Fiscal Policy in an Unemployment Crisis

Pontus Rendahl

University of Cambridge, CEPR and CFM

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The new-Keynesian view

1. $G_t \uparrow \Rightarrow P_t \uparrow$
2. Only a small fraction of firms can adjust prices, with a larger mass able to do so in the future (Calvo pricing)
3. $\Rightarrow P_{t+1} > P_t$.
4. Real interest rate $r_t \approx -\pi_t \downarrow$
5. Private spending $C_t \uparrow \Rightarrow Y_t \uparrow$

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1. Rinse and repeat

THIS PAPER

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2. Downward nominal wage rigidity:
3. $\Rightarrow W_t/P_t \downarrow$.
4. NPV profits $J_t \uparrow$
5. $u_t \downarrow$ and $u_{t+1} \downarrow$
6. Since $u_{t+1} \sim C_{t+1}$, consumption smoothing implies $C_t \uparrow \Rightarrow Y_t \uparrow$

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Differences

- Transmission mechanism
  - Spending out of lower real interest rate
  - Spending out of getting a job that lasts

A STYLIZED MODEL

- A useful starting point

$$u'(c_t) = \beta(1 + i_{t+1})\frac{p_t}{p_{t+1}}u'(c_{t+1})$$

- Assumptions
  - Predetermined price level in t.
  - Cash in advance price level in $t+1$: $p_{t+1} = m_{t+1}/y_{t+1}$.
  - Natural interest rate
  - Exogenous y_{t+1}.
  - $EIS < 1$.
  - Potential output in t, $y = 1$

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- For some β^*, $\beta \geq \beta^* \Rightarrow i_{t+1} = 0$ and $y_t < y = 1$.

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$$u'(y_t - g_t) = \beta \frac{y_{t+1}}{m_{t+1}} u'(y_{t+1})$$

- $c_t = y_t - g_t$ and $g_{t+1} = 0$
- Cash-in-advance: $p_{t+1} = m_{t+1}/y_{t+1}$ and $p_t = 1$.
- If $\beta \uparrow \Rightarrow i_{t+1} \downarrow$
- (If $EIS < 1$ then $y_{t+1} \downarrow \Rightarrow i_{t+1} \downarrow$)
- For some β^*, $\beta \geq \beta^* \Rightarrow i_{t+1} = 0$ and $y_t < y = 1$.
- Krugman's (1998) results follow

A stylized model

- Suppose that output is produced as $y_t = n_t$.
- Assume further that employment is inertial such that $n_{t+1} = n_t^{\alpha}$
- ($\alpha = 0$ collapses the model to that of Krugman (1998))

A stylized model

- Then for $\beta > \beta^*$ we have

$$u'(y_t - g_t) = \beta \frac{y_{t+1}}{m_{t+1}} u'(y_{t+1})$$

A stylized model

- Then for $\beta > \beta^*$ we have

$$u'(y_t - g_t) = \beta \frac{y_t^\alpha}{m_{t+1}} u'(y_t^\alpha)$$

A stylized model

- With CRRA preferences

$$\frac{\partial y_t}{\partial g_t} = \frac{1}{1 - \alpha(1 - \frac{1}{\gamma})} \in [1, \gamma]$$

- Thus

$$\lim_{\alpha \to 1} \frac{\partial y_t}{\partial g_t} = \gamma > 1$$

A stylized model

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- Thus

$$\lim_{\alpha \to 1} \frac{\partial y_t}{\partial g_t} = \gamma > 1$$

- And one can show

$$\sum_{s=0}^{\infty} \frac{\partial y_{t+s}}{\partial g_t} \geq \frac{1}{1 - \alpha} \frac{\partial y_t}{\partial g_t}$$

Model

The model largely follows the previous framework but with equilibrium unemployment and endogenous α

- Continuum of households of measure one
- Continuum of potential firms
- A government

Model

- One sector model, $y_t = n_t$
- Cashless limit. Prices p_t
- Time is discrete, $t = 0, 1, 2 \ldots$, and the horizon infinite
- Investments, but no capital

Model: Households

- Households search for jobs inelastically
- Employment denoted n_t, so $u_t = 1 - n_t$
- Nominal wage-rate is denoted w_t
- Total income, W_t, is labor income, $n_t \times w_t$, and profits, Π_t.

Model: Households

- Period budget constraint

$$B_t(1 + i_t) + W_t - T_t = C_t + B_{t+1}$$

with $C_t = p_t c_t$

Model: Households

- Problem: Given prices and taxes pick feasible $\{c_t, B_{t+1}\}$ to maximize

$$U(\{c_t\}_{t=0}^{\infty}) = E \sum_{t=0}^{\infty} \beta^t u(c_t)$$

- E denotes the (mathematical) expectations over future processes

Model: Households

- First order condition

$$u'(c_t) = \beta(1 + i_{t+1})E_t\left[\frac{p_t}{p_{t+1}}u'(c_{t+1})\right].$$

- Plus TVC

Model: Firms

- The asset values of an operating firm is

$$J_t = 1 - \frac{w_t}{p_t} + \beta E_t \left[\frac{u'(c_{t+1})}{u'(c_t)} (1-\delta) J_{t+1} \right].$$

- Post vacancy gives match with probability h_t and costs κ.
- Free entry

$$\kappa = h_t J_t \tag{1}$$

Model: Labor Market

- The labor market is frictional with matching function

$$M_t = M(v_t, \hat{u}_t), \quad \hat{u}_t = 1 - n_{t-1} + \delta n_{t-1}$$

- Job-filling rate, and job-finding probability

$$h(\theta_t) = \frac{M_t}{v_t}, \quad f(\theta_t) = \frac{M_t}{\hat{u}_t}, \quad \text{with} \quad \theta_t = \frac{v_t}{\hat{u}_t}$$

- Law of motion for employment

$$n_t = \hat{u}_t f(\theta_t) + (1 - \delta) n_{t-1}$$

Model: Households

Nominal wages are rigid, $w_t = w$. But useful benchmark to define flexible wages.

$$V_t = \hat{w}_t + \beta E_t \left[\frac{u'(c_{t+1})}{u'(c_t)} \left\{ [1 - \delta(1 - f_{t+1})] V_{t+1} + \delta(1 - f_{t+1}) U_{t+1} \right\} \right],$$

and

$$U_t = z + \beta E_t \left[\frac{u'(c_{t+1})}{u'(c_t)} \left[f_{t+1} V_{t+1} + (1 - f_{t+1}) U_{t+1} \right] \right],$$

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- Nash bargaining

$$\hat{w}_t = \text{argmax} \{ J_t^{1-\omega} (V_t - U_t)^{\omega} \}$$

Model: Monetary policy

- Nominal interest rate

$$i_{t+1} = \max\{i^*_{t+1}, 0\}$$

- Implies prices outside of a liquidity trap

$$p_t = \frac{w}{\hat{w}_t}, \tag{2}$$

Model: Government

- Government's budget constraint

$$T_t + D_{t+1} = G_t + (1 + i_t)D_t$$

as well as the no-Ponzi condition

$$\lim_{n\to\infty} \frac{D_{n+1}/p_{n+1}}{\Pi_{s=t}^{n} R_{s+1}} \leq 0,$$

with $R_{s+1} = (1 + i_{s+1})p_s/p_{s+1}$.

- But Ricardian equivalence holds, so $G_t = T_t$ works as well

Model: Equilibrium

Given a fiscal plan $\{D_t, G_t, T_t\}$, an equilibrium is a process of prices $\{w_t, p_t, i_{t+1}, J_t\}$ and allocations $\{c_t, y_t, n_t, \theta_t, B_{t+1}\}$ such that

1. The above equations are satisfied
2. Bond market clears; $B_t = D_t$
3. Goods market clears; $Y_t = p_t n_t = C_t + G_t + I_t$, with $I_t = p_t \kappa v_t$

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Profits are then,

$$\Pi_t = n_t(p_t - w_t) - p_t \kappa v_t$$

Model: Silliest slide so far

Proposition

There exist a unique steady-state equilibrium.

Intuition

$$u'(c_t) = \beta(1 + i_{t+1})E_t\left[\frac{p_t}{p_{t+1}}u'(c_{t+1})\right],$$
$$J_t = 1 - \frac{w}{p_t} + \beta E_t\left[\frac{u'(c_{t+1})}{u'(c_t)}(1-\delta)J_{t+1}\right].$$

- Two key equations.
- $\beta \uparrow$ does really nothing as long as $i_{t+1} \downarrow$.
- If anything, it creates a small expansion.
- Liquidity trap dynamics are very different.

Intuition

$$u'(c_t) = \beta E_t \left[\frac{p_t}{p_{t+1}} u'(c_{t+1}) \right],$$
$$J_t = \frac{1}{p_t} \left(p_t - w + E_t \left[p_{t+1}(1-\delta) J_{t+1} \right] \right).$$

- $\beta \uparrow$ means demand below supply ($c_t^d \downarrow$), so $p_t \downarrow$ to lower the real interest rate.
- With p_t down, J_t falls and equilibrium output contracts.
- Search frictions: $\Delta n_{t+1} \approx 0.25 \Delta n_t$, and $\Delta c_{t+1} \sim \Delta n_{t+1}$.
- With $c_{t+1} \downarrow$, the economy is set on a downward spiral.

Intuition

$$u'(c_t - g_t) = \beta E_t \left[\frac{p_t}{p_{t+1}} u'(c_{t+1}) \right],$$

$$J_t = \frac{1}{p_t} \left(p_t - w + E_t \left[p_{t+1}(1-\delta) J_{t+1} \right] \right).$$

- $g_t \uparrow$ means demand exceeds supply ($(c_t^d + g_t) \uparrow$), so $p_t \uparrow$ to raise the real interest rate.
- With p_t up, J_t increases and equilibrium output expands.
- Again, search frictions: $\Delta n_{t+1} \approx 0.25 \Delta n_t$, and $\Delta c_{t+1} \sim \Delta n_{t+1}$.
- With $c_{t+1} \uparrow$, the economy enters a virtuous cycle.

Experiment

- The economy is in its steady state in period t
- Unexpectedly the discount factor rises to $\hat{\beta} = \beta + 0.015$.
- With probability q it reverts back in the subsequent period, but with $1 - q$ it remains high.
- If it reverts back, it does so for perpetuity.
- $\Rightarrow$ liquidity trap with expected duration $1/q$

Experiment

- Government may or may not increase spending in response
- If it does, it remains high with probability ρ in the subsequent period.
- With probability $1 - \rho$ it reverts back to its steady state instead, and remains there for perpetuity.

Experiment

- Useful parameter

$$\zeta = \frac{\frac{1}{1-(1-q)\rho} - 1}{\frac{1}{q} - 1} = \frac{q\rho}{1-(1-q)\rho}$$

- Fiscal multiplier defined as

$$\mu(q,\zeta) = \frac{\sum_{s=0}^{\infty} E_t[\Delta y_{t+s}]}{\sum_{s=0}^{\infty} E_t[\Delta g_{t+s}]}.$$

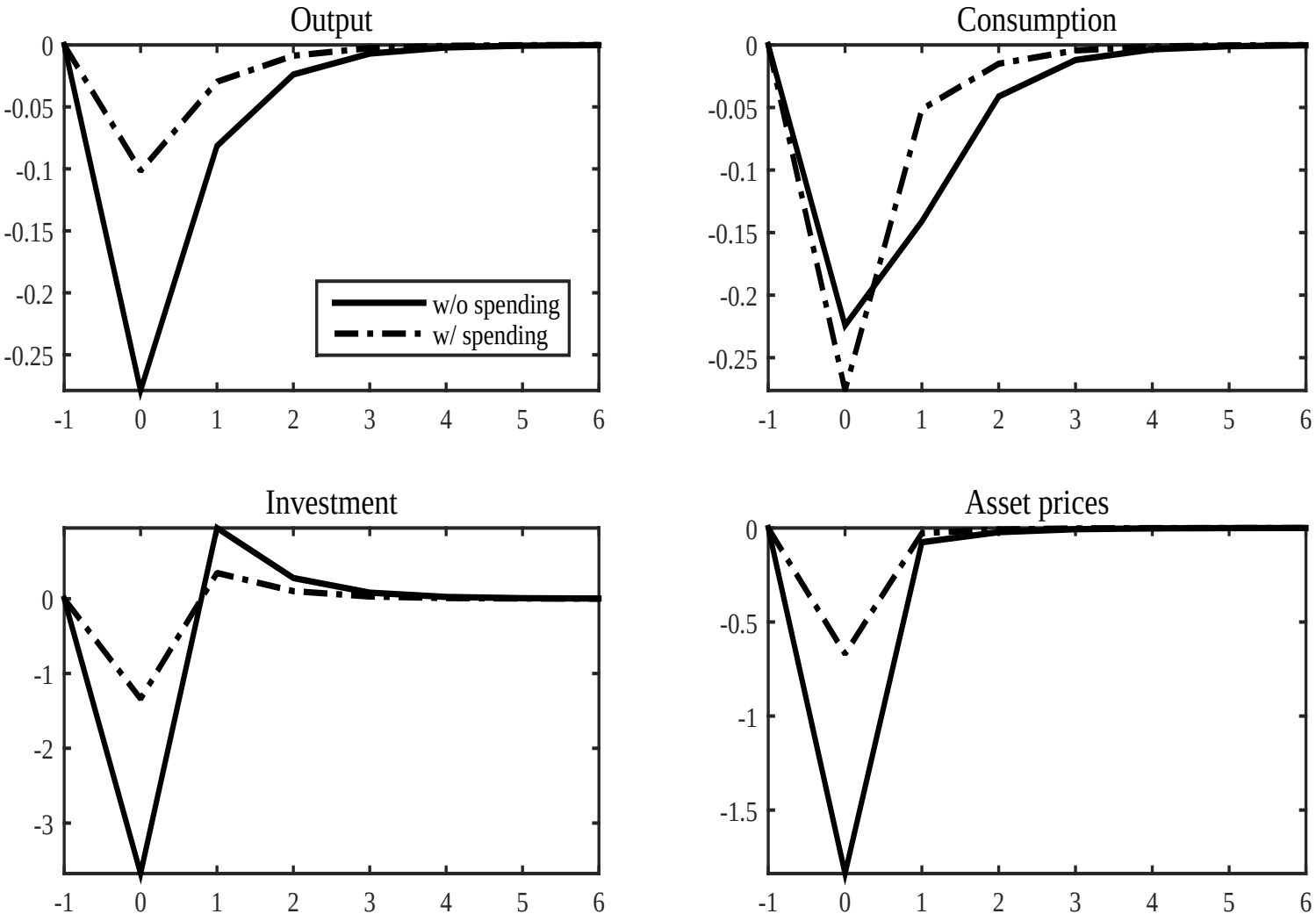
Calibration

Table 1: Calibrated parameters

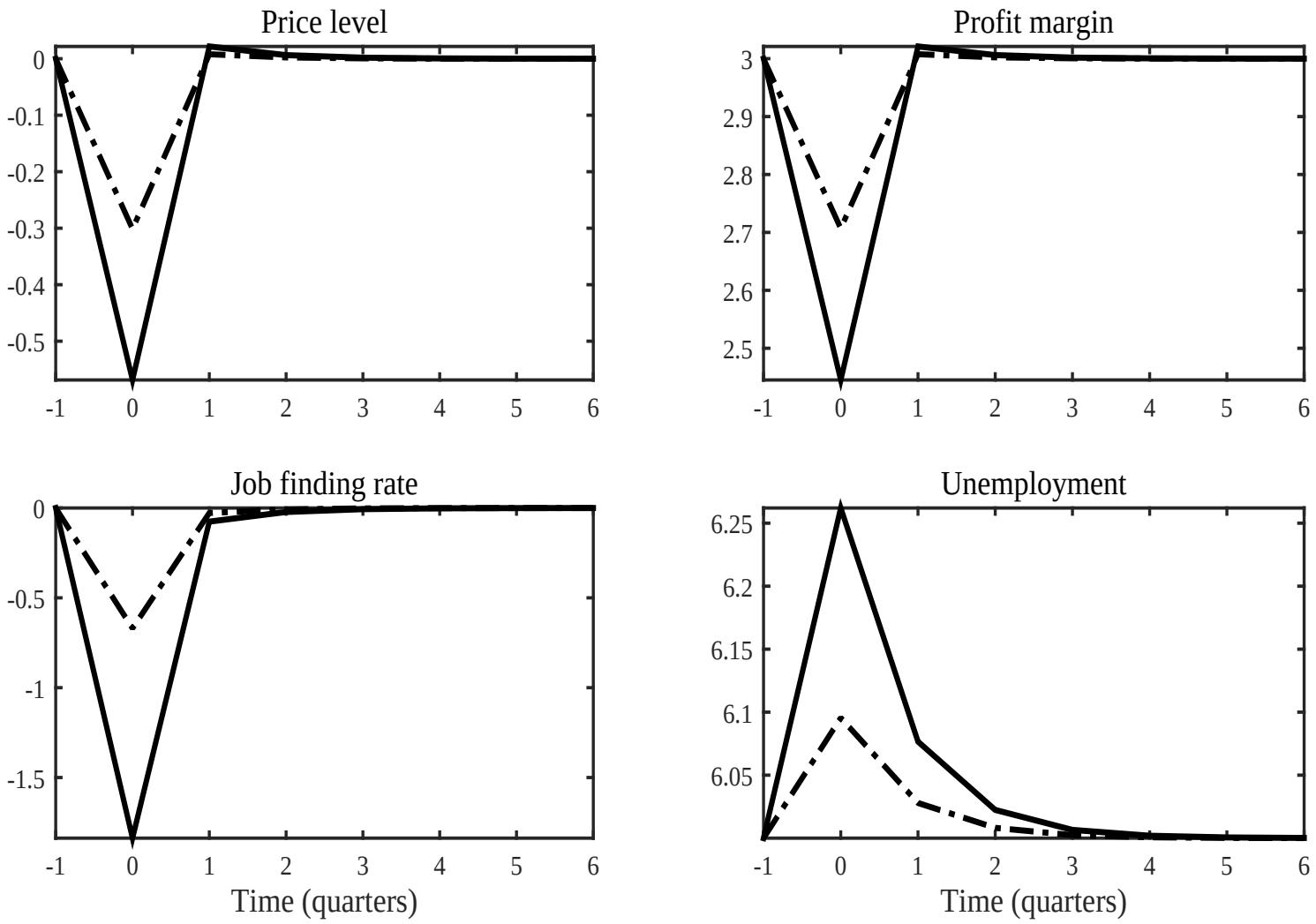
Parameter	Interpretation	Value	Source/steady state target
γ	Inverse of EIS	2	Convention
β	Discount factor	0.993	Annual real interest rate of 3%
φ	Efficiency of matching	0.704	Unemployment rate of 6%
δ	Separation rate	0.152	Time to convergence of 5 months
ω	Workers bargaining power	0.767	Steady state profit margin of 3%
η	Elasticity of $f(\theta)$	0.5	Petrongolo and Pissarides (2001)
κ	Vacancy posting cost	0.134	Steady state θ normalized to one
z	Unemployment benefits	0.5	Chetty (2008)
g	Steady state fiscal spending	0.188	20% of steady state output

Notes. This table lists the parameter values of the model. The calculations and targets are described in the main text. One period in the model corresponds to one quarter.

Results, $q = 1$


Output
Consumption
Investment
Asset prices
w/o spending
w/ spending
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.5
-1
-1.5
-2
-3
-1
0
1
2
3
4
5
6

Results, $q = 1$


Price level
0
-0.1
-0.2
-0.3
-0.4
-0.5
-1 0 1 2 3 4 5 6
Profit margin
3
2.9
2.8
2.7
2.6
2.5
-1 0 1 2 3 4 5 6
Job finding rate
0
-0.5
-1
-1.5
-1 0 1 2 3 4 5 6
Time (quarters)
Unemployment
6.25
6.2
6.15
6.1
6.05
-1 0 1 2 3 4 5 6
Time (quarters)

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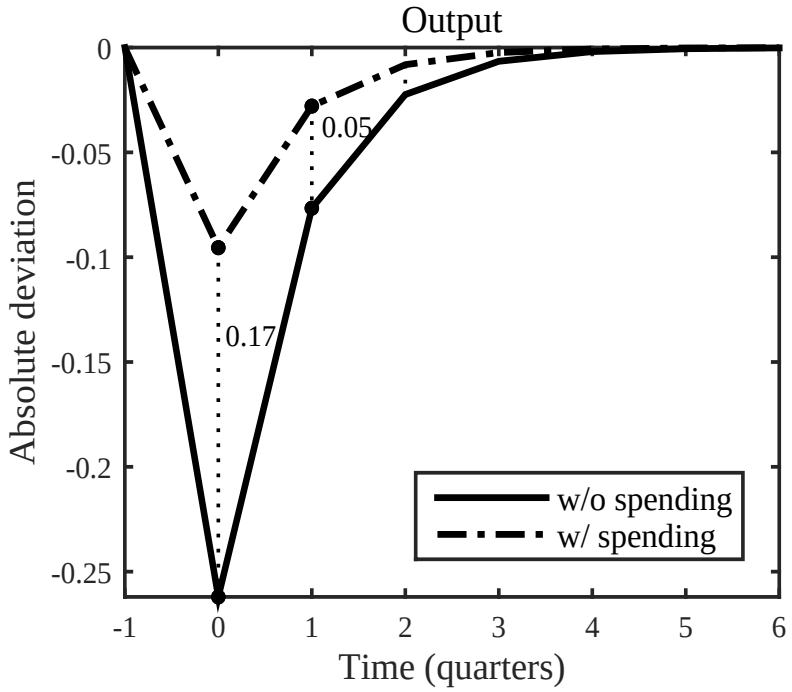
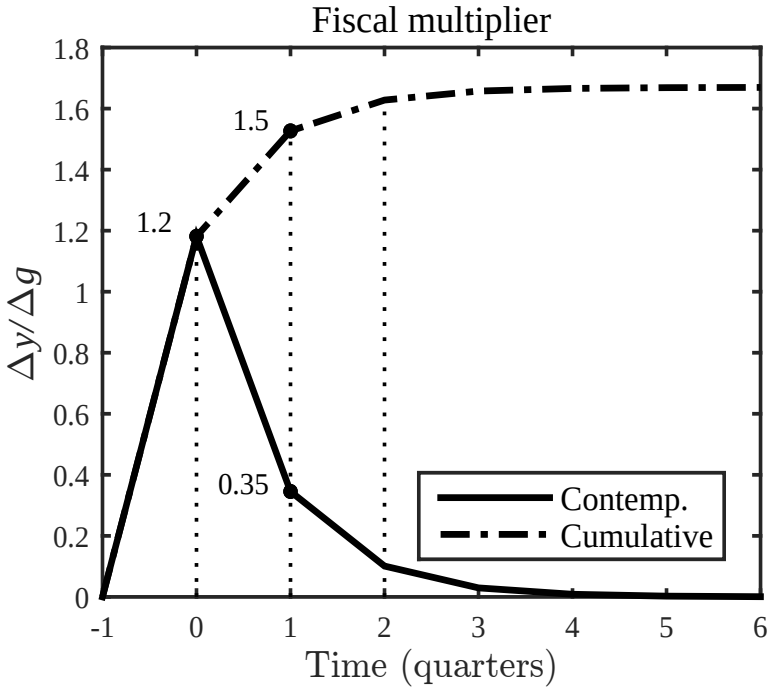
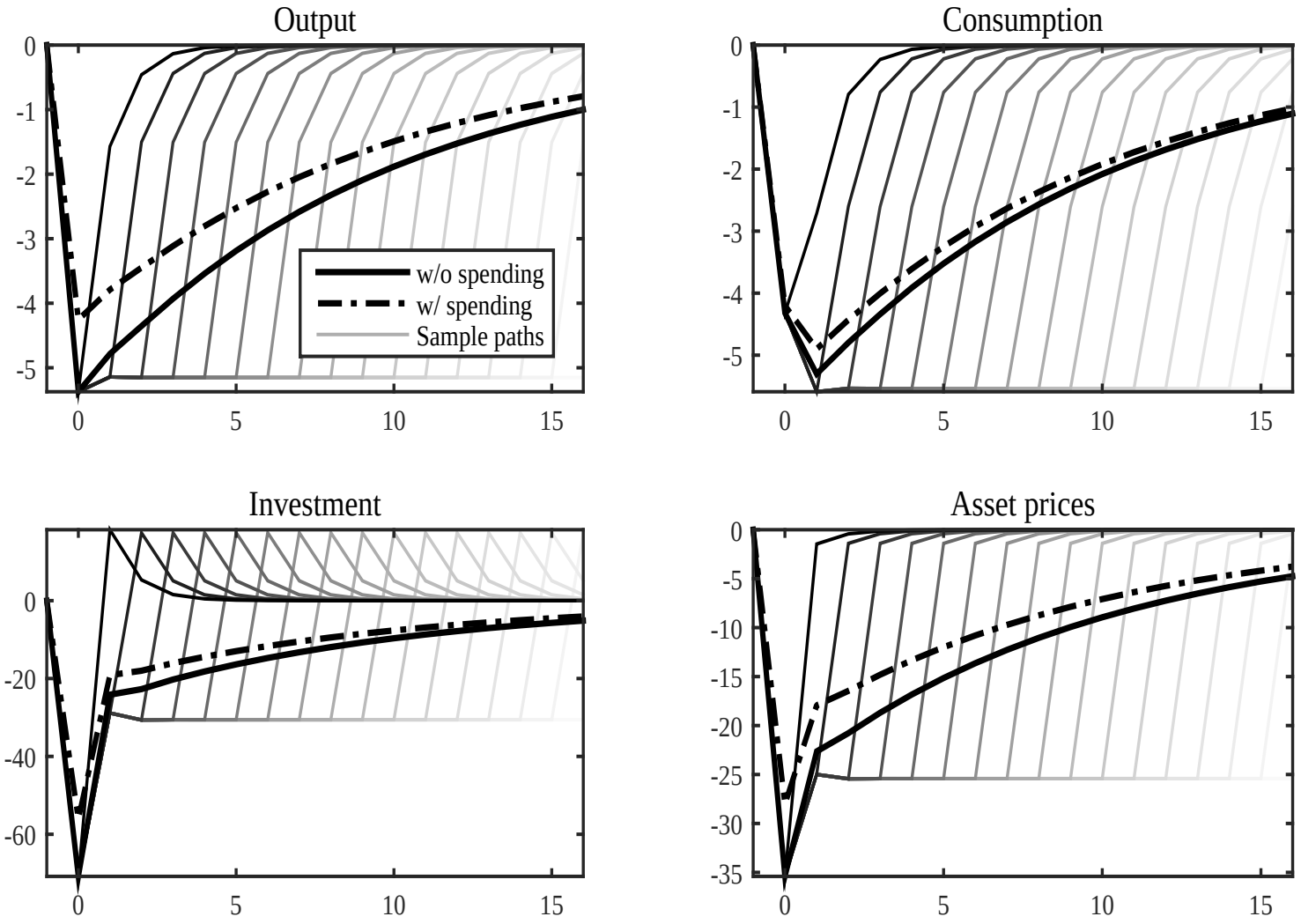
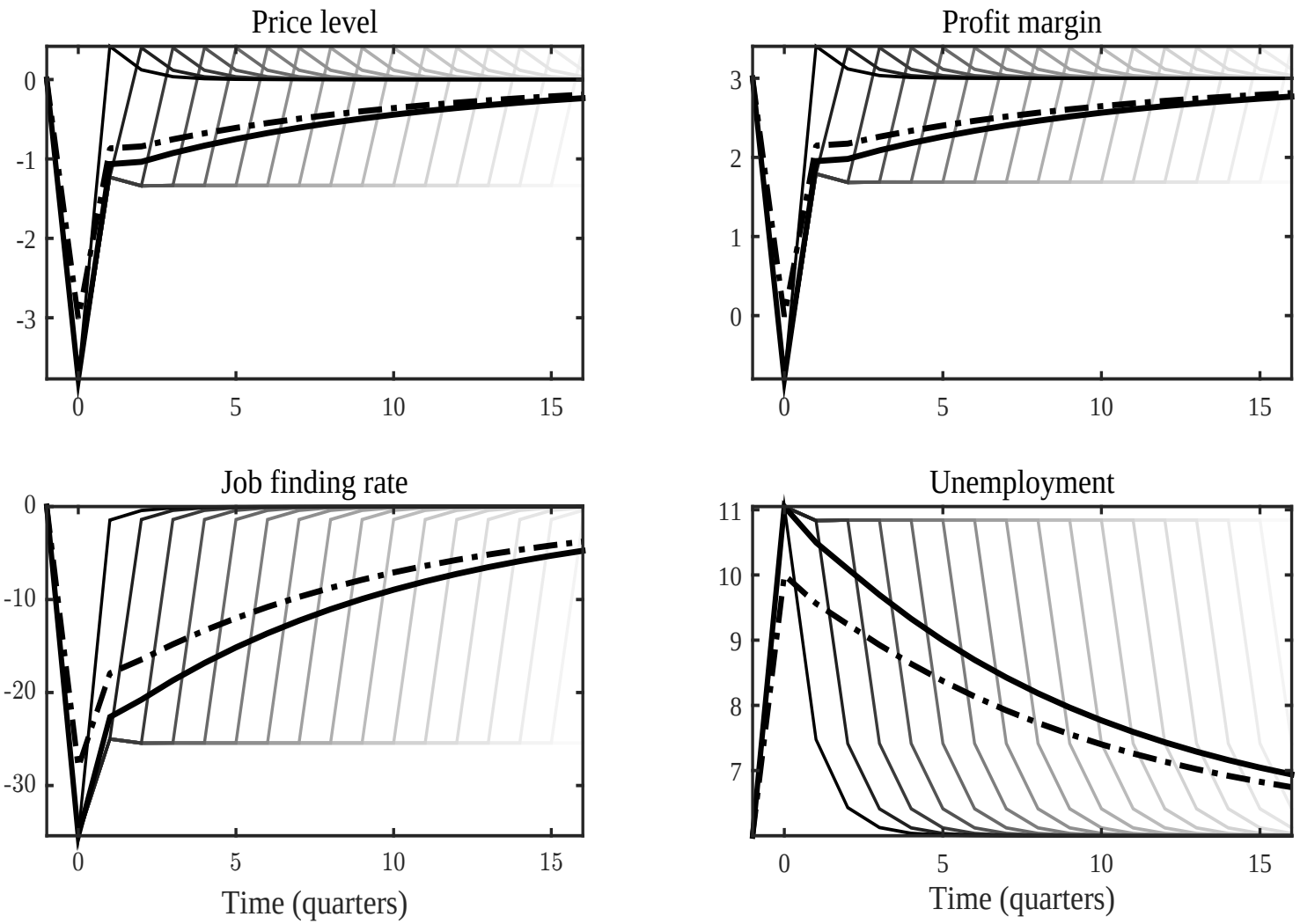

Output
Absolute deviation
Time (quarters)
0.05
0.17
w/o spending
w/ spending


Fiscal multiplier
$\Delta y / \Delta g$
Time (quarters)
1.5
1.2
0.35
Contemp.
Cumulative

Results, $q = 0.1, \zeta = 1$



Results, $q = 0.1, \zeta = 1$



Welfare and multipliers

- Define

$$v(n; g, q, \zeta) = u[c(n; g, q, \zeta)] + \hat{\beta} E[v(n'; g, q, \zeta)],$$

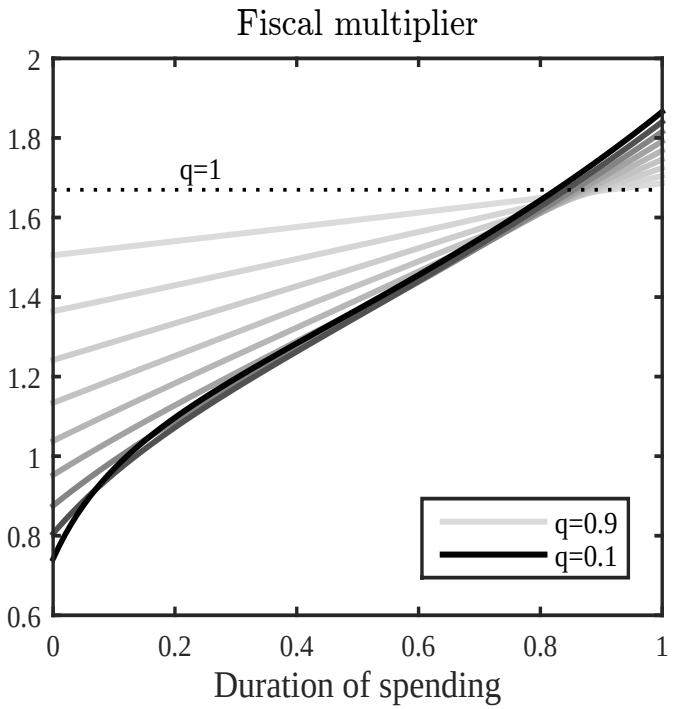
- Define $\hat{c}(g; q, \zeta)$ as

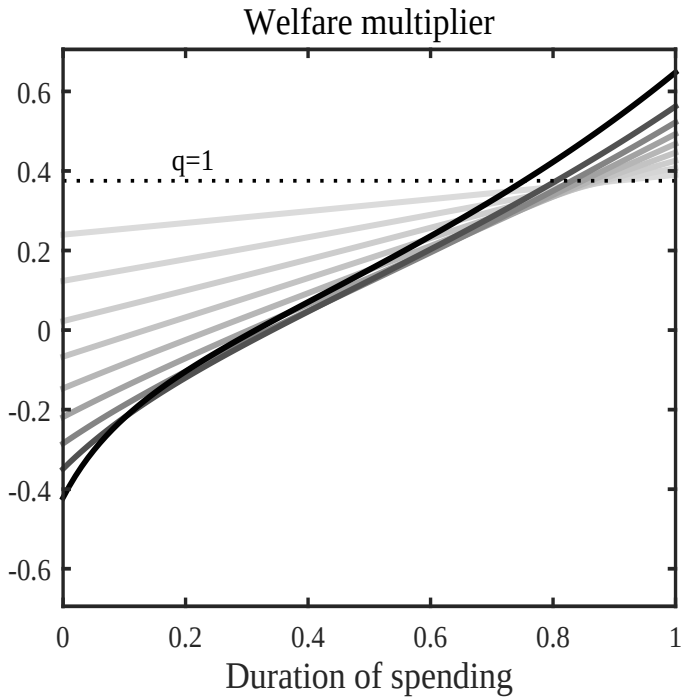
$$\hat{c}(g; q, \zeta) = [(1-\beta)(1-\gamma) v(n_{ss}; g, q, \zeta)]^{\frac{1}{1-\gamma}}$$

- Welfare

$$W(q, \zeta) = [1 - (1-q)\rho] \times \frac{\partial \hat{c}(g; q, \zeta)}{\partial g} \times \frac{1}{1-\beta}$$

Welfare and multipliers

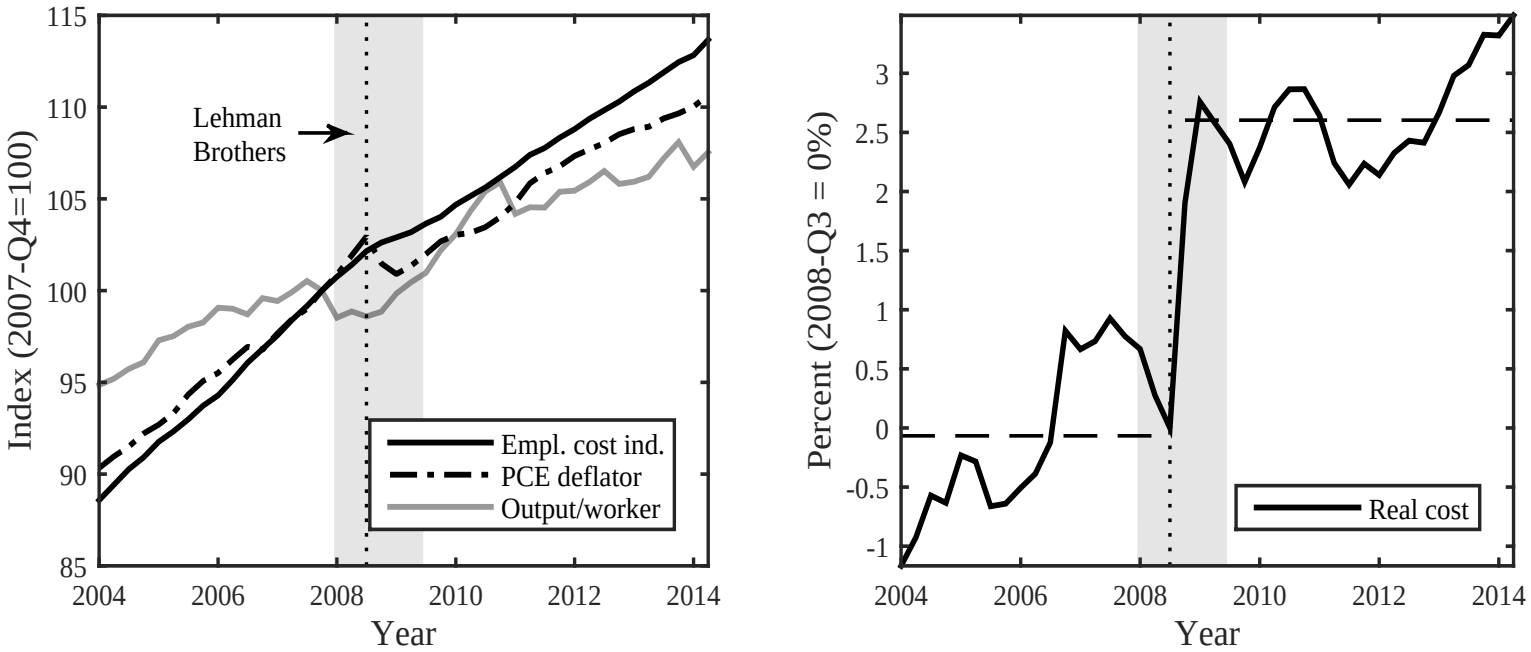




Conclusions

- In a liquidity trap with downwardly nominal wages and persistent unemployment the fiscal multiplier can be large
- The associated welfare effects can be positive and sizeable
- Fiscal policy is not efficacious, however, because the government pays out income to workers (hole-digging policy not viable)
- But because the government create jobs that lasts
  - Government spending should therefore focus on goods and services that would be provided in the economy had the crisis not interfered with the macroeconomic equilibrium

A tiny bit of data



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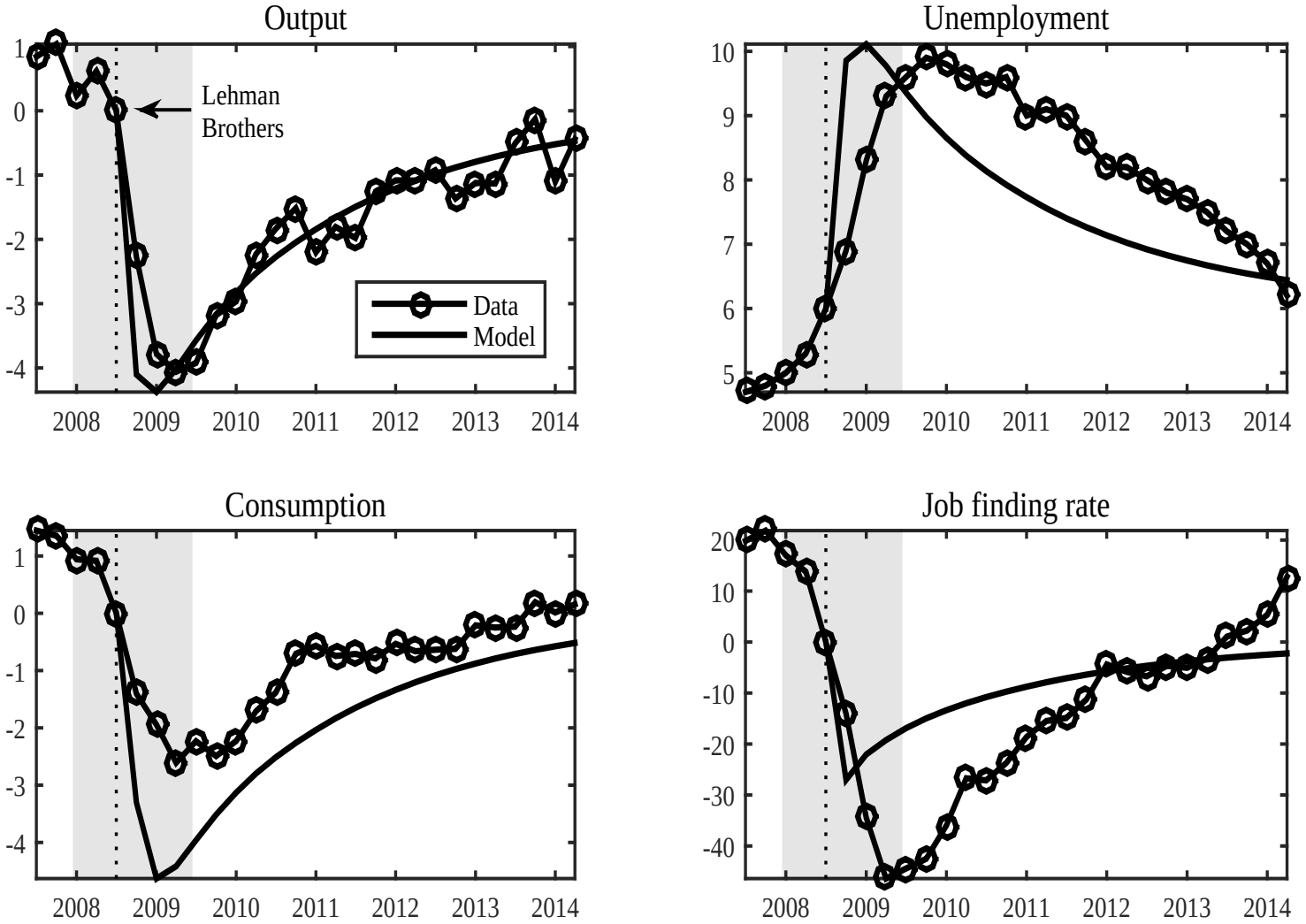

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