The Reversal Interest Rate

Markus Brunnermeier[1] Yann Koby[1]

[1]Princeton University

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Motivation

- NIRP: in DK, SWE, JP, CHE, ECB, ...
- Fear: NIRPs erode banks' Net Interest Income (NII)

  "Low interest rates squeeze Q4 profits by 67% at Credit Agricole" (FT, 2017/03)

$\rightarrow$ potentially eroding lending channel

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→ potentially eroding lending channel

- Evidence of eroding profits
  - Borio et al. (2017)
  - Claessens et al. (2017)
  - Ampudia and Van den Heuvel (2017)
- Direct evidence for lending too:
  - Heider et al. (2017)
  - Basten and Mariathasan (2017)

Mechanism

Reversal Interest Rate:

- Interest rate at which accommodative policy becomes contractionary

Mechanism:

- interest rate cut: $i \downarrow$
  - capital gains (CG) $\uparrow$ (The I Theory of Money)
  - banks' NII on new business $\downarrow$ (Market Power)
- if $|\Delta \text{NII}| > |\Delta \text{CG}|$, banks net worth $N_1 \downarrow$
- decrease in risk-weighted assets: $L(i^L) \downarrow$
  - capital constraint

Key Findings

Partial Equilibrium, Two Periods

1. Reversal Interest Rate i^{RR}:
   - Further policy rate cuts contract bank lending
2. i^{RR} determinants:
   - Capital Gains (-), bank profitability/capitalization (-)
   - Capital constraint (+), Deposit Stickiness (+)
3. Optimal QE-Sequencing: cut before QE

Partial Equilibrium, Three Periods

4. Creeping-up: Long-lasting low-rate environment harmful

General Equilibrium, ∞ Periods

5. i^{RR} in GE $<$ i^{RR} in PE: intermediation boom
6. Low r^*: less leeway for MP as $i^{SS} \downarrow \not\Rightarrow i^{RR} \downarrow$

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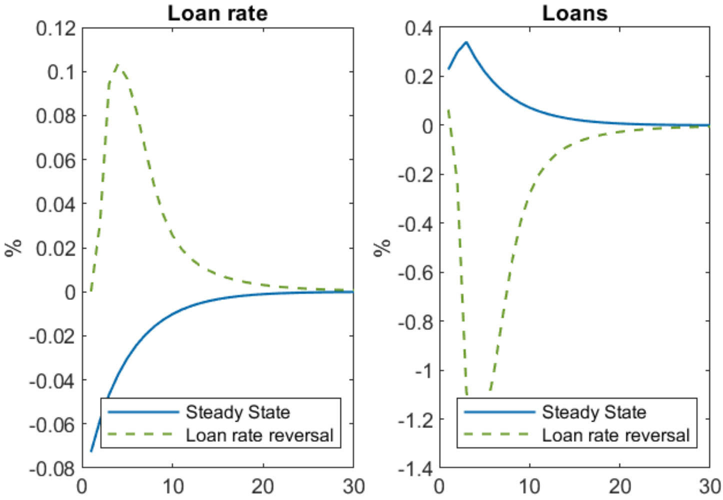
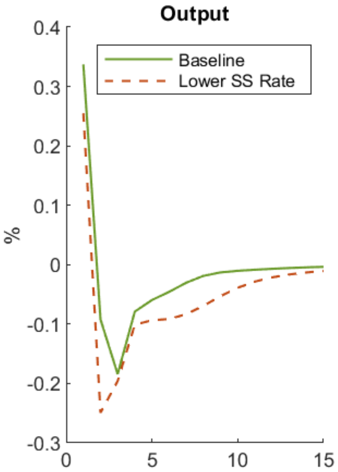
Results Preview I

Response to marginal shock (0.1%), in steady-state and at loan rate reversal



Results Preview II

- Can compare $i^{SS} = 2.0\%$ vs. 1.5% (e.g. $r^* \downarrow$, π^* constant)
- Worse response to large shock ($i^{SS} = 2.0\%$ reversal)
- Take-away: $i^{SS} \downarrow \not\Rightarrow i^{RR} \downarrow$



Outline

1. Reversal Rate in Two-Period Model
2. Creeping up Result
3. New Keynesian DSGE
4. Conclusion

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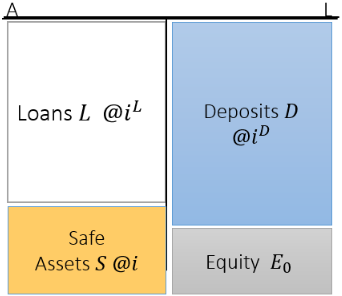
Two-Period model

Continuum of identical banks with Balance Sheet:



Timing of events:

1. Central Bank unexpectedly changes i
2. Banks realize capital gains
3. Banks choose L, i^L, D, i^D, S
4. Next period profits realized

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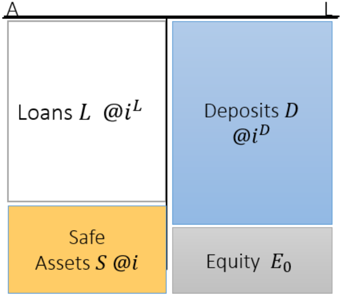

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Two-Period model

Safe assets:

- Rate i is chosen by the Central Bank

Loans:

- Demand function $L(i^L)$, $L'(\cdot) < 0$, elasticity $\varepsilon^L(\cdot)$

Deposits:

- Each bank associated with depositors with intensive margin deposit supply $d(i^D)$, $d'(i^D) > 0$, elasticity $\varepsilon^D(\cdot)$
- Depositors tolerate spread up to $\eta(i)$ ("wake up & search"), "activation spread threshold" bounds banks' market power:

$$D(i^D) = d(i^D) \times \mathbf{1}_{\{i - i^D \leq \eta(i) \,\vee\, i^D > \max_{j'} i^D_{j'}\}}$$

Equity:

- $E_0(i)$ with $E_0'(i) < 0$: capital gains/asset re-evaluation from unexpected i change
  - e.g. maturity mismatch on initial balance sheet

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Two-Period model

Financial frictions:

- Capital constraint $\psi^L L \leq N_1$
  - Regulations (e.g. Basel III)
  - Endogenous risk-taking behavior, agency problems
- Liquidity constraint $\psi^D D \leq S$
  - Reserve requirements
  - Bank runs

Banks' problem:

$$\max_{i^L, i^D, L, D, S, N_1} \quad N_1 = (1+i^L)L(i^L) + (1+i)S - (1+i^D)D(i^D)$$

$$L + S = D + E_0(i)$$

$$\psi^L L \leq N_1, \; \psi^D D \leq S$$

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Two-Period model: Search Activation

Activation Spread Threshold $\eta^D(i)$ (Sharpe 1997, Yankov 2017)

- if $i^D < i - \eta^D(i) \Rightarrow$ start searching for other bank
- $\eta^D(i)$ is increasing in i

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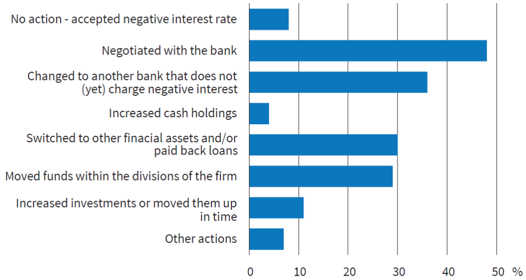
Figure 3

Firms' Measures to Avoid Negative Interest Rate



Note: Multiple responses possible.

Source: ifo Business Climate Index Survey June 2017.

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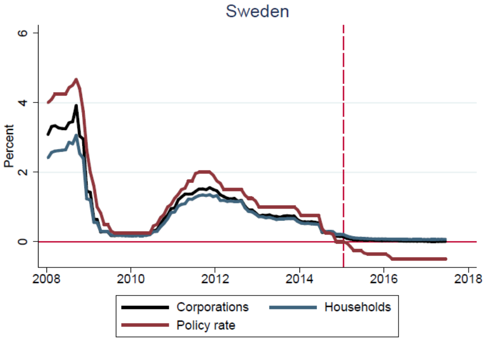

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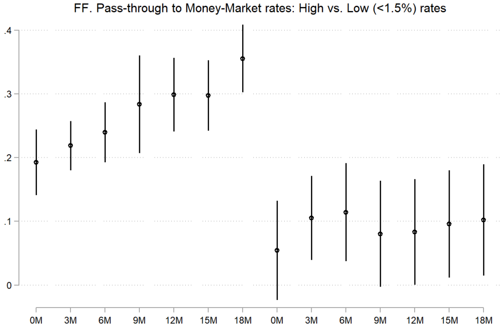

Two-Period model: Optimal Rates

Optimal loan rate:

$$i^{L*} = \underbrace{i}_{\substack{\text{Marginal} \\ \text{opportunity cost}}} + \underbrace{\frac{1}{\varepsilon^{L*}}}_{\text{Mark-up}} + \underbrace{\frac{\psi^L}{1+\psi^L}\lambda^{L*}}_{\text{capital constraint}} .$$

Optimal deposit rate

$$i^{D*} = \underbrace{i}_{\substack{\text{Marginal} \\ \text{benefit}}} - \underbrace{\eta(i)}_{\text{Mark-down}}$$

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Two-Period model: Existence of i^{RR}

Reversal interest rate i^{RR} defined as:

- $\frac{dL^*}{di} \leq 0$ iff $i \geq i^{RR}$

Proposition:

- For $E_0(i)$ & $E_0'(i)$ (capital gains) small enough, $i^{RR} > -\infty$ exists.

Intuition:

- Envelope theorem:

$$\frac{dN_1^*}{di} = \frac{1}{1+\lambda^{L*}}\Big(\underbrace{\frac{d\text{NII}}{di}}_{S>0} + (1+i)\underbrace{\frac{dE_0(i)}{di}}_{\leq 0}\Big)$$

where: $\text{NII} = \underbrace{i^{L*}L^* + i\,S^*}_{\text{interest income}} - \underbrace{i^{D*}D^*}_{\text{interest expenses}}$

- Key question: How much hedging/capital gains?

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Two-Period model: Existence of i^{RR}

Main Insight

- As long as capital constraint is slack, $\psi^L L(i^L) < N_1$,

$$\frac{dL(i^L)}{di^L}\frac{di^L}{di} < 0 \text{ and } \frac{dN_1}{di} > 0.$$

- When capital constraint binds, $\psi^L L(i^L) = N_1$,

$$\frac{dL(i^L)}{di^L}\frac{di^L}{di} = \frac{1}{\psi^L}\frac{dN_1}{di} > 0$$

- Reversal interest rate, i^{RR}
  - below which capital constraint binds and
  - loan supply contracts with interest rate cuts.

Two-Period model: Comparative Static

Determinants of i^{RR}:

1. Let $E_0(i) = \bar{e}_0 + CG_0(i)$.
   - i^{RR} decreases in $\bar{e}_0$.
   - i^{RR} increases in $\partial CG_0(i)/\partial i$ holding $E_0(i)$ fixed and assuming $i > i^{RR}$.
2. Let $E_0(i) = \bar{e}_0 + (1 - \chi_0) CG_0(i)$ i^{RR} increases with dividend rate χ_0. (dividend)
3. i^{RR} increases in ψ^L and ψ^D. (regulation)
4. i^{RR} decreases in $\eta^D(i)$. (market power)

Optimal sequencing of QE result from 1. above:

- QE decreases maturity mismatch on banks' balance sheets
- First cut rates, then do QE

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Creeping-up result

- i^{RR} creeps up over time (as bonds mature)

Intuition:

- Loss in NII last as long as low-interest rate environment does
- Capital gains last only until bonds mature

Profit determinants	$t = 1$	$t = 2$	$t = 3$	$t = 4$
NII (new business)	$dNII/di$ $(-)$	$dNII/di$ $(-)$	$dNII/di$ $(-)$	$dNII/di$ $(-)$
Capital gains	dE_0/di $(+)$	dE_0/di $(+)$		

Outline

NK DSGE with Banks

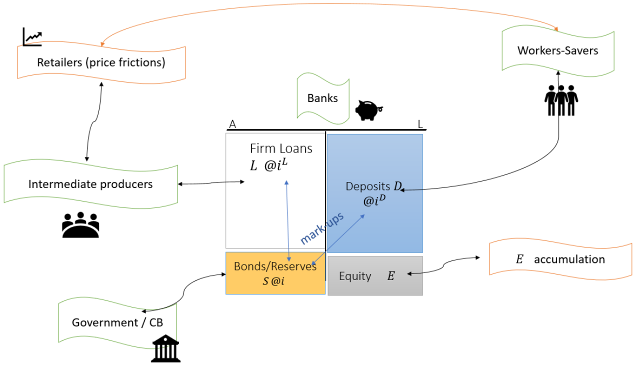
"Banks with market power" in NK DSGE model

- Embeds standard NK model as frictionless case
- Adds banks and bank-dependent production sector

Main insights:

- Impact: i^{RR} in G.E. $<$ i^{RR} in P.E.
  - intermediation boom
- Low rate/inflation env.: less lee-way for MP
  - $i^{SS} \downarrow \not\Rightarrow i^{RR} \downarrow$

NK DSGE Overview

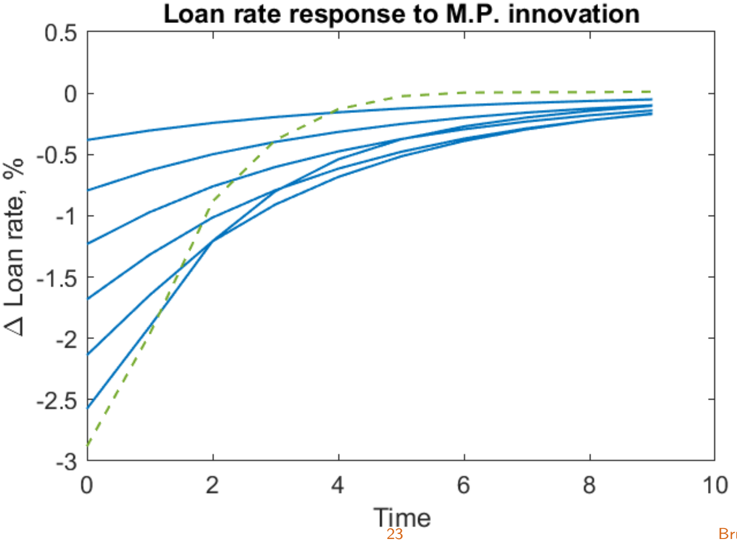


Key additions:

- "SMEs" need bank loans until retained earnings suffice
- Bank maturity structure: LT bonds (3.4 yr.), loans (1.9 yr.)
- Imperfect deposit pass-through

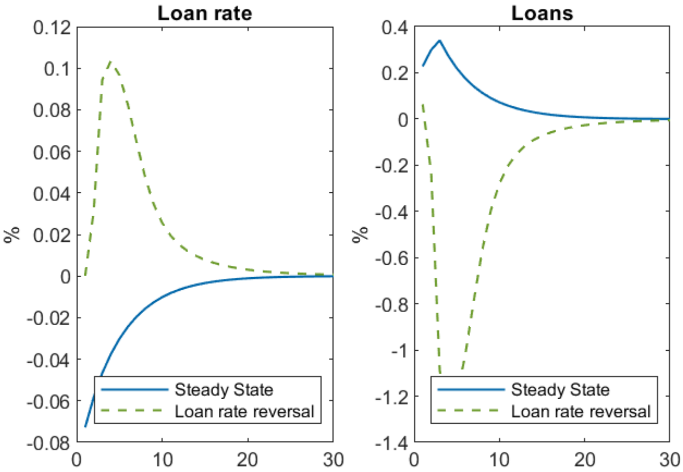
Loan rate i^L response

Innovations (0.5%, 1.0%, ..., 3.5%) to the Taylor Rule ($i_{SS} = 2.0\%$)



Other Outcomes at Loan Rate Reversal

Response to marginal shock, in steady-state and at loan rate reversal (post -3.5% shock)



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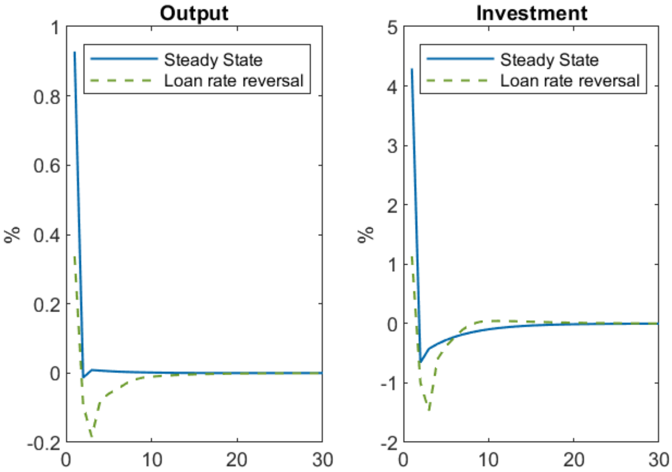

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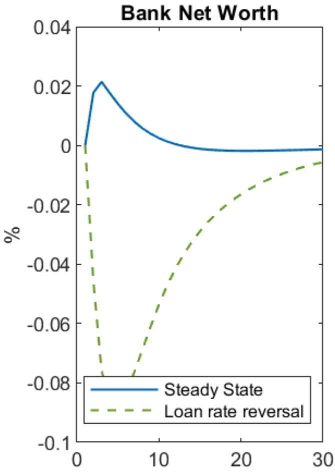
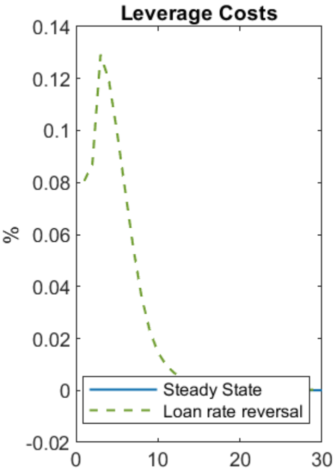
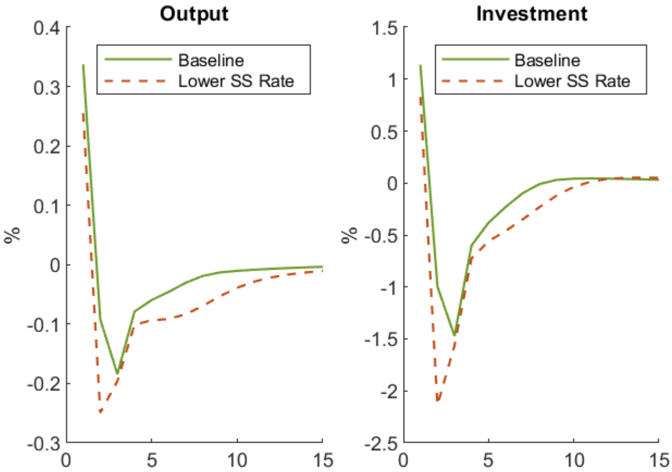




Low r^* environment

- Can compare $i^{SS} = 2.0\%$ vs. 1.5% (e.g. $r^* \downarrow$, π^* constant)
- Worse response to 350bps shock ($i^{SS} = 2.0\%$ reversal)
- Take-away: $i^{SS} \downarrow \not\Rightarrow i^{RR} \downarrow$



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1. Reversal Rate in Two-Period Model

2. Creeping up Result

3. New Keynesian DSGE

4. Conclusion

Conclusion

- Existence of Reversal Interest Rate:
  - Lower bank NII & profits
  - Lower lending due to capital/liquidity constraint
- Reversal rate determinants:
  - Regulatory constraints, capitalization, profitability, dividends
- QE only after exhaustion of interest rate cuts
- Creeping up effect: Long-lasting low-rate environment harmful
- Intermediation boom weakens i^{RR} in GE
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