Electricity Market Reform and Potential Tacit Collusion

Kari-Anne Fange* and Olvar Bergland**

Ostfold University College*
and
Norwegian University of Life Sciences NMBU**

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Outline

- A restructured Norwegian electricity market
- Motivation and research hypothesis
- The hidden markov model (HMM) approach
- Data
- Estimation results
- Policy implications and key findings
Background

From monopoly structure to competitive market structure in the early 1990s

- An independent electricity pool established
- Competition at the production level
- Competition in the retailing segment
- Prices available for comparison at an on-line information clearinghouse site
Timeline

**Figure:** Regulatory/Legislative Events

- **1990:** Introduction of the new Energy Act
- **1991:** An official trading company established
- **1993:** A joint Norwegian-Swedish power exchange
- **1997:** Switching fees eliminated
- **2000:** Mandatory reporting of standard electricity contracts
- **2006:** Mandatory reporting for all electricity contracts by new regulation

Before 1995 there was no technical system in place to handle switching of retailer.
Households switching of retailer

Figure: Number of switches per quarter

Date

Switches

0

1995q1
2000q1
2005q1
2010q1
2015q1

0

50000

100000

150000

Kari-Anne Fange

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The Norwegian competition authority (NCA) gathered and published prices for specific electricity contracts from January 1998:

- The default contract
- The market price contract
- Fixed price contracts of 1 year and 3 years duration

Information available on price site:
- Effective date for price change
- Announcement of new price in advance
- Any fixed monthly fees in contract
Research motivation

- We observe features that resembles tacit coordination of prices
- Crucial factors for collusion are present
- Stigler (1964); argue that transparency of prices might function as an option for retailers to observe and adjust
- Unique long history since opening up market to competition
Literature and previous studies

- Stigler (1964) A Theory of Oligopoly
- Albæk et al. (1997) found that following the publication of prices for cement, prices increased on average between 15-20 percent
- U.S. v. Airline Tariff et al., Competitive Impact Statement, Federal Register 12 January 1993 at p. 3976
  - DOJ file of a civil antitrust suit under section 4 of the Sherman Act in order to prevent and restrain violations of Section 1 by eight major air carriers
Methodology: The Hidden Markov Model (HMM) Approach

- First popularized by Hamilton (1990) and first studied from Bayesian MCMC perspective by Albert and Chib (1993)
- By a HMM approach we relate a sequence of price observations to a sequence of hidden states
- A probability distribution is computed and assigned to each possible sequence of labels
HMM model is specified by the following components:

- \( Y_1, \ldots, Y_t \), observed outcomes
- \( S = s_1 s_2 \ldots s_n \), a set of \( N \) states
  - \( B = b_{i(o_t)} \)
    - A sequence of observation probabilities
- \( A = a_{11} a_{12} \ldots a_{n1} \ldots a_{nn} \)
  - A transition probability matrix \( A \), each \( a_{ij} \), representing the probability of moving from state \( i \) to state \( j \)
- An array of variables \( x_t \) influences \( y_t \)
- An array of variables \( z_t \) influences transition probabilities (p)
Hypothesis - pricing options

Figure: Hypothesis

- current_state
- price_increase_follow
- price_increase_margin
- no_price_change
- price_decrease_margin
- price_decrease_follow
Figure: HMM

Hidden Markov Models
Data

- Market price (daily, years 2003-2010)
  - Obtained from NordPool Spot

- Default contract prices for 7 nationwide retailers (daily, years 2003-2010)
  - NCA

- Markups by retailers (daily, years 2003-2010)
  - NCA
Market price, retail price, mark-up
Markup, price change, hidden state
## Table: Predicted price adjustments by retailers

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<thead>
<tr>
<th>$\Delta price$</th>
<th>R-1</th>
<th>R-2</th>
<th>R-3</th>
<th>R-4</th>
<th>R-5</th>
<th>R-6</th>
<th>R-7</th>
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<td>−</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>R-2</td>
<td>−</td>
<td>*</td>
<td>0</td>
<td>−</td>
<td>0</td>
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<td>+</td>
</tr>
<tr>
<td>R-3</td>
<td>0</td>
<td>0</td>
<td>*</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>−</td>
</tr>
<tr>
<td>R-4</td>
<td>−</td>
<td>++</td>
<td>+</td>
<td>*</td>
<td>++</td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td>R-5</td>
<td>+</td>
<td>+</td>
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<td>*</td>
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<tr>
<td>R-6</td>
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<td>++</td>
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<td>−</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>*</td>
</tr>
</tbody>
</table>
We see distinct price dynamics among retailers
Certain retailers compete in a regional market
One major retailer is more eager to adjust the price up, independently of what other retailers do
We identify two price leaders which compete up and down
Policy implications and further studies

1. Price overview can serve as a price coordinating tool among retailers
2. Price leaders for price increases, may serve as signal

Further studies and extensions
- Include more data
  - Weekly observations can capture more detailed information
  - Longer data series
  - More firms
Thank you!

karianaf@hiof.no

