Virtual Divestitures: Will they make a difference?

Cournot Competition, Option Markets and Efficiency

Bert Willems

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Overview

- Background: EU-electricity liberalization
- Virtual Divestiture as a remedy for market power
- A model for Virtual Divestitures
- Some Policy Conclusions
Liberalization in European Continent

- Little attention was given to
  - **Market design**: patchwork of incompatible market designs, no spot market
  - **Market structure**: no privatizations, no divestitures
    - IDEA: with EU wide competition, no company has market power

- (Healthy) competition did not develop
  - Lack of harmonization
  - Mergers
  - National Champions

- Competition authorities are worried
  - Potential abuse of market power
    - Which remedies can they take?
Remedies for Market Power

- Obstacles for **structural remedies** (divestiture)
  - Politically infeasible
  - Non-reversible + uncertain effects
  - Economies of scale in production

- Alternative is **behavioral remedy**
  - Market monitoring and **Bid mitigation**
    - Regulate short run behavior
    - You need to have a working wholesale market

- **Virtual Divestiture**
  - Contract which mimics a real divestiture
  - Legally no assets change hands
  - Firms auction **CALL OPTIONS**

- In EU, Virtual Divestitures have been used often

*Note: Exelon–PSEG = Futures contract*
When are Virtual Divestitures used?

- As a remedy in Merger Policy

<table>
<thead>
<tr>
<th>Firm</th>
<th>MW</th>
<th>Date</th>
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<tbody>
<tr>
<td>EDF(F)</td>
<td>5000</td>
<td>2002</td>
</tr>
<tr>
<td>Electrabel (B)</td>
<td>1200</td>
<td>2003</td>
</tr>
<tr>
<td>Nuon (NL)</td>
<td>*900</td>
<td>2005</td>
</tr>
<tr>
<td>ELSAM(DK)</td>
<td>600</td>
<td>2006</td>
</tr>
<tr>
<td>CES(CS)</td>
<td>400</td>
<td>2005</td>
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- To address a dominant position
  - Italy (First try-out), the Netherlands (consultation note), Spain (White paper)

- RWE (G) sold a virtual coal plant voluntary
Modeling Virtual Divestitures

OBJECTIVES

- Study effect of virtual divestiture on MARKET POWER of GENERATORS
- Will generators virtually divest if there is NO REGULATION?

ASSUMPTIONS

- Cournot Model in Generation
- No Uncertainty – No hedging → See Oum, Oren, Deng
- No Entry → See Cramton & Stoft
Related Literature

- Allaz & Vila (1993)
  - Use a similar model to look at Futures Contracts

  - Physical options in a model with Entry and Regulation

- Literature on delegation
  Shareholders:
  - Set-up an incentive structure for managers
  - Decide whether managers set prices or quantities
The players

- Generators
  - Bid in spot market à la Cournot
  - Have sold Virtual Power Plants (Physical or Financial)

- Consumers
  - Price takers in spot market

- Traders
  - Have bought Virtual Power Plants
Virtual Power Plants

- Virtual Power Plant = option contract

- Two Types
  - Financial Call Option
    - *Insurance contract* against high spot price
  - Physical Call Option
    - Contract for *physical delivery*
    - Buyer can *sell energy* in spot market
Bidding in Spot Market

**FINANCIAL VPP**
- Generator bids into spot market
- Gen pays insurance to traders
- Gen produces Q and receives revenue \( p \times Q \)

**PHYSICAL VPP**
- Generator + Traders bid into spot market
- Trader pays Gen to produce \( q_T \)
- Gen produces own output \( q \) and quantity nominated by trader

Insurance Payment

Virtual Production Cost
Financial vs Physical VPPs

Virtual Power Plant has a supply function $\Gamma(P)$

**Financial VPP**
- Insurance contract
- Trader receives compensation based on spot price

**Physical VPP**
- Produce when Virtual MC < $p$
- Trader produces $q_T = \Gamma(p)$ MW
- Trade pays virtual Cost

\[ \int_0^\infty \max\{0, p - S\} d\Gamma(S) \]

\[ \int_0^p S d\Gamma(S) \]
**Effect of Virtual Divestiture on Spot Market**

**Financial VPP**
- Residual Demand Function
- Virtual MC
- Insurance Payment
- Profit

**Physical VPP**
- Residual Demand Function
- Profit

**Effect:** VPP plant reduces incentives to set high prices

- Competition improves

**Extra Effect:** Traders in spot market: more elastic residual demand function

- Competition improves a lot
Will firms Virtually Divest?

- Why did RWE sell a virtual coal plant of 200MW?

- Extended Model = Two stage game

- **Stage 1**: contract market: Gens sell standardized VPPs
  - Fixed proportion of peak and base load plants
  - Firms choose size of VPP

- **Stage 2**: spot market
  - As discussed before

- Assumption:
  - Perfect arbitrage between 2 stages
## Will firms Virtually Divest?

<table>
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<tr>
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<th>Physical VPP</th>
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<tr>
<td>■ = Commitment</td>
<td></td>
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<tr>
<td>■ to be more aggressive</td>
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<tr>
<td>■ Delegation Game</td>
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<tr>
<td>■ In Cournot game there is an incentive to commit to be aggressive</td>
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<td>➢ Firms will Virtually Divest</td>
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<td>■ Delegation Game</td>
<td></td>
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<tr>
<td>■ Playing Cournot dominates Betrand</td>
<td></td>
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<tr>
<td>➢ Firms are reluctant to Virtually Divest</td>
<td></td>
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<td>➢ Prices are higher than with forward contracting</td>
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Policy Conclusions

- Use physical VPPs to mitigate Market Power
  - Competition a la Bertrand
  - Active players in markets = Help Price Discovery
  - A lot of questions remain
    - Monitoring of all L.T. commitments needed
    - Length of contracts, choice of strike price, indexed, plant outage, balancing responsibility, nomination responsibility

- Promote markets for financial options
  - Regulators should promote flexible contracts, next to
  - Markets will become more competitive with financial options than with futures
  - Makes volumetric hedging possible
EXTRA SLIDES

Bert Willems
1. Profit of Generators in Spot Market

Financial VPP
- Set $Q_i$

$$pQ_i - C(Q_i) - \int_0^p \Gamma_i(S) dS$$

Physical VPP
- Set $q_i$

$$pq_i - C(Q_i) + \int_0^p Sd\Gamma_i(S)$$

$$Q_i = q_i + \Gamma_i(p)$$

$$p = P(Q_1 + Q_2)$$
2. Price after a Voluntary V.D?

- Lower price if financial VPP is more elastic

\[
p \downarrow \quad \text{IF} \quad \epsilon = \frac{p\Gamma'(p)}{\Gamma(p)}.
\]

- Intuition
  - The incentive to sell VPPs depends on the number of \textit{marginal} VPPs \( \Gamma'(p) \).
  - The effect on the spot market depends on the amount of \textit{infra-marginal} VPPs \( \Gamma'(p) \).

- Corollary
  - Financial Option markets lead to lower prices than Futures markets.
3. Price after Voluntary V.D.

- By selling VPPs firm 2 can move spot market equilibrium over reaction function of firm 1
- Optimum: Trade-off Price-Quantity
- If at the same location the reaction function of firm 2 is steeper then firm 2 sells more
  - Location
    - Determined by \( k_1 \Gamma(p) \)
  - Slope
    - Determined by \( k_1 \Gamma'(p) \)
4. Possible Extensions of the model

- Entry in generation
- Add uncertainty and risk aversion
- Flexible composition of VPPs
- Imperfect arbitrage between contracting and production stage
- Make contracting positions unobservable
- Other types of competition in spot market