The Reversal Interest Rate

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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)*

→ potentially eroding *lending channel*
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→ potentially eroding lending channel

• Evidence of eroding profits
  ○ Borio et al. (2017)
  ○ Claessens et al. (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) \( \uparrow \) \quad (The I Theory of Money)
  - banks' NII on new business \( \downarrow \) \quad (Market Power)

- if \( |\Delta NII| > |\Delta CG| \), 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, $\infty$ Periods

5. $i^{RR}$ in GE $< i^{RR}$ in PE: intermediation boom

6. Low $r^*$: less leeway for MP as $i^{SS} \downarrow \Rightarrow i^{RR} \downarrow$
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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. $r^* \downarrow$, $\pi^*$ 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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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:

$$D(i^D) = d(i^D) \times 1_{\{i - i^D \leq \eta(i) \lor i^D > \max_j i^D_j\}}$$

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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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:

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

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

$$\psi^L L \leq N_1, \quad \psi^D D \leq S$$
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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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Hainz et al. 2017 (Survey evidence: Germany)

Figure 3
Firms' Measures to Avoid Negative Interest Rate

No action - accepted negative interest rate
Negotiated with the bank
Changed to another bank that does not (yet) charge negative interest
Increased cash holdings
Switched to other financial assets and/or paid back loans
Moved funds within the divisions of the firm
Increased investments or moved them up in time
Other actions

Note: Multiple responses possible.
Source: ifo Business Climate Index Survey June 2017.
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Two-Period model: Optimal Rates

Optimal loan rate:

\[ i^{L*} = \left( i + \frac{1}{\varepsilon^{L*}} + \frac{\psi^L}{1 + \psi^L} \lambda^{L*} \right) \]

Marginal opportunity cost

Mark-up

capital constraint

Optimal deposit rate

\[ i^{D*} = i - \eta(i) \]

Marginal benefit

Mark-down
Two-Period model: Optimal Rates

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- Marginal opportunity cost
- Mark-up
- Capital constraint

Optimal deposit rate

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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:

$$
\frac{dN_1^*}{di} = \frac{1}{1 + \chi L^*} \left( \frac{dNII}{di} \bigg|_{S \geq 0} + (1 + i) \frac{dE_0(i)}{di} \bigg|_{\leq 0} \right)
$$

where: $NII = i^{L*}L^* + iS^* - i^{D*}D^*$

- Key question: How much hedging/capital gains?
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where: $NII = i^{L*}L^* + iS^* - \underbrace{\lambda^{P*}D^*}_{\text{interest expenses}}$

- Key question: How much hedging/capital gains?
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 $\chi_0$. (dividend)

3. $i^{RR}$ increases in $\psi^L$ and $\psi^D$. (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
Two-Period model: Comparative Static

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2. Creeping up Result

3. New Keynesian DSGE

4. Conclusion
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

<table>
<thead>
<tr>
<th>Profit determinants</th>
<th>$t = 1$</th>
<th>$t = 2$</th>
<th>$t = 3$</th>
<th>$t = 4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>NII (new business)</td>
<td>$dNII/di$ (-)</td>
<td>$dNII/di$ (-)</td>
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<tr>
<td>Capital gains</td>
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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
  - $i^{SS} \downarrow \not\Rightarrow i^{RR} \downarrow$
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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Low $r^*$ environment

- Can compare $i^{SS} = 2.0\% \text{ vs. } 1.5\%$ (e.g. $r^* \downarrow$, $\pi^*$ constant)
- Worse response to 350bps shock ($i^{SS} = 2.0\%$ reversal)
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Conclusion

• Existence of Reversal Interest Rate:
  o Lower bank NII & profits
  o Lower lending due to capital/liquidity constraint

• Reversal rate determinants:
  o 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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