Monetary Policy and the Financing of Firms

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Helsinki, 15-16 October 2009

The questions

- How should monetary policy react to financial shocks? And to other shocks, when financial conditions are relevant?
- Are the risks of debt-deflation a reason for monetary policy to induce some inflation during recessions?
- Do financial factors provide a reason for monetary policy to deviate from zero nominal interest rates?

The model

- A model where monetary policy affects firms' financing conditions.
- Distinguishing features:
  - Firms' internal and external sources of finance are imperfect substitutes.
  - Firms' internal and external funds are nominal assets.
  - Those funds, as well as the interest rate on bank loans, are predetermined when aggregate shocks occur.

Main results

1. Maintaning price stability at all times is not optimal. Because firms' funds are nominal and predetermined, after setting interest rates policy can choose the price level so as to adjust the real value of total funds.
2. The distortions introduced by financial factors do not justify deviating from a zero nominal interest rate.

Main results

3. The optimal response to a negative productivity shock is to maintain the nominal interest rate fixed and to engineer a short period of inflation. This policy stabilizes default rates, credit spreads and the financial markup.
4. The optimal response to a reduction in internal funds is to reduce the nominal interest rate or, if it is at the zero bound, to engineer a short period of inflation. This mitigates the adverse consequences on bankruptcy rates and allows firms to de-leverage more quickly.

Outline of the presentation

1. Related literature
2. The model
3. Optimal monetary policy
4. Numerical results
5. Conclusions

Related Literature

Financial factors and the transmission of shocks

- Bernanke, Gertler and Gilchrist (1999)
- Calstrom and Fuerst (1997, 1998)

Financial factors and optimal monetary policy

- Ravenna and Walsh (2006)
- Curdia and Woodford (2008)
- De Fiore and Tristani (2008)
- Faia (2008)

The environment

Agents: Households, firms facing credit constraints and iid productivity shocks, competitive banks, and a central bank.

Timing: There is a goods market at the beginning of the period and an assets market at the end, when firms' internal funds, external funds and interest rates are decided for the following period.

Financial intermediation: Firms need to pay wages in advance of production. They have nominal internal funds but also need external finance. Banks raise deposits from households and lend to entrepreneurs on the basis of a nominal debt contract.

The model

Households

Maximize

$$E_0 \left\{ \sum_0^\infty \beta^t \left[u\left(c_t\right) + \kappa\left(m_t\right) - \alpha n_t \right] \right\}$$

subject to

$$M_t + E_t Q_{t,t+1} \overline{A}_{t+1} + D_t \leq \overline{A}_t + R_{t-1}^d D_{t-1} + M_{t-1} - P_t c_t + W_t n_t - T_t$$

The model

Firm i, $i \in (0,1)$

- produces a homogeneous good with the technology

$$y_{i,t} = \omega_{i,t} A_t N_{i,t};$$

- decides in the assets market at $t-1$ the amount of internal funds, $B_{i,t-1}$, and total funds, $X_{i,t-1}$, to be available in t;
- pays wages before production, so decisions are restricted by

$$W_t N_{i,t} \leq X_{i,t-1}.$$

The model

The financial contract

- For given $B_{i,t-1}$, the optimal contract sets an amount $R^l_{i,t-1}\left(X_{i,t-1} - B_{i,t-1}\right)$ to be repaid when $\omega_{i,t} \geq \overline{\omega}_{i,t}$, where $\overline{\omega}_{i,t}$ is the minimum productivity level such that the firm is able to repay.
- If the firm defaults, it hands out production to banks but a constant fraction μ_t is destroyed in monitoring.
- Define $b_{t-1} = \frac{B_{t-1}}{X_{t-1}}$. The optimal contract is a vector $\left(b_{t-1}, R^l_{t-1}, \overline{\omega}_t\right)$ that solves a standard costly state verification problem. It is the same across firms.

The model

Useful notation

- $f\left(\overline{\omega}_t\right)$ is the average share of production accruing to firms, when the threshold that triggers default is $\overline{\omega}_t$.
- $\mu_t G\left(\overline{\omega}_t\right)$ is aggregate output lost in monitoring
- $\phi\left(\omega\right)$ and $\Phi\left(\omega\right)$ are the density and cdf of the log-normal iid shock.

The model

Entrepreneurs

- Entrepreneurs are infinitely lived and risk neutral. Their discount rate is sufficiently low that entrepreneurs keep postponing consumption and only accumulate internal funds.
- There is a proportional tax γ_t that prevents their wealth from growing to the point where there is no need for external finance.
- The accumulation of internal funds is given by

$$B_t = (1 - \gamma_t) f(\overline{\omega}_t) P_t A_t N_t$$

Some properties of the model

- Since X_t and B_t are predetermined, $b_t = \frac{B_t}{X_t}$ does not change on impact, neither does leverage (equal to $\frac{1}{b_t} - 1$).
- $\overline{b}_t = B_{t-1}/P_t$ is the real value of internal funds. It changes according to

$$\overline{b}_t = (1 - \gamma_{t-1})\, f\left(\overline{\omega}_{t-1}\right) \frac{v_{t-1}}{b_{t-2}} \frac{\overline{b}_{t-1}}{\pi_t}.$$

- $v_t = \frac{A_t}{w_t}$ is the financial markup. Larger v_t increase firms' profits, because firms pay a lower real wage, for given productivity A_t.

The financial murkup

- v_t reflects three financial distortions:
  - the predetermination of financial decisions
  - the credit constraint faced by firms'
  - the presence of asymmetric information and monitoring costs
- In equilibrium,

$$E_{t-1}\left\{v_t\left[1-\mu_t G\left(\overline{\omega}_t\right)-f\left(\overline{\omega}_t\right)\frac{E_{t-1}\left[\mu_t\overline{\omega}_t\phi\left(\overline{\omega}_t\right)\right]}{E_{t-1}\left[1-\Phi\left(\overline{\omega}_t\right)\right]}\right]\right\}=R^d_{t-1}.$$

The financial murkup

- If $\mu_t = 0$,

$$E_{t-1}\{v_t\} = R^d_{t-1}$$

and $R^d_{t-1} = 1$ would minimize the average distortion.

- If $\mu_t = 0$ and decisions were not predetermined,

$$v_t = R^d_t$$

and $R^d_t = 1$ would achieve the first best.

- If $\mu_t = 0$, decisions were not predetermined, and firms did not have to borrow,

$$v_t = 1$$

and the economy would be in the first best irrespective of R^d_t.

Optimal interest rate policy

- Since $\overline{\omega}$ is independent of R^d, we can consider a social planner that max utility, for given $\overline{\omega}$, s.t. the resource constraint only

$$c = An\left[1 - \mu G\left(\overline{\omega}\right)\right].$$

Optimality requires that

$$v = \frac{1}{1 - \mu G\left(\overline{\omega}\right)}.$$

- In equilibrium,

$$v = \frac{R^d}{1 - \mu G\left(\overline{\omega}\right) - \mu f\left(\overline{\omega}\right) \frac{\overline{\omega}\phi(\overline{\omega})}{1-\Phi(\overline{\omega})}}.$$

When $\mu \neq 0$, it is optimal to set $R^d = 1$.

Intuition for the optimality of the Friedman rule

- The first best response to the restriction on the accumulation of internal funds is $b = 1$, then

$$\overline{\omega}_t = \frac{R^l_{t-1}\left(1 - b_{t-1}\right)}{v_t} = 0.$$

$$E_{t-1}\widetilde{v}_t = R^d_{t-1} < E_{t-1}v_t$$

- As a second best, it is still optimal to subsidize, but subsidizing also increases production and the amount of resources lost in bankruptcy when $\overline{\omega}_t > 0$; overall, it is optimal to subsidize, but not possible all the way to the point where $v_t = 1$.
- Production subsidy can take the form of a negative deposit rate; since $R^d \geq 1$, $R^d = 1$ is optimal.

Monetary policy instruments

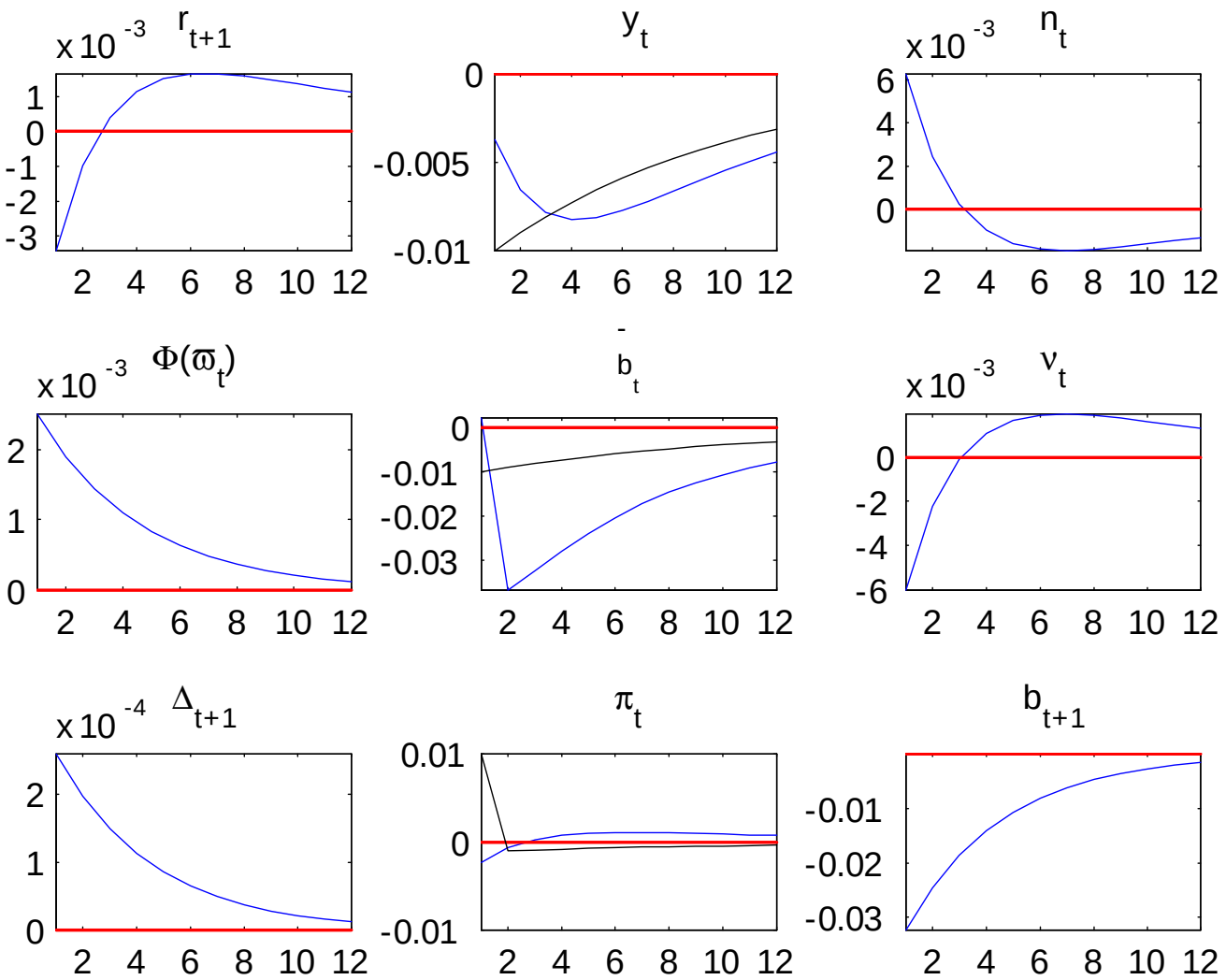
- Because firms' funds are nominal and predetermined, after setting interest rates policy can affect the price level.
- This can be seen from the set of implementability conditions. The solution to the planner's problem is unique if P_t is set exogenously

Numerical analysis

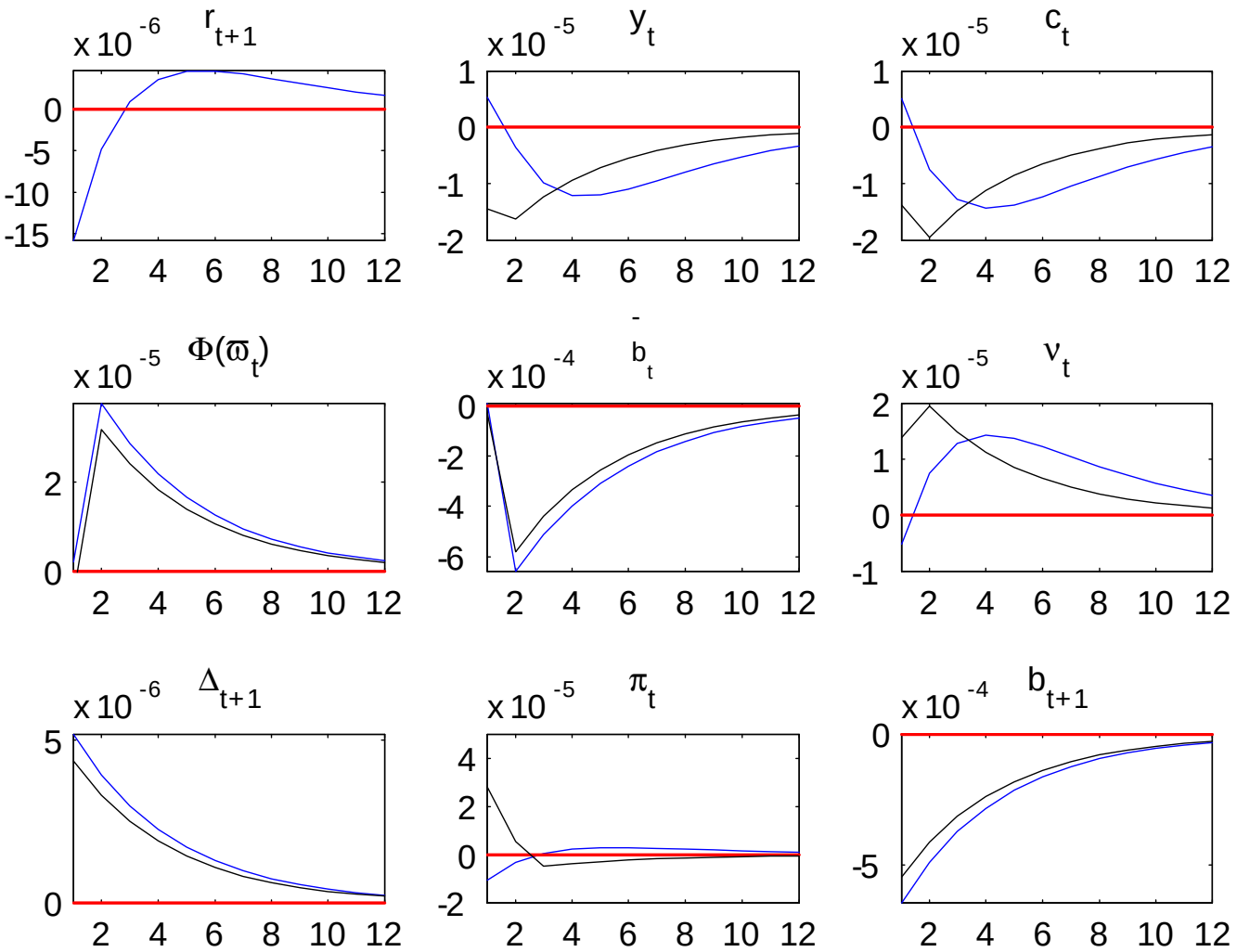
Calibration: $\mu = .15$; σ_ω and γ are set such that 1% of firms go bankrupt each quarter and the credit spread is 2% per year.

Taylor rule: $\widehat{i}_t = 1.5 \cdot \widehat{\pi}_t$

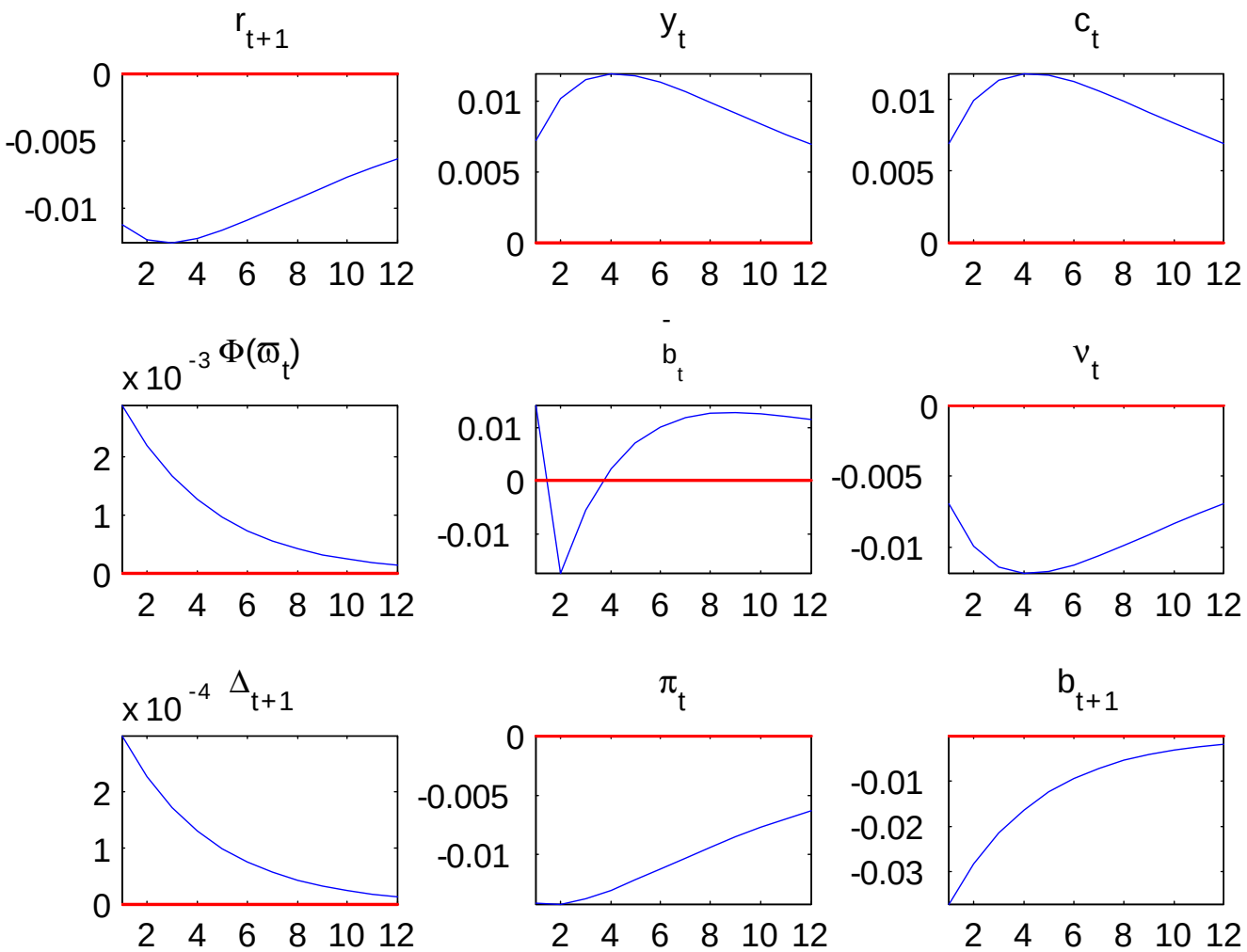
Technology shock (OMP black, TR blue)



Shock to internal funds (OMP black, TR blue)



Policy shock



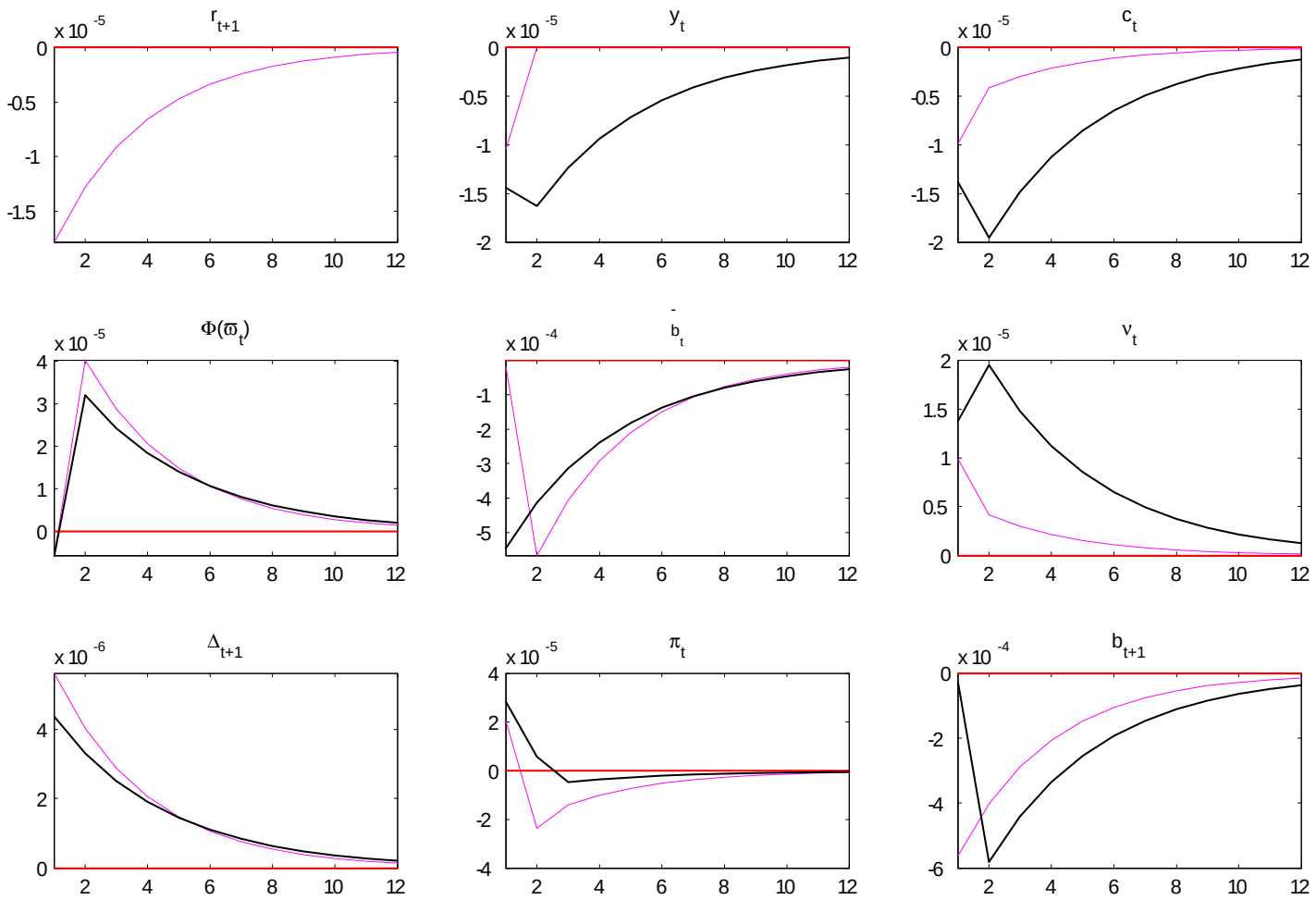
Role of the zero lower bound

We compare the response to a negative shock to internal funds under the optimal policy when $R^d = 0$ and when $R^d > 0$.

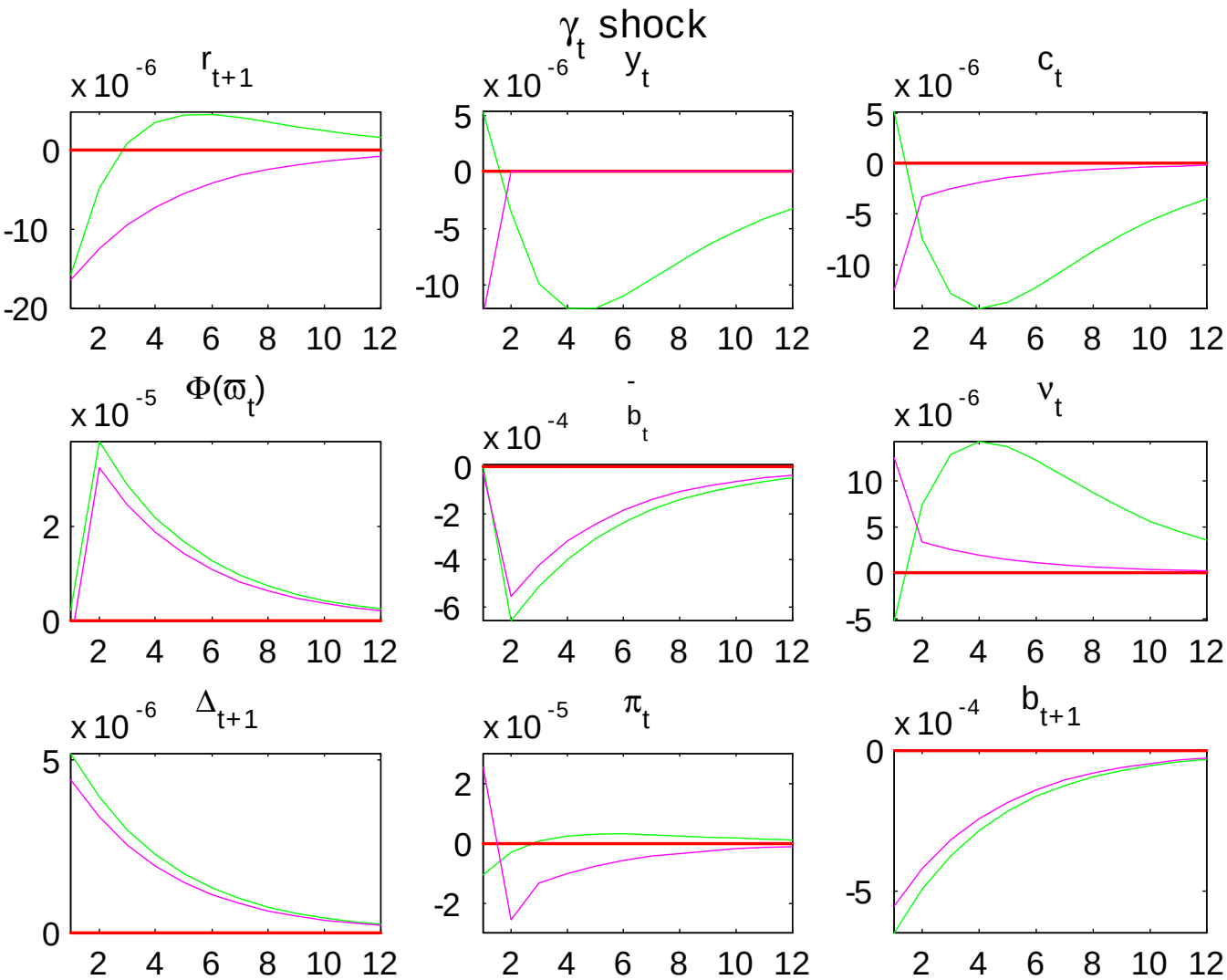
Technology shock: Despite the ability of monetary policy to move the nominal interest rate, it is optimal not to do so; a policy that keeps it fixed and creates some inflation on impact is able to generate the same response as in the first best.

Financial shock: The ability to lower the nominal interest rate enables to affect credit conditions directly, by reducing - ceteris paribus - the loan rates. This generates a much faster adjustment in response to the shock.

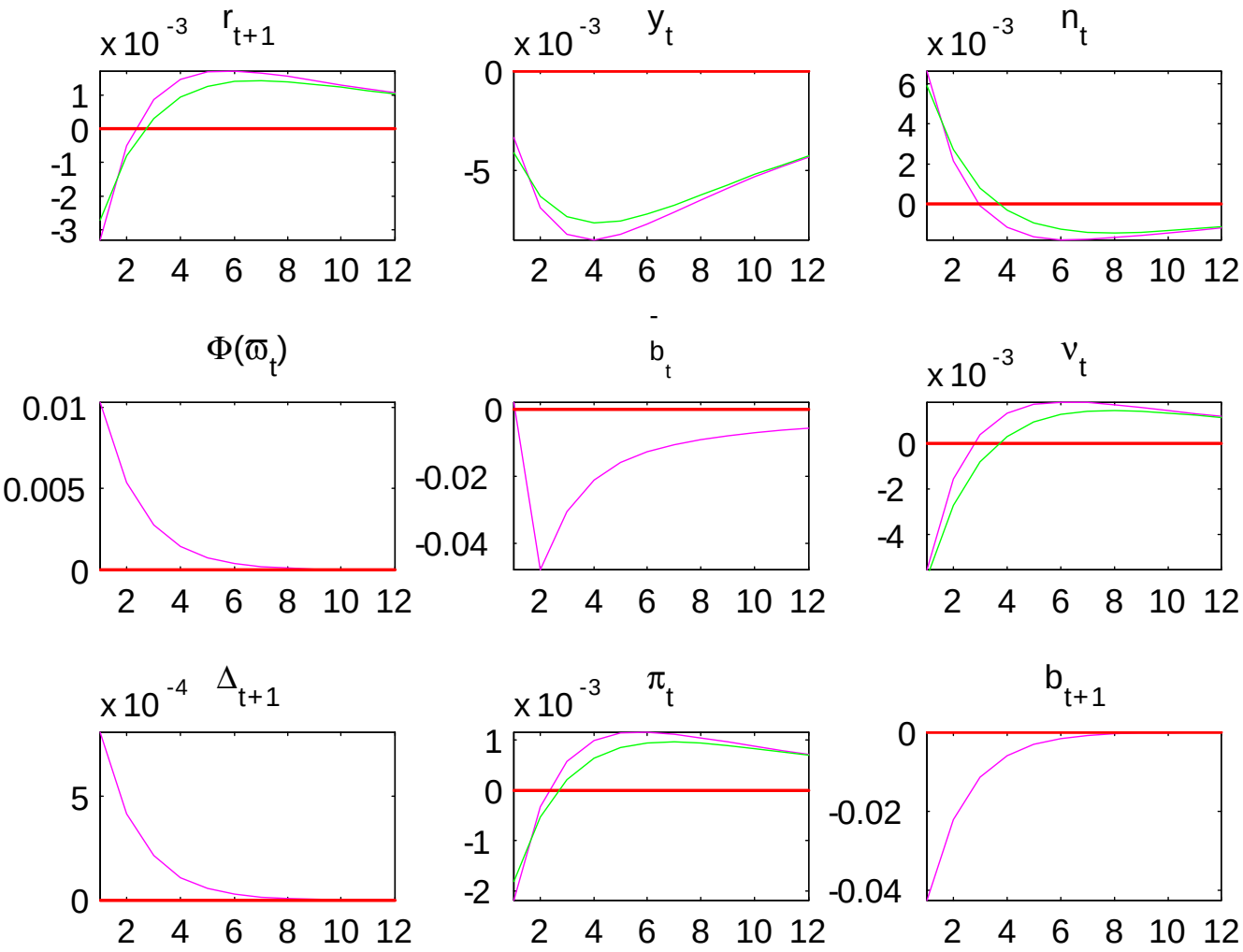
Zero lower bound: financial shock



Zero lower bound: financial shock



No asymmetric information: technology shock



Conclusions

- When firms' financial positions are denominated in nominal terms and debt contracts are not state-contingent, policy can induce some inflation during recessions in order to reduce the real value of funds according to current production needs.
- The optimal response to a negative productivity shock is to maintain the nominal interest rate fixed and to engineer a short period of inflation. This way, nominal wages and labor can be kept constant and the predetermined value of total funds is ex-post optimal. This policy stabilizes default rates, credit spreads and the financial markup.

Conclusions

- The optimal response to a reduction in internal funds is to reduce the nominal interest rate or, if it is at the zero bound, to engineer a short period of inflation. This mitigates the adverse consequences on bankruptcy rates and allows firms to de-leverage more quickly.