Exporting Collusion under Capacity Constraints: an Anti-Competitive Effect of Market Integration

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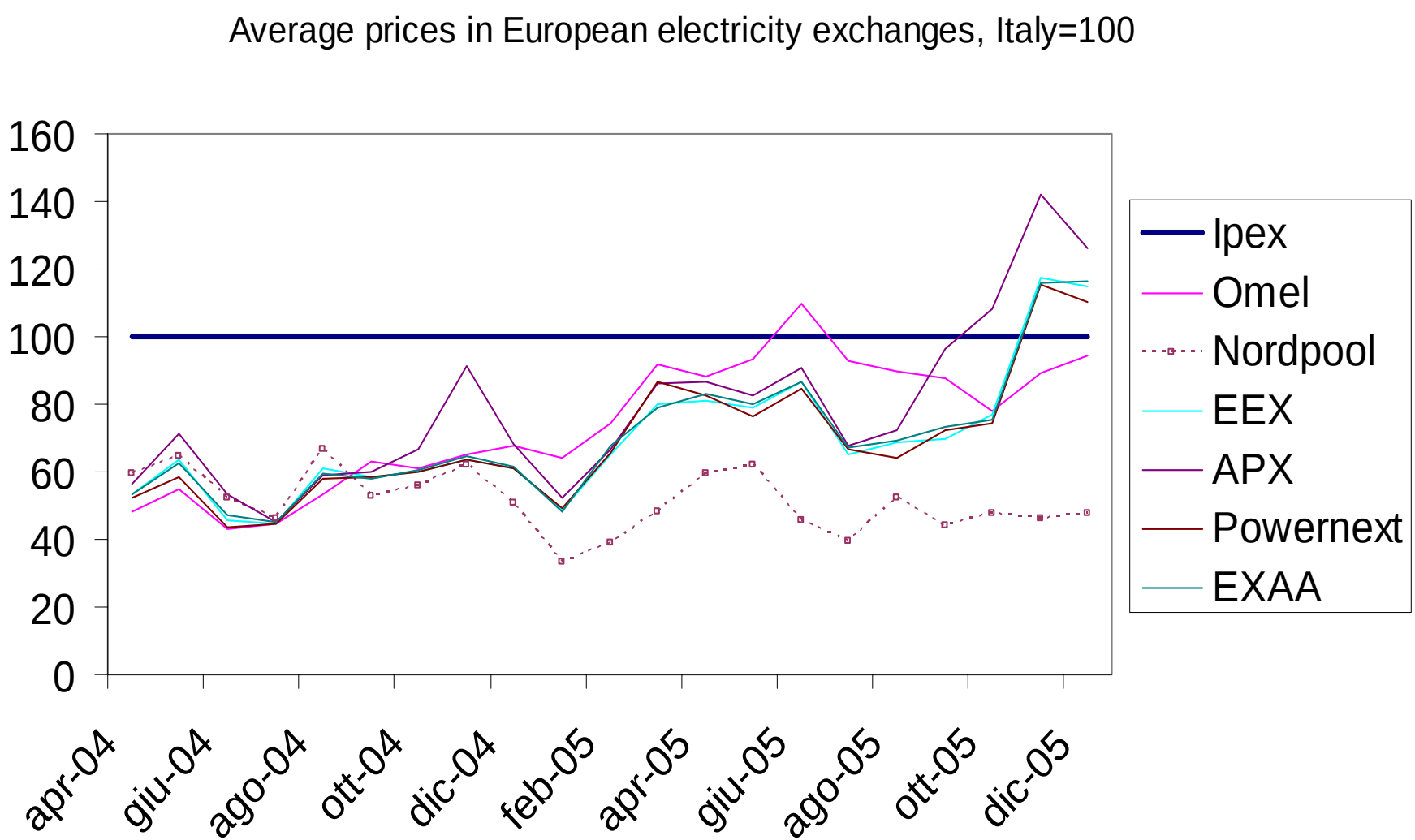
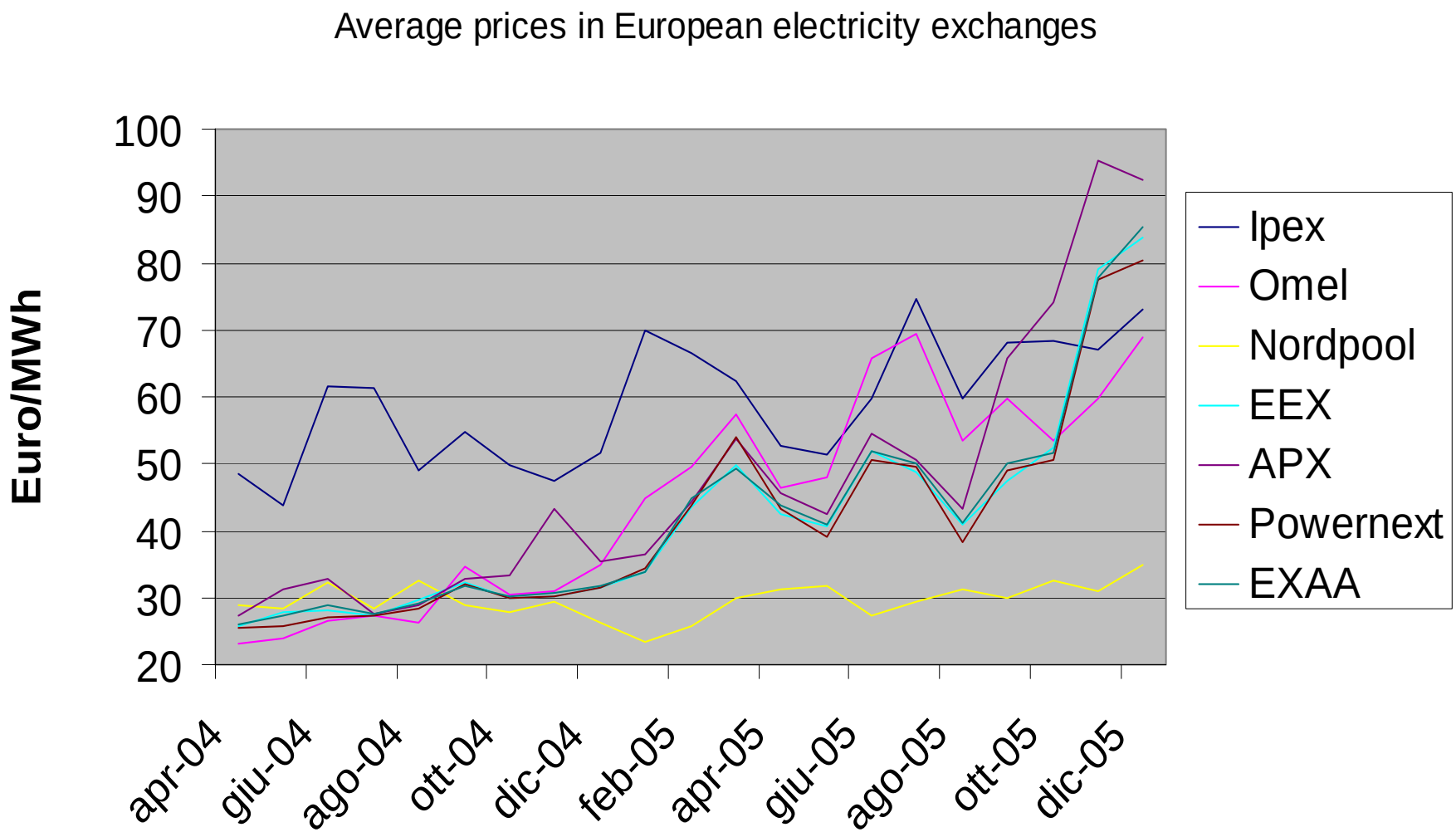
Outline

- Introduction
- The general result
- Policy implications and comments

Electricity integration



Covergence upwards



Questions

- Suspicion: is market integration insufficient to enhance competition?
- Possible that integration simply gives some countries a “vent for surplus” and *decreases* competition where prices were low?
- Possible benefit in the high price country – and in the other one? Can this lead to a Pareto worsening?

Our paper

- Compares two alternative market arrangements
  - Two separate markets, A and B
  - A single market that includes A and B
- Effect of connecting the markets under
  - capacity constraints
  - tacit collusion
- Conventional wisdom: market opening increases welfare
- Our conclusion: market opening may actually lower social welfare
- Possible applications:
  - effects of eliminating physical barriers: interconnection in the electricity market; debate over railroad interconnection
  - effects of eliminating legal barriers
  - effects of reducing transportation costs among different regions

Related literature

1. Competition under capacity constraints (Kreps & Scheinkman, 1983)

2. Collusion and capacity constraints - Davidson & Deneckere, Staiger & Wolak (1992), Brock & Scheinkman (1985)

3. Multimarket contacts - Bernheim & Whinston (1990)

4. Trade literature:
   - Positive effects of openness (Ricardo)
   - Possible distributional effects – at least one country gains
   - Infant industries argument

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The model

- Two areas ($j = A, B$)
- The number of firms in each area (N_j) exogenous and fixed
- Homogenous product
- Firms capacity constrained *(k*)
- Marginal cost *c* up to capacity
- Linear demand functions $P_j = P(Q_j)$, same maximal willingness to pay
  - Consumers' utility quasi-linear: a) no income effect; b) consumer surplus adequate welfare measure; c) demand in the interconnected market sum of individual demands
- No firm is essential for producing the competitive output, i.e., $(N_j - 1)k \geq Q_j(c)$
  - Necessary for Bertrand reversion to lead to null profit

Firms' strategies

- Firms compete in prices
- Tacit collusion (p^C) whenever rational
  - Deviation price arbitrarily close to p^C
  - Trigger strategy
  - Discount factor same for all firms
- If multiple equilibria emerge, firms coordinate on the aggregate profit-maximizing one.

No capacity constraints

- Without capacity constraints, collusion among symmetric firms is sustainable if:

$$\frac{(p^C - c)q_j(p^C)}{1-\delta} \geq (p^C - c)N_j q_j(p^C)$$

  - Only the discount factor and the number of firms matter (not market size or price level).

$$\delta \geq 1 - \frac{1}{N_j}$$

Capacity constrained collusion

- With capacity constraints, the IR for firm *i* is:

$$\frac{(p^C - c)q_j(p^C)}{1-\delta} \geq (p^C - c)\min(k; N_j q_j(p^C))$$

- If the capacity constraint matters:

$$q_j(p^C) \geq (1-\delta)k$$

- Symmetric capacity implies:

$$Q_j(p^C) \geq (1-\delta)N_j k$$

- The collusive price depends on the relationship between aggregate capacity and market size.

Collusive output in a single market

- Assume

$$(1-\delta)N_j k < Q^b$$

- When capacity constraints bind the deviation output:

$$Q_j(p^C) = \begin{cases} Q_j^{mon} \; if \; Q_j^{mon} \geq (1-\delta)N_j k \\ (1-\delta)N_j k \; if \; Q_j^{mon} \leq (1-\delta)N_j k \end{cases}$$

Collusive output after interconnection

- After interconnection, the threshold

$$(1-\delta)Nk = (1-\delta)N_A k + (1-\delta)N_B k$$

  results from the sum of the two individual thresholds in the single markets
- Monopoly output also results from the sum of the outputs in the two markets

$$Q^{mon} = Q_A^{mon} + Q_B^{mon}$$

- Collusive output after interconnection:

$$Q(p^C) = \begin{cases} Q^{mon} \; if \; Q^{mon} \geq (1-\delta)Nk \\ (1-\delta)Nk \; if \; Q^{mon} \leq (1-\delta)Nk \end{cases}$$

Exporting collusion

- Suppose that before integration

$$Q_A = Q_A^{mon}$$
$$Q_B > Q_B^{mon}$$

- This implies:

$$(1-\delta)N_A k \leq Q_A^{mon}$$
$$(1-\delta)N_B k > Q_B^{mon}$$

- After integration, monopoly prevails. This implies:

$$(1-\delta)N_A k + (1-\delta)N_B k \leq Q_A^{mon} + Q_B^{mon}$$

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Intuition

- Reallocation of capacity after interconnection: firms in the market with higher aggregate capacity “divert” part of their capacity to the other market
- Supergame equilibrium: interplay between market demand, and aggregate capacity.
- Linear relation?
  - collusive price in the integrated market would be the average of the collusive prices in the two markets
- But the relation is indeed non-linear
  - There is a threshold of aggregate capacity below which the market can be run as a monopolistic cartel.

Policy implications

- Market integration has ambiguous welfare consequences

- Supergame equilibrium: interplay between market demand, and aggregate capacity.
- Linear relation?
  - collusive price in the integrated market would be the average of the collusive prices in the two markets
- But the relation is indeed non-linear
  - There is a threshold of aggregate capacity below which the market can be run as a monopolistic cartel.

Final remarks

- We have only provided sufficient conditions for welfare reduction
- Increasing cost functions possess most of the qualitative properties of capacity constraints
  - most of the results in the paper might hold even in the case of continuously increasing cost functions
- Nothing substantial would change if we introduced asymmetric capacity
  - Possibly more interesting distributional implications

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- A simple example
- Comments

A simple example : 4 + 7

- Two identical countries, $Q = a - P$
  - 4 firms in country A, 7 in country B
  - all capacity constrained ($k = a/3$)
  - Zero marginal cost
  - Infinite time horizon
- Firms set prices and collude whenever rational
  - Common discount factor $\delta = ¾$
  - Punishment: Bertrand (zero profit)

Colluding under capacity constraints

- Deviation is limited because of *k*
- If p^C is the collusive price, deviation profits are bounded by $p^C k$
- IR: collusion pays off when

$$\frac{p^C q_i(p^C)}{1-\delta} \geq p^C k \quad \Rightarrow \quad \frac{q_i(p^C)}{1-\delta} \geq k = \frac{a}{3} \quad \Rightarrow \quad q_i(p^C) \geq \frac{1}{4}\frac{a}{3}$$

- This depends on price
  - not all output levels are sustainable
  - a very high price may be non-sustainable

Collusive equilibria in the 2 markets

- In market A, with 4 firms, total minimum collusive output is $$Q_A^C = \frac{a}{3} < Q_{mon} = \frac{a}{2}$$
- Hence firms coordinate on monopoly price
- In market B, with 7 firms, total minimum collusive output is $$Q_A^C = \frac{7}{12}a > Q_{mon} = \frac{a}{2}$$
- Monopoly price is not sustainable as a collusive equilibrium

Collusion in the integrated market

- Let us integrate the two countries, $Q = 2(a - P)$
- Now, monopoly output is $Q_{mon} = a$
- With 11 firms, total minimum collusive output is

$$Q_{A+B}^{C} = \frac{11}{12}a < Q_{mon} = a$$

- Hence firms coordinate on monopoly price
- In market A, the price remains the same
- In market B, the price goes up !

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