The Long-Term Merit Order Effect of Renewable Electricity

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The Merit-Order Effect ...

- ... measures how wholesale electricity prices are influenced by feed-in from intermittent renewable electricity generators.
- ... is quantified in more than 20 scientific papers.
- ... regards an important policy question ("co-benefit" of renewables for consumers).
- ... regards an important business question (prices and price structures are highly relevant for investment decisions on the supply and demand side).
- ... is controversially debated (between >10 and 0 €/MWh)
- An analysis of the literature reveals that an analysis in a general framework is lacking.
Phase 1: No Renewable Generation

\[ p_1^* \]

Demand

Supply: merit order

\( p \)

\( q \)
Phase 2: Renewable Generation is Added

The graph illustrates the interaction between demand and supply in a market. The demand curve is shown as a downward-sloping line, indicating the quantity demanded at various price levels. The supply curve is also depicted, with a merit order indicated by the ordered sequence of generators.

Mathematically, the demand function can be represented as $p = p_1 - p_2$, where $p_1$ and $p_2$ are functions of the quantity $q$. The supply function, on the other hand, is described by a merit order, where each generator is activated in order of their marginal cost.

At the point where demand intersects with supply, the market clears at a price $p^*$.
Phase 3: Conventional System Adjusts

\[ p_1^* \quad p_2^* \]

- demand
- supply: merit order
Phase 3: Conventional System Adjusts

\[ p_3'' = p_1' = p_3' \]

Demand

Supply: merit order
Research Question and Methodology

Research question(s):
What will happen in a medium/long-term equilibrium, i.e. in a system with high shares of renewables, after adjustment from conventional suppliers (phase 3) …

• … to the average wholesale electricity price?
• … to price volatility?

Methodology:
Use stylized market models under different assumptions and derive analytical results.

Results:
In an „economic baseline“ (perfect competition, perfect foresight, identical costs between phase 1 and 3, …) we can prove identical average prices in phase 1 and phase 3. Under these assumptions, the long-term merit-order effect is zero.
Thank you very much!
Questions?
Intermittent Renewables and Price Volatility

- Wozabal et al. (2014, p. 1): „The dominating view in the literature is that renewable electricity production increases the price variance on spot markets for electricity.“
- Eurelectric (2010, p. 16): „Short term price volatily will increase as a consequence of higher penetration of intermittent RES.“
- Cailliau et al. (2010, p. 55) „Thus, short-term price volatility will increase.“
- Milstein and Tishler (2011) imply that price volatility increases with intermittent renewables.
- However, the results are ambiguous, other papers come to different conclusions.