Market Power in Power Markets: The Case of French Wholesale Electricity Market

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2. Literature review
3. Modeling market power
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1 Context

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Electricity reforms in Europe since the late 1990s: unbundling, market opening, deregulation.

Creation of market and price liberalization.
Wholesale electricity price year-ahead base load in EUR/MWh
2000-2007

Evolution of French electricity prices and tariffs 2000-2013

Source: Authors, based on data from EPEX
Weekly prices and volumes on electricity spot market in France (2005-2013)

Source: Authors, based on data from EPEX, CRE, Eurostat
France’s case:

- Highly concentrated market structure despite of the electricity reform
- Substantial increases in wholesale power prices since the liberalization
- Very little empirical studies on market power issues in France
Literature review on diagnosing market power in power markets

- **Structure approaches:**
  - Market share and HHI: Schmalensee and Golub [1984]; Economic Londons [2007]
  - Pivotal Supplier & Residual Supply Indicator: Sheffrin [2002]
Literature review on diagnosing market power in power markets

- **Structure approaches:**
  - Market share and HHI: Schmalensee and Golub [1984]; Economic Londons [2007]
  - Pivotal Supplier & Residual Supply Indicator: Sheffrin [2002]

- **Market simulation approaches:**
  - Supply function equilibrium model: Green and Newbery [1992]; Willems et al [2005]
  - Cournot/Nash models: Borenstein, Bushnell & Wolak [1999 – 2002]
  - Optimization models: Lang and Schwarz [2006]; Weigt and Von Hirschhausen [2008]
  - **New Empirical Industrial Organisation:** Hjalmarsson [2000]; Bergland et Mirza [2012]
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Following Bresnahan [1982], Lau [1982] and Hjalmarsson [2000]

- **Demand equation:**

\[ Q_{ht} = \alpha_0 + \sum_{i=1}^{k} \gamma_i Q_{h,t-i} + \sum_{i=0}^{k} \alpha_{P,i} P_{h,t-i} + \sum_{i=0}^{k} \alpha_{Z,i} Z_{h,t-i} + \sum_{i=0}^{k} \alpha_{PZ,i} PZ_{h,t-i} + \varepsilon_{ht} \]  

with

\[ \varepsilon_{ht} = \mu_h + \nu_{ht} \]  

(1)
Following Bresnahan [1982], Lau [1982] and Hjalmarsson [2000]

- **Demand equation:**

\[
Q_{ht} = \alpha_0 + \sum_{i=1}^{k} \gamma_i Q_{h,t-i} + \sum_{i=0}^{k} \alpha_{P,i} P_{h,t-i} + \sum_{i=0}^{k} \alpha_{Z,i} Z_{h,t-i} + \sum_{i=0}^{k} \alpha_{PZ,i} PZ_{h,t-i} + \varepsilon_{ht}
\]  

with

\[
\varepsilon_{ht} = \mu_h + \upsilon_{ht}
\]  

- **Supply relation:**

\[
P_{ht} = \beta_0 + \sum_{i=1}^{k} \phi_i P_{h,t-i} + \sum_{i=0}^{k} \beta_{Q,i} Q_{h,t-i} + \sum_{i=0}^{k} \beta_{W,i} W_{h,t-i} + \sum_{i=0}^{k} \lambda_i Q_{h,t-i}^* + \eta_{ht}
\]  

with

\[
\eta_{ht} = \nu_h + \tau_{ht}
\]  

and

\[
Q_{ht}^* = \frac{Q_{ht}}{(\theta_P + \theta_{PZ} Z_{ht})}; \quad \theta_j = \frac{\sum_{i=0}^{k} \alpha_{j,i}}{1 - \sum_{i=1}^{k} \gamma_{i}}; \quad j = P, Y, Z, PZ
\]
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The whole sample spans from 26 October 2009 to 31 December 2012, yielding $T = 1163$ for each hour and 27912 observations for the whole panel dataset.
### Estimation results for the Demand Equation

<table>
<thead>
<tr>
<th>Variables</th>
<th>coef</th>
<th>Robust Std.Err</th>
<th>z-stat</th>
<th>Prob.</th>
<th>[95% Conf. Interval]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>-0.0210***</td>
<td>(0.00789)</td>
<td>-2.662</td>
<td>0.0077</td>
<td>-0.0365 -0.00554</td>
</tr>
<tr>
<td>Temperature</td>
<td>-0.130***</td>
<td>(0.0416)</td>
<td>-3.129</td>
<td>0.0017</td>
<td>-0.212 -0.0487</td>
</tr>
<tr>
<td>$P \times Temp$</td>
<td>0.00196***</td>
<td>(0.000674)</td>
<td>2.910</td>
<td>0.0036</td>
<td>0.000640 0.00328</td>
</tr>
<tr>
<td>Turnover(-1)</td>
<td>0.522***</td>
<td>(0.0195)</td>
<td>26.84</td>
<td>0.0000</td>
<td>0.484 0.561</td>
</tr>
<tr>
<td>Daylength</td>
<td>0.00813</td>
<td>(0.0201)</td>
<td>0.404</td>
<td>0.6860</td>
<td>-0.0313 0.0476</td>
</tr>
<tr>
<td>Holidays</td>
<td>-0.249***</td>
<td>(0.0766)</td>
<td>-3.251</td>
<td>0.0011</td>
<td>-0.399 -0.0989</td>
</tr>
<tr>
<td>Summer</td>
<td>-0.147</td>
<td>(0.117)</td>
<td>-1.256</td>
<td>0.2090</td>
<td>-0.375 0.0822</td>
</tr>
<tr>
<td>Spring</td>
<td>-0.258***</td>
<td>(0.0859)</td>
<td>-3.003</td>
<td>0.0026</td>
<td>-0.426 -0.0896</td>
</tr>
<tr>
<td>Fall</td>
<td>-0.0929</td>
<td>(0.0738)</td>
<td>-1.258</td>
<td>0.2080</td>
<td>-0.238 0.0518</td>
</tr>
</tbody>
</table>
### Estimation results for the Supply Equation

<table>
<thead>
<tr>
<th>Variable</th>
<th>coef</th>
<th>Robust Std.Err</th>
<th>z-stat</th>
<th>Prob.</th>
<th>[95% Conf. Interval]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q^*$</td>
<td>1.33e-05*</td>
<td>-7.46E-06</td>
<td>1.787</td>
<td>0.0871</td>
<td>-2.10E-06 2.88E-05</td>
</tr>
<tr>
<td>Load</td>
<td>0.346***</td>
<td>-0.051</td>
<td>6.797</td>
<td>0.0000</td>
<td>0.241 0.452</td>
</tr>
<tr>
<td>$Load^2$</td>
<td>0.00130***</td>
<td>-0.000309</td>
<td>4.192</td>
<td>0.0003</td>
<td>0.000657 0.00194</td>
</tr>
<tr>
<td>Price (-1)</td>
<td>0.276***</td>
<td>-0.0287</td>
<td>9.623</td>
<td>0.0000</td>
<td>0.216 0.335</td>
</tr>
<tr>
<td>Price (-2)</td>
<td>0.0783***</td>
<td>-0.0155</td>
<td>5.066</td>
<td>0.0000</td>
<td>0.0463 0.11</td>
</tr>
<tr>
<td>Price (-3)</td>
<td>0.0603***</td>
<td>-0.00987</td>
<td>6.106</td>
<td>0.0000</td>
<td>0.0399 0.0807</td>
</tr>
<tr>
<td>Price (-4)</td>
<td>0.0533***</td>
<td>-0.0082</td>
<td>6.498</td>
<td>0.0000</td>
<td>0.0363 0.0703</td>
</tr>
<tr>
<td>Price (-5)</td>
<td>0.00692</td>
<td>-0.0106</td>
<td>0.652</td>
<td>0.5210</td>
<td>-0.015 0.0289</td>
</tr>
<tr>
<td>Price (-6)</td>
<td>0.0350***</td>
<td>-0.00999</td>
<td>3.5</td>
<td>0.0019</td>
<td>0.0143 0.0556</td>
</tr>
<tr>
<td>Price (-7)</td>
<td>0.115***</td>
<td>-0.0202</td>
<td>5.683</td>
<td>0.0000</td>
<td>0.0732 0.157</td>
</tr>
<tr>
<td>Gas price</td>
<td>0.142</td>
<td>-0.116</td>
<td>1.226</td>
<td>0.2330</td>
<td>-0.0974 0.381</td>
</tr>
<tr>
<td>Margin</td>
<td>-0.629***</td>
<td>-0.0569</td>
<td>-11.05</td>
<td>0.0000</td>
<td>-0.747 -0.511</td>
</tr>
<tr>
<td>Carbon</td>
<td>-0.0241</td>
<td>-0.0191</td>
<td>-1.259</td>
<td>0.2210</td>
<td>-0.0636 0.0155</td>
</tr>
<tr>
<td>EX Germany</td>
<td>0.180***</td>
<td>-0.0625</td>
<td>2.879</td>
<td>0.0085</td>
<td>0.0507 0.309</td>
</tr>
<tr>
<td>EX Italy</td>
<td>-1.887***</td>
<td>-0.302</td>
<td>-6.239</td>
<td>0.0000</td>
<td>-2.513 -1.261</td>
</tr>
<tr>
<td>EX Spain</td>
<td>-0.960***</td>
<td>-0.233</td>
<td>-4.123</td>
<td>0.0004</td>
<td>-1.442 -0.478</td>
</tr>
<tr>
<td>EX Belgium</td>
<td>0.278***</td>
<td>-0.0814</td>
<td>3.409</td>
<td>0.0024</td>
<td>0.109 0.446</td>
</tr>
<tr>
<td>Holidays</td>
<td>-6.935***</td>
<td>-1.546</td>
<td>-4.486</td>
<td>0.0002</td>
<td>-10.13 -3.737</td>
</tr>
<tr>
<td>Summer</td>
<td>7.007***</td>
<td>-0.358</td>
<td>19.57</td>
<td>0.0000</td>
<td>6.267 7.748</td>
</tr>
<tr>
<td>Spring</td>
<td>5.341***</td>
<td>-0.28</td>
<td>19.09</td>
<td>0.0000</td>
<td>4.763 5.92</td>
</tr>
<tr>
<td>Fall</td>
<td>7.715***</td>
<td>-0.379</td>
<td>20.37</td>
<td>0.0000</td>
<td>6.931 8.498</td>
</tr>
</tbody>
</table>
Robustness test: Multivariate time series models

<table>
<thead>
<tr>
<th></th>
<th>LI-h5</th>
<th>LI-h8</th>
<th>LI-h9</th>
<th>LI-h11</th>
<th>LI-h22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short term</td>
<td>0.01963641</td>
<td>0.02803341</td>
<td>0.04188475</td>
<td>0.01715386</td>
<td>4.7438E-07</td>
</tr>
<tr>
<td>Long term</td>
<td>0.0446282</td>
<td>0.03467772</td>
<td>0.02644286</td>
<td>0.01000519</td>
<td>8.7443E-07</td>
</tr>
</tbody>
</table>
Discussion

- Extremely regulated market in France.
- No economic incentives for incumbent firm to exercise its market power.
- High prices can be justified by other exogenous factors.
Context

Literature review

Modeling market power

Data

Estimation results

Conclusion
Market power parameters are found statistically significant for several peak hours but remain at very low levels. On average, no market power was exercised during the examined period (2009-2012) in France.

Various economic justifications for this result

Implications for further research
Thank you