Evaluating Interest Rate Adjustment Costs

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The observation

- Deposit rate changes are infrequent

Deposit rates offered by a major bank in a selected local market
Questions

• Why do banks change their deposit rates infrequently?

• Are the costs associated with interest rate adjustments substantial?
This paper

- Presents a structural model for the evaluation of retail (deposit) interest rate adjustment costs.
Why this topic?

• Research on interest rate dynamics assumes the existence of adjustment costs but does not try to evaluate them

• Challenges to:
  ▪ Understanding interest rate dynamics
  ▪ Predicting monetary policy transmission (especially close to the zero bound)
  ▪ Understanding deposit volume dynamics
  ▪ Understanding the effect of exogenous changes of adjustment costs
Why this topic…?

• But more generally: understanding dynamic choices with costly adjustments

• Other applications in banking:
  ▪ When to enter a new market?
  ▪ When to close branches?
  ▪ When to issue new capital?
Why a structural approach?

• The structural approach:
  ▪ describes agents’ preferences and beliefs about exogenous constraints
  ▪ limits endogeneity concerns
  ▪ enables counterfactual experiments
The model

•...is built in the tradition of dynamic discrete choice models:
  
  - Intertemporal profit function maximization: \( \max U = \sum_{t=0}^{\infty} \beta^t u_t \)
  
  - Profit=markup\((MU_t)\)*volume \((S_t)\)=(T-Bill\ rate-deposit\ rate)*volume
  
  - Adjustment costs \((C_t)\): profit foregone due to the deposit rate change

\[
 u_t = S_t \times MU_t - C_t
\]
The model

• Assumptions:
  ▪ Infinitely inelastic demand for deposits
  ▪ Deposit supply modeled in a monopolistic competition framework
  ▪ The decision of the bank is discrete:

\[
Y_t = \begin{cases} 
2 & \text{if } r_t > r_{t-1} \text{ (increase rates)} \\
1 & \text{if } r_t = r_{t-1} \text{ (keep rates unchanged)} \\
3 & \text{if } r_t < r_{t-1} \text{ (decrease rates)}
\end{cases}
\]
The model

- The adjustment costs, $C_t$, of changing the deposit rate depend on $Y_t$, and are given by:

$$C_t = \begin{cases} 
C_u, & \text{if } r_t > r_{t-1} \iff Y_t = 2 \\
0, & \text{if } r_t = r_{t-1} \iff Y_t = 1 \\
C_d, & \text{if } r_t < r_{t-1} \iff Y_t = 3 
\end{cases}$$

- The costs of deposit rate adjustment does not depend on the magnitude of the adjustment (but can depend on bank and market characteristics)
The static problem

As in Hannan and Berger (1991)
The static problem

\[
\text{Profit after adjustment} = \text{Profit without adjustment} > \text{or}< C_t
\]

The bank will only change the rate if the induced change of the profit is larger than the deposit rate adjustment costs.
The dynamic problem

Incorporates:

- the interaction of accumulated profit changes and adjustment costs
- the transition probabilities
- the discount factor
The dynamic problem

Before taking a decision, \( Y_t \), the bank observes the state variable \( X_t \) which depends on:

- Markup
- Bank size
- Market share
- Market concentration

The bank also observes the transition probabilities \( X_{i,t} \rightarrow X_{j,t+1} \)
The dynamic problem

- Is solved using the nested-pseudo likelihood algorithm (Aguirregabiria and Mira 2002)

- This algorithm combines the **efficiency** of the nested-fixed point algorithm (Rust 1987) with the **computational gain** of the conditional choice probabilities model (Hotz and Miller 1993)
Data

- Weekly deposit rate series for 624 banks in 164 local markets (MSAs) from 1997 to 2006 (*BankRate Monitor*)
- Bank financial statements data
- Local market characteristics
### Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROFIT</td>
<td>1.77E-08 ***</td>
</tr>
<tr>
<td></td>
<td>1.53E-09</td>
</tr>
<tr>
<td>CONSTANT Up</td>
<td>-4.739 ***</td>
</tr>
<tr>
<td></td>
<td>14.390</td>
</tr>
<tr>
<td>BANK SIZE Up</td>
<td>7.894 ***</td>
</tr>
<tr>
<td></td>
<td>0.839</td>
</tr>
<tr>
<td>MARKET SHARE Up</td>
<td>-162.265 ***</td>
</tr>
<tr>
<td></td>
<td>3.045</td>
</tr>
<tr>
<td>CONCENTRATION Up</td>
<td>157.541 ***</td>
</tr>
<tr>
<td>CONSTANT Down</td>
<td>-70.661 ***</td>
</tr>
<tr>
<td></td>
<td>14.341</td>
</tr>
<tr>
<td>BANK SIZE Down</td>
<td>11.498 ***</td>
</tr>
<tr>
<td></td>
<td>0.836</td>
</tr>
<tr>
<td>MARKET SHARE Down</td>
<td>-157.658 ***</td>
</tr>
<tr>
<td></td>
<td>3.037</td>
</tr>
<tr>
<td>CONCENTRATION Down</td>
<td>162.820 ***</td>
</tr>
<tr>
<td>Observations</td>
<td>154990</td>
</tr>
<tr>
<td>Log-likelihood function</td>
<td>119471.7</td>
</tr>
</tbody>
</table>

* mean values of bank and market characteristics

** scaled by weekly deposit market profit
## Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fixed costs evaluated at the mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT Up</td>
<td>-0.042</td>
</tr>
<tr>
<td>BANK SIZE Up</td>
<td>0.206</td>
</tr>
<tr>
<td>MARKET SHARE Up</td>
<td>0.224</td>
</tr>
<tr>
<td>CONCENTRATION Up</td>
<td>0.224</td>
</tr>
<tr>
<td>CONSTANT Down</td>
<td>-0.629</td>
</tr>
<tr>
<td>BANK SIZE Down</td>
<td>1.784</td>
</tr>
<tr>
<td>MARKET SHARE Down</td>
<td>-0.200</td>
</tr>
<tr>
<td>CONCENTRATION Down</td>
<td>0.232</td>
</tr>
</tbody>
</table>

**Costs of positive deposit rate changes**
- 1.20

**Costs of negative deposit rate changes**
- 1.18
Results

Adjustment costs normalized weekly deposit market profit

LARGE BANK
(bank size=90pctl)

Market share=10pctl

Average market share

Market share=90pctl

1.55

1.39

1.18

1.62

1.46

1.26
Results

Adjustment costs normalized weekly deposit market profit

SMALL BANK
(bank size=10pctl)

Market share=10pctl

Average market share

Market share=90pctl

1.16  0.99  0.78
1.05  0.89  0.67
Results

Probability of deposit rate changes

Compare three counter-factual scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>No change</th>
<th>Increase</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>No change in the market rate</td>
<td>93%</td>
<td>1%</td>
<td>6%</td>
</tr>
<tr>
<td>A permanent market rate increase of 0.25%</td>
<td>92%</td>
<td>2%</td>
<td>6%</td>
</tr>
<tr>
<td>A temporary market rate increase of 0.25%</td>
<td>94%</td>
<td>1%</td>
<td>5%</td>
</tr>
</tbody>
</table>
Results

Probability of deposit rate changes

LARGE vs SMALL BANKS

<table>
<thead>
<tr>
<th>No change in the market rate</th>
<th>A permanent market rate increase of 0.25%</th>
<th>A temporary market rate increase of 0.25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>Small</td>
<td>Large</td>
</tr>
<tr>
<td>↑ 1.7%</td>
<td>↑ 0.1%</td>
<td>↑ 1.8%</td>
</tr>
<tr>
<td>No change 98.2%</td>
<td>No change 87.4%</td>
<td>No change 98.1%</td>
</tr>
<tr>
<td>↓ 0.1%</td>
<td>↓ 12.5%</td>
<td>↓ 0.1%</td>
</tr>
<tr>
<td>No change 97.3%</td>
<td>No change 87.3%</td>
<td>No change 90.1%</td>
</tr>
<tr>
<td>↓ 0.1%</td>
<td>↓ 12.4%</td>
<td>↓ 9.8%</td>
</tr>
</tbody>
</table>
Conclusion

- Deposit rate dynamics is affected by substantial adjustment costs
- These vary with bank and market characteristics
- Their estimated magnitude suggests that a reaction to small monetary policy rate changes is unlikely
Further steps

• Explore potential changes in adjustment costs across time

• Examine the reaction of the probability of deposit rate changes to exogenous (e.g. regulatory) changes in adjustment costs
The algorithm

• Estimate the deposit supply function
• Evaluate the instantaneous profit as a function of the parameters
• Estimate the transition probabilities
• Start with an initial value of $P(Y_{Y=1,2,3})$
• Calculate the value function
• Use logistic assumption to give an implied probability for each of the actions => estimate the parameters from a conditional logit
• Generate a new value of $P(Y_{Y=1,2,3})$