The inc-dec game in zonal electricity markets

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Co-authored papers on inc-dec game

1. Comparison of congestion management techniques: Nodal, zonal and discriminatory pricing, Energy Journal, 2015, (with Lazarczyk)

2. Production efficiency of nodal and zonal pricing in imperfectly competitive electricity markets, Energy Strategy Reviews, 2019. (with Sarfati and Hesamzadeh)

3. Increase-Decrease Game under Imperfect Competition in Two-stage Zonal Power Markets, 2018. (with Sarfati and Hesamzadeh).

4. Simulation and Evaluation of Zonal Electricity Market Designs, 2018. (with Sarfati and Hesamzadeh).

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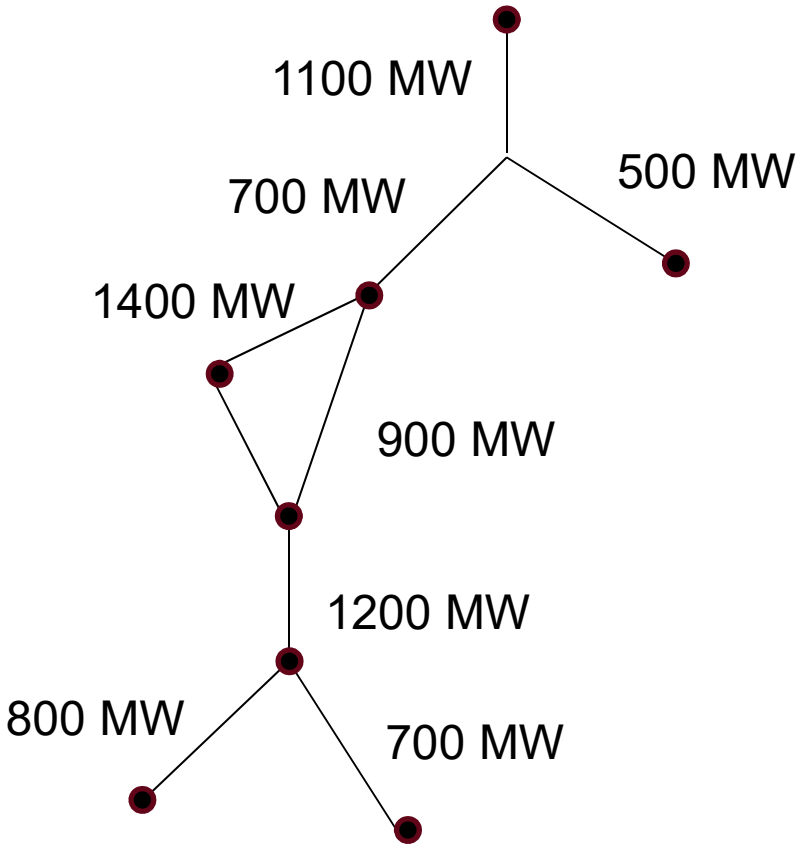
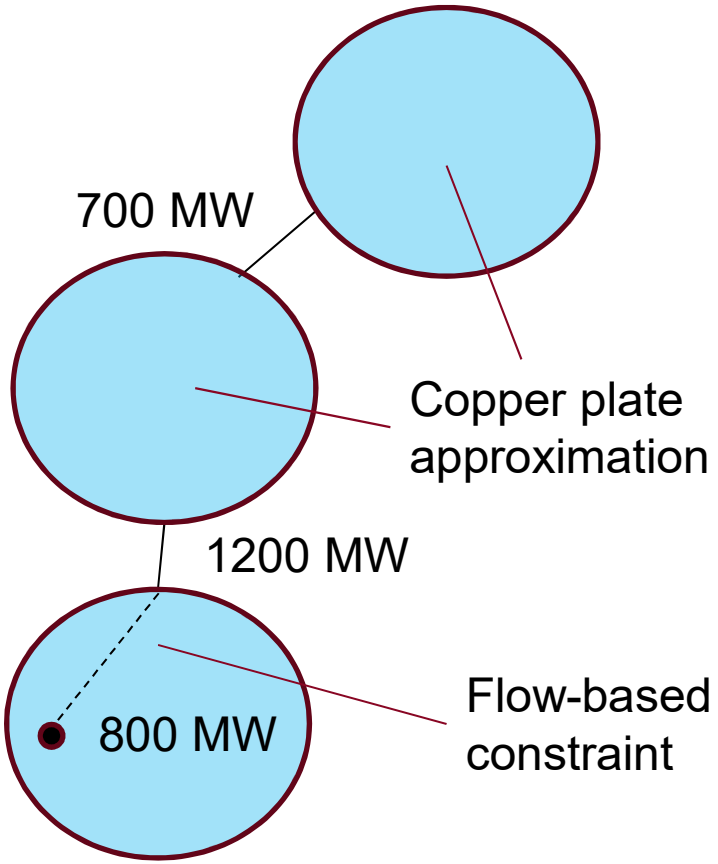
Zonal electricity markets set prices differently in day-ahead and real-time markets

Real-time market (including redispatch)



Considers all transmission constraints

Day-ahead market



Neglects all/most transmission constraints inside zones.

Arbitrage problem

- Prices set differently in day-ahead and real-time markets => arbitrage opportunities
- Export-constrained producer has higher day-ahead price than real-time price
- Export-constrained producers sell more than they plan to produce day-ahead and then buy back in real-time => arbitrage profit.
- Strategy has many names: increase-decrease game, inc-dec game, dec game, death star (Enron)

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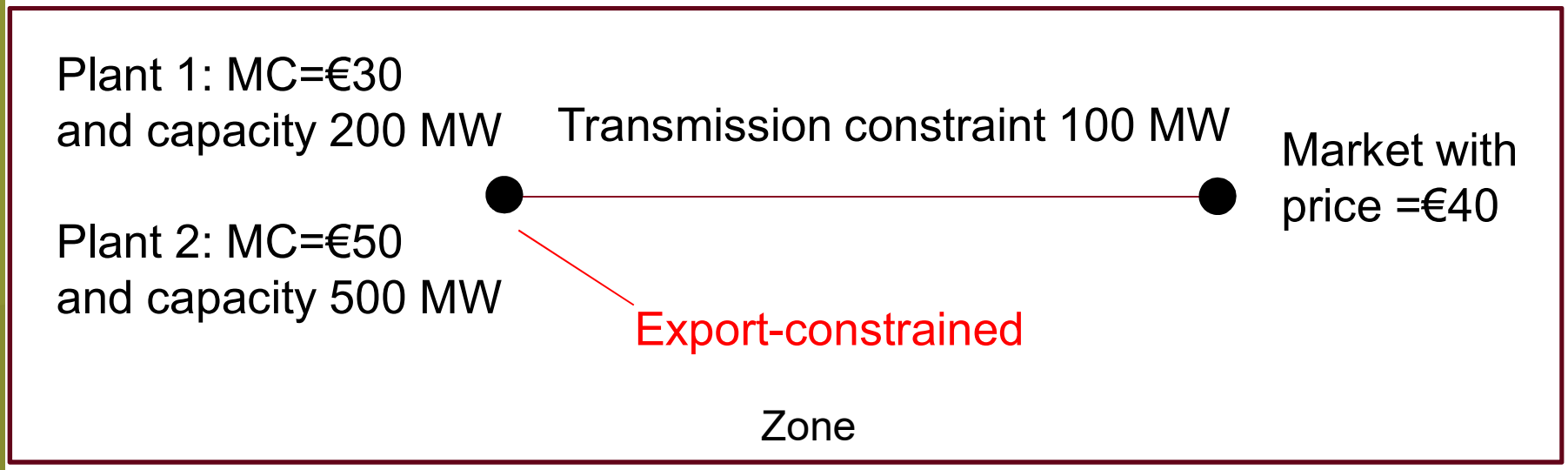
Inc-dec game



- Real-time: price is €30 in export-constrained node
- Day-ahead: price is €40 in export-constrained node
- Sell both plants (700 MW) at €40 day-ahead and buy back 600 MW at €30 in real-time.
- Inc-dec game => congestion worsened by 500 MW
- Inc-dec volumes can be large also for small price differences

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Problems with inc-dec game

Short-run problem:

Worse congestion=> larger volumes redispatched in real-time => Security concern and less efficient production.

Long-run problem:

Increases profit of export-constrained production => More investments where it is not needed.

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Inc-dec game in practice

US markets started out as zonal markets. Now all are nodal. Inc-dec problems in California (Alaywan et al., 2004; Hobbs, 2009; Neuhoff et al., 2011) and PJM (Hogan, 1999).

Inc-dec game at English-Scottish border =>TCLC act (Hirth et al., 2019).

Arbitrage game at German-Danish border (Hirth et al., 2019).

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How to mitigate inc-dec game?

- More zones (Scandinavia and Italy) or nodal pricing (US).
- Flow-based zonal pricing as in Central West Europe, CWE.
- Make real-time market similar to zonal market => Inefficient ex-post, but less inc-dec game => Ex-ante efficiency may increase.
- Stricter regulation of bids, e.g. cost-based redispatch as in Germany (Hirth et al., 2019).
- Increase market uncertainty, and/or introduce long-lived bids.

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What does not work

Improved competition good for electricity markets, but does not solve inc-dec problem.

The inc-dec game is an arbitrage problem due to inconsistencies in market design.

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Summary of inc-dec game

- Arbitrage opportunities occur when prices are set differently in day-ahead and real-time markets.
- Export-constrained producers make extra money by selling more day-ahead and buying back in real-time.
- Large redispatch volumes and distort investment signal
- Contributed to US moving from zonal to nodal
- Mitigated by regulations and/or market design changes, not by improved market competitiveness.

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Thanks!

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