Gone with the wind?

An empirical analysis of the renewable energy rent transfer

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Question

What is the effect of subsidized wind power on the electricity prices?

Two opposite cases

1. taxes or other penalties on old technologies
   - prices go up
2. subsidies to new technologies
   - prices go down

Policy incidence

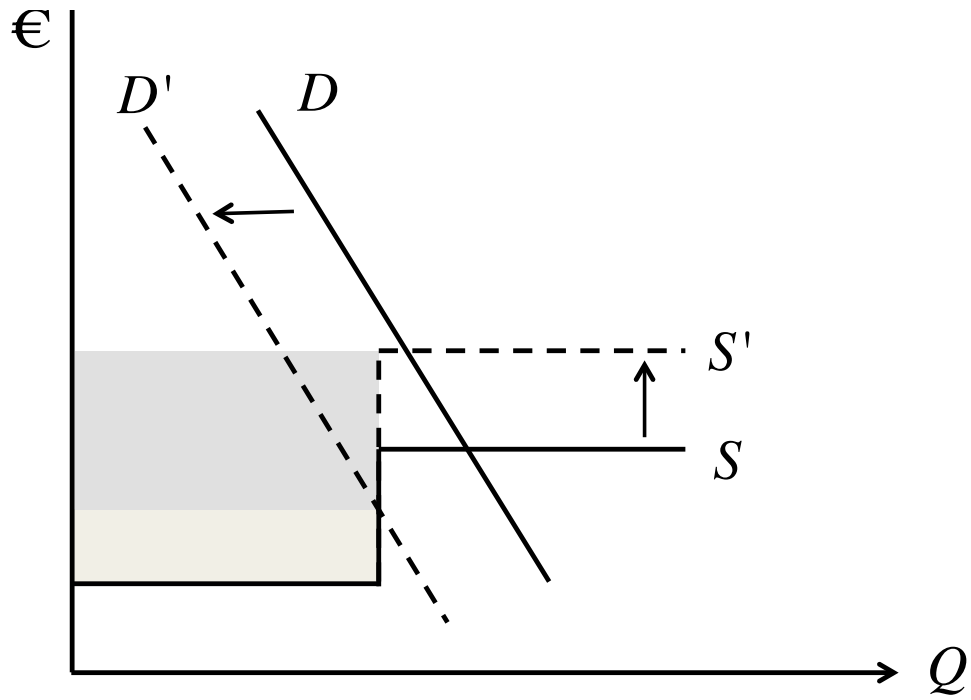

Figure 1: A schematic illustration of the policy cost incidence, with low and high cost of portions in supply. Carbon pricing increases the cost differentials in supply and the rent (in grey) to the existing low cost suppliers. In contrast, subsidies to new entrants shift the overall demand for the incumbent capacity to the left, and extract the rent.

This research

The objective is to quantify the impact

- The Nordic Market (Nord Pool)
- 50 % is hydro
- Hydro facilitates large scale entry of RE: intermittency
- Focus here: pressure on existing assets

Findings

- Current WIND: only 5 % market share; 3-4 billion € annual change in revenue
- WIND 2020: 10 % market share; additional 9-10 billion € annual change in revenue
  - HYDRO: 2/3 rents
  - NUCLEAR: 1/3 rents
  - THERMAL: fully stranded
- Each MWh WIND extracts 70-80 € of incumbent revenue

The Market: Nord Pool

Figure: ca. 400TWh annual consumption. 200 TWh Hydro. The rest: Nuclear, CHP, Thermal, Wind. The NordPool: day-ahead spot market for wholesale electricity.

Invariant Prices

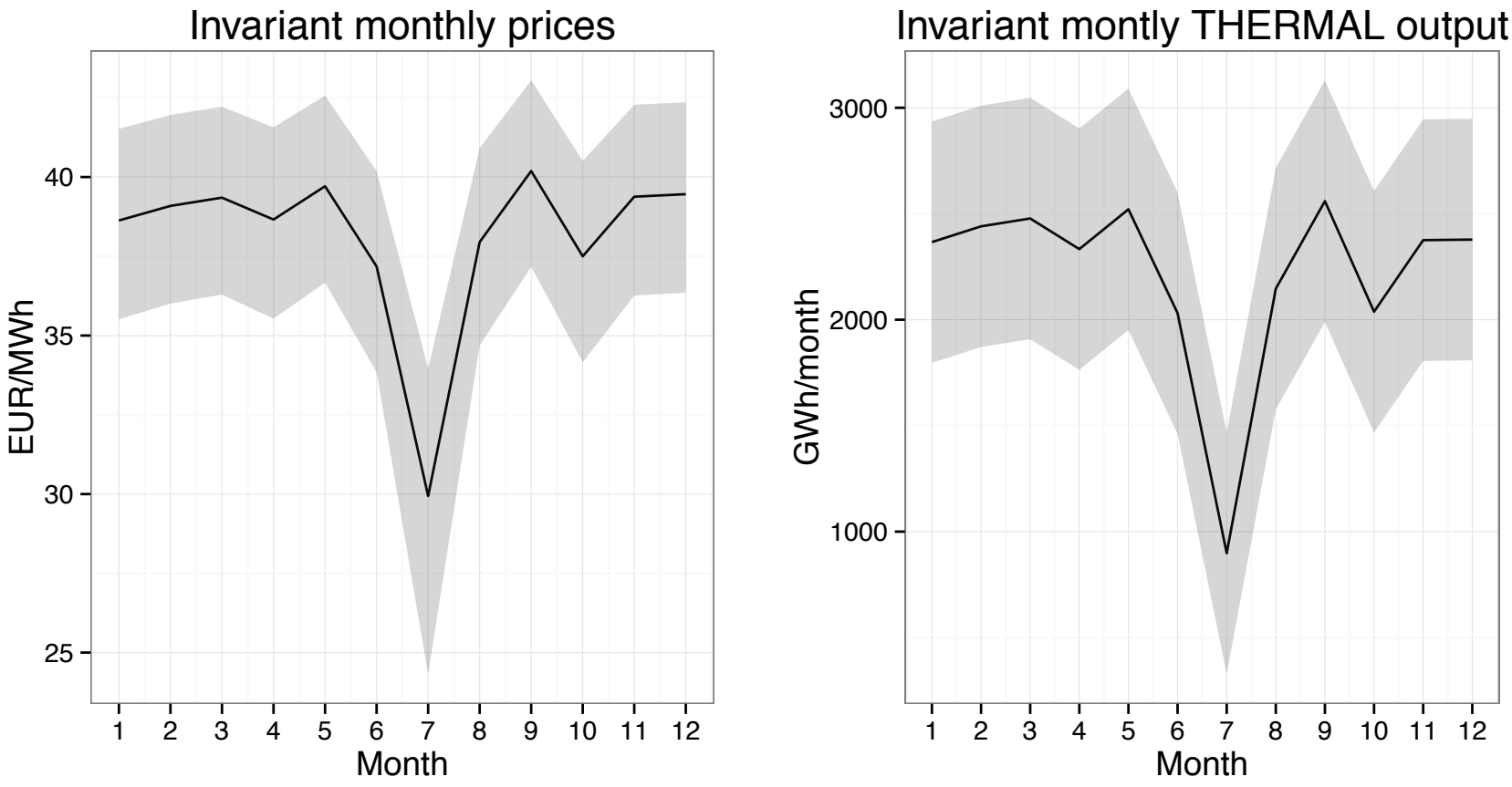

Figure: mean and the 95 % confidence intervals

The impact on revenues

The analysis builds on:

1. the existing fleet of capacity units remains stable
   - we measure the pressure on the existing assets
2. thermal must response, on average, one to one to permanent increases in WIND
3. WIND is scaled up following the estimated pattern (which seems stable)

The WIND pattern

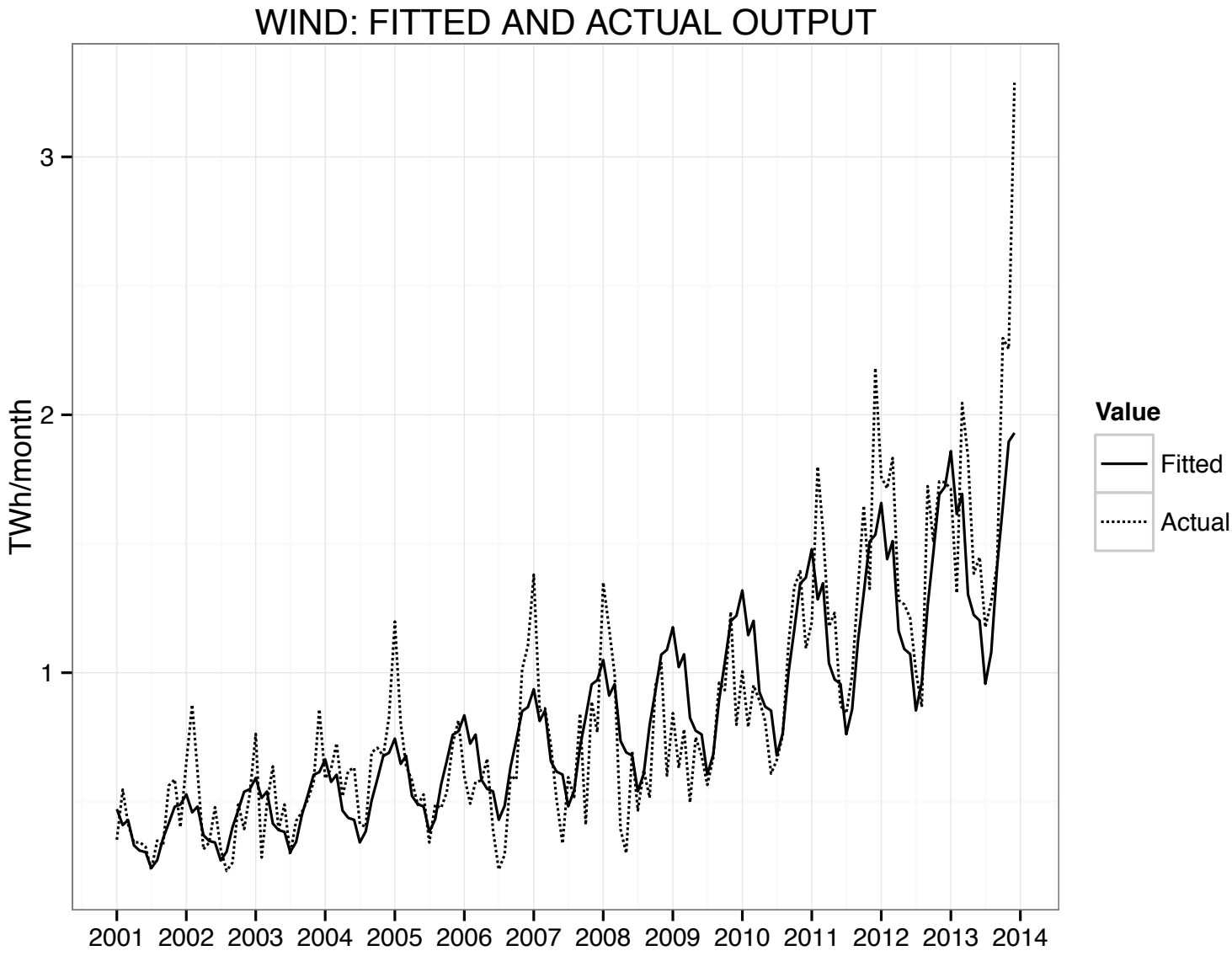

Figure: Monthly output

The revenues

TWh WIND	low estimate	mean	high estimate
0	16, 906	18, 180	19, 330
10	15, 223	16, 497	17, 647
20	**13,517**	**14,791**	**15,941**
30	11, 562	12, 836	13, 986
40	8, 682	9, 956	11, 106
50	4, 530	5, 804	6, 954

Table: Total annual invariant electricity market expenditures in the Nordic countries in millions of 2010 euros for Terawatt-hours WIND generated. Low and high estimates from the 95 per cent confidence interval (invariant distribution).

The revenues by region

TWh WIND	0	10	20	30	40	50
DEN	1,654	1,501	1,346	1,168	906	528
FIN	3,956	3,590	3,218	2,793	2,166	1,263
NOR	5,787	5,251	4,708	4,086	3,169	1,847
SWE	6,783	6,155	5,518	4,789	3,714	2,165
Total	18,180	16,497	14,790	12,836	9,955	5,803

Table: Annual invariant electricity market expenditures by country in millions of 2010 euros for Terawatt-hours WIND generated. Mean values reported.

The losses by technology

	0	10	20	30	40	50
HYDRO	10,081	9,151	8,207	7,125	5,527	3,246
NUCLEAR	4,005	3,637	3,262	2,833	2,197	1,299
CHP	2,334	2,110	1,885	1,628	1,248	678
THERMAL	2,200	1,569	1,025	561	191	0
WIND	0	429	768	999	1,031	742
Total	18,620	16,896	15,147	13,146	10,194	5,944

Table: Annual invariant electricity market revenues losses by technology in millions of 2010 euros for Terawatt-hours WIND generated. Mean values reported.

Concluding remarks

- This is not a prediction! We measure only the pressure on the existing assets.
  - changes in the market environment
  - changes in capacity
- But the change is persistent