The Effects of a Money-Financed Fiscal Stimulus

Jordi Galí

CREI, UPF and Barcelona GSE

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Motivation

- How to jumpstart a depressed economy

  - expansionary monetary policy?
  - debt-financed fiscal expansion?
  - supply-side policies?

Motivation

- How to jumpstart a depressed economy

  - expansionary monetary policy?
  - debt-financed fiscal expansion?
  - supply-side policies?

- An alternative: a money-financed fiscal stimulus

Present Paper

- *Question: What are the effects of a money-financed fiscal stimulus?*
- Basic New Keynesian model
- Tax cut vs. Increase in government purchases
- Comparison to debt-financed fiscal stimulus
- Role of nominal rigidities
- Welfare effects
- Two environments: "Normal times" and "ZLB times"

Experiments: Exogenous Fiscal Stimuli

- *Tax cut*

$$\widehat{t}_t^* = -\delta^t < 0$$

for $t = 0, 1, 2, ...$where $\widehat{t}_t^* \equiv \frac{T_t^* - T^*}{Y}$

- *Increase in government purchases*

$$\widehat{g}_t = \delta^t > 0$$

for $t = 0, 1, 2, ...$where $\widehat{g}_t \equiv \frac{G_t - G}{Y}$.

Experiments: Financing Regimes

- Debt financing (+ inflation targeting)

$$\pi_t = 0$$

$$m_t = p_{-1} + l(c_t, i_t)$$

$$\widehat{b}_t = (1 + \rho - \psi_b)\widehat{b}_{t-1} + b(1+\rho)\widehat{i}_{t-1} + \delta^t - \varkappa \Delta m_t$$

where $\widehat{b}_t \equiv \frac{\mathcal{B}_t - \mathcal{B}}{Y}$

- Money financing

$$\widehat{b}_t = 0$$

$$\Delta m_t = (1/\varkappa)\left[\delta^t + b(1+\rho)\left(\widehat{i}_{t-1} - \pi_t\right)\right]$$

Non-Policy Block

- *Households*

$$\max E_0 \sum_{t=0}^{\infty} \beta^t [U(C_t, L_t) - V(N_t)] Z_t$$

subject to:

$$P_t C_t + B_t + M_t = B_{t-1}(1 + i_{t-1}) + M_{t-1} + W_t N_t + P_t D_t - P_t T_t$$

- *Firms*: monopolistic competition, staggered price setting à la Calvo

Simulations

- Exogenous fiscal stimulus: $\delta = 0.5$

(i) Tax cut vs. increase in government purchases
(ii) Money financing vs. debt financing

Figure 1. Dynamic Effects of a Tax Cut:
Debt vs. Money Financing

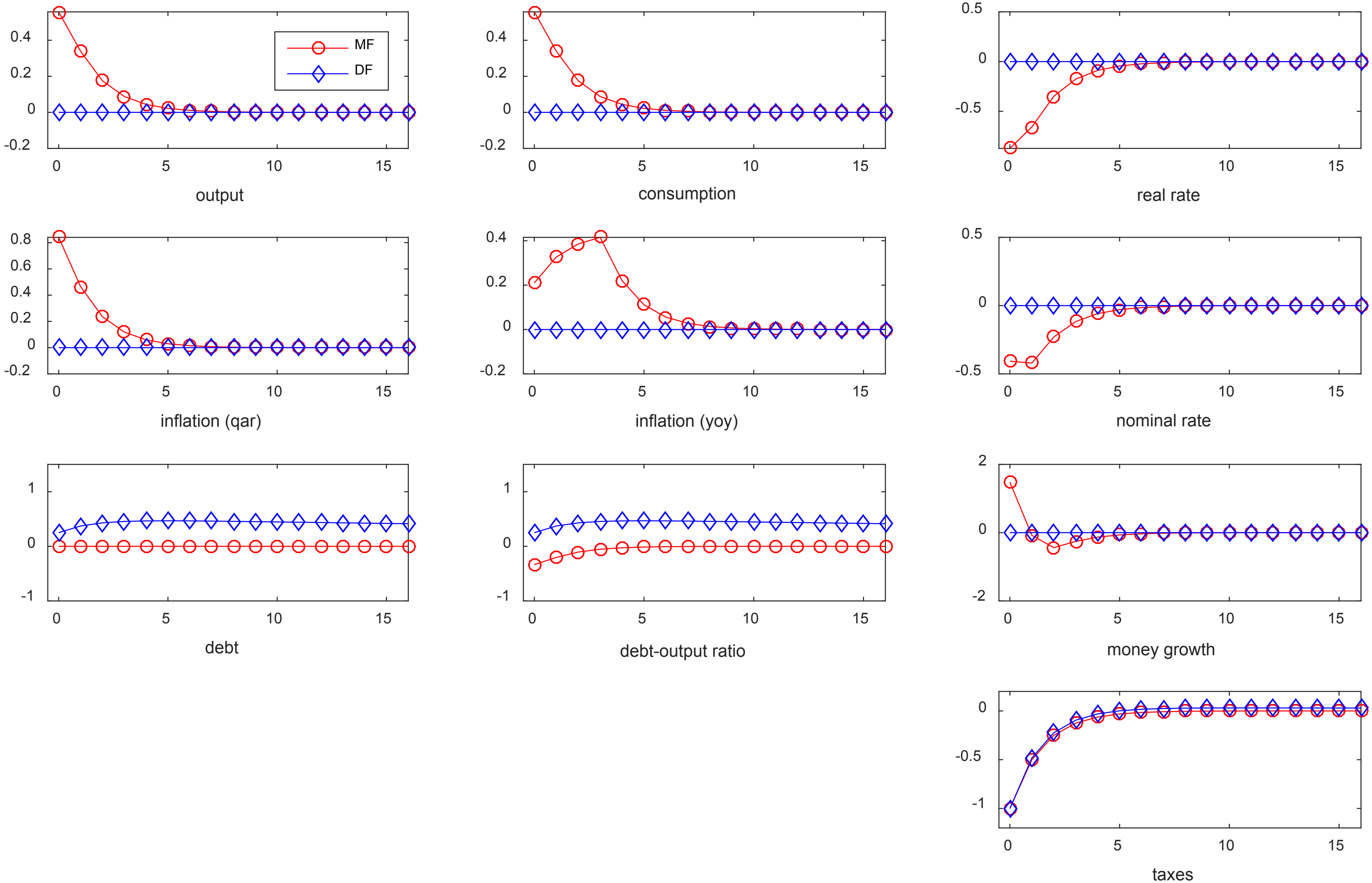


Figure 2. Dynamic Effects of an Increase in Government Purchases: *Debt vs. Money Financing*

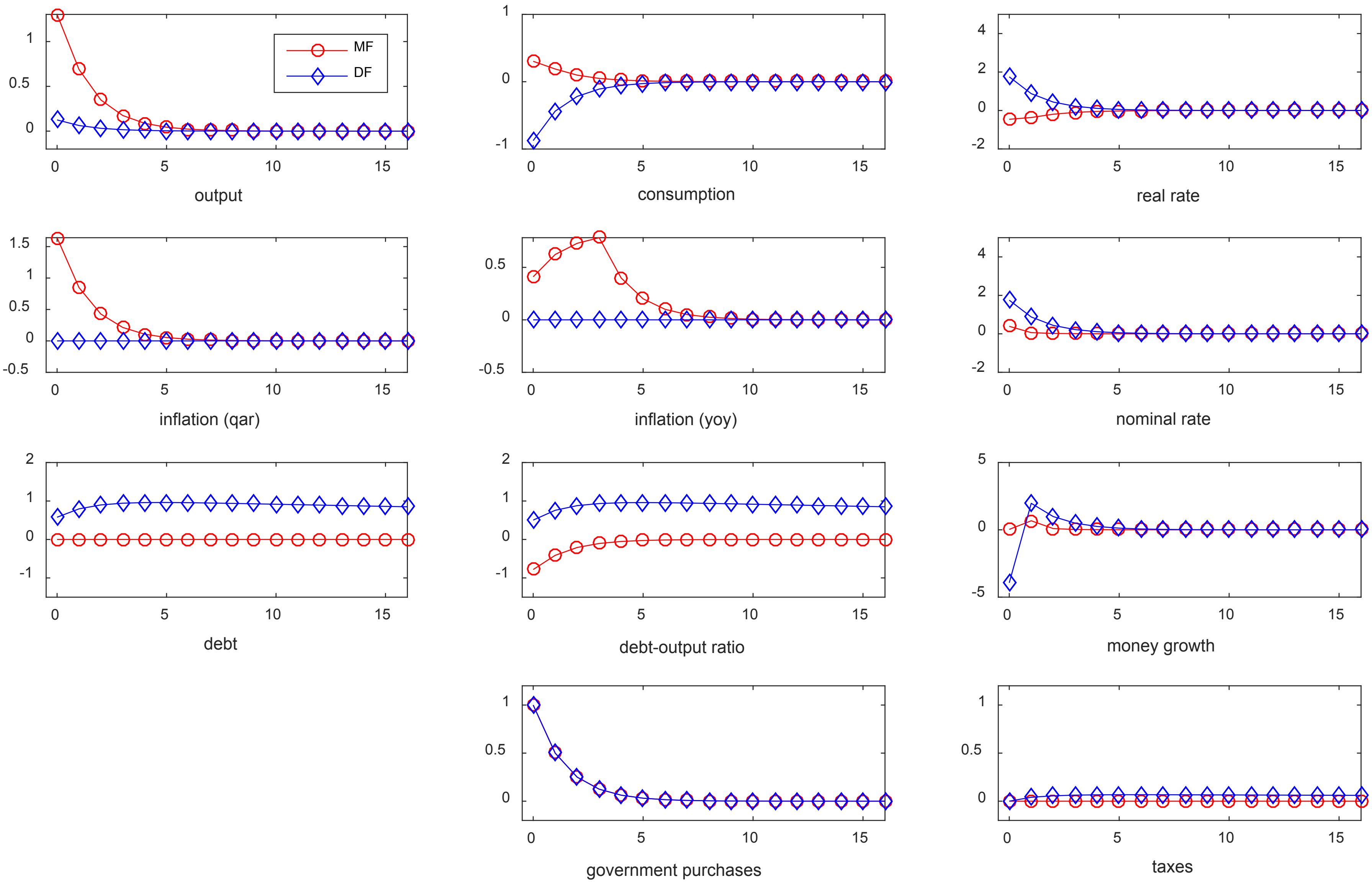
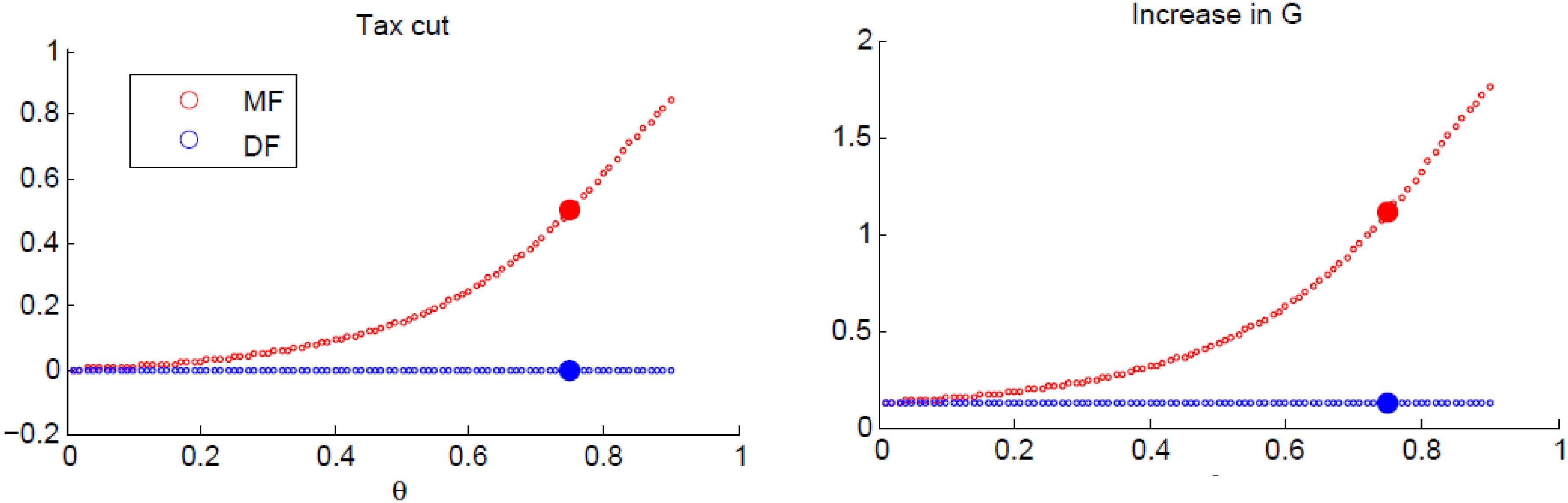


Figure 5a. Fiscal Multipliers: The Role of Price Stickiness



Welfare

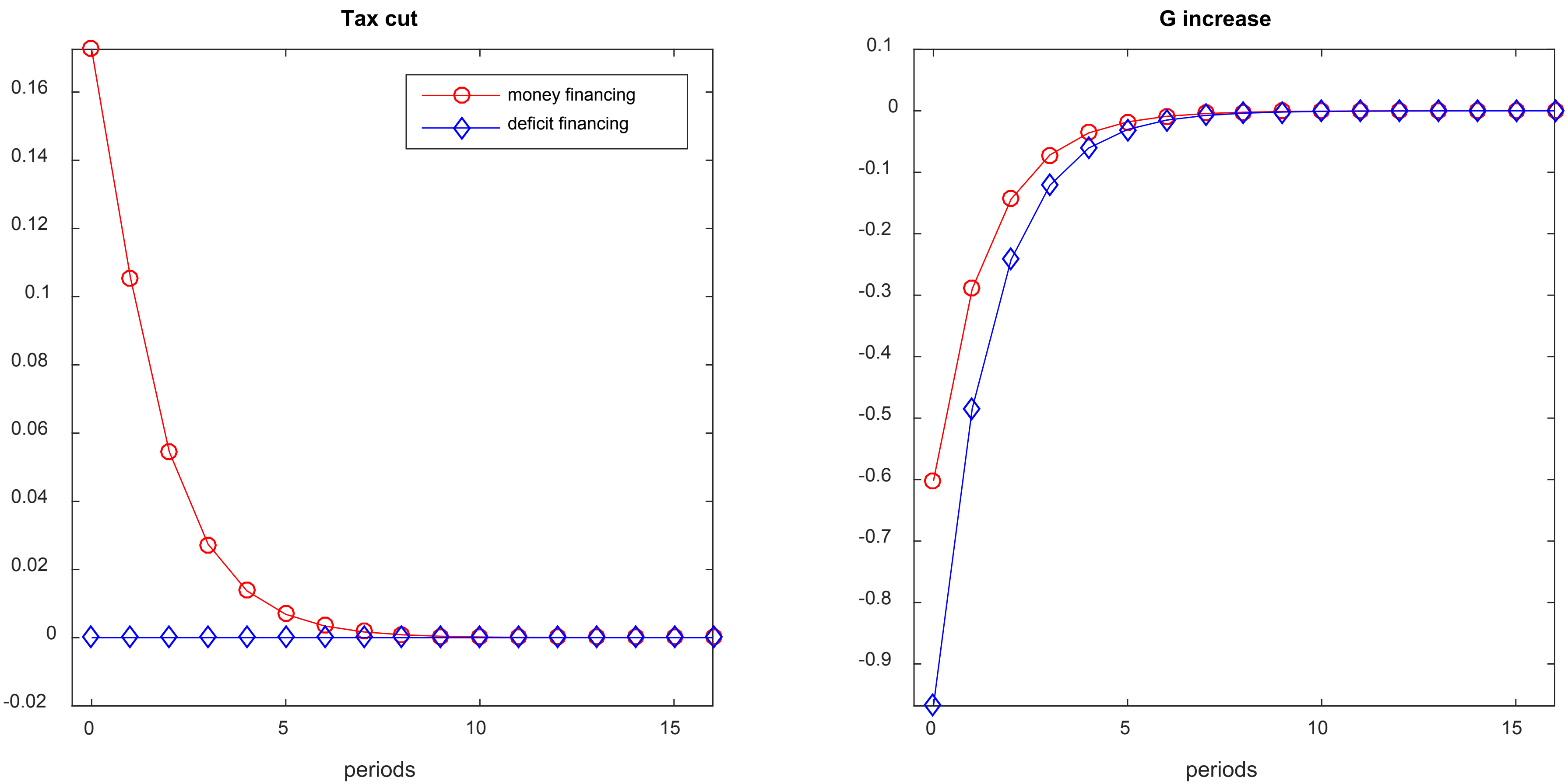
- First order effects on utility

$$\begin{aligned} \widehat{\mathcal{U}}_t &= U_c C \widehat{c}_t + U_l L \widehat{l}_t - V_n N \widehat{n}_t \\ &= U_c C \left[\widehat{c}_t - \left(\frac{1-\alpha}{\mathcal{M}} \right) \widehat{n}_t + \varkappa(1-\beta) \widehat{l}_t \right] \\ &= U_c C \left[\left(1 - \frac{1}{\mathcal{M}} \right) \widehat{y}_t - \widehat{g}_t + \varkappa(1-\beta) \widehat{l}_t \right] \end{aligned}$$

for $t = 0, 1, 2, ...$where $\mathcal{M} \equiv \mathcal{M}_p \mathcal{M}_w$

- Simulations

Figure 4. Welfare Effects



The Effects of Fiscal Stimuli under the ZLB

- Negative Z shock $\Rightarrow$

$$r_t^n = -0.5\%$$

for $t = 0, 1, 2, \dots T$, followed by $r_t^n = 0.5\%$, for $t \geq T + 1$.

- ZLB constraint and slackness condition:

$$i_t \geq 0 \quad ; \quad l_t \geq l(c_t, i_t)$$

$$i_t [l_t - l(c_t, i_t)] = 0$$

- *Tax response*

$$\widehat{t}_t^* = -1\%$$

for $t = 0, 1, 2, \dots T$, followed by $\widehat{t}_t^* = 0$, for $t \geq T + 1$.

- *Government purchases response*

$$\widehat{g}_t = +1\%$$

for $t = 0, 1, 2, \dots T$, followed by $\widehat{g}_t = 0$, for $t \geq T + 1$.

Figure 6a. Dynamic Effects of a Tax cut in a Liquidity Trap

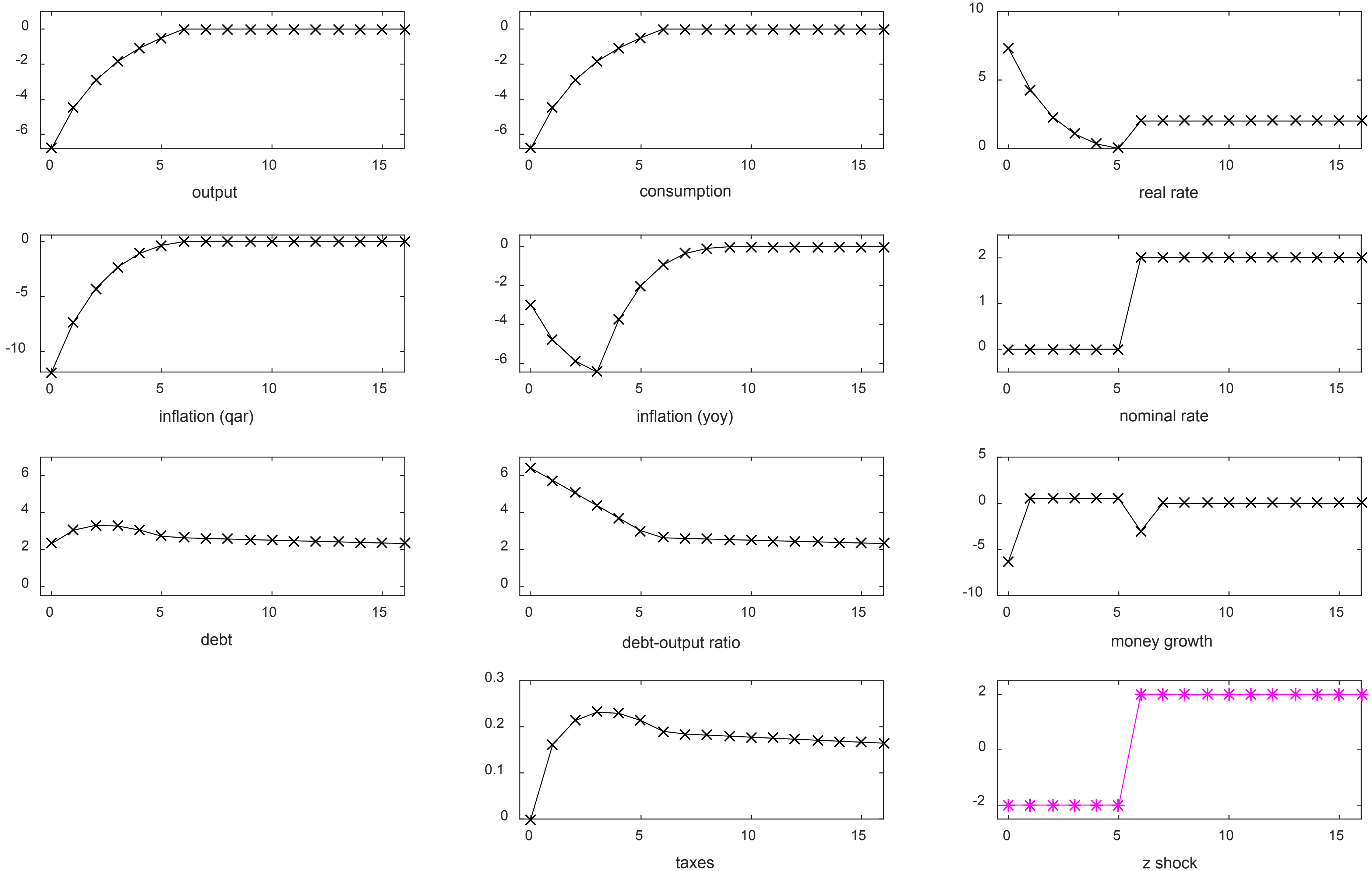


Figure 6b. Dynamic Effects of a Tax cut in a Liquidity Trap

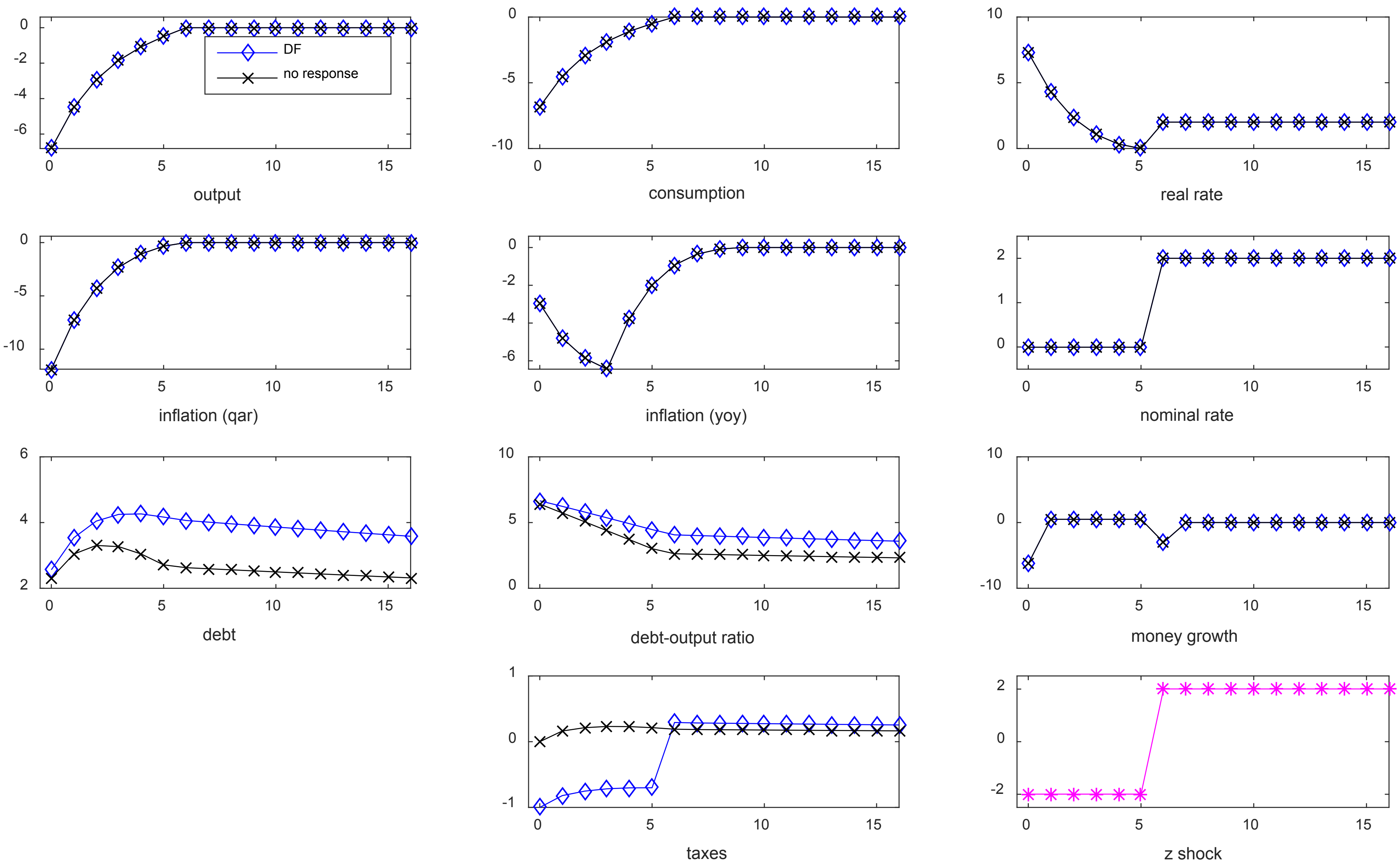


Figure 6. Dynamic Effects of a Tax Cut in a Liquidity Trap

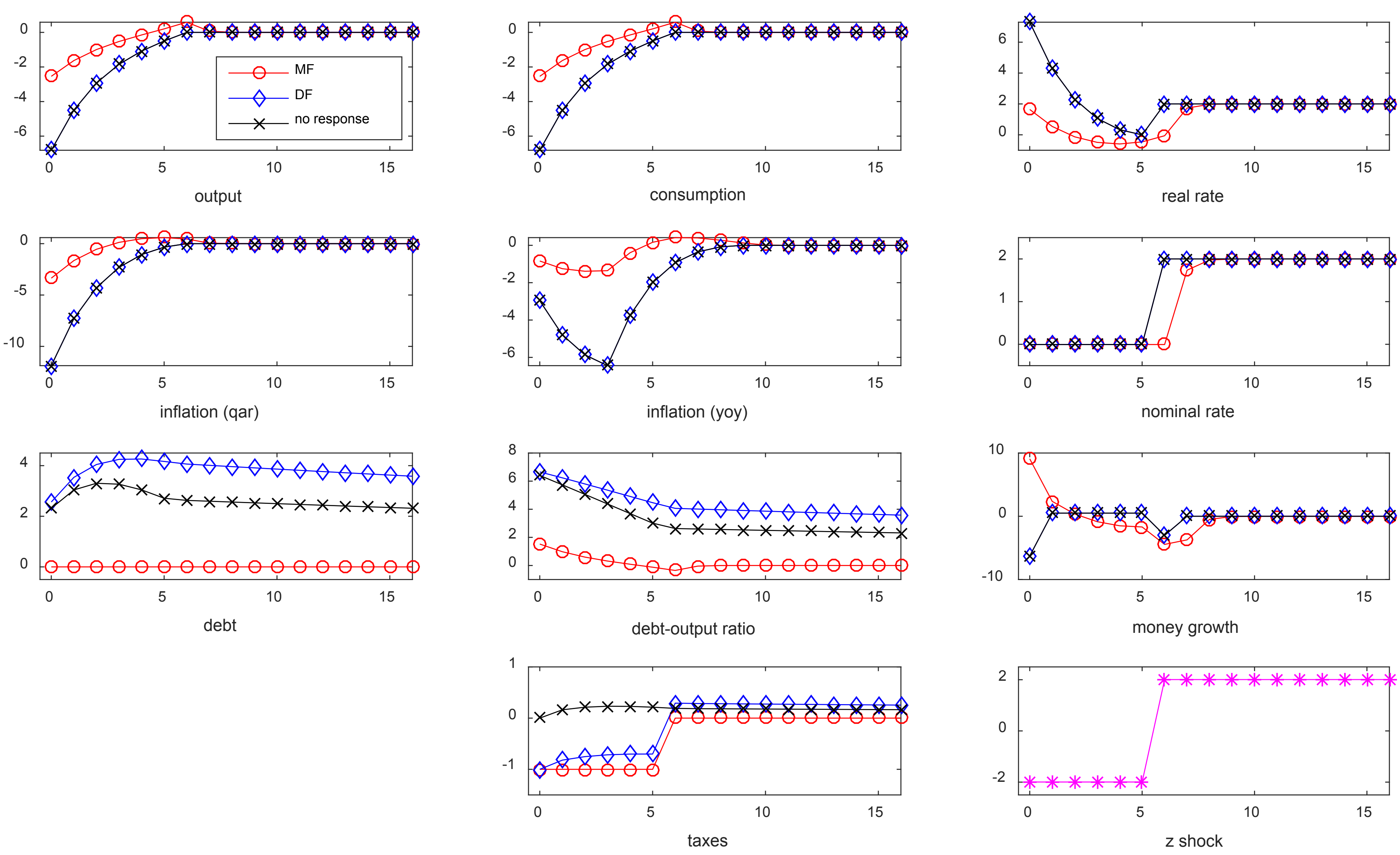


Figure 7b. Dynamic Effects of an Increase in Government Purchases in a Liquidity Trap

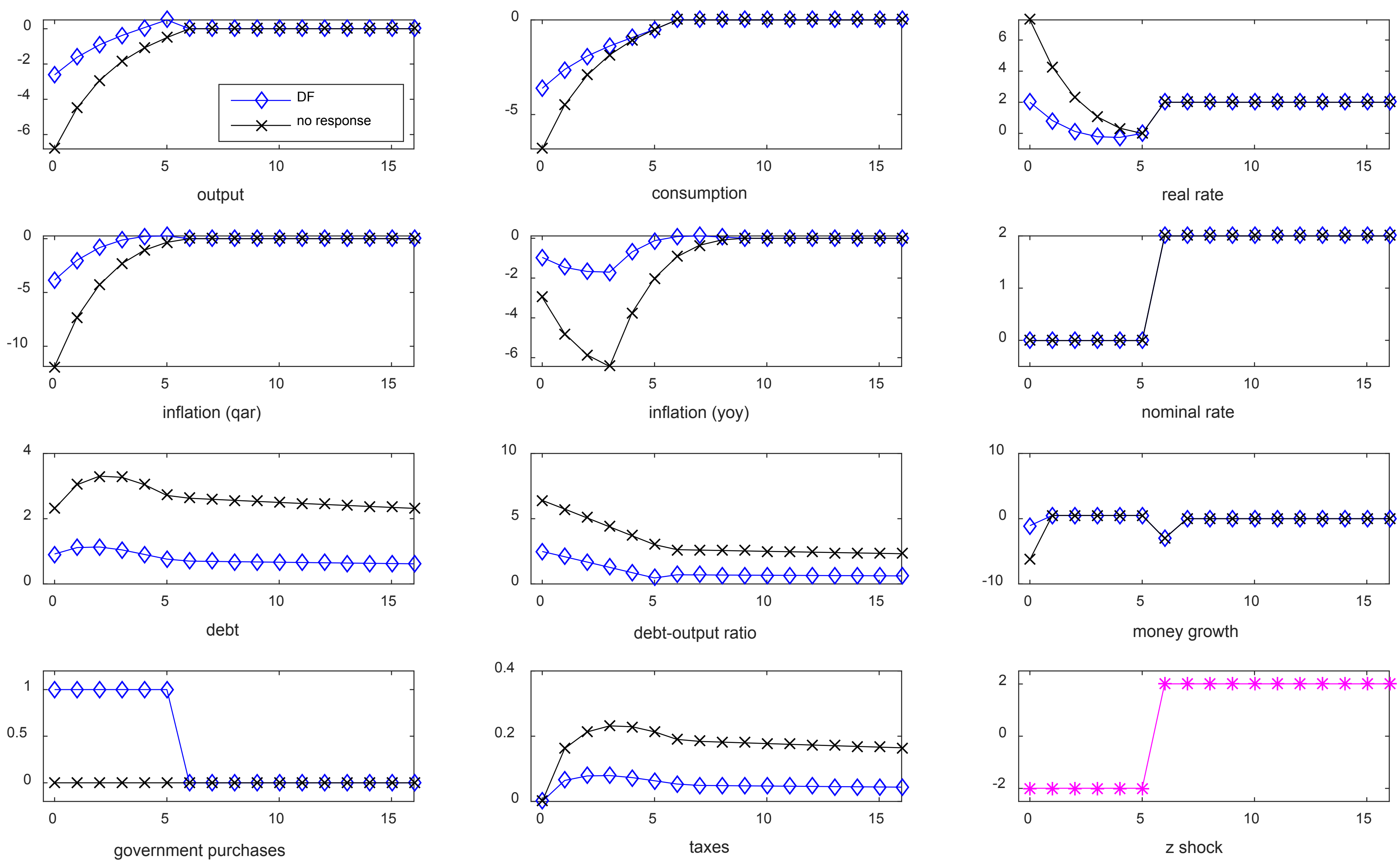


Figure 7. Dynamic Effects of an Increase in Government Purchases in a Liquidity Trap

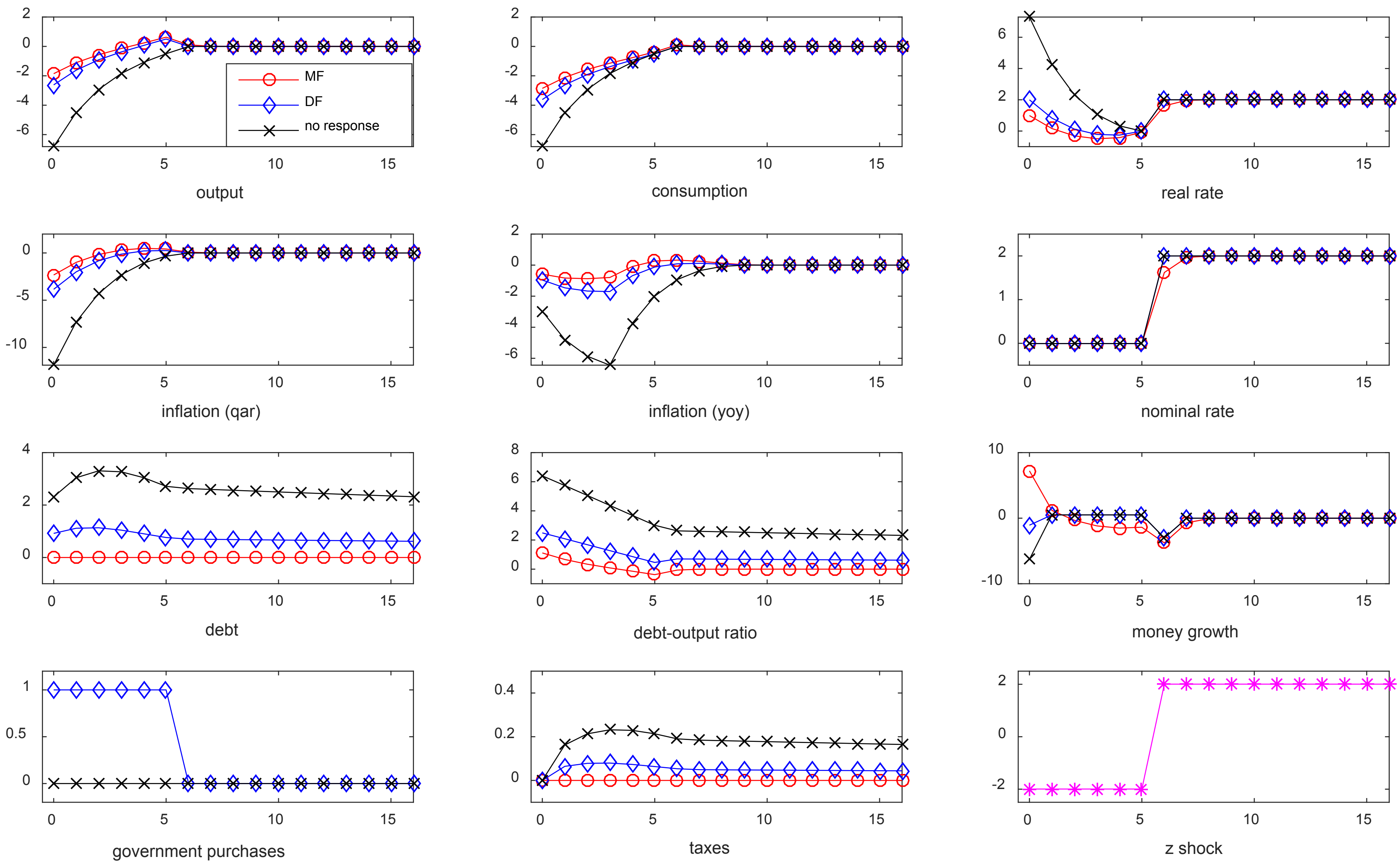


Figure 9a. Fiscal Stimuli and Welfare in a Liquidity Trap

The Case of Small Distortions

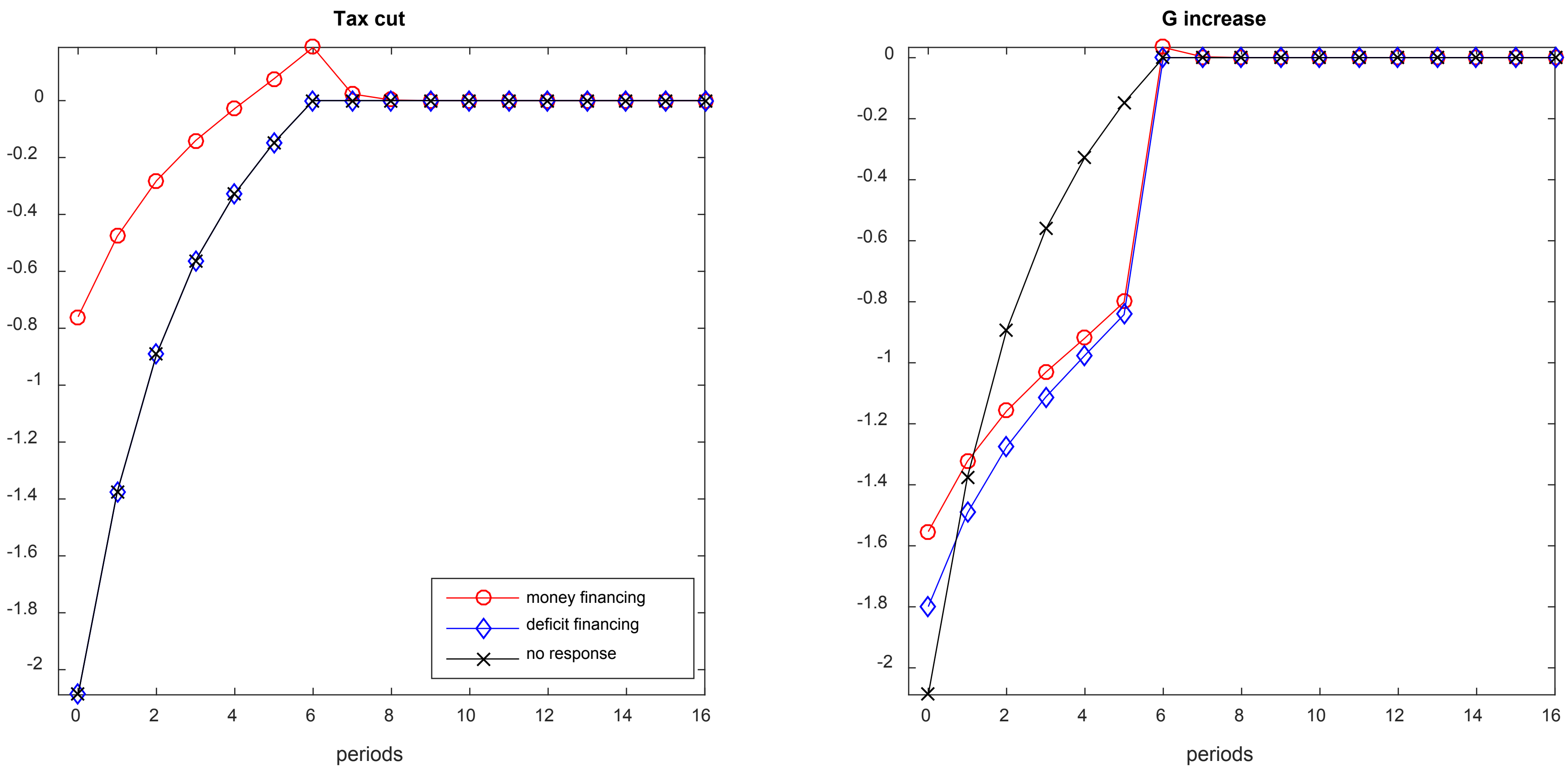
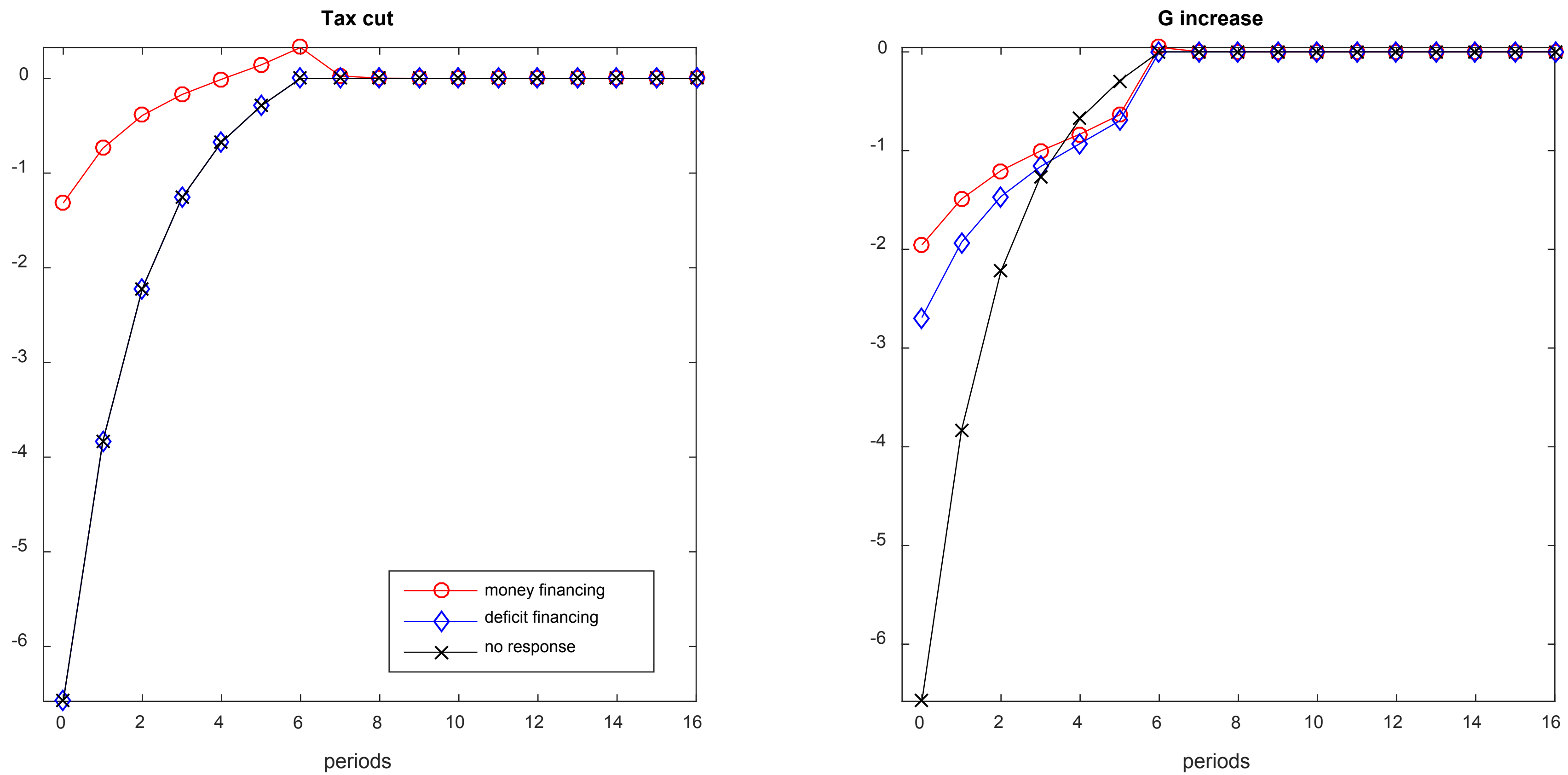


Figure 9b. Fiscal Stimuli and Welfare in a Liquidity Trap

The Case of Large Distortions



Summary and Concluding Remarks

- Money-financed fiscal stimuli can boost economic activity effectively. No side effects, other than reasonably higher inflation.
- G increase more effective than tax cut, but the latter has better welfare properties.
- Money-financed discal stimuli more effective than debt-financed counterparts, and better welfare properties
- Reasonable price rigidities are key to the above results
- Money-financed fiscal stimuli are also more effective countercyclical policies when the ZLB is binding. G and T have similar effectiveness. When initial distortions are large, increase in G may be desirable even if wasteful.

- Individual household's IBC:

$$\sum_{t=0}^{\infty} \Lambda_{0,t} \left(C_t + \frac{i_t}{1+i_t} L_t \right) = \mathcal{A}_0 + \sum_{t=0}^{\infty} \Lambda_{0,t} \left(Y_t - T_t \right)$$

where $\Lambda_{0,t} \equiv \mathcal{R}_0^{-1} \mathcal{R}_1^{-1} ... \mathcal{R}_{t-1}^{-1}$.

- Consolidated government's IBC

$$\sum_{t=0}^{\infty} \Lambda_{0,t} G_t + \frac{B_{-1}(1+i_{-1})}{P_0} = \sum_{t=0}^{\infty} \Lambda_{0,t} \left(T_t + \frac{\Delta M_t}{P_t} \right)$$

- Combining both we can rewrite the individual IBC

$$\sum_{t=0}^{\infty} \Lambda_{0,t} \left(C_t + \frac{i_t}{1+i_t} L_t \right) = \frac{M_{-1}}{P_0} + \sum_{t=0}^{\infty} \Lambda_{0,t} \left(Y_t - G_t + \frac{\Delta M_t}{P_t} \right)$$

In the log-log case $\chi C_t = \frac{i_t}{1+i_t} L_t$,

$$\sum_{t=0}^{\infty} \Lambda_{0,t} C_t = \frac{1}{1+\chi} \left(\frac{M_{-1}}{P_0} + \sum_{t=0}^{\infty} \Lambda_{0,t} \left(Y_t - G_t + \frac{\Delta M_t}{P_t} \right) \right)$$

The Euler equation (without preference shocks) implies $\Lambda_{0,t} = \beta^t (C_0 / C_t)$ thus we must have:

$$C_0 = \frac{1-\beta}{1+\chi} \left(\frac{M_{-1}}{P_0} + \sum_{t=0}^{\infty} \Lambda_{0,t} \left(Y_t - G_t + \frac{\Delta M_t}{P_t} \right) \right)$$

A Fiscal and Monetary Framework

- Fiscal authority's budget constraint

$$P_t G_t + B_{t-1}^F (1 + i_{t-1}) = P_t (T_t + S_t) + B_t^F$$

- Central bank's budget constraint:

$$B_t^M + P_t S_t = B_{t-1}^M (1 + i_{t-1}) + \Delta M_t$$

- Consolidated budget constraint (letting $B_t = B_t^F - B_t^M$)

$$P_t G_t + B_{t-1}(1 + i_{t-1}) = P_t T_t + B_t + \Delta M_t$$

$$G_t + \mathcal{B}_{t-1} \mathcal{R}_{t-1} = T_t + \mathcal{B}_t + \frac{\Delta M_t}{P_t}$$

where $\mathcal{B}_t \equiv B_t / P_t$ and $\mathcal{R}_t = (1 + i_t)(P_t / P_{t+1})$

A Fiscal and Monetary Framework

- Steady state (zero inflation, no growth, constant $\mathcal{B}$, $r = \rho$):

$$\Delta M = 0$$

$$T = G + \rho \mathcal{B}$$

$$S = \rho \mathcal{B}^M$$

- Seignorage and money growth:

$$\begin{aligned} (\Delta M_t / P_t)(1/Y) &= (\Delta M_t / M_{t-1})(P_{t-1}/P_t) L_{t-1}/Y \\ &\simeq \varkappa \Delta m_t \end{aligned}$$

where $L_t \equiv M_t / P_t$, $m_t \equiv \log M_t$, and $\varkappa \equiv L/Y$

A Fiscal and Monetary Framework

- Linearized debt dynamics around steady state:

$$\widehat{b}_t = (1+\rho)\widehat{b}_{t-1} + b(1+\rho)(\widehat{i}_{t-1} - \pi_t) + \widehat{g}_t - \widehat{t}_t - \varkappa \Delta m_t$$

where $\widehat{i}_t \equiv \log \frac{1+i_t}{1+\rho}$, $\widehat{b}_t \equiv \frac{\mathcal{B}_t - \mathcal{B}}{Y}$, $\widehat{g}_t \equiv \frac{G_t - G}{Y}$ and $\widehat{t}_t \equiv \frac{T_t - T}{Y}$

- Tax rule

$$\widehat{t}_t = \psi_b \widehat{b}_{t-1} + \widehat{t}_t^*$$

- Implied debt dynamics:

$$\widehat{b}_t = (1+\rho-\psi_b)\widehat{b}_{t-1} + b(1+\rho)(\widehat{i}_{t-1} - \pi_t) + \widehat{g}_t - \widehat{t}_t^* - \varkappa \Delta m_t$$

- Assumption: $\psi_b > \rho \quad \Rightarrow$ Ricardian fiscal policy

Aside: Alternative Money Financing Regimes

- "Targeted Funding"

$$\Delta m_t = (1/\varkappa)\delta^t$$

$$\widehat{b}_t = (1+\rho-\psi_b)\widehat{b}_{t-1} + b(1+\rho)(\widehat{i}_{t-1}-\pi_t)$$

- Constant nominal debt

$$\widehat{b}_t = -b\widehat{p}_t$$

$$\Delta m_t = (1/\varkappa)\left[\delta^t + b(1+\rho)(\widehat{i}_{t-1}-\pi_t) + b\widehat{p}_t - b(1+\rho-\psi_b)\widehat{p}_{t-1}\right]$$

where $\widehat{p}_t \equiv p_t - p_{-1}$.

Non-Policy Block: Households

- Preferences

$$E_0 \sum_{t=0}^{\infty} \beta^t \mathcal{U}(C_t, L_t, N_t; Z_t)$$

Assumption:

$$\mathcal{U}(C, L, N; Z) = (U(C, L) - V(N))\, Z$$

where $U_l / U_c = h(L/C)$ with $h(\cdot)$ continuous and decreasing, satisfying $h(\overline{\varkappa}) = 0$ for some $0 < \overline{\varkappa} < \infty$.

- Budget constraint

$$P_t C_t + B_t + M_t = B_{t-1}(1 + i_{t-1}) + M_{t-1} + W_t N_t + P_t D_t - P_t T_t$$

Non-Policy Block: Households

- Euler equation

$$U_{c,t} = \beta(1 + i_t)E_t \left\{ U_{c,t+1}(P_t/P_{t+1}) \right\}$$

- Money demand

$$L_t = C_t h^{-1}(i_t/(1 + i_t))$$

- Wage setting

$$W_t/P_t = \mathcal{M}_w (V_{n,t}/U_{c,t})$$

where $\mathcal{M}_w \equiv \epsilon_w/(\epsilon_w - 1)$

Non-Policy Block: Firms

- Final goods (perfect competition):

$$Y_t \equiv \left(\int_0^1 X_t(i)^{1-\frac{1}{\epsilon_p}} di \right)^{\frac{\epsilon_p}{\epsilon_p - 1}}$$

- Intermediate goods (monopolistic competition + sticky prices)

(i) *Technology:*

$$X_t(i) = N_t(i)^{1-\alpha}$$

where $N_t(i) = \left(\int_0^1 N_t(i,j)^{1-\frac{1}{\epsilon_w}} dj \right)^{\frac{\epsilon_w}{\epsilon_w - 1}}$

(ii) *Demand schedule:*

$$X_t(i) = (P_t(i)/P_t)^{-\epsilon} Y_t$$

(iii) *Staggered price setting à la Calvo*

Calibration

- Households

$\sigma = 1$
$\varphi = 5$ (inverse Frisch labor supply elasticity)
$\eta = 7$ ($\simeq 1.8 * 4$, Ireland (2009))
$\varkappa = 1/3$ (annual M0 velocity $\simeq 12$)

- Firms

$\alpha = 0.25$
$\epsilon_p = 9 \Rightarrow \mathcal{M}_p = 1.12$ ["large distortions": $\mathcal{M}_p = 1.35$]
$\epsilon_w = 4.5 \Rightarrow \mathcal{M}_w = 1.28$ ["large distortions": $\mathcal{M}_w = 1.82$]
$\theta = 3/4$

Simulations

- Exogenous fiscal stimulus: $\delta = 0.5$

(i) Tax cut vs. increase in government purchases
(ii) Money financing vs. debt financing

- Remark: Equivalence of money-financed tax cut with sequence of asset purchases by the central bank (OMOs) given by:

$$\Delta m_t = (1/\varkappa)\left[\delta^t + b(1+\rho)\left(\widehat{i}_{t-1} - \pi_t\right)\right]$$

with path for $\{\widehat{b}_t^M\}$ and $\{\widehat{b}_t^F\}$ depending on the transfer and (endogenous) tax policies policy $\{\widehat{s}_t, \widehat{t}_t\}$.

Fiscal Stimuli under the ZLB: Financing Regimes

- Money financing:

$$\widehat{b}_t = 0$$

for all t. For $t = 0, 1, 2, ... T$,

$$\Delta m_t = (1/\varkappa)\left[0.01 + b(1+\rho)(\widehat{i}_{t-1} - \pi_t)\right]$$

For $t \geq T + 1$,

$$\Delta m_t = (1/\varkappa) b(1+\rho)(\widehat{i}_{t-1} - \pi_t)$$

- Debt financing

$$i_t \pi_t = 0$$

$$m_t = p_t + l(c_t, i_t)$$

for all t. For $t = 0, 1, 2, ... T$,

$$\widehat{b}_t = (1 + \rho - \psi_b)\widehat{b}_{t-1} + b(1+\rho)(\widehat{i}_{t-1} - \pi_t) + 0.01 - \varkappa \Delta m_t$$

For $t \geq T + 1$

$$\widehat{b}_t = (1 + \rho - \psi_b)\widehat{b}_{t-1}$$

Figure 3. Dynamic Effects of a *Money-Financed* Fiscal Stimulus: *Tax Cut vs. Increase in Government Purchases*

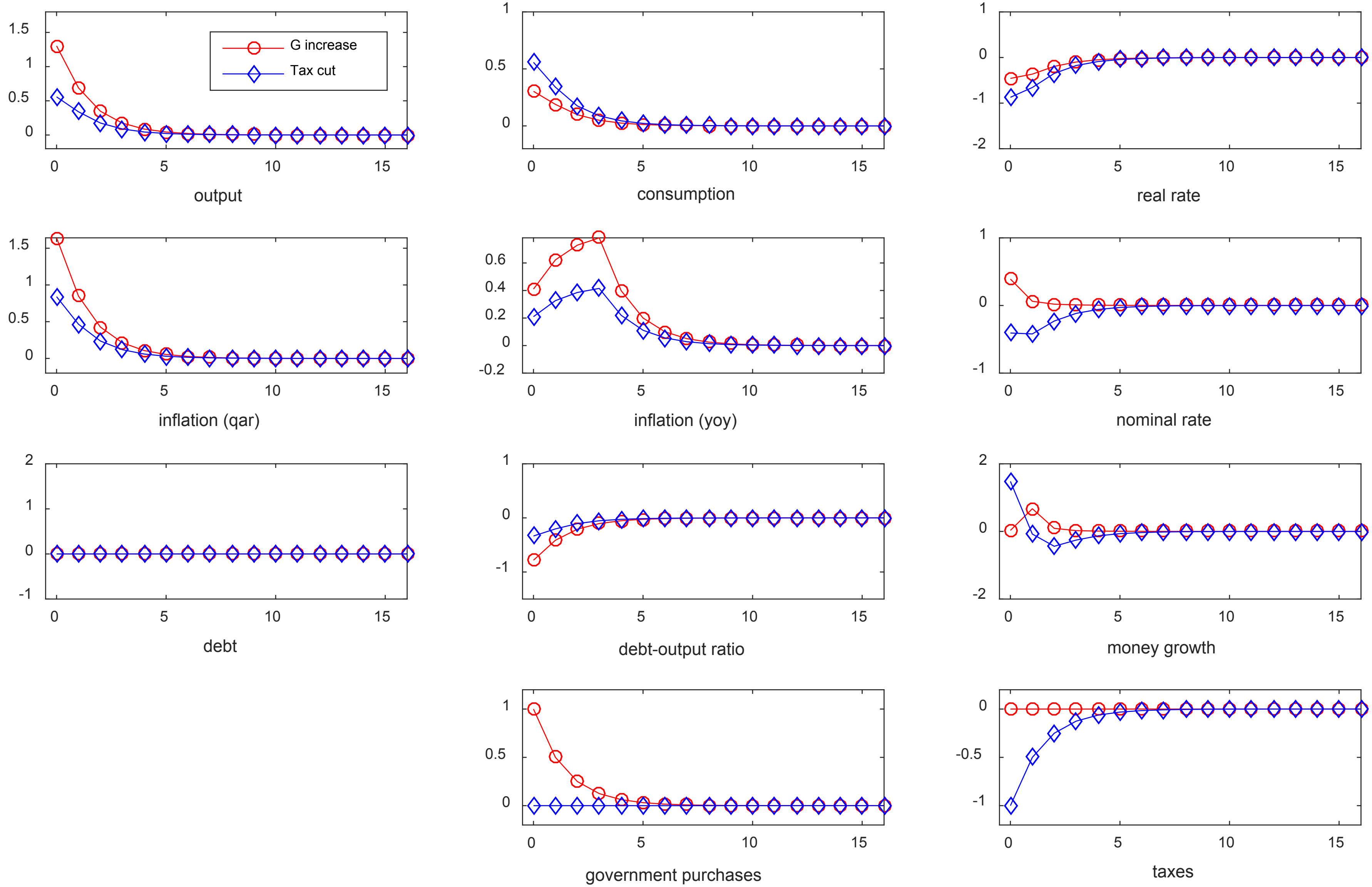


Figure 8. Dynamic Effects of Money-Financed Fiscal Stimuli in a Liquidity Trap

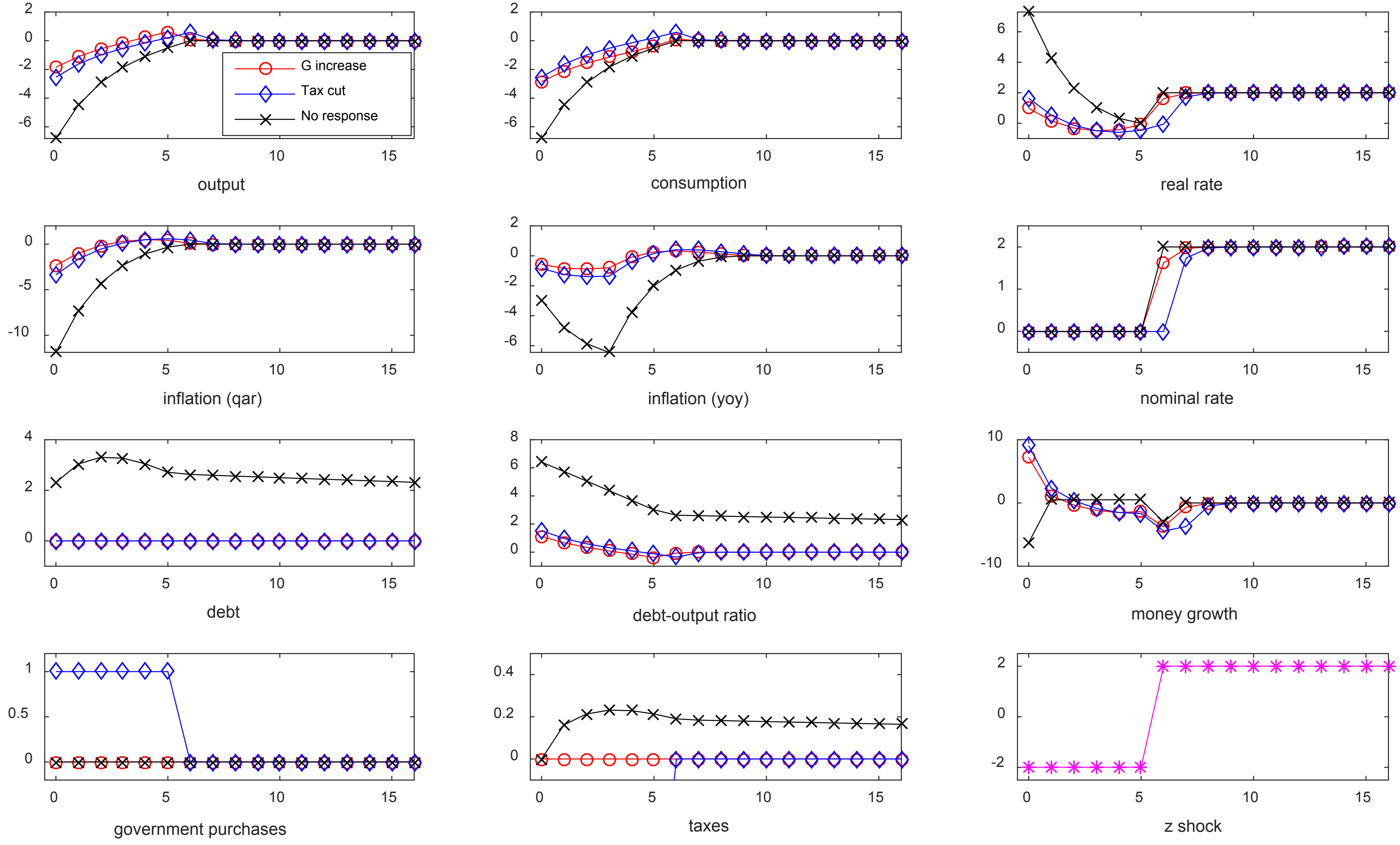
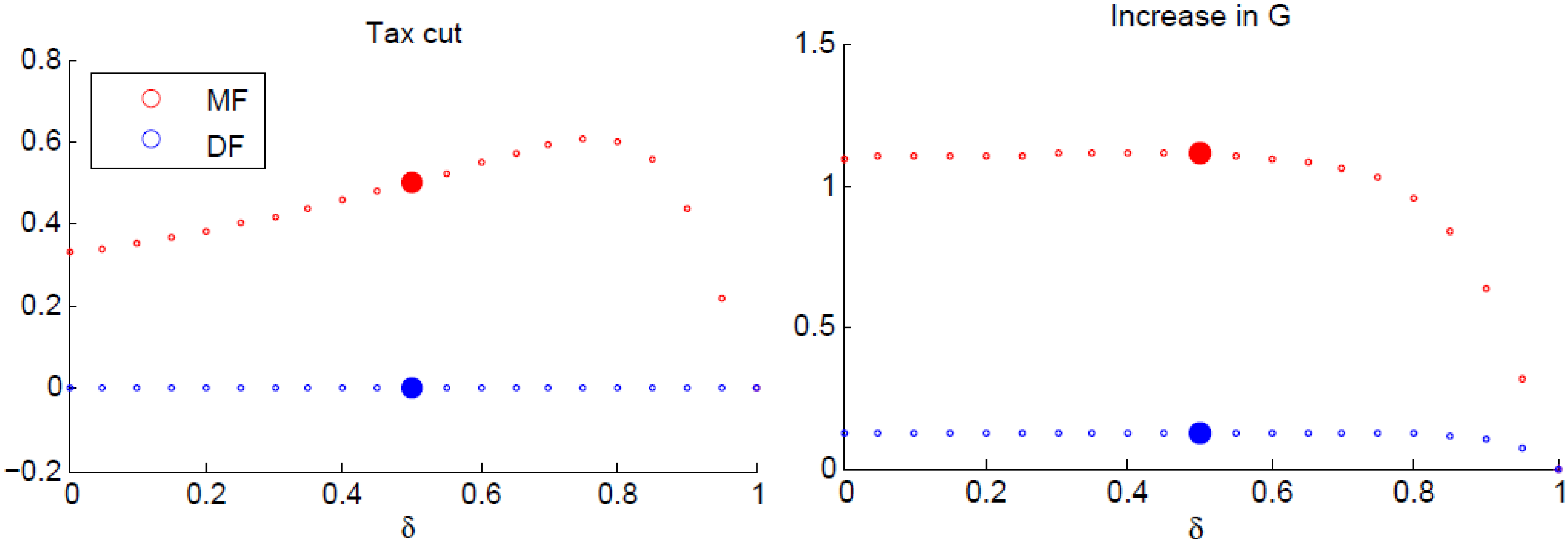
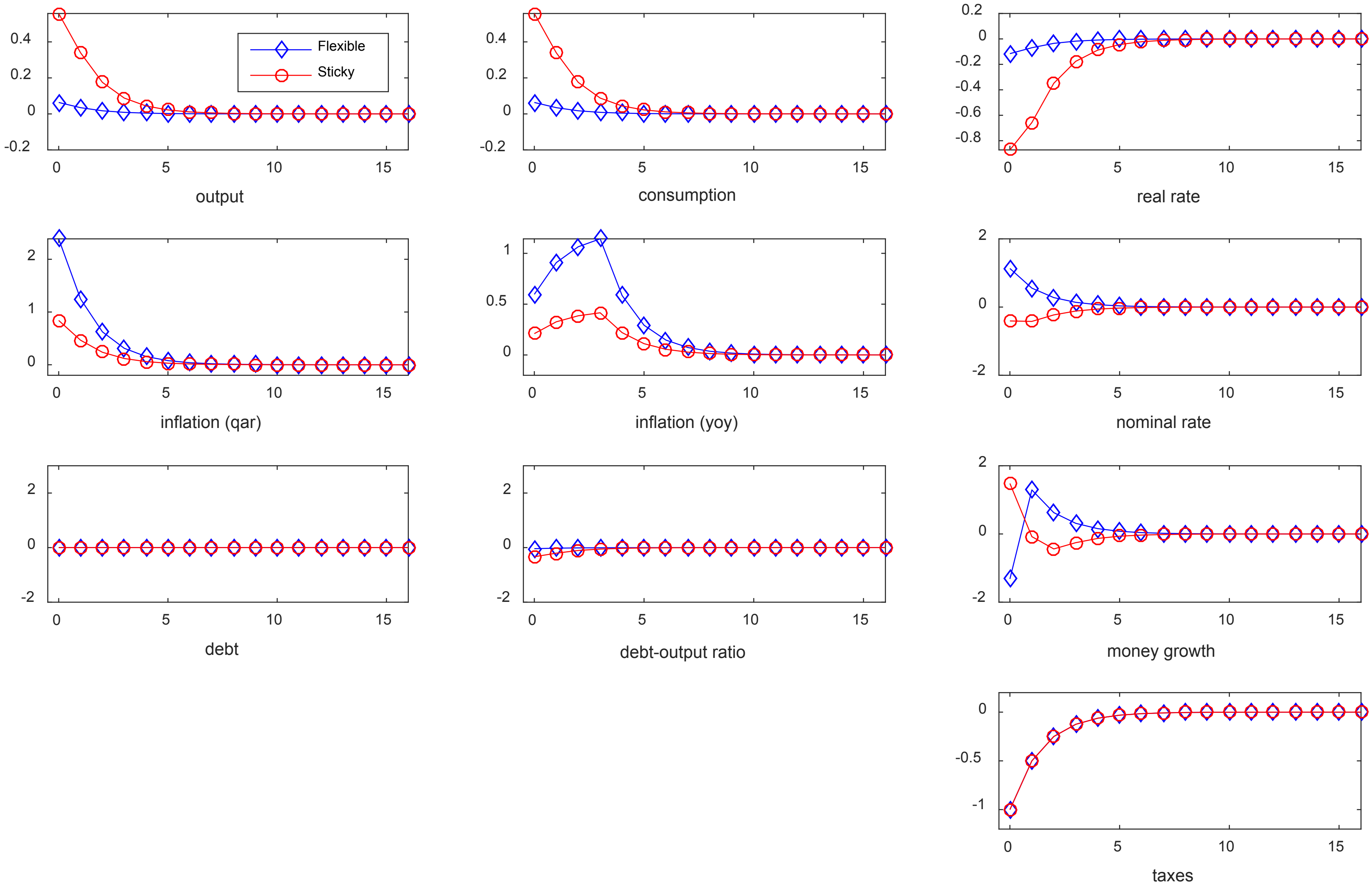


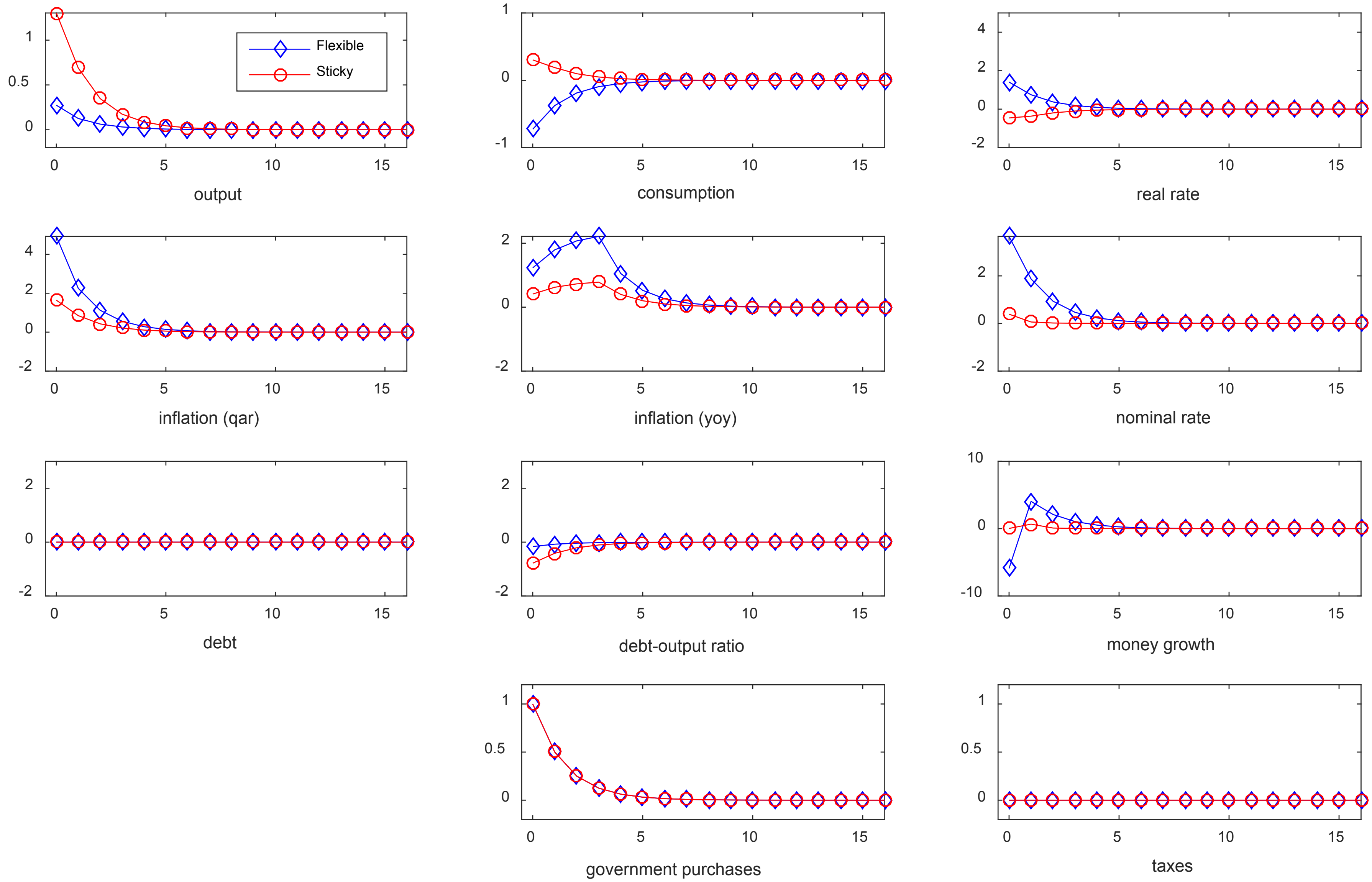
Figure 5b. Fiscal Multipliers: The Role of Shock Persistence



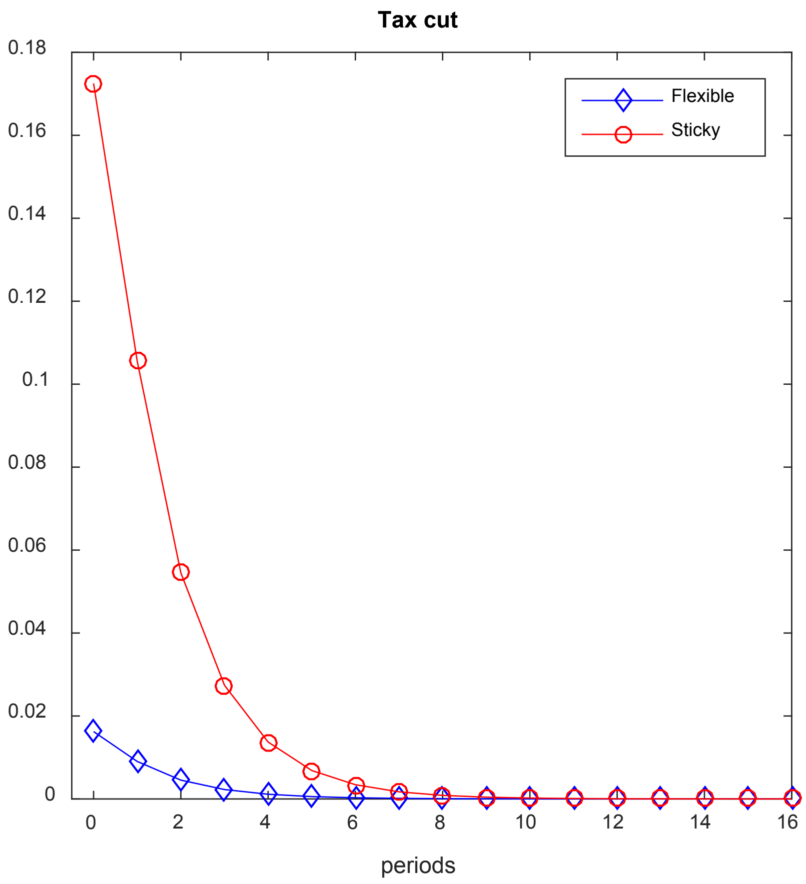
Dynamic Effects of a *Money-Financed* Tax Cut: *The Role of Price Stickiness*

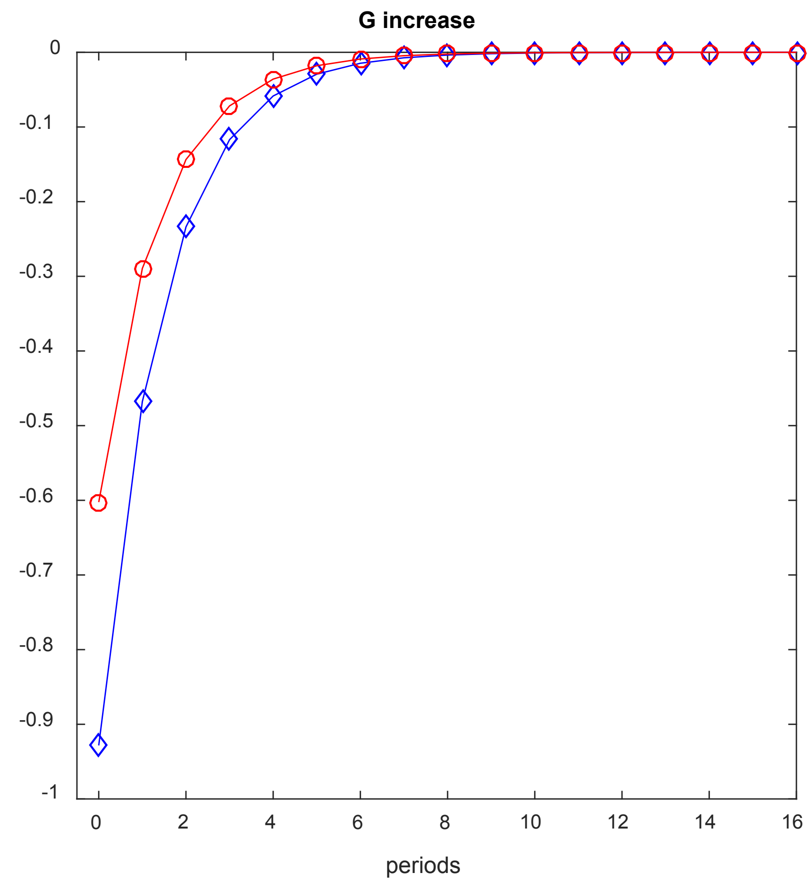


Dynamic Effects of a *Money-Financed* Increase in Government Purchases: *The Role of Price Stickiness*



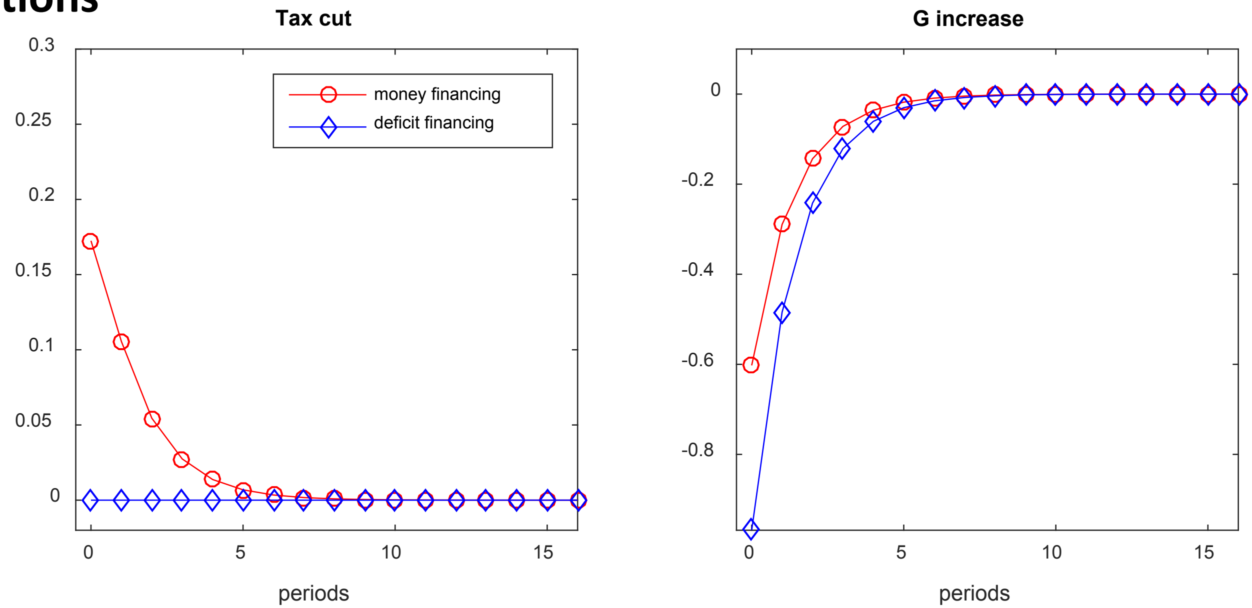
Welfare Effects: *The Role of Price Stickiness*





Welfare Effects: *The Role of Distortions*

Small distortions



Large distortions