

Analys av elmarknad med flaskhalsar och förnybar elproduktion

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Project

IFN

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Budget: 5.8 MSEK Project period: 2015-07-01 – 2018-12-31

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Background

Electricity must be delivered just-in-time. Renewable production fluctuates in time and location. Combination is a technical and economical challenge.

Transmission constraints become more apparent.

Ramping constraints become more apparent. Larger difference between flexible production (hydro power) and inflexible production (nuclear power).

Greater need to adjust production plans near delivery.

More scope for market power in a stressed system.

Issues that we focus on

How does more uncertainty and production/transmission constraints influence market power?

What is best market design when production is uncertain?

Intra-day markets and real-time markets facilitate adjustments in production plans near delivery. How can they be improved?

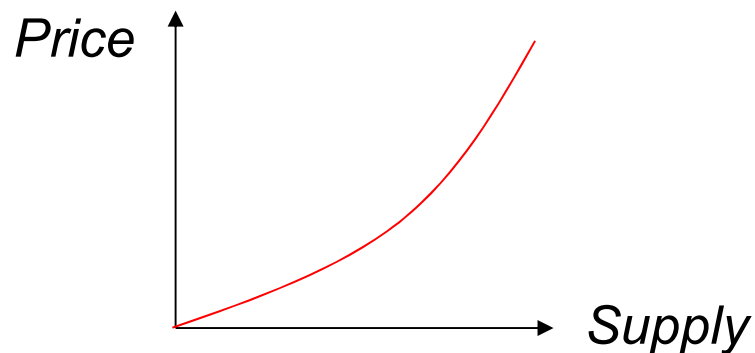
Methods

Auction theory predicts market behaviour for different market designs.

Each producer chooses its bid to maximize its expected profit.

In Nash equilibrium (Supply function equilibrium) all producers maximize profit, no producer could increase profit by changing its bid.

Example of bid



Optimal market design for uncertain production

Holmberg and Wolak: “Comparing auction designs where suppliers have uncertain costs and uncertain pivotal status” (Revise and resubmit in *Rand Journal of Economics*)

Uniform-pricing better than pay-as-bid pricing if producers have positively correlated production uncertainties

EU has introduced measures that will increase market transparency. Does this improve market competitiveness?

Yes, it does, at least in the short-run. Moreover, regulatory transparency improves market performance for hydro-dominated markets.

Switching costs in production/consumption

”Multiproduct Supply Function Equilibria” by Holmberg, Ruddell and Willems.

- * Developed new model that can be used to analyse strategic bidding in multi-units auctions with related goods, such as a spot market with many delivery hours.
- * We show how bundling of goods can be used to disentangle couplings between markets.
- * Flexible consumers will make bidding more competitive.
- If society wants to invest in flexible technologies (storage, transmission capacity etc.), it is better for social welfare if those technologies are controlled by non-strategic agents (not producers with market power).

Price instability due to indivisibilities

”Price instability in multi-unit auctions” by Anderson and Holmberg
(conditionally accepted by Journal of Economic Theory)

Some production plants are indivisible. For example in the sense that if they are started, then they have to produce at maximum output.

Related indivisibilities can also be introduced by the bidding format. Nord Pool has *Block bids* that have to be fully accepted or entirely rejected (Fill or Kill).

How does such indivisibilities influence market performance?

We find that indivisibilities introduce an uncertainty in the market price (price instability). We predict that it will be worst at high prices, near the price cap. There we predict that the standard deviation can be 0.1-3% of the price cap in a typical electricity market.

Evaluation of real-time market designs

”Simulation and evaluation of zonal electricity market designs” by Sarfati, Hesamzadeh and Holmberg.

Real-time electricity markets are important to balance the system with regard to fluctuations in renewable power production and related disturbances.

European electricity markets use zonal pricing in the spot market. In this paper we evaluate, which real-time market design works best together with a zonal spot market.

Improved intra-day market

Intra-day markets are important for renewable energy production, which has intermittent output. European intra-day markets have poor liquidity and are uncompetitive. How can they be improved?

” Pro-competitive rationing in multi-unit auctions” by Holmberg (Accepted by *Economic Journal*)

* Develops new rationing rule (tie-breaker) and shows that it improves market competitiveness. The effect is largest in markets where bids are entered at a few price levels, such as intra-day and forward markets.

Effect of transmission constraints and tariffs

"On Supply Function equilibria in constrained transmission networks" by Holmberg and Philpott (conditionally accepted by *European Journal of Operations Research*)

Outline method on how to solve for unconstrained Supply Function Equilibria in a radial network

Mario Blázquez de Paz has written a series of papers: "Production or Transmission Investments? A Comparative Analysis", "Auction Performance on Wholesale Electricity Markets in the Presence of Transmission Constraints and Transmission Costs" and "Transmission Costs, Transmission Capacities and their Influence on Market Power in Wholesale Electricity Markets".

Mario takes market power into account and compares how electricity markets with transmission constraints are influenced by network tariffs, market design and investments.

Media

- "A minor change in market trading rules could save taxpayers billions of dollars", LSE Business Review, November 29, 2017.
- "Regeringens svajiga energipolitik höjer elpriset", Dagens samhälle, 18 mars, 2016.
- "Ny ransoneringsregel kan förbättra värdepappershandeln", Realtid.se, 15 mars, 2016.
- "IFN: Sverige vandrar samma väg som UK", Montel Kraft-Affärer, Nr 2, vecka 4, 2016.
- "Debatt: Lär av Storbritanniens avskräckande exempel", Dagens Industri, 25 januari, 2016.

Tack för uppmärksamheten!

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