Optimal monetary policy, asset purchases, and credit market frictions

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This paper

- How do financial market frictions matter for the conduct of monetary policy?
  - Trade-off of a welfare maximizing central bank (CB)
- Is there a role for central bank purchases (not creation) of loans?
  - A CB asset exchange is typically irrelevant
- Main idea
  - CB asset purchases can matter when money supply is rationed

The model

- A sticky price model where money is essential and private agents borrow/lend
  - To facilitate aggregation, we consider ex-ante identical agents (Shi, 1997)
- Household members draw preference shocks
  - High valuation of consumption $\longrightarrow$ borrowing money from other members
- Financial market friction
  - Private debt contracts are not perfectly enforceable
  - Loans secured by pledgeable assets (Kiyotaki and Moore, 1997)

Monetary policy

- Central bank supplies money against eligible assets
  - Money supply is fully backed (e.g. by treasury securities)
  - Central bank sets the price of money in terms of eligible assets
- When the policy rate equals the marginal valuation of money
  - Conventional regime where asset purchases are irrelevant
- When the policy rate is set below marginal valuation of money
  - Eligible asset are scare and quantitative instruments can matter

Results

- Positive inflation rates are not desirable
  - Intraperiod loans: real debt burden cannot be reduced by higher inflation
  - Inflation raises the loan rate and amplifies the credit market friction
- Optimal monetary policy (without money rationing)
  - Under sticky prices: central bank mainly aims at stabilizing prices
  - When prices are more flexible, monetary policy eases the borrowing constraint
- CB can enhance welfare by purchasing asset at a favorable price

Related studies

- Studies on optimal monetary policy under financial market frictions
  - Monacelli (2008): household borrowing constrained by collateral
  - De Fiore et al. (2011): optimal monetary policy under imperfect monitoring
- Studies on unconventional monetary policies
  - Curdia and Woodford (2011): direct central bank lending under costly banking
  - Gertler and Kiyotaki (2011): balance sheet constraint of financial intermediaries
  - Araújo et al. (2013): asset purchases without a specific role of currency

Timing

Beginning of the period: Household members hold money, gov. bonds, and housing

- Aggregate productivity shocks are realized
- Money supplied against treasuries at policy rate
- Idiosyncratic preference shocks are realized
- Loans are originated and might be purchased by the central bank
- Household members buy goods from firms with money as means of payment
- Borrowers repay loans and government bonds are issued

End of the period

Households I/IV

- Infinitely many households of measure one, each with members $i \in [0, 1]$
  - household wealth equally distributed at the beginning of each period (Shi, 1997)
  - Utility depends on consumption $c_{i,t}$, housing $h_{i,t}$, labor $n_{i,t}$

$$u(\epsilon_{i,t}, c_{i,t}, h_{i,t}, n_{i,t}) = \epsilon_{i,t}\frac{c_{i,t}^{1-\sigma} - 1}{1-\sigma} + \gamma\frac{h_{i,t}^{1-\sigma_h} - 1}{1-\sigma_h} - \chi\frac{n_{i,t}^{1+\eta}}{1+\eta},$$

  - i.i.d. shocks $\epsilon_i \in \{\epsilon_b, \epsilon_l\}$ with equal probabilities and $\epsilon_l < \epsilon_b$

- End-of-period stock of housing $h_{i,t}$ might differ between both types of members
  - Supply of housing is fixed at h

Households II/IV

- Money injections $I_{i,t}$ against eligible assets discounted with the policy rate R_t^m

$$I_{i,t} \leq \kappa_t^B \cdot B_{i,t-1}/R_t^m, \tag{1}$$

- Drawing ϵ_b implies $b$orrowing, partially constrained by collateral

$$-L_{b,t} \leq z_t P_t q_t h_{b,t}, \quad \text{where } L_{b,t} < 0 \tag{2}$$

where z_t is the liquidation value and q_t the real price of the housing good.

- Lenders can refinance secured loans $L_{l,t} = -L_{b,t}$ at the CB

$$I_{l,t}^L \leq \kappa_t \cdot L_{l,t}/R_t^m \tag{3}$$

Households III/IV

- Households rely on money for purchases of consumption goods

$$P_t c_{l,t} \leq I_{l,t} + I^L_{l,t} + M^H_{l,t-1} - \left[(1+\upsilon)\, L_{l,t} + L^r_{l,t}\right] / R^L_t$$

$$P_t c_{b,t} \leq I_{b,t} + M^H_{b,t-1} - \left[(1+\upsilon)\, L_{b,t} + L^r_{b,t}\right] / R^L_t$$

  - Loans funded by proceeds of CB purchases $L^r_{l,t} = -L^r_{b,t} \leq L^r_{l,t}/R^L_t$
  - Unsecured loans $\upsilon L_{l,t}$ and refinanced loans $L^r_{l,t}$ are not pledgeable

- Lenders are willing to sell all secured loans to the CB if $R^m_t < R^L_t$
  - Money supply constraint (1) and (3) are then binding (money rationing)

Households IV/IV

- Maximizing $E\sum_{t=0}^{\infty}\beta^t u_{i,t}$ s.t. money, goods, and asset market constraints
  - Borrower's credit demand is affected by the borrowing constraint ($\zeta_{b,t} \geq 0$)

$$\frac{1}{R_t^L} = \beta E_t \frac{0.5(\epsilon_b c_{b,t+1}^{-\sigma} + \epsilon_l c_{l,t+1}^{-\sigma})}{\epsilon_b c_{b,t}^{-\sigma}\pi_{t+1}} + \frac{\zeta_{b,t}}{\epsilon_b c_{b,t}^{-\sigma}(1+\upsilon)},$$

  - Lender's credit supply affected by possible CB loan purchases

$$\frac{1}{R_t^L} = \beta E_t \frac{0.5(\epsilon_b c_{b,t+1}^{-\sigma} + \epsilon_l c_{l,t+1}^{-\sigma})}{\epsilon_l c_{l,t}^{-\sigma}\pi_{t+1}} \left[1 + \frac{\kappa_t}{1+\upsilon}\left(\frac{R_t^L}{R_t^m} - 1\right)\right],$$

  - $\zeta_{b,t} = 0$ and $R_t^m = R_t^L$ lead to a standard consumption Euler equations.

Firms

- Typical New Keynesian set-up
  - Identical intermediate goods producing firms produces with labor and receive a constant subsidy that eliminates average mark-ups
  - Monopolistically competitive retailers buy intermediate goods and set prices like according to Calvo/Yun

- Price dispersion leads to short-run and long-run inefficiency
  - Minimized by price stability

Central bank

- Central bank supplies money outright and temporarily,
  - sets the price of money in terms of eligible assets $R_t^m \geq 1$
  - decides how many assets are purchased/repoed $\kappa_t \in [0,1]$ and $\kappa_t^B \in (0,1]$
  - and transfers its interest earnings to the treasury

    $$P_t \tau_t^m = (1 - 1/R_t)\, B_t^c + R_t^m \left(M_t^H - M_{t-1}^H\right) + (R_t^m - 1)\left(M_t^L + M_t^R\right),$$

    leading to the end-of-period balance sheet

    $$B_t^c = M_t^H.$$

Government

- Government issues one-period bonds, pays a subsidy at a constant rate, and
  - has access to lump-sum taxes/transfers τ_t

$$(B_t^T/R_t) + P_t\tau_t^m = B_{t-1}^T + P_t\tau_t + P_t\tau^p.$$

- Supply of short-term government bonds is specified in a simple way,

$$B_t^T = \Gamma B_{t-1}^T$$

where $\Gamma > \beta$ and bond market clearing requires $B_t^T = B_t + B_t^c$.

First best allocation

Proposition 1: *The first best allocation* $\{c^*_{b,t}, c^*_{l,t}, n^*_{b,t}, n^*_{l,t}, h^*_{b,t}, h^*_{l,t}\}_{t=0}^{\infty}$ *satisfies*

$$\begin{aligned} \epsilon_{b,t}(c^*_{b,t})^{-\sigma} &= \epsilon_{l,t}(c^*_{l,t})^{-\sigma}, \\ n^*_{b,t} &= n^*_{l,t}, \\ h^*_{b,t} &= h^*_{l,t}, \end{aligned}$$

$\epsilon_b(c^*_{b,t})^{-\sigma} = [\chi/(a_t\alpha)]0.5^{\eta}(n^*_t)^{1+\eta-\alpha}$, $h^*_{b,t} + h^*_{l,t} = h$ and $c^*_{l,t} + c^*_{b,t} = a_t(n^*_t)^{\alpha}$.

- Competitive equilibrium
  - Three frictions: borrowing constraint, cash vs. credit goods, and sticky prices

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Long-run properties

- Suppose that money supply is not rationed ($R^m = R^L$)
  - loan rate equals lender's marginal rate of intertemporal substitution

$$R^L = (\pi/\beta) \cdot \left(\epsilon_l c_l^{-\sigma} / \overline{c}^{-\sigma}\right)$$

    where $\overline{c}^{-\sigma} = 0.5\epsilon_l c_l^{-\sigma} + 0.5\epsilon_b c_b^{-\sigma}$.

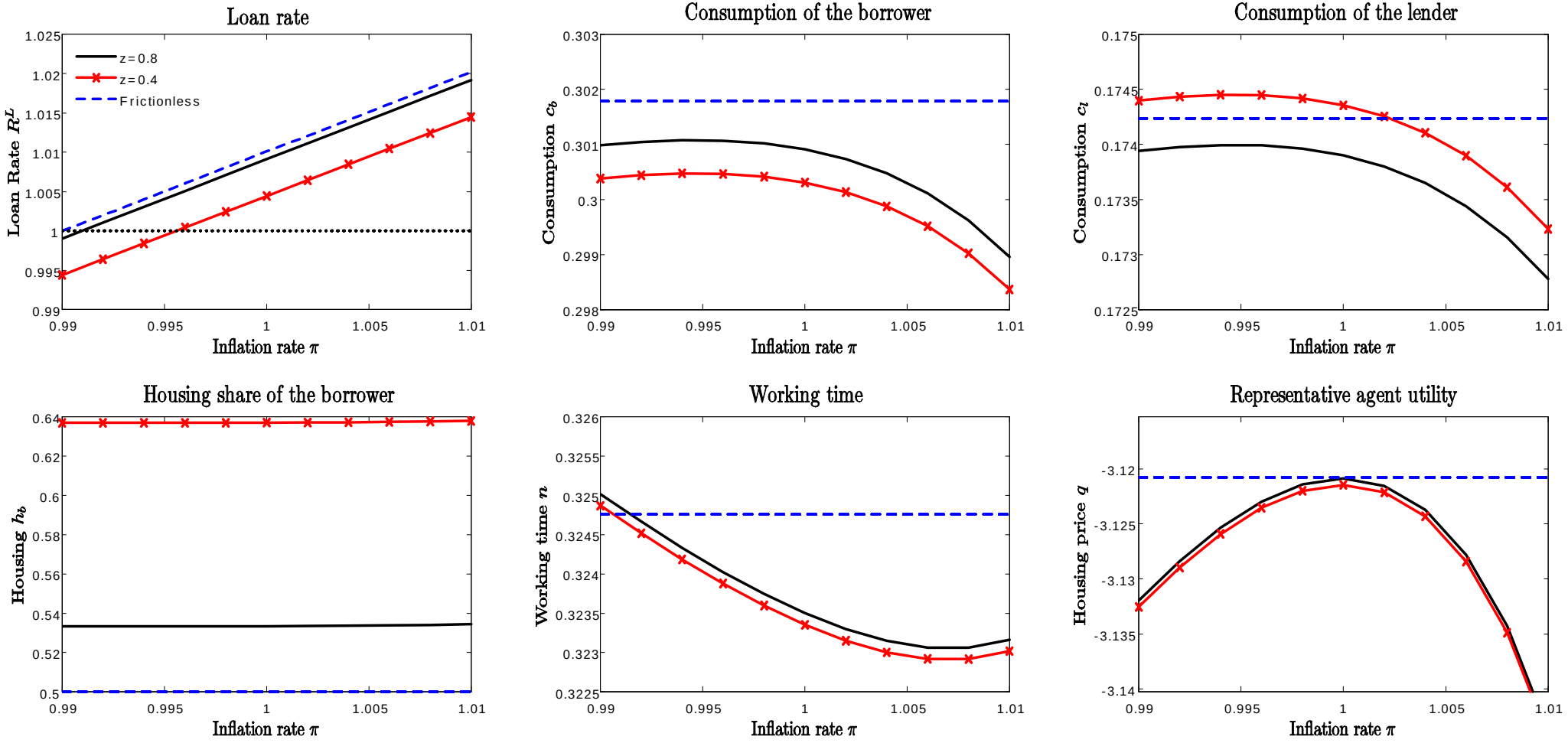
  - If the borrowing constraint is slack, $\zeta_{b,t} = 0$, relative consumption satisfies

$$\epsilon_l c_l^{-\sigma} = \epsilon_b c_b^{-\sigma}$$

  - If borrowing is constrained $\zeta_{b,t} > 0$, relative consumption of the lender satisfies

$$c_l > (\epsilon_l/\epsilon_b)^{1/\sigma}\, c_b$$

  $\rightarrow$ Tighter borrowing constraints lead to *lower* loan rates



Steady state values for different inflation rates

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Flexible prices

Proposition 2: *A long-run efficient allocation can, in general, neither be implemented under rationed money supply nor under non-rationed money supply.*

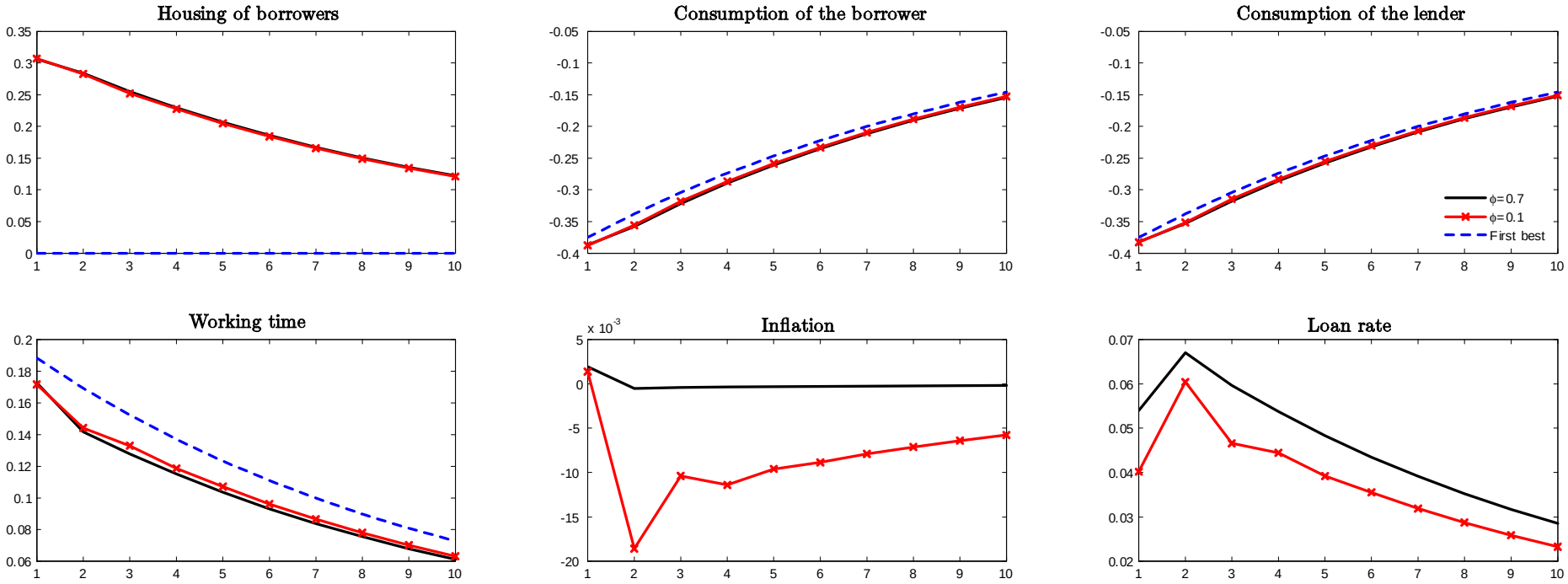
- Efficiency would require the Friedman rule and a slack borrowing constraint
  - Under $R^L = 1$, borrowing constraint will in general be binding
  - Money cannot be supplied in a rationed way, since $R^m \not< R^L = 1$
- Under second best with ($R^L > 1$)
  - Money rationing ($R^m < R^L$) and purchasing loans can enhance welfare

Optimal monetary policy under sticky prices

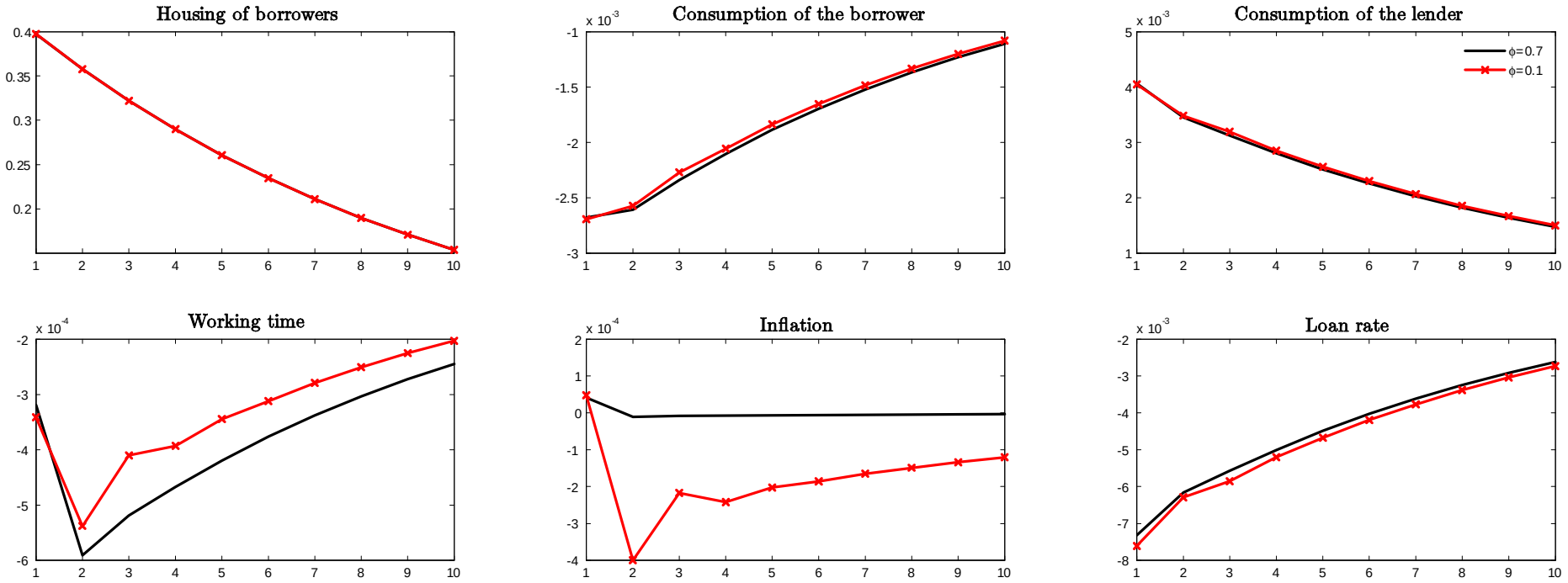
- Central bank maximizes welfare under full commitment
  - Analysis restricted to time invariant policies (neglecting time inconsistency)
- Reasonable degree of price stickiness
  - Long-run inflation rate equals one (price stability)
  - Price stability even for tighter borrowing constraint (z=0.4)
- When prices are more flexible,
  - monetary policy eases the borrowing constraint

Steady state values under optimal monetary policy **without** money rationing

	First best	Benchmark	More flexible prices	Tighter borrow. constraint
Consumption of the borrower	0.3018	0.3009	0.3010	0.3003
Consumption of the lender	0.1742	0.1739	0.1739	0.1744
Borrower's housing share	0.5	0.5334	0.5333	0.6369
Working time	0.3248	0.3235	0.3237	0.3233
Loan rate	–	1.0091	1.0007	1.0044
Inflation rate	–	1	0.9982	1
Representative agent utility	–3.12078	–3.12086	–3.12085	–3.12145



Responses to a contractionary productivity shock under optimal policy



Responses to a lower liquidation value under optimal policy w/o money rationing

Money rationing and loan purchases

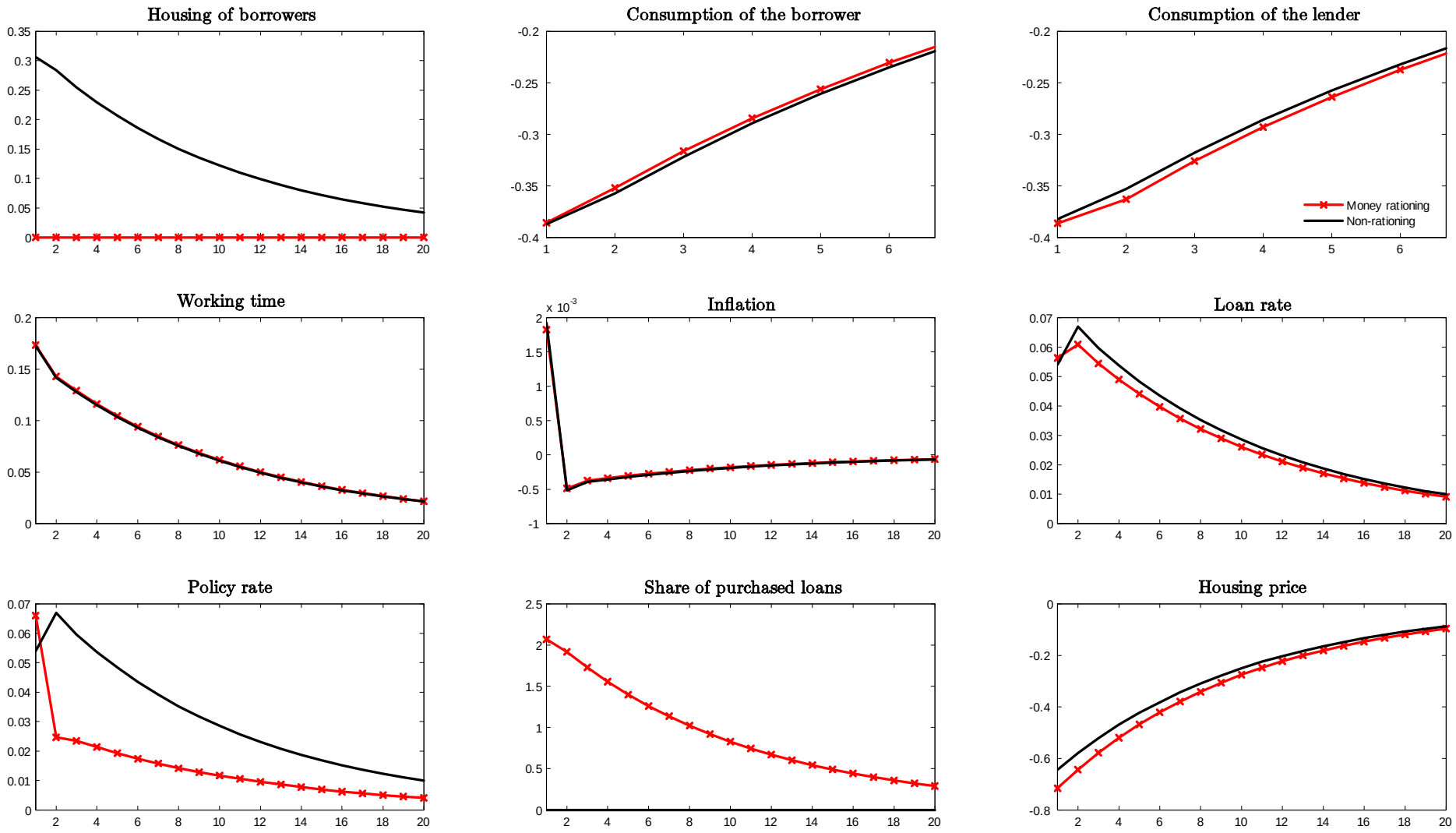
- Policy rate below the lender's marg. rate of intertemp. substitution, $R_t^m < R_t^L$
  - Purchases of loans $\kappa_t > 0$ tends to reduce the loan rate
- Non-optimizing policy (for $z = 0.4$)
  - Loan purchases with $\kappa = 0.5$ and $\kappa = 1$
  - Optimal policy without money rationing is outperformed
- An extreme case (for $z = 0.8$)
  - Monetary policy sets κ_t to slacken the borrowing constraint
  - Welfare loss (perm. consump.) relative to first best reduced by 75%

Steady state values for non-optimizing policies for z=0.4

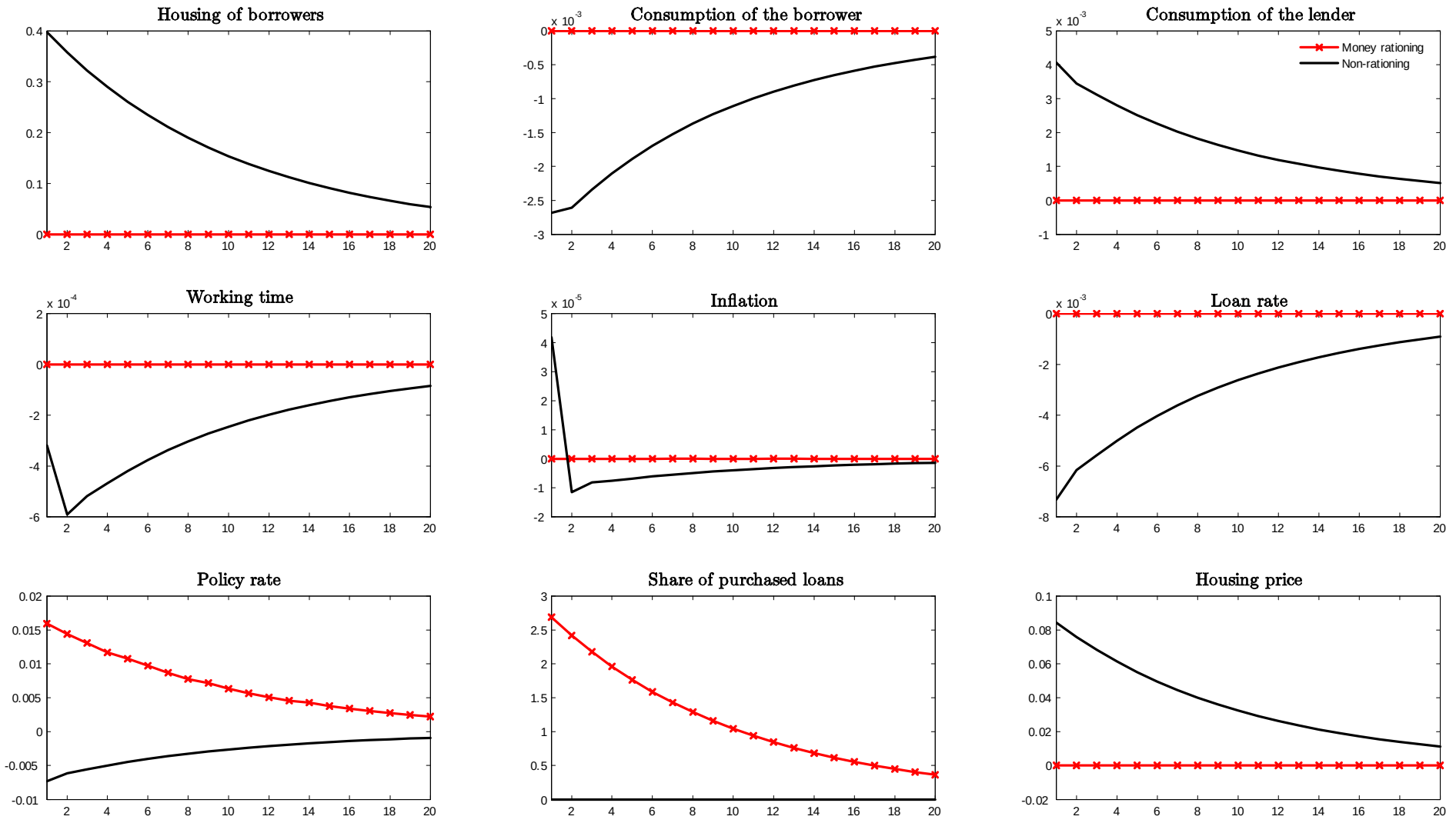
	Optimal policy w/o m. rationing	Policy regime I with m. rationing	Policy regime II with m. rationing	First best
Borrower's consumption	0.3003	0.3004	0.3005	0.3018
Lender's consumption	0.1744	0.1743	0.1742	0.1742
Housing of the borrower	0.6369	0.6150	0.5954	0.5
Working time	0.3233	0.3234	0.3234	0.3248
Loan rate	1.0044	1.0049	1.0052	–
Inflation rate	1	1	1	–
Policy rate	–	1.0040	1.0040	–
Share of purchased loans	–	0.5	1	–
Rep. agent utility	–3.12145	–3.12126	–3.12112	–3.12078

Steady state values with and w/o money rationing for z=0.8

	Optimal policy w/o money rationing	Optimal policy with money rationing	First best
Consumption of the borrower	0.3009	0.3012	0.3018
Consumption of the lender	0.1739	0.1737	0.1742
Housing of the borrower	0.5334	0.5	0.5
Working time	0.3235	0.3236	0.3248
Loan rate	1.0091	1.0086	–
Inflation rate	1	1	–
Policy rate	–	1.0026	–
Fraction of purchased loans	–	0.6860	–
Representative agent utility	–3.12086	–3.12083	–3.12078



Responses to a contractionary productivity shock under optimizing policies



Responses to a lower liquidation value under optimizing policies

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- Optimal monetary policy under constrained borrowing
  - Conventional policy: central bank trade-off hardly affected by the credit friction
- When money supply is rationed
  - Central bank loan purchases can enhance welfare