57	-0.54
	[-0.88, -0.38]	[-0.84, -0.55]	[-0.77, -0.55]	[-0.67, -0.48]	[-0.63, -0.44]
V4: Gov. Spending Finance	-0.71	-0.78	-0.82	-0.97	-1.27
	[-0.91, -0.50]	[-0.92, -0.64]	[-0.97, -0.68]	[-1.24, -0.70]	[-1.77, -0.76]
V5: Labor Tax Finance	-0.61	-0.68	-0.66	-0.61	-0.60
	[-0.87, -0.34]	[-0.84, -0.51]	[-0.78, -0.54]	[-0.72, -0.49]	[-0.71, -0.48]
V6: All Finance	-0.71	-0.79	-0.84	-0.97	-1.07
	[-0.92, -0.49]	[-0.94, -0.63]	[-1.04, -0.67]	[-1.29, -0.67]	[-1.46, -0.65]
V7: All Finance, variable utilization	-0.74	-0.82	-0.88	-1.04	-1.15
	[-0.93, -0.54]	[-0.96, -0.67]	[-1.07, -0.71]	[-1.35, -0.74]	[-1.55, -0.75]
V8: All Finance, inv. costs	-0.08	-0.17	-0.33	-0.56	-0.68
	[-0.13, -0.04]	[-0.23, -0.11]	[-0.43, -0.22]	[-0.80, -0.32]	[-1.02, -0.32]
V9: All Finance, cons. habit	-0.80	-0.84	-0.89	-1.02	-1.12
	[-0.95, -0.64]	[-0.99, -0.69]	[-1.09, -0.70]	[-1.34, -0.70]	[-1.54, -0.70]
V10: All Finance, Real Frictions	-0.10	-0.17	-0.31	-0.57	-1.09
	[-0.15, -0.04]	[-0.24, -0.10]	[-0.43, -0.20]	[-0.84, -0.32]	[-1.14, -0.29]
V11: All Finance, Frictions & Nonsavers	-0.12	-0.21	-0.37	-0.64	-0.82
	[-0.19, -0.05]	[-0.30, -0.12]	[-0.51, -0.23]	[-0.93, -0.31]	[-1.37, -0.26]
V12: All Finance, Frictions & G in utility	-0.11	-0.19	-0.35	-0.74	-1.03
	[-0.28, 0.06]	[-0.47, 0.09]	[-0.82, 0.12]	[-1.52, 0.13]	[-2.14, 0.14]

Table 24: Multipliers for investment following gov. spending shock. Prior mean and 90 percent credible intervals [in brackets].

Closed New Keynesian Models Regime M: $PV\frac{\Delta Y}{\Delta G}$

	Impact	4 quart.	10 quart.	25 quart.	10 years
V1: Sticky Prices	0.75	0.52	0.33	0.02	-0.19
	[0.41, 1.09]	[0.28, 0.78]	[0.11, 0.56]	[-0.33, 0.42]	[-0.71, 0.32]
V2: Sticky Wages	0.22	0.15	-0.08	-0.42	-0.65
	[0.01, 0.42]	[-0.03, 0.33]	[-0.37, 0.22]	[-1.87, 0.13]	[-4.37, 0.10]
V3: Sticky Prices & Wages	0.81	0.65	0.48	0.23	0.06
	[0.55, 1.08]	[0.40, 0.91]	[0.19, 0.75]	[-0.22, 0.66]	[-0.54, 0.64]
V4: Sticky Prices & Wages, $\gamma_C > 0$	0.82	0.66	0.48	0.23	0.06
	[0.56, 1.09]	[0.40, 0.91]	[0.19, 0.74]	[-0.20, 0.68]	[-0.51, 0.65]
V5: Sticky Wages & Nonsavers	0.27	0.18	-0.20	-0.50	0.53
	[0.01, 0.52]	[-0.06, 0.41]	[-0.61, 0.25]	[-3.77, 0.13]	[-8.34, 3.77]
V6: Sticky Prices, Wages, & Nonsavers	1.03	0.84	0.61	0.33	0.15
	[0.65, 1.40]	[0.48, 1.19]	[0.25, 0.97]	[-0.22, 0.86]	[-0.55, 0.86]
V7: Sticky Prices, Wages, & Nonsavers, $\gamma_C > 0$	1.03	0.84	0.61	0.33	0.16
	[0.66, 1.41]	[0.48, 1.18]	[0.24, 0.97]	[-0.24, 0.85]	[-0.54, 0.85]
V8: Sticky Prices, Wages, & Nonsavers, $Z_t^S \neq Z_t^N$	1.03	0.83	0.61	0.32	0.15
	[0.67, 1.42]	[0.48, 1.18]	[0.25, 0.97]	[-0.23, 0.87]	[-0.57, 0.84]
V9: Sticky Prices, Wages, & G-in-Util	0.84	0.68	0.51	0.25	0.08
	[-0.57, 2.15]	[-0.50, 1.78]	[-0.49, 1.49]	[-0.75, 1.28]	[-0.96, 1.21]
V10: Sticky Prices, Wages, Nonsavers, & G-in-Util	1.05	0.86	0.63	0.34	0.16
	[-0.21, 2.24]	[-0.20, 1.88]	[-0.28, 1.53]	[-0.57, 1.32]	[-0.83, 1.27]

Table 25: Multipliers for output following gov. spending shock. Prior mean and 90 percent credible intervals [in brackets].

Closed New Keynesian Models Regime M: $PV\frac{\Delta C}{\Delta G}$

	Impact	4 quart.	10 quart.	25 quart.	10 years
V1: Sticky Prices	-0.31	-0.42	-0.47	-0.60	-0.74
	[-0.52, -0.10]	[-0.59, -0.26]	[-0.59, -0.34]	[-0.77, -0.43]	[-0.96, -0.50]
V2: Sticky Wages	-0.69	-0.67	-0.71	-0.83	-1.03
	[-0.90, -0.49]	[-0.85, -0.50]	[-0.93, -0.48]	[-1.51, -0.52]	[-2.62, -0.60]
V3: Sticky Prices & Wages	-0.22	-0.30	-0.35	-0.44	-0.54
	[-0.40, -0.03]	[-0.47, -0.13]	[-0.51, -0.19]	[-0.67, -0.21]	[-0.87, -0.23]
V4: Sticky Prices & Wages, $\gamma_C > 0$	-0.21	-0.30	-0.35	-0.45	-0.56
	[-0.39, -0.03]	[-0.47, -0.12]	[-0.51, -0.19]	[-0.68, -0.22]	[-0.87, -0.24]
V5: Sticky Wages & Nonsavers	-0.60	-0.61	-0.74	-0.81	-0.36
	[-0.86, -0.35]	[-0.82, -0.37]	[-1.05, -0.37]	[-2.69, -0.42]	[-5.19, 1.46]
V6: Sticky Prices, Wages, & Nonsavers	-0.01	-0.12	-0.20	-0.34	-0.46
	[-0.29, 0.28]	[-0.37, 0.12]	[-0.42, 0.02]	[-0.66, -0.04]	[-0.88, -0.06]
V7: Sticky Prices, Wages, & Nonsavers, $\gamma_C > 0$	-0.01	-0.12	-0.20	-0.35	-0.48
	[-0.28, 0.28]	[-0.37, 0.13]	[-0.42, 0.02]	[-0.66, -0.05]	[-0.89, -0.08]
V8: Sticky Prices, Wages, & Nonsavers, $Z_t^S \neq Z_t^N$	-0.01	-0.12	-0.20	-0.34	-0.47
	[-0.28, 0.28]	[-0.37, 0.12]	[-0.43, 0.02]	[-0.65, -0.03]	[-0.88, -0.06]
V9: Sticky Prices, Wages, & G-in-Util	-0.19	-0.27	-0.31	-0.40	-0.51
	[-1.55, 1.02]	[-1.46, 0.84]	[-1.44, 0.75]	[-1.49, 0.65]	[-1.55, 0.57]
V10: Sticky Prices, Wages, Nonsavers, & G-in-Util	0.01	-0.09	-0.17	-0.31	-0.44
	[-1.16, 1.14]	[-1.15, 0.93]	[-1.17, 0.79]	[-1.31, 0.62]	[-1.43, 0.52]

Table 26: Multipliers for consumption following gov. spending shock. Prior mean and 90 percent credible intervals [in brackets].

Closed New Keynesian Models Regime M: $PV\frac{\Delta I}{\Delta G}$

	Impact	4 quart.	10 quart.	25 quart.	10 years
V1: Sticky Prices	-0.08	-0.14	-0.26	-0.44	-0.52
	[-0.13, -0.02]	[-0.22, -0.07]	[-0.38, -0.15]	[-0.65, -0.22]	[-0.81, -0.24]
V2: Sticky Wages	-0.12	-0.19	-0.35	-0.61	-0.65
	[-0.19, -0.05]	[-0.28, -0.11]	[-0.50, -0.21]	[-1.26, -0.24]	[-2.32, -0.10]
V3: Sticky Prices & Wages	-0.06	-0.12	-0.23	-0.38	-0.46
	[-0.11, -0.01]	[-0.19, -0.04]	[-0.35, -0.10]	[-0.61, -0.16]	[-0.76, -0.16]
V4: Sticky Prices & Wages, $\gamma_C > 0$	-0.06	-0.12	-0.23	-0.38	-0.44
	[-0.11, -0.01]	[-0.19, -0.04]	[-0.35, -0.11]	[-0.60, -0.15]	[-0.73, -0.15]
V5: Sticky Wages & Nonsavers	-0.16	-0.24	-0.42	-0.76	-0.14
	[-0.24, -0.06]	[-0.34, -0.13]	[-0.59, -0.24]	[-1.59, -0.17]	[-3.08, 0.65]
V6: Sticky Prices, Wages, & Nonsavers	-0.07	-0.14	-0.26	-0.40	-0.46
	[-0.13, -0.01]	[-0.23, -0.05]	[-0.40, -0.11]	[-0.65, -0.14]	[-0.79, -0.14]
V7: Sticky Prices, Wages, & Nonsavers, $\gamma_C > 0$	-0.07	-0.14	-0.26	-0.39	-0.44
	[-0.14, -0.02]	[-0.23, -0.05]	[-0.40, -0.11]	[-0.65, -0.15]	[-0.76, -0.12]
V8: Sticky Prices, Wages, & Nonsavers, $Z_t^S \neq Z_t^N$	-0.07	-0.14	-0.26	-0.40	-0.46
	[-0.14, -0.01]	[-0.23, -0.05]	[-0.40, -0.11]	[-0.68, -0.18]	[-0.78, -0.14]
V9: Sticky Prices, Wages, & G-in-Util	-0.06	-0.12	-0.24	-0.41	-0.48
	[-0.17, 0.04]	[-0.32, 0.06]	[-0.57, 0.08]	[-0.88, 0.04]	[-1.02, -0.01]
V10: Sticky Prices, Wages, Nonsavers, & G-in-Util	-0.08	-0.15	-0.27	-0.42	-0.48
	[-0.18, 0.01]	[-0.32, 0.02]	[-0.57, 0.01]	[-0.86, -0.02]	[-0.98, -0.02]

Table 27: Multipliers for investment following gov. spending shock. Prior mean and 90 percent credible intervals [in brackets].

Closed New Keynesian Models Regime F: $PV\frac{\Delta Y}{\Delta G}$

	Impact	4 quart.	10 quart.	25 quart.	10 years
V1a: Sticky Prices, short debt	1.54	0.99	0.79	0.74	0.72
	[0.68, 2.25]	[0.41, 1.55]	[0.29, 1.35]	[0.17, 1.37]	[0.13, 1.39]
V1b: Sticky Prices, long debt	1.23	0.81	0.63	0.56	0.54
	[0.62, 1.68]	[0.36, 1.22]	[0.26, 1.04]	[0.15, 1.01]	[0.10, 1.00]
V2a: Sticky Prices & Wages, short debt	1.69	1.59	1.64	1.89	2.01
	[1.06, 2.35]	[1.06, 2.10]	[0.98, 2.24]	[0.94, 2.89]	[0.92, 3.26]
V2b: Sticky Prices & Wages, long debt	1.32	1.19	1.13	1.22	1.27
	[0.93, 1.68]	[0.81, 1.54]	[0.66, 1.57]	[0.57, 1.85]	[0.53, 2.01]
V3a: Sticky Prices, Wages, & Nonsavers, short debt	1.91	1.78	1.80	2.03	2.14
	[1.24, 2.56]	[1.20, 2.30]	[1.09, 2.41]	[1.04, 3.05]	[0.92, 3.32]
V3b: Sticky Prices, Wages, & Nonsavers, long debt	1.53	1.36	1.27	1.33	1.37
	[1.08, 1.91]	[0.95, 1.77]	[0.75, 1.72]	[0.65, 1.98]	[0.61, 2.14]
V4a: Sticky Prices, Wages, & Nonsavers, $Z_t^S \neq Z_t^N$, short debt	1.92	1.79	1.80	2.02	2.13
	[1.23, 2.58]	[1.17, 2.30]	[1.08, 2.44]	[1.00, 3.03]	[0.96, 3.37]
V4b: Sticky Prices, Wages, & Nonsavers, $Z_t^S \neq Z_t^N$, long debt	1.54	1.37	1.27	1.33	1.37
	[1.10, 1.94]	[0.94, 1.78]	[0.74, 1.73]	[0.63, 1.97]	[0.60, 2.13]
V5a: Sticky Prices, Wages, & G-in-Util, short debt	1.70	1.62	1.66	1.91	2.03
	[-0.04, 3.15]	[0.36, 2.88]	[0.55, 2.75]	[0.60, 3.12]	[0.62, 3.38]
V5b: Sticky Prices, Wages, & G-in-Util, long debt	1.33	1.21	1.16	1.24	1.29
	[-0.16, 2.74]	[0.04, 2.38]	[0.23, 2.12]	[0.32, 2.18]	[0.31, 2.24]
V6a: Sticky Prices, Wages, Nonsavers, & G-in-Util, short debt	1.92	1.79	1.81	2.04	2.15
	[0.36, 3.23]	[0.62, 2.92]	[0.78, 2.85]	[0.75, 3.22]	[0.77, 3.52]
V6b: Sticky Prices, Wages, Nonsavers, & G-in-Util, long debt	1.54	1.37	1.28	1.34	1.38
	[0.22, 2.79]	[0.29, 2.40]	[0.40, 2.14]	[0.46, 2.25]	[0.39, 2.27]

Table 28: Multipliers for output following gov. spending shock. Prior mean and 90 percent credible intervals [in brackets].

Closed New Keynesian Models Regime F: $PV\frac{\Delta C}{\Delta G}$

	Impact	4 quart.	10 quart.	25 quart.	10 years
V1a: Sticky Prices, short debt	0.14	-0.16	-0.26	-0.31	-0.35
	[-0.34, 0.56]	[-0.52, 0.12]	[-0.52, 0.02]	[-0.62, 0.00]	[-0.69, 0.01]
V1b: Sticky Prices, long debt	-0.04	-0.27	-0.35	-0.41	-0.45
	[-0.38, 0.24]	[-0.53, -0.02]	[-0.55, -0.14]	[-0.63, -0.17]	[-0.70, -0.20]
V2a: Sticky Prices & Wages, short debt	0.43	0.32	0.31	0.46	0.56
	[-0.03, 0.94]	[-0.06, 0.63]	[-0.05, 0.61]	[-0.07, 1.01]	[-0.10, 1.36]
V2b: Sticky Prices & Wages, long debt	0.15	0.04	0.00	0.05	0.08
	[-0.14, 0.43]	[-0.21, 0.28]	[-0.26, 0.25]	[-0.33, 0.41]	[-0.40, 0.54]
V3a: Sticky Prices, Wages, & Nonsavers, short debt	0.63	0.51	0.49	0.63	0.72
	[0.12, 1.13]	[0.12, 0.86]	[0.09, 0.83]	[0.07, 1.20]	[0.02, 1.51]
V3b: Sticky Prices, Wages, & Nonsavers, long debt	0.35	0.23	0.16	0.19	0.21
	[0.02, 0.65]	[-0.07, 0.50]	[-0.14, 0.45]	[-0.21, 0.58]	[-0.27, 0.69]
V4a: Sticky Prices, Wages, & Nonsavers, $Z_t^S \neq Z_t^N$, short debt	0.64	0.51	0.49	0.62	0.72
	[0.13, 1.16]	[0.12, 0.89]	[0.07, 0.83]	[0.07, 1.22]	[-0.01, 1.49]
V4b: Sticky Prices, Wages, & Nonsavers, $Z_t^S \neq Z_t^N$, long debt	0.36	0.23	0.16	0.19	0.21
	[0.03, 0.67]	[-0.07, 0.51]	[-0.15, 0.44]	[-0.21, 0.58]	[-0.29, 0.69]
V5a: Sticky Prices, Wages, & G-in-Util, short debt	0.44	0.34	0.33	0.48	0.59
	[-1.06, 1.78]	[-0.82, 1.56]	[-0.72, 1.42]	[-0.58, 1.56]	[-0.57, 1.65]
V5b: Sticky Prices, Wages, & G-in-Util, long debt	0.16	0.07	0.03	0.08	0.11
	[-1.13, 1.52]	[-1.09, 1.22]	[-0.99, 1.06]	[-0.90, 1.00]	[-0.82, 1.01]
V6a: Sticky Prices, Wages, Nonsavers, & G-in-Util, short debt	0.64	0.52	0.50	0.64	0.74
	[-0.73, 1.79]	[-0.54, 1.58]	[-0.41, 1.51]	[-0.36, 1.64]	[-0.29, 1.85]
V6b: Sticky Prices, Wages, Nonsavers, & G-in-Util, long debt	0.36	0.24	0.18	0.21	0.23
	[-0.80, 1.54]	[-0.80, 1.25]	[-0.73, 1.10]	[-0.68, 1.06]	[-0.66, 1.05]

Table 29: Multipliers for consumption following gov. spending shock. Prior mean and 90 percent credible intervals [in brackets].

Closed New Keynesian Models Regime F: $PV\frac{\Delta I}{\Delta G}$

	Impact	4 quart.	10 quart.	25 quart.	10 years
V1a: Sticky Prices, short debt	-0.02	-0.07	-0.14	-0.15	-0.15
	[-0.09, 0.04]	[-0.17, 0.04]	[-0.28, 0.03]	[-0.35, 0.03]	[-0.34, 0.04]
V1b: Sticky Prices, long debt	-0.04	-0.10	-0.17	-0.19	-0.18
	[-0.09, 0.01]	[-0.18, -0.01]	[-0.29, -0.05]	[-0.34, -0.06]	[-0.33, -0.06]
V2a: Sticky Prices & Wages, short debt	0.07	0.09	0.15	0.26	0.29
	[-0.01, 0.15]	[-0.06, 0.20]	[-0.12, 0.37]	[-0.15, 0.66]	[-0.16, 0.74]
V2b: Sticky Prices & Wages, long debt	0.02	0.01	0.00	0.04	0.06
	[-0.03, 0.07]	[-0.08, 0.09]	[-0.17, 0.15]	[-0.22, 0.28]	[-0.21, 0.33]
V3a: Sticky Prices, Wages, & Nonsavers, short debt	0.06	0.07	0.11	0.20	0.23
	[-0.03, 0.14]	[-0.07, 0.18]	[-0.15, 0.34]	[-0.20, 0.63]	[-0.21, 0.71]
V3b: Sticky Prices, Wages, & Nonsavers, long debt	0.00	-0.02	-0.04	-0.02	-0.00
	[-0.05, 0.05]	[-0.12, 0.06]	[-0.22, 0.12]	[-0.28, 0.24]	[-0.27, 0.29]
V4a: Sticky Prices, Wages, & Nonsavers, $Z_t^S \neq Z_t^N$, short debt	0.06	0.07	0.11	0.20	0.23
	[-0.03, 0.14]	[-0.07, 0.19]	[-0.16, 0.34]	[-0.20, 0.63]	[-0.21, 0.71]
V4b: Sticky Prices, Wages, & Nonsavers, $Z_t^S \neq Z_t^N$, long debt	0.01	-0.02	-0.04	-0.02	-0.00
	[-0.05, 0.05]	[-0.11, 0.07]	[-0.21, 0.13]	[-0.27, 0.24]	[-0.27, 0.29]
V5a: Sticky Prices, Wages, & G-in-Util, short debt	0.07	0.09	0.15	0.25	0.28
	[-0.05, 0.19]	[-0.13, 0.28]	[-0.25, 0.51]	[-0.29, 0.83]	[-0.28, 0.90]
V5b: Sticky Prices, Wages, & G-in-Util, long debt	0.02	0.00	-0.01	0.03	0.04
	[-0.09, 0.12]	[-0.20, 0.19]	[-0.37, 0.35]	[-0.47, 0.49]	[-0.47, 0.52]
V6a: Sticky Prices, Wages, Nonsavers, & G-in-Util, short debt	0.06	0.06	0.10	0.19	0.22
	[-0.06, 0.16]	[-0.14, 0.25]	[-0.26, 0.44]	[-0.34, 0.71]	[-0.33, 0.80]
V6b: Sticky Prices, Wages, Nonsavers, & G-in-Util, long debt	0.00	-0.02	-0.05	-0.03	-0.01
	[-0.10, 0.09]	[-0.21, 0.14]	[-0.38, 0.26]	[-0.45, 0.41]	[-0.47, 0.41]

Table 30: Multipliers for investment following gov. spending shock. Prior mean and 90 percent credible intervals [in brackets].

Open New Keynesian Models Regime M: $PV\frac{\Delta Y}{\Delta G}$

		Impact	4 quart.	10 quart.	25 quart.	∞
Basic						
Fin. Autarky, G NonTraded	0.79	0.61	0.38	-0.01	-0.28	
	[0.52, 1.06]	[0.32, 0.89]	[0.03, 0.78]	[-0.76, 0.76]	[-1.34, 0.81]	
Fin. Autarky, G Traded	0.65	0.58	0.42	0.11	-0.09	
	[0.38, 0.91]	[0.34, 0.79]	[0.16, 0.66]	[-0.37, 0.59]	[-0.83, 0.56]	
Fin. Int., G NonTraded	0.75	0.59	0.35	0.03	-0.37	
	[0.48, 1.05]	[0.30, 0.90]	[0.03, 0.77]	[-0.67, 0.79]	[-1.24, 0.84]	
Fin. Int., G Traded	0.61	0.53	0.42	0.16	-0.04	
	[0.33, 0.89]	[0.29, 0.75]	[0.16, 0.67]	[-0.30, 0.68]	[-0.72, 0.68]	
with Nonsavers						
Fin. Autarky, G NonTraded	0.97	0.78	0.51	0.05	-0.23	
	[0.64, 1.32]	[0.42, 1.11]	[0.08, 0.93]	[-0.75, 0.89]	[-1.30, 0.98]	
Fin. Autarky, G Traded	0.80	0.70	0.52	0.17	-0.09	
	[0.45, 1.13]	[0.42, 1.00]	[0.21, 0.81]	[-0.36, 0.71]	[-0.83, 0.67]	
Fin. Int., G NonTraded	0.92	0.76	0.52	0.12	-0.15	
	[0.55, 1.26]	[0.38, 1.09]	[0.08, 0.95]	[-0.65, 0.95]	[-1.26, 0.98]	
Fin. Int., G Traded	0.73	0.63	0.49	0.17	-0.03	
	[0.41, 1.07]	[0.36, 0.92]	[0.19, 0.80]	[-0.29, 0.76]	[-0.71, 0.77]	
with G-in-Utility						
Fin. Autarky, G NonTraded	0.80	0.57	0.40	-0.01	-0.36	
	[-0.44, 1.98]	[-0.45, 1.74]	[-0.54, 1.41]	[-1.11, 1.20]	[-1.67, 1.18]	
Fin. Autarky, G Traded	0.74	0.58	0.44	0.13	-0.14	
	[-0.51, 1.83]	[-0.47, 1.60]	[-0.49, 1.33]	[-0.82, 1.10]	[-1.21, 1.01]	
Fin. Int., G NonTraded	0.78	0.62	0.42	0.12	-0.28	
	[-0.39, 1.91]	[-0.43, 1.63]	[-0.56, 1.41]	[-1.09, 1.28]	[-1.70, 1.23]	
Fin. Int., G Traded	0.61	0.68	0.41	0.15	-0.07	
	[-0.53, 1.72]	[-0.47, 1.50]	[-0.49, 1.36]	[-0.84, 1.23]	[-1.15, 1.26]	

Table 31: Multipliers for output following gov. spending shock from open economy New Keynesian models in regime M. Prior mean and 90 percent credible intervals [in brackets].

Open New Keynesian Models Regime M: $PV\frac{\Delta C}{\Delta G}$

		Impact	4 quart.	10 quart.	25 quart.	∞
Basic						
Fin. Autarky, G NonTraded	-0.23	-0.32	-0.41	-0.57	-0.79	
	[-0.48, -0.01]	[-0.59, -0.08]	[-0.72, -0.15]	[-1.14, -0.10]	[-1.64, -0.07]	
Fin. Autarky, G Traded	-0.12	-0.16	-0.23	-0.39	-0.49	
	[-0.34, 0.09]	[-0.44, 0.07]	[-0.53, 0.02]	[-0.79, -0.00]	[-1.13, -0.00]	
Fin. Int., G NonTraded	-0.26	-0.36	-0.71	-0.57	-1.27	
	[-0.51, -0.02]	[-0.61, -0.09]	[-0.72, -0.14]	[-1.14, -0.11]	[-1.61, -0.04]	
Fin. Int., G Traded	-0.13	-0.18	-0.24	-0.38	-0.50	
	[-0.36, 0.03]	[-0.44, 0.03]	[-0.53, 0.02]	[-0.81, -0.00]	[-1.14, -0.02]	
with Nonsavers						
Fin. Autarky, G NonTraded	-0.02	-0.13	-0.25	-0.54	-0.76	
	[-0.34, 0.30]	[-0.45, 0.17]	[-0.58, 0.06]	[-1.08, 0.04]	[-1.57, 0.09]	
Fin. Autarky, G Traded	0.05	-0.03	-0.10	-0.30	-0.48	
	[-0.19, 0.29]	[-0.28, 0.24]	[-0.39, 0.16]	[-0.74, 0.08]	[-1.10, 0.08]	
Fin. Int., G NonTraded	-0.06	-0.13	-0.26	-0.50	-0.70	
	[-0.37, 0.27]	[-0.47, 0.15]	[-0.61, 0.05]	[-1.07, 0.07]	[-1.52, 0.16]	
Fin. Int., G Traded	0.01	-0.06	-0.14	-0.35	-0.50	
	[-0.23, 0.22]	[-0.30, 0.19]	[-0.42, 0.13]	[-0.74, 0.09]	[-1.08, 0.08]	
with G-in-Utility						
Fin. Autarky, G NonTraded	-0.19	-0.39	-0.38	-0.55	-0.90	
	[-1.65, 1.26]	[-1.69, 1.13]	[-1.73, 0.99]	[-1.94, 0.88]	[-2.29, 0.79]	
Fin. Autarky, G Traded	0.11	-0.18	-0.21	-0.30	-0.51	
	[-1.54, 1.30]	[-1.49, 1.24]	[-1.50, 1.12]	[-1.63, 1.01]	[-1.88, 0.89]	
Fin. Int., G NonTraded	-0.21	-0.30	-0.38	-0.37	-0.80	
	[-1.63, 1.22]	[-1.63, 1.08]	[-1.75, 0.95]	[-1.95, 0.89]	[-2.26, 0.83]	
Fin. Int., G Traded	-0.11	0.16	-0.25	-0.37	-0.56	
	[-1.57, 1.21]	[-1.46, 1.16]	[-1.48, 1.10]	[-1.66, 1.01]	[-1.93, 0.90]	

Table 32: Multipliers for consumption following gov. spending shock from open economy New Keynesian models in regime M. Prior mean and 90 percent credible intervals [in brackets].

Open New Keynesian Models Regime M: $PV\frac{\Delta I}{\Delta G}$

		Impact	4 quart.	10 quart.	25 quart.	∞
Basic						
Fin. Autarky, G NonTraded	-0.07	-0.14	-0.32	-0.61	-0.75	
	[-0.15, -0.01]	[-0.28, -0.03]	[-0.59, -0.07]	[-1.20, -0.05]	[-1.54, -0.03]	
Fin. Autarky, G Traded	-0.03	-0.06	-0.15	-0.39	-0.50	
	[-0.10, 0.05]	[-0.20, 0.07]	[-0.43, 0.08]	[-0.82, 0.06]	[-1.10, -0.01]	
Fin. Int., G NonTraded	-0.08	-0.15	-0.35	-0.57	-0.78	
	[-0.16, -0.01]	[-0.28, -0.04]	[-0.56, -0.07]	[-1.15, -0.06]	[-1.47, -0.03]	
Fin. Int., G Traded	-0.03	-0.06	-0.14	-0.33	-0.46	
	[-0.11, 0.02]	[-0.19, 0.05]	[-0.39, 0.10]	[-0.78, 0.13]	[-1.01, 0.11]	
with Nonsavers						
Fin. Autarky, G NonTraded	-0.08	-0.16	-0.33	-0.63	-0.75	
	[-0.17, -0.01]	[-0.30, -0.04]	[-0.61, -0.09]	[-1.22, -0.07]	[-1.53, -0.04]	
Fin. Autarky, G Traded	-0.03	-0.09	-0.18	-0.40	-0.53	
	[-0.12, 0.03]	[-0.22, 0.05]	[-0.44, 0.06]	[-0.85, 0.02]	[-1.09, -0.01]	
Fin. Int., G NonTraded	-0.09	-0.14	-0.32	-0.58	-0.70	
	[-0.17, -0.01]	[-0.30, -0.04]	[-0.59, -0.07]	[-1.16, -0.07]	[-1.46, -0.02]	
Fin. Int., G Traded	-0.04	-0.09	-0.19	-0.38	-0.48	
	[-0.12, 0.02]	[-0.22, 0.03]	[-0.42, 0.06]	[-0.78, 0.08]	[-1.00, 0.08]	
with G-in-Utility						
Fin. Autarky, G NonTraded	-0.07	-0.16	-0.33	-0.64	-0.83	
	[-0.19, 0.01]	[-0.35, 0.02]	[-0.73, 0.05]	[-1.40, 0.07]	[-1.72, 0.07]	
Fin. Autarky, G Traded	0.03	-0.06	-0.15	-0.37	-0.56	
	[-0.14, 0.07]	[-0.27, 0.13]	[-0.58, 0.19]	[-1.05, 0.20]	[-1.26, 0.18]	
Fin. Int., G NonTraded	-0.07	-0.15	-0.31	-0.54	-0.79	
	[-0.20, 0.02]	[-0.35, 0.03]	[-0.70, 0.03]	[-1.30, 0.03]	[-1.63, 0.05]	
Fin. Int., G Traded	-0.03	-0.02	-0.16	-0.34	-0.48	
	[-0.15, 0.07]	[-0.29, 0.11]	[-0.55, 0.21]	[-0.96, 0.25]	[-1.21, 0.21]	

Table 33: Multipliers for investment following gov. spending shock from open economy New Keynesian models in regime M. Prior mean and 90 percent credible intervals [in brackets].

A Open Economy Version of the Model

Relative to the main text, we derive conditions here for an augmented model that considers an open economy. This allows us to present additional robustness results as to the size of multipliers under various assumptions about the openness of an economy. The model nests the closed economy variants presented in the main text, and all multiplier analysis makes explicit parameterizations to achieve the different variations to the model.

The world economy consists of two large countries, Home (H) and Foreign (F), with symmetric preferences. Public and private consumption and investment consist of domestically produced and imported goods. In the short run, the pass-through of the nominal exchange rate to export and import prices is incomplete due to local currency pricing.

Three distinct types of final-good firms combine the domestically produced and imported intermediate goods to produce the three final non-tradable goods: a private consumption good, a private investment good, and a public consumption good. In what follows, we sketch the additional details of the model, relative to the main text.

Each country consists of a continuum of monopolistically competitive intermediate goods firms (indexed by $i \in [0,1]$). These firms charge different prices at home and abroad, as in Betts and Devereux (1996). In the home market, the demand for firm i's output $y_t^H(i)$ is given by

$$y_t^H(i) = Y_t^H \left(\frac{p_t^H(i)}{P_t^H}\right)^{-\frac{1+\eta_t^p}{\eta_t^p}} \tag{49}$$

where η_t^p denotes an exogenous time-varying markup to the intermediate goods' prices., $p_t^H(i)$ is the output price in the home market charged by firm i, Y_t^H is aggregate domestic demand, and P_t^H is the aggregate domestic price index. Likewise, in the foreign market, the demand for firm i's output is

$$m_t(i) = M_t^* \left(\frac{p_t^{H*}(i)}{P_t^{H*}}\right)^{-\frac{1+\eta_t^p}{\eta_t^p}} \tag{50}$$

where $m_t(i)$ denotes the foreign quantity demanded of home good i, $p_t^{H*}(i)$ is the price that firm i charges in the foreign market, P_t^{H*} is the foreign import price index, and M_t^* denotes aggregate foreign imports.

Home and foreign prices evolve by a Calvo (1983) mechanism. An intermediate firm has a probability of $(1-\omega_p)$ each period to reoptimize its price at home and a probability of $(1-\omega_{p,x})$ each period to reoptimize its price abroad. Firms that cannot reoptimize partially index their prices to past inflation according to the rules

$$p_t^H(i) = \left(\pi_{t-1}^H\right)^{\chi_p} \left(\pi^H\right)^{1-\chi_p} P_{t-1}^H(i), \quad p_t^{H*}(i) = \left(\pi_{t-1}^{H*}\right)^{\chi_{p,x}} \left(\pi^{H*}\right)^{1-\chi_{p,x}} P_{t-1}^{H*}(i) \tag{51}$$

where $\pi_{t-1}^H \equiv P_{t-1}^H / P_{t-2}^H$ and $\pi_{t-1}^{H*} \equiv P_{t-1}^{H*}/P_{t-2}^{H*}$. Firms that are allowed to reoptimize their price in the domestic market in period t maximize expected discounted nominal profits

$$E_t \sum_{s=0}^{\infty} (\beta\omega_p)^s \frac{\lambda_{t+s}}{\lambda_t} \left[\left(\prod_{k=1}^{s} (\pi^H_{t+k-1})^{\chi_p} (\pi^H)^{1-\chi_p} \right) p^H_t(i) y^H_{t+s}(i) - MC_{t+s} y^H_{t+s}(i) \right] \tag{52}$$

subject to (49). Analogously, firms that are allowed to reoptimize their price in the foreign market in period t maximize

$$E_t \sum_{s=0}^{\infty} (\beta\omega_{p,x})^s \frac{\lambda_{t+s}}{\lambda_t} \left[\left(\prod_{k=1}^{s} (\pi^{H*}_{t+k-1})^{\chi_{p,x}} (\pi^{H*})^{1-\chi_{p,x}} \right) p^{H*}_t(i) S_{t+s} m_{t+s}(i) - MC_{t+s} m_{t+s}(i) \right] \tag{53}$$

subject to (50). S_t is the nominal exchange rate, expressed as the price of one domestic consumption basket in terms of foreign consumption.

The final private consumption good Q^C_t is produced by combining a bundle of domestically-produced intermediate goods C^H_t with a bundle of imported foreign intermediate goods, C^F_t via the technology

$$Q^C_t = \left[(1-\nu_C)^{\frac{1}{\mu_C}} (C^H_t)^{\frac{\mu_C - 1}{\mu_C}} + \nu_C^{\frac{1}{\mu_C}} (C^F_t)^{\frac{\mu_C - 1}{\mu_C}} \right]^{\frac{\mu_C}{\mu_C - 1}}$$

where $\mu_C > 0$ is the elasticity of substitution between home and foreign goods, $\nu_C \in [0,1]$ determines the relative preference a country has for domestic and foreign goods. Home and foreign intermediate goods bundles combine differentiated output from each domestic firm i and foreign firm i^* via

$$C^H_t = \left[\int_0^1 C^H_t(i)^{\frac{1}{1+\eta^p_t}} di \right]^{1+\eta^p_t} \qquad C^F_t = \left[\int_0^1 C^F_t(i^*)^{\frac{1}{1+\eta^p_t}} di \right]^{1+\eta^p_t}$$

The consumption final good firm first chooses optimal amounts of each differentiated output from firms i and i^* via cost minimization, and then chooses the optimal bundles to maximize profits. P^C_t denotes the price of the final consumption good. Similarly, the final private investment good Q^I_t with price P^I_t and the public consumption good Q^G_t with price P^G_t are produced via the technologies

$$Q^I_t = \left[(1-\nu_I)^{\frac{1}{\mu_I}} (I^H_t)^{\frac{\mu_I - 1}{\mu_I}} + \nu_I^{\frac{1}{\mu_I}} (I^F_t)^{\frac{\mu_I - 1}{\mu_I}} \right]^{\frac{\mu_I}{\mu_I - 1}} \qquad Q^G_t = \left[(1-\nu_G)^{\frac{1}{\mu_G}} (G^H_t)^{\frac{\mu_G - 1}{\mu_G}} + \nu_G^{\frac{1}{\mu_G}} (G^F_t)^{\frac{\mu_G - 1}{\mu_G}} \right]^{\frac{\mu_G}{\mu_G - 1}}$$

where

$$I^H_t = \left[\int_0^1 I^H_t(i)^{\frac{1}{1+\eta^p_t}} di \right]^{1+\eta^p_t} \qquad I^F_t = \left[\int_0^1 I^F_t(i^*)^{\frac{1}{1+\eta^p_t}} di \right]^{1+\eta^p_t} \tag{54}$$

$$G^H_t = \left[\int_0^1 G^H_t(i)^{\frac{1}{1+\eta^p_t}} di \right]^{1+\eta^p_t} \qquad G^F_t = \left[\int_0^1 G^F_t(i^*)^{\frac{1}{1+\eta^p_t}} di \right]^{1+\eta^p_t} \tag{55}$$

Households solve the same problems as indicated in the main text. However, savers additionally have access to one-period, risk-free international bonds F_t that are denominated in the foreign currency and pay a gross nominal interest R^*. $\Gamma_f(\cdot)$ is a risk premium on foreign bonds that depends on the net foreign asset position of the home economy and ensures stationarity. Specifically, the risk premium is defined as $\Gamma_f\left(\frac{s_t F_t}{Y_t}\right) = \zeta\left(\exp\left(\frac{s_t F_t}{Y_t}\right) - 1\right)$, where s_t is the real exchange rate, which is defined as the ratio of consumption prices expressed in the same currency, $s_t \equiv S_t P_t^{C*}/P_t^C$.

Market clearing in the final-good markets implies $Q_t^C = C_t$, $Q_t^I = I_t + \psi(v_t)\bar{K}_{t-1}$, $Q_t^G = G_t$. The home country's aggregate resource constraint is $Y_t = C_t^H + I_t^H + G_t^H + M_t^*$ where foreign imports are defined as $M_t^* \equiv C_t^{H*} + I_t^{H*} + G_t^{H*}$. Net foreign assets evolve according to

$$S_t F_t = R_{t-1}^* S_t[1 - \Gamma_f(\cdot)]F_{t-1} + S_t P_t^{H*} M_t^* - P_t^F M_t$$

We define the domestic terms of trade, TOT_t, as the ratio between the import price and domestically produced price levels in domestic currency terms: $TOT_t = \frac{P_t^F}{S_t P_t^{H*}}$.

As discussed in the main text, the domestic economy features a permanent shock to technology. We assume that the foreign economy is subject to the same permanent shock to technology, so that all variables in the world economy grow at the same rate.[16] In order to induce stationarity, we perform a change of variables and define: $y_t = \frac{Y_t}{A_t}$, $c_t^S = \frac{C_t^{*S}}{A_t}$, $c_t^S = \frac{C_t^S}{A_t}$, $c_t^N = \frac{C_t^N}{A_t}$,$k_t = \frac{K_t}{A_t}$, $\bar{k}_t = \frac{\bar{K}_t}{A_t}$, $i_t = \frac{I_t}{A_t}$, $g_t = \frac{G_t}{A_t}$, $z_t^S = \frac{Z_t^S}{A_t}$, $z_t^N = \frac{Z_t^N}{A_t}$, $w_t = \frac{W_t}{P_t^C A_t}$, and $\lambda_t^S = \Lambda_t^S A_t$. Foreign variables are made stationary in the same manner.

A.1 The Equilibrium System.

We present the equations for the home economy; symmetric conditions for the foreign economy complete the model specification.

A.1.1 Households

We define Λ_t^S as the Lagrange multiplier associated with the savers' budget constraint, $\Lambda_t^S q_t$ as the Lagrange multiplier associated with the capital accumulation equation, and $r_t^k \equiv R_t^k / P_t^C$.

Savers' FOC for consumption:

$$\lambda_t^S(1 + \tau_t^c) = \frac{u_t^b}{c_t^{*S} - \theta c_{t-1}^{*S} e^{-u_t^a}} \tag{56}$$

c^{*S} definition:

$$c_t^{*S} = c_t^S + \alpha_g g_t \tag{57}$$

Euler equation for one-period private bonds:

$$\lambda_t^S = \beta R_t E_t \frac{\lambda_{t+1}^S e^{-u_{t+1}^a}}{\pi_{t+1}^C} \tag{58}$$

[16] An alternative assumption often made in the literature is that foreign technology, denoted by A_t^*, is cointegrated with domestic technology. The ratio $A_t/A_t^* = \epsilon_t^{aa*}$ is assumed to be stationary and to measure the degree of asymmetry in the technology across the two countries. See for instance Adolfson, Laseen, Lindé, and Villani (2007). As long as the steady state technological growth rates are the same across countries, this alternative does not affect government spending multipliers.

Price relation between long and short bonds:

$$P_t^B = E_t\left(\frac{1}{R_t}(1+\rho P_{t+1}^B)\right) \tag{59}$$

Euler equation for foreign bonds:

$$1 = \beta R_t^* \left[1 - \Gamma\left(\frac{s_t f_t}{y_t}\right)\right] E_t\left[\frac{\lambda_{t+1}^S e^{-u_{t+1}^a} s_{t+1}}{\lambda_t^S s_t \pi_{t+1}^{C*}}\right] \tag{60}$$

where s_t is the real exchange rate. Savers' FOC for capacity utilization:

$$(1-\tau_t^k) r_t^k = \psi'(v_t)\frac{P_t^I}{P_t^C} \tag{61}$$

Savers' FOC for capital:

$$q_t = \beta E_t \frac{\lambda_{t+1}^S e^{-u_{t+1}^a}}{\lambda_t^S}\left\{(1-\tau_{t+1}^K) r_{t+1}^k v_{t+1} - \psi(v_{t+1})\frac{P_{t+1}^I}{P_{t+1}^C} + (1-\delta) q_{t+1}\right\} \tag{62}$$

where q_t is Tobin's Q. Savers' FOC for investment:

$$\begin{aligned}\frac{P_t^I}{P_t^C} =& q_t u_t^i \left[1 - s\left(\frac{i_t e^{u_t^a}}{i_{t-1}}\right) - s'\left(\frac{i_t e^{u_t^a}}{i_{t-1}}\right)\frac{i_t e^{u_t^a}}{i_{t-1}}\right] \\ &+ \beta E_t\left[q_{t+1}\frac{\lambda_{t+1}^S e^{-u_{t+1}^a}}{\lambda_t^S} u_{t+1}^i s'\left(\frac{i_{t+1} e^{u_{t+1}^a}}{i_t}\right)\left(\frac{i_{t+1} e^{u_{t+1}^a}}{i_t}\right)^2\right]\end{aligned} \tag{63}$$

Effective capital:

$$k_t = v_t \bar{k}_{t-1} e^{-u_t^a} \tag{64}$$

Law of motion for capital:

$$\bar{k}_t = (1-\delta) e^{-u_t^a} \bar{k}_{t-1} + u_t^i \left[1 - s\left(\frac{i_t e^{u_t^a}}{i_{t-1}}\right)\right] i_t \tag{65}$$

Nonsavers' real budget constraint:

$$(1+\tau_t^c) c_t^N = (1-\tau_t^L) w_t L_t + z_t^N \tag{66}$$

A.1.2 Wage Determination.

FOC for optimal wage ($\tilde{w}_t \equiv \tilde{W}_t/(A_t P_t^C)$):

$$0 = E_t\left\{\sum_{t=0}^{\infty} (\beta\omega_w)^s \lambda_{t+s}^S \bar{L}_{t+s}\left[(1-\tau_{t+s}^L)\tilde{w}_t \prod_{k=1}^{s}\left\{\left(\frac{\pi_{t+k-1}^C e^{u_{t+k-1}^a}}{\pi^C e^\gamma}\right)^{\chi^w}\left(\frac{\pi^C e^\gamma}{\pi_{t+k}^C e^{u_{t+k}^a}}\right)\right\} - \frac{(1+\eta_{t+s}^w) u_{t+s}^b \bar{L}_{t+s}^\xi}{\lambda_{t+s}^S}\right]\right\} \tag{67}$$

where

$$\bar{L}_{t+s} = \left(\tilde{w}_t \prod_{k=1}^{s} \left\{ \left(\frac{\pi^C_{t+k-1} e^{u^a_{t+k-1}}}{\pi^C e^{\gamma}} \right)^{\chi^w} \left(\frac{\pi^C e^{\gamma}}{\pi^C_{t+k} e^{u^a_{t+k}}} \right) \right\} \right)^{-\frac{1+\eta^w_{t+s}}{\eta^w_{t+s}}} L_{t+s} \tag{68}$$

Aggregate wage evolution:

$$w_t^{\frac{1}{\eta^w_t}} = (1-\omega_w)\tilde{w}_t^{\frac{1}{\eta^w_t}} + \omega_w \left[\left(\frac{\pi^C_{t-1} e^{u^a_{t-1}}}{\pi^C e^{\gamma}} \right)^{\chi_w} \left(\frac{\pi^C e^{\gamma}}{\pi^C_t e^{u^a_t}} \right) w_{t-1} \right]^{\frac{1}{\eta^w_t}} \tag{69}$$

A.1.3 Intermediate Goods Firms.

Production function:

$$y_t(i) = (k_t(i))^{\alpha} (L_t(i))^{1-\alpha} - \Omega \tag{70}$$

Capital-labor ration:

$$\frac{k_t}{L_t} = \frac{w_t}{r^k_t} \frac{\alpha}{1-\alpha} \tag{71}$$

Real marginal cost ($\equiv MC_t/P^C_t$):

$$mc_t = (1-\alpha)^{\alpha-1} \alpha^{-\alpha} (r^k_t)^{\alpha} w_t^{1-\alpha} \tag{72}$$

Intermediate firm's FOC for domestic price:

$$0 = E_t \left\{ \sum_{s=0}^{\infty} (\beta\omega_p)^s \lambda^S_{t+s} \bar{y}^H_{t+s} \left[\frac{\tilde{p}^H_t}{P^H_t} \prod_{k=1}^{s} \left[\left(\frac{\pi^H_{t+k-1}}{\pi^H} \right)^{\chi^p} \left(\frac{\pi^H}{\pi^H_{t+k}} \right) \right] - (1+\eta^p_{t+s}) \frac{P^C_{t+s} mc_{t+s}}{P^H_{t+s}} \right] \right\} \tag{73}$$

where

$$\bar{y}^H_{t+s} = \left(\frac{\tilde{p}^H_t}{P^H_t} \prod_{k=1}^{s} \left[\left(\frac{\pi^H_{t+k-1}}{\pi^H} \right)^{\chi^p} \left(\frac{\pi^H}{\pi^H_{t+k}} \right) \right] \right)^{-\frac{1+\eta^p_{t+s}}{\eta^p_{t+s}}} y^H_{t+s}$$

Intermediate firm's FOC for foreign import price:

$$0 = E_t \left\{ \sum_{s=0}^{\infty} (\beta\omega_{p,x})^s \lambda^S_{t+s} \bar{m}_{t+s} \left[\frac{\tilde{p}^{H*}_t}{P^{H*}_t} \prod_{k=1}^{s} \left[\left(\frac{\pi^{H*}_{t+k-1}}{\pi^{H*}} \right)^{\chi^{p,x}} \left(\frac{\pi^{H*}}{\pi^{H*}_{t+k}} \right) \right] - (1+\eta^p_{t+s}) \frac{P^C_{t+s} mc_{t+s}}{P^{H*}_{t+s} S_{t+s}} \right] \right\} \tag{74}$$

where

$$\bar{m}_{t+s} = \left(\frac{\tilde{p}^{H*}_t}{P^{H*}_t} \prod_{k=1}^{s} \left[\left(\frac{\pi^{H*}_{t+k-1}}{\pi^{H*}} \right)^{\chi^{p,x}} \left(\frac{\pi^{H*}}{\pi^{H*}_{t+k}} \right) \right] \right)^{-\frac{1+\eta^p_{t+s}}{\eta^p_{t+s}}} M^*_{t+s}$$

A.1.4 Final Goods Firms

Final consumption good technology:

$$q_t^C = \left[(1-\nu_C)^{\frac{1}{\mu_C}}(c_t^H)^{\frac{\mu_C-1}{\mu_C}} + \nu_C^{\frac{1}{\mu_C}}(c_t^F)^{\frac{\mu_C-1}{\mu_C}}\right]^{\frac{\mu_C}{\mu_C-1}} \tag{75}$$

Demand for the domestically produced and imported intermediate goods i and i^* by the final private consumption good firm:

$$c_t^H(i) = \left(\frac{p_t^H(i)}{P_t^H}\right)^{-\frac{1+\eta_t^p}{\eta_t^p}} c_t^H, \;\; c_t^F(i^*) = \left(\frac{p_t^F(i^*)}{P_t^F}\right)^{-\frac{1+\eta_t^p}{\eta_t^p}} c_t^F \tag{76}$$

Demand for the domestically produced and imported intermediate good bundles by the final private consumption good firm:

$$c_t^H = (1-\nu_C)\left(\frac{P_t^H}{P_t^C}\right)^{-\mu_C} q_t^C, \;\; c_t^F = \nu_C\left(\frac{P_t^F}{P_t^C}\right)^{-\mu_C} q_t^C \tag{77}$$

where

$$P_t^C = [(1-\nu_C)(P_t^H)^{1-\mu_C} + \nu_C(P_t^F)^{1-\mu_C}]^{\frac{1}{1-\mu_C}} \tag{78}$$

Final investment technology:

$$q_t^I = \left[(1-\nu_I)^{\frac{1}{\mu_I}}(i_t^H)^{\frac{\mu_I-1}{\mu_I}} + \nu_I^{\frac{1}{\mu_I}}(i_t^F)^{\frac{\mu_I-1}{\mu_I}}\right]^{\frac{\mu_I}{\mu_I-1}} \tag{79}$$

Demand for the domestically produced and imported intermediate goods i and i^* by the private investment good firm:

$$i_t^H(i) = \left(\frac{p_t^H(i)}{P_t^H}\right)^{-\frac{1+\eta_t^p}{\eta_t^p}} i_t^H, \;\; i_t^F(i^*) = \left(\frac{p_t^F(i^*)}{P_t^F}\right)^{-\frac{1+\eta_t^p}{\eta_t^p}} i_t^F \tag{80}$$

Demand for the domestically produced and imported intermediate good bundles by the final private investment good firm:

$$i_t^H = (1-\nu_I)\left(\frac{P_t^H}{P_t^I}\right)^{-\mu_I} q_t^I, \;\; i_t^F = \nu_I\left(\frac{P_t^F}{P_t^I}\right)^{-\mu_I} q_t^I \tag{81}$$

where

$$P_t^I = [(1-\nu_I)(P_t^H)^{1-\mu_I} + \nu_I(P_t^F)^{1-\mu_I}]^{\frac{1}{1-\mu_I}} \tag{82}$$

Final government spending technology:

$$q_t^G = \left[(1-\nu_G)^{\frac{1}{\mu_G}}(g_t^H)^{\frac{\mu_G-1}{\mu_G}} + \nu_G^{\frac{1}{\mu_G}}(g_t^F)^{\frac{\mu_G-1}{\mu_G}}\right]^{\frac{\mu_G}{\mu_G-1}} \tag{83}$$

Demand for the domestically produced and imported intermediate goods i and i^* by the final public consumption good firm:

$$g_t^H(i) = \left(\frac{p_t^H(i)}{P_t^H}\right)^{-\frac{1+\eta_t^p}{\eta_t^p}} g_t^H, \quad g_t^F(i^*) = \left(\frac{p_t^F(i^*)}{P_t^F}\right)^{-\frac{1+\eta_t^p}{\eta_t^p}} g_t^F \tag{84}$$

Demand for the domestically produced and imported intermediate good bundles by the final public consumption good firm:

$$g_t^H = (1-\nu_G)\left(\frac{P_t^H}{P_t^G}\right)^{-\mu_G} q_t^G, \quad g_t^F = \nu_G \left(\frac{P_t^F}{P_t^G}\right)^{-\mu_G} q_t^G \tag{85}$$

where

$$P_t^G = [(1-\nu_G)(P_t^H)^{1-\mu_G} + \nu_G(P_t^F)^{1-\mu_G}]^{\frac{1}{1-\mu_G}} \tag{86}$$

Note that aggregating across the three final-goods firms gives the aggregate demand for the domestically produced and imported intermediate goods i and i^*:

$$y_t^H(i) \equiv c_t^H(i) + i_t^H(i) + g_t^H(i) = \left(\frac{p_t^H(i)}{P_t^H}\right)^{-\frac{1+\eta_t^p}{\eta_t^p}} y_t^H \tag{87}$$

$$y_t^F(i^*) \equiv c_t^F(i^*) + i_t^F(i^*) + g_t^F(i^*) = \left(\frac{p_t^F(i^*)}{P_t^F}\right)^{-\frac{1+\eta_t^p}{\eta_t^p}} y_t^F \tag{88}$$

where $y_t^H \equiv c_t^H + i_t^H + g_t^H$ and $y_t^F \equiv c_t^F + i_t^F + g_t^F$.

A.1.5 Policy.

Government budget constraint (where $b_t \equiv P_t^B B_t / A_t P_t^C$):

$$b_t + \tau_t^K r_t^k k_t + \tau_t^L w_t L_t + \tau_t^C c_t = \frac{1+\rho P_t^B}{P_{t-1}^B}\frac{b_{t-1}}{\pi_t^C e^{u_t^a}} + \frac{P_t^G}{P_t^C} g_t + z_t \tag{89}$$

A.1.6 Aggregation.

$$c_t = \mu c_t^S + (1-\mu)c_t^N \tag{90}$$

Market clearing in final consumption good market:

$$q_t^C = c_t \tag{91}$$

Market clearing in final investment good market:

$$q_t^I = i_t + \psi(v_t)\bar{k}_{t-1}e^{-u_t^a} \tag{92}$$

Market clearing in final government spending good market:

$$q_t^G = g_t \tag{93}$$

Home aggregate resource constraint:

$$y_t = c_t^H + i_t^H + g_t^H + m_t^* \tag{94}$$

where foreign imports are defined as

$$m_t^* = c_t^{H*} + i_t^{H*} + g_t^{H*} \tag{95}$$

Net foreign asset evolution:

$$S_t f_t = S_t R_{t-1}^* \left[1 - \Gamma\left(\frac{s_{t-1} f_{t-1}}{y_{t-1}}\right)\right] f_{t-1} e^{-u_t^a} + S_t P_t^{H*} m_t^* + P_t^F m_t \tag{96}$$

A.1.7 Priors. We continue to use the calibration and priors from section 2.2 of the main text. In addition, we adopt the following priors for the open economy parameters: ζ uniform over the interval 0.0001 to 0.4; $\nu_C \sim B(0.3, 0.2)$; $\nu_I \sim B(0.3, 0.2)$; $\nu_G \sim B(0.3, 0.2)$; $\mu_C \sim G(2.0, 0.5)$; $\mu_I \sim G(2.0, 0.5)$; $\mu_G \sim G(2.0, 0.5)$; $\omega_{p,x} \sim B(0.5, 0.2)$; and $\chi_{p,x} \sim B(0.5, 0.2)$. B stands for beta distribution, and G stands for gamma distribution. To force financial autarky, we set $\zeta = \infty$. To force government spending to consist only of domestic goods, we set $\nu_G = 0$.