Liquidity Traps and Monetary Policy: Managing a Credit Crunch

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Motivation & Question

- Important economic contractions are often associated with large banking/financial crisis:
  - great depression, 1929-33
  - great recession, 2007-08
- Monetary policy (or the lack of it) is attributed a prominent role in ameliorating or exacerbating these contractions.

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- Important economic contractions are often associated with large banking/financial crisis:
  - great depression, 1929-33
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- Monetary policy (or the lack of it) is attributed a prominent role in ameliorating or exacerbating these contractions.
- What are the effects of alternative monetary policy during a credit crunch?

Motivation & Question (cont'd)

- **great depression, 1929-33:** unresponsive monetary policy, large deflation, pronounce recession, large drop in TFP, ..., nominal interest rate near zero

- **great recession, 2007-08:** large increase in government liabilities, low and stable inflation, less pronounce recession but slow recovery, large drop in investment, ..., nominal interest rate near zero

This Paper

Studies the effects of alternative monetary policies in an economy with heterogeneous producers during a credit crunch, i.e., a tightening of collateral constraints:

0. real benchmark, no government
1. unresponsive money supply
2. constant inflation target
3. distribution of welfare consequences

Preview of Results

0. real benchmark, no government

- drop in TFP, sharp drop in the real interest rate

1. unresponsive monetary policy

- deflation, larger drop in TFP if debts are nominal

2. constant inflation target

- requires a large increase in money supply/government debt, leads to an initially less severe, but more persistent contraction

3. distribution of welfare consequences

- winners and losers

Model Economy

- Entrepreneurs w/ heterogenous productivity, $z \sim \Psi(z)$, and workers.
- Financial frictions: collateral constraint.
- Money: cash-in-advance constraint, potential "store of value".

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- Entrepreneurs w/ heterogenous productivity, $z \sim \Psi(z)$, and workers.
- Financial frictions: collateral constraint.
- Money: cash-in-advance constraint, potential "store of value".
- No aggregate uncertainty, study response to unanticipated shocks.
- Flexible prices.

Entrepreneurs' Problem

$$\max_{\{c_t, m_{t+1}, l_t, k_{t+1}, b_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \left[\nu \log c_{1t} + (1-\nu) \log c_{2,t}\right],$$

s.t.

$$k_{t+1} + \frac{m_{t+1}}{p_t} + c_{1t} + c_{2t} + T_t(z)$$

$$= (z_t k_t)^{\alpha} l_t^{1-\alpha} - w_t l_t + (1 + r_t) b_t + (1-\delta) k_t + \frac{m_t}{p_t} - b_{t+1},$$

$$-b_{t+1} \leq \theta_t k_{t+1}, \quad \theta_t \in [0, 1], \qquad \text{(borrowing constraint)}$$

$$c_{1,t} \leq \frac{m_t}{p_t}. \qquad \text{(cash-in-advance)}$$

(Simplified) Entrepreneurs' Problem

$$\max_{\{c_t, m_{t+1}, a_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \left[\nu \log c_{1t} + (1-\nu) \log c_{2,t}\right]$$

s.t.

$$a_{t+1} + \frac{m_{t+1}}{p_t} + c_{1t} + c_{2t} + T_t(z) = R_t(z) a_t + \frac{m_t}{p_t},$$

$$k_{t+1} \leq \lambda_t a_{t+1}, \quad \lambda_t \equiv \frac{1}{1-\theta_t} \in [1, \infty], \qquad \text{(borrowing constraint)}$$

$$c_{1,t} \leq \frac{m_t}{p_t}. \qquad \text{(cash-in-advance)}$$

Optimal Portfolio Choice

Gross return of net-worth solves

$$R_t(z)a = \max_{k,b,l} (zk)^\alpha l^{1-\alpha} + (1-\delta)k + (1+r_t)b, \quad \text{s.t.}$$

$$k + b = a, \quad -b \leq \theta_{t-1} k$$

Optimal Portfolio Choice

Gross return of net-worth

$$R_t(z) = \begin{cases} \lambda_{t-1}(\varrho_t z - r_t - \delta) + 1 + r_t, & z \geq \hat{z}_t \\ 1 + r_t, & z < \hat{z}_t \end{cases}$$

Capital and bond demand (supply if $b_t < 0$)

$$k_t = \begin{cases} \lambda_{t-1} a_t, & z \geq \hat{z}_t \\ 0, & z < \hat{z}_t \end{cases}, \quad b_t = \begin{cases} -(\lambda_{t-1} - 1) a_t, & z \geq \hat{z}_t \\ a_t, & z < \hat{z}_t. \end{cases}$$

where $\varrho_t \hat{z}_t = r_t + \delta$ and $\varrho_t \equiv \alpha \left((1-\alpha)/w_t\right)^{(1-\alpha)/\alpha}$.

Workers' Problem

$$\max_{\{c_t, m_{t+1}, a_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \left[\nu \log c_{1t} + (1-\nu) \log c_{2,t}\right]$$

s.t.

$$a_{t+1} + \frac{m_{t+1}}{p_t} + c_{1t} + c_{2t} + T_t^W = w_t + (1+r_t)a_t + \frac{m_t}{p_t},$$

$$a_{t+1} \geq 0, \qquad \text{(borrowing constraint)}$$

$$c_{1,t} \leq \frac{m_t}{p_t}. \qquad \text{(cash-in-advance)}$$

To derive analytical expressions we assume that for workers $\nu = 0$ and $a_t = 0$, but in the numerical example we treat workers and entrepreneurs symmetrically.

Government

Budget constraint

$$\frac{M_{t+1}}{p_t} - \frac{M_t}{p_t} + B_{t+1} + \int T_t(z)\Psi(dz) + T_t^W = (1 + r_t)B_t.$$

Two alternative policies:

1. constant M
2. constant inflation target

Demographics & Mixing of Wealth

- A fraction $1 - \gamma$ of entrepreneurs (workers) die and are replaced by equal number of new entrepreneurs (workers).
- Productivity z of new entrepreneurs drawn from $\Psi(z)$, iid across entrepreneurs and over time.
- Each new entrepreneur (worker) inherits the assets of a randomly drawn dying entrepreneur (worker).
- These assumptions guarantee a non-degenerated measure of net-wealth across types $\Phi_t(z)$.

Numerical Examples

Simulate the effect of a credit crunch, i.e., an unanticipated shock to θ_t, under alternative three scenarios:

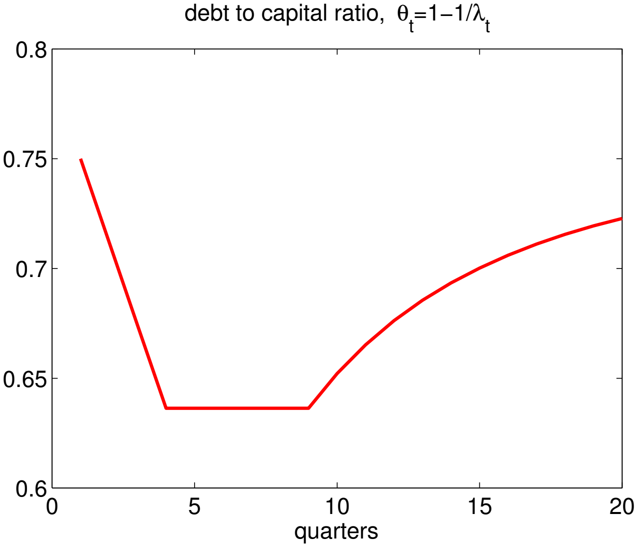
0. benchmark real economy, no government

1. monetary economy, unresponsive monetary policy

2. monetary economy, constant inflation target

3. distribution of welfare consequences

Credit Crunch



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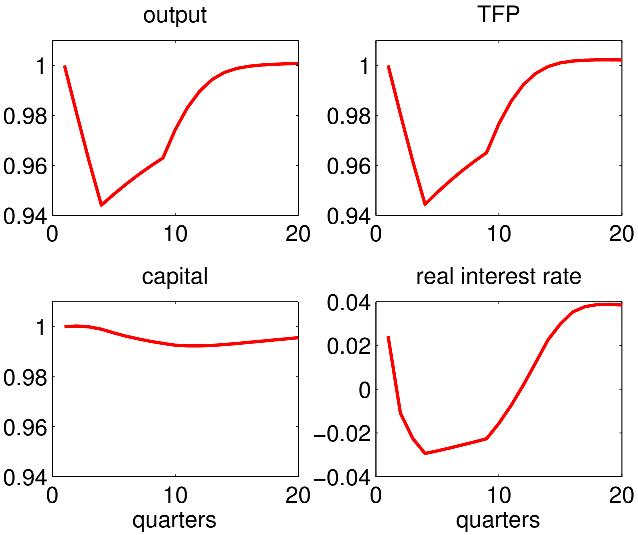
Benchmark Real Economy, No Government

Moll(2012), Buera & Moll (2012)



Intuition: Bond Market

The bond market clearing condition is

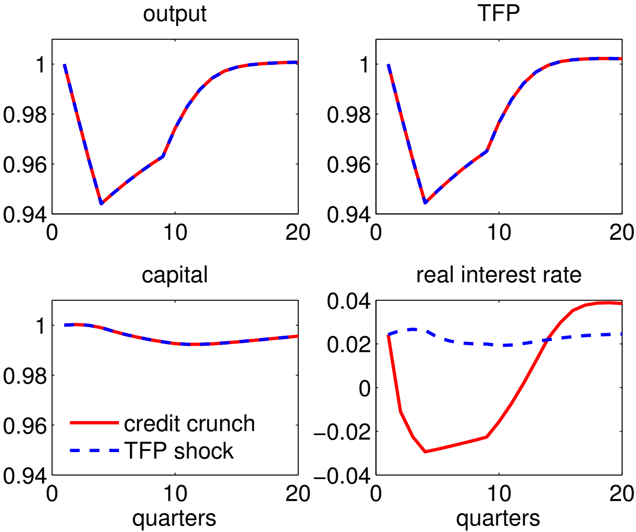
$$\overbrace{\int_0^{\hat{z}_{t+1}} \Phi_{t+1}(dz)}^{\text{demand for bonds}} = \overbrace{(\lambda_t - 1)\int_{\hat{z}_{t+1}}^{\infty} \Phi_{t+1}(dz) + B_{t+1}}^{\text{supply of bonds}}.$$

and the marginal entrepreneur solve

$$\alpha\left(\frac{1-\alpha}{w_{t+1}}\right)^{(1-\alpha)/\alpha} \hat{z}_{t+1} = r_{t+1} + \delta.$$

Given w_{t+1} and $\Phi_{t+1}(z)$, there is a positive relationship between λ_t and r_{t+1}.

Comparison with Exogenous TFP Shock



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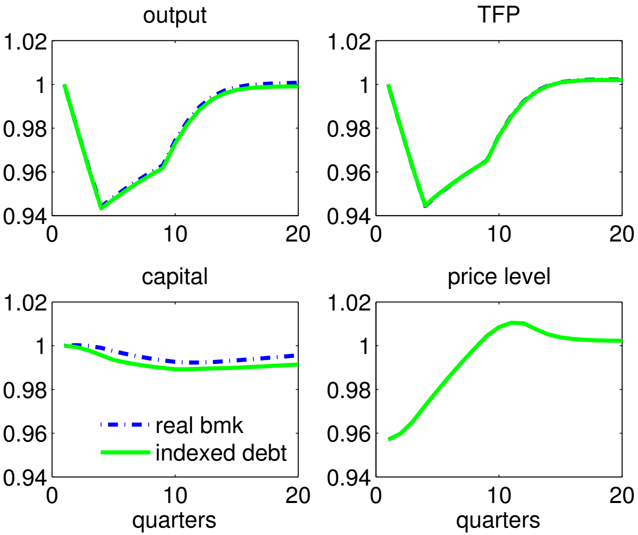
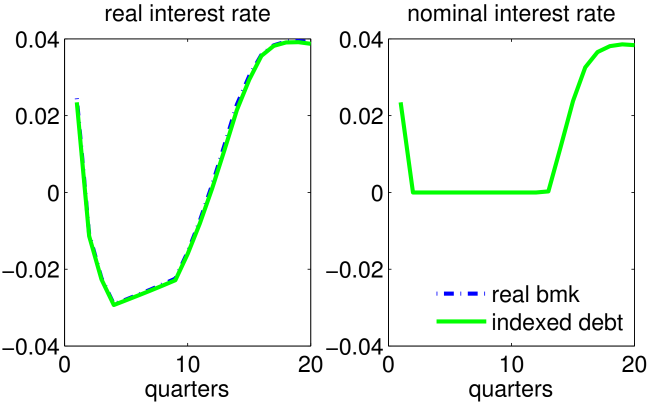
Monetary Economy: Unresponsive Policy

Indexed Bonds



Monetary Economy: Unresponsive Policy

Indexed Bonds (cont'd)



Intuition for the Deflation

- the credit crunch generates a large drop in the real return of bonds, i.e., the real interest rate
- if the price level remains constant, excess demand for real cash balances, i.e., "store of value"
- since the supply of money is fixed, the price level must decline to clear the money market
- ... and the return of money must drop in the future, the inflation increase, so that money and bonds have the same real return

Money Market

If $(1 + r_{t+1})p_{t+1}/p_t > 0$, then the price level at t is determined by

$$\overbrace{\frac{M_{t+1}}{p_t}}^{\text{money supply}} = \overbrace{\frac{\nu(1-\beta)\beta}{1-\nu(1-\beta)}\left[\int R_{t+1}(z)\Phi_{t+1}(dz) \right.}^{\text{money demand for transaction purposes}}$$
$$\left. - \sum_{j=0}^{\infty} \int_0^{\infty} \frac{T_{t+j}(z)}{\prod_{s=1}^{j} R_{t+s}(z)} \Psi(dz) \right].$$

At the zero lower bound, when monetary policy is unresponsive, the sequence of price levels must satisfy

$$p_t = (1 + r_{t+1})p_{t+1}$$

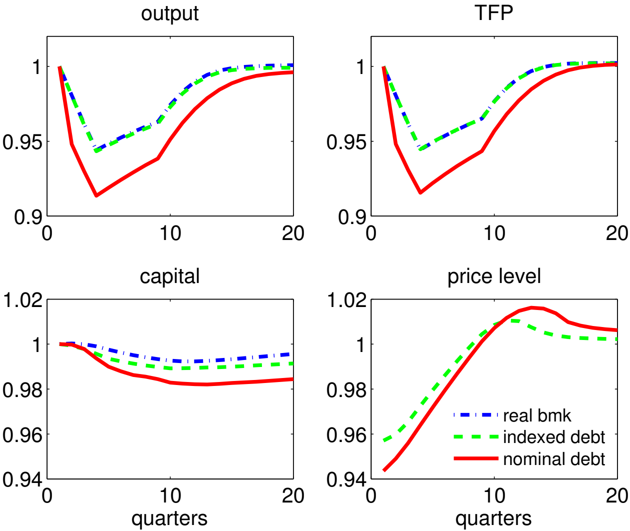
and the money demand includes the demand for "store of value".

Monetary Economy: Unresponsive Policy

Nominal Bonds, Debt Deflation

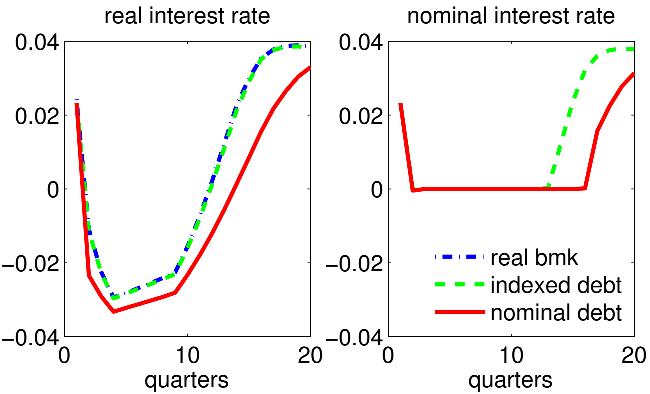
Monetary Economy: Unresponsive Policy

Nominal Bonds, Debt Deflation



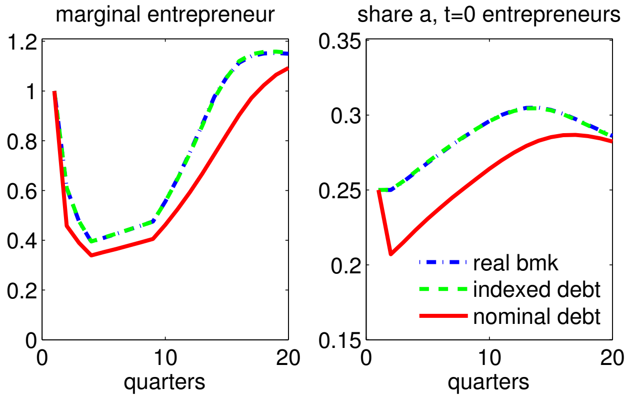
Monetary Economy: Unresponsive Policy

Nominal Bonds, Interest Rates



Monetary Economy: Unresponsive Policy

Nominal Bonds, Explaining TFP



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Simulate the effect of a credit crunch, i.e., an unanticipated shock to θ_t, under alternative three scenarios:

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Monetary Economy: Constant Inflation Target

Policy Rules

Government liabilities adjust to attain price stability

$$B_{t+1} = \begin{cases} \int_0^{\hat{z}_{t+1}} \Phi_{t+1}(dz) \\ -(\lambda_{t+1} - 1) \int_{\hat{z}_{t+1}}^{\infty} \Phi_{t+1}(dz) & \text{if } r_{t+1} = \frac{p_t}{p_{t+1}} - 1 \\ \\ B_t & \text{if } r_{t+1} > \frac{p_t}{p_{t+1}} - 1 \end{cases}.$$

and

$$\begin{aligned} M_{t+1} \quad = \quad p_t \frac{\nu(1-\beta)\beta}{1-\nu(1-\beta)} \Bigg[\int R_{t+1}(z)\Phi_{t+1}(dz) \\ - \sum_{j=0}^{\infty} \int_0^{\infty} \frac{T_{t+j}(z)}{\prod_{s=1}^{j} R_{t+s}(z)} \Psi(dz) \Bigg]. \end{aligned}$$

Monetary Economy: Constant Inflation Target

Policy Rules (cont'd)

1. lump-sum case:
   - pure lump-sum taxes (transfers), $T_t(z) = T_t^W = T_t$,

$$T_t = \frac{M_t - M_{t+1}}{p_t} + (1 + r_t)B_t - B_{t+1}.$$

2. bailout case:
   - entrepreneurs receive proceeds of new bond issues,

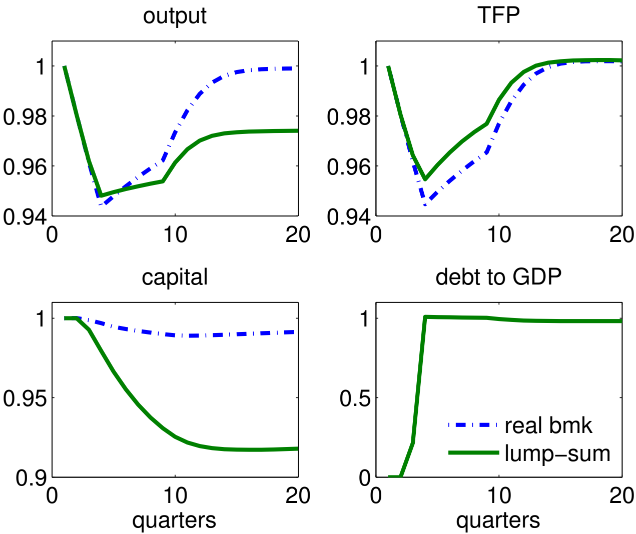
$$\int T_t(z)\Psi(dz) = \frac{M_t - M_{t+1}}{p_t} + (1 + r_t)B_t - B_{t+1}, \text{ if } B_{t+1} > B_t$$

   - lump-sum taxes (transfers) otherwise, $T_t(z) = T_t^W = T_t$,

$$T_t = \frac{M_t - M_{t+1}}{p_t} + (1 + r_t)B_t - B_{t+1}.$$

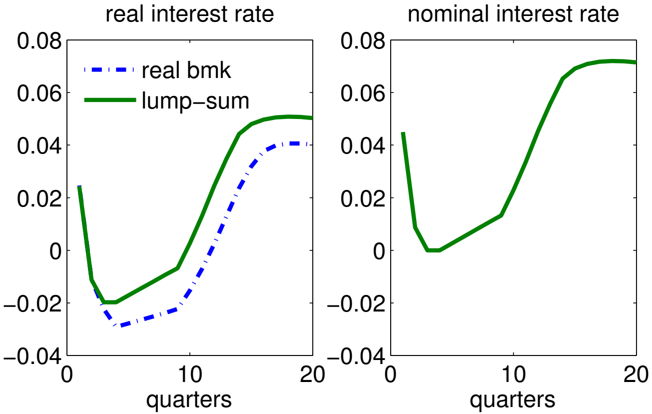
Monetary Economy: Constant Inflation Target

Lump-Sum Case



Constant Inflation Target

Lump-Sum Case (cont'd)



Intuition: Government Liabilities

- the credit crunch results in an excess demand for bonds
- to maintain price stability the government must increase the supply of "store of value", money or bonds
- higher government liabilities imply higher future taxes
- unconstrained individuals further increase their savings, i.e., their demand for bonds, in anticipation of future taxes

Intuition: Non-Ricardian Model

Again, assuming workers are hand-to-mouth, the evolution of aggregate capital is given by

$$\begin{aligned} K_{t+1} &= \beta\left[\alpha Y_t + (1-\delta)K_t\right] + (1-\beta)\sum_{j=1}^{\infty}\int_0^{\infty}\frac{T_{t+j}(z)}{\prod_{s=1}^{j} R_{t+s}(z)}\Psi(dz) \\ &\quad -(1-\beta)\sum_{j=1}^{\infty}\frac{\int T_{t+j}(z)\Psi(dz) + T_{t+j}^{W}}{\prod_{s=1}^{j}(1+r_{t+s})} \end{aligned}$$

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- productive entrepreneurs are constrained, i.e., for $z > \hat{z}_{t+s}$, $R_{t+s}(z) > 1 + r_{t+s}$

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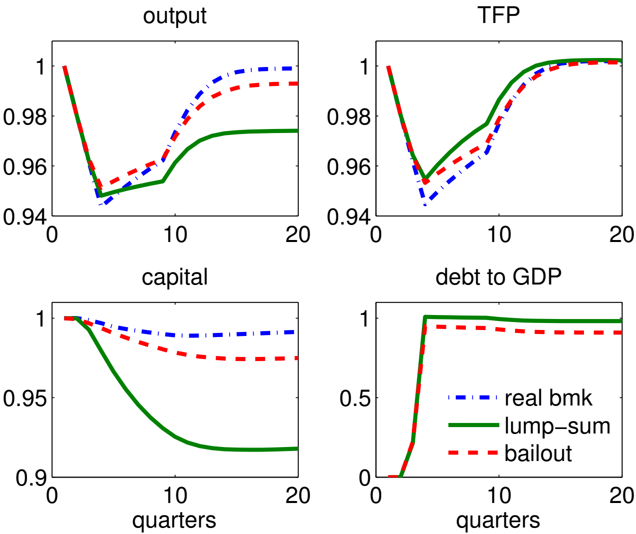
$$-(1-\beta)\sum_{j=1}^{\infty}\frac{\int T_{t+j}(z)\Psi(dz)}{\prod_{s=1}^{j}(1+r_{t+s})} - (1-\beta)\sum_{j=1}^{\infty}\frac{T^W_{t+j}}{\prod_{s=1}^{j}(1+r_{t+s})}$$

- productive entrepreneurs are constrained, i.e., for $z > \hat{z}_{t+s}$, $R_{t+s}(z) > 1 + r_{t+s}$
- transfers to workers are consumed

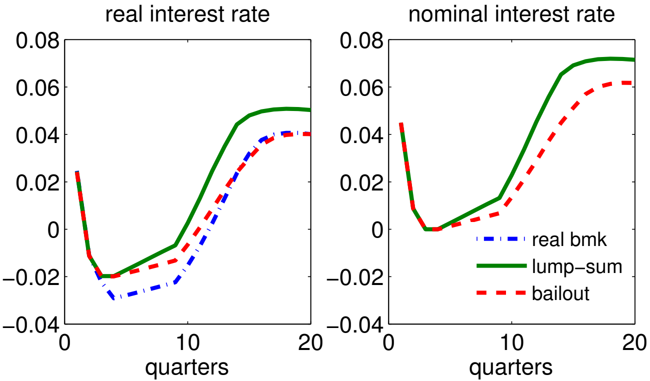
Monetary Economy: Constant Inflation Target

Bailout Case



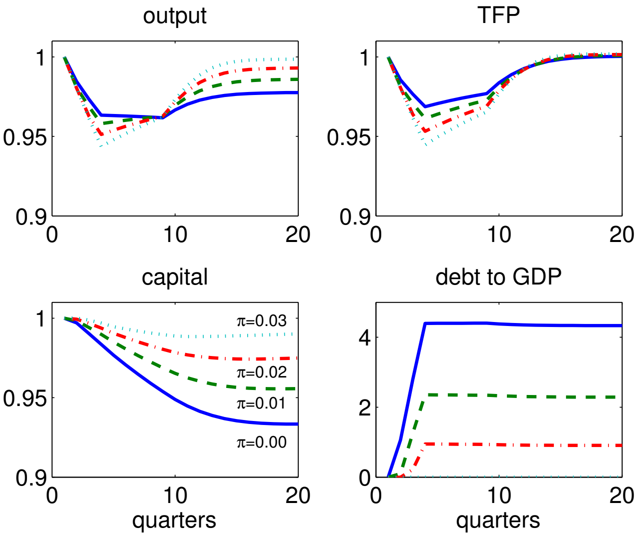
Monetary Economy: Constant Inflation Target

Bailout Case (cont'd)



Monetary Economy: Constant Inflation Target

Bailout Case, Alternative Inflation Targets



Monetary Economy: Constant Inflation Target

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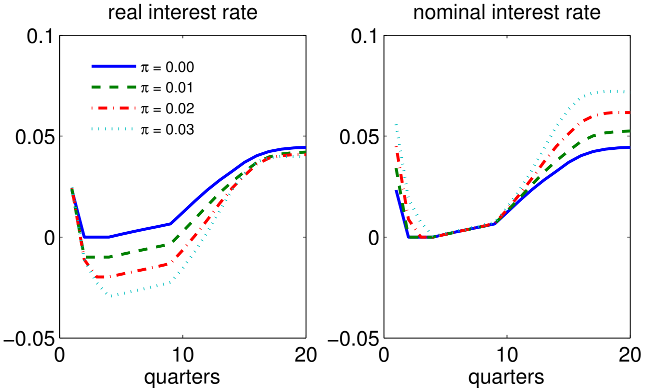

Welfare Gains of a Credit Crunch

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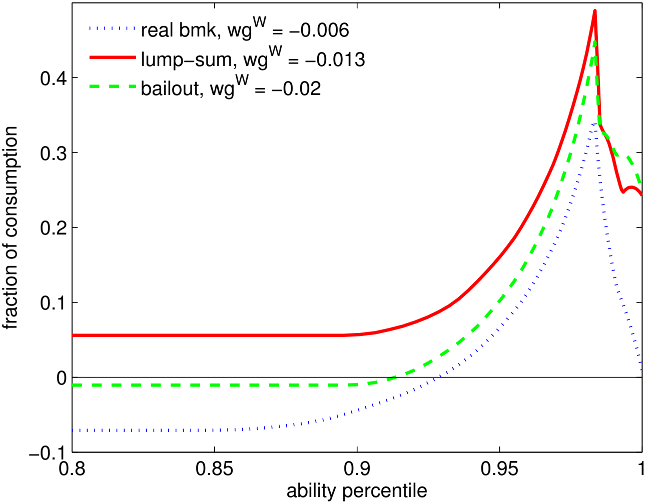
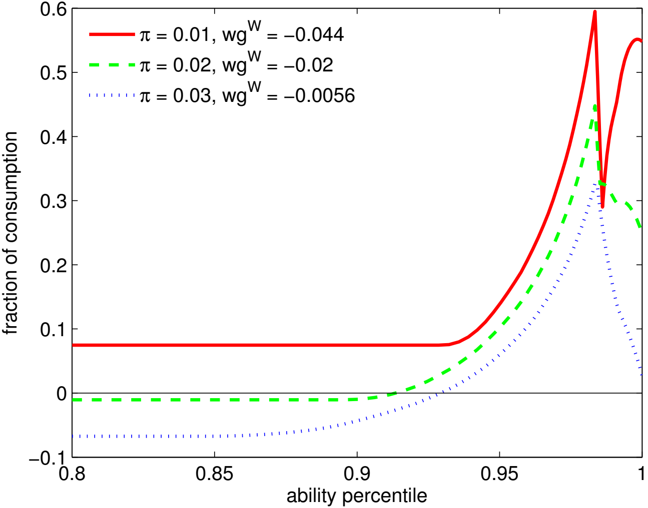
Alternative Tax Schemes



Welfare Gains of a Credit Crunch

Alternative Inflation Targets, Bailout Case



Conclusions

- credit contractions lead to a large drop in the return of safe assets
- money offers an alternative "store of value", thus the zero lower bound
- what is the role of (lack of) monetary policy?
  - an unresponsive monetary policy leads to a deflation, and debt deflation and larger drop in TFP if debts are not indexed (Fisher, 1933)
  - monetary/debt policy needs to be very expansionary to stabilize prices, and output, at the cost of crowding out private investment and generating a slow recovery