

Competition in Germany's Minute Reserve Power Market: An Econometric Analysis

Justus Haucap
Ulrich Heimeshoff
Dragan Jovanovic

DICE, Heinrich-Heine-Universität Düsseldorf

Overview

1. The German Minute Reserve Power Market
2. Data Set and Some Descriptive Analysis
3. Interrelationship between Regional Reserve Markets?
4. Determinants of Minute Reserve Prices
5. Conclusion

Motivation

- In response to high prices and low liquidity a redesign of Germany's market for Minute Reserve Power (MRP) took place on December 1, 2006
- A common web-based platform was established which synchronized the procurement of MRP
- The political goal was to increase market efficiency by facilitating market entry and eliminate opportunities of strategic as well as collusive behavior
- After two and half years later the time has come to evaluate the performance of the new market design
- The key question is: Did the reform succeed?
- Based on a unique data set panel data models are applied to account for unobservable heterogeneity between the for control areas
- Furthermore, instrument variable techniques are used to estimate causal effects

The German MRP market

- To ensure system stability in the electricity market the maintenance of the balance between demand and supply at each point in time is crucial
- This task is accomplished by a balancing power system where the four transmission operators (TSOs) in Germany play a crucial role
- For this purpose TSOs are obliged to procure reserve power
- 3 different qualities: primary, secondary and tertiary control; focus on tertiary control, i.e. MRP both incremental and decremental
- From 2001/2002 each TSO procured MRP separately in its control area via an auction mechanism
- Since December 1, 2006 the procurement is synchronized in terms of
 1. Place: common web-based platform
 2. Time: simultaneous auction right before the spot market
- Furthermore, prequalification conditions were modified and standardized
- **Result:** day-ahead, multi-unit, one-sided, multi-part and pay as bid auction

Related Literature

- The literature on Germany's MRP market is rather scarce
- Literature which deals with the auction mechanism and other characteristics of the MRP market from an theoretical perspective: see e.g. Müller & Rammerstorfer (2008), Riedel & Weigt (2007)....
- Studies which apply empirical analysis:
 - Growitsch & Weber (2008)
 - Growitsch et al. (2008)
 - Wieschhaus & Weigt (2008); rather for simulation purposes

Data Set and Descriptive Statistics

- Most important descriptive statistics of both time series for each control area
- Period 1: From January 1, 2006 to November 30, 2006
- Period 2: From December 1, 2006 to May 31, 2009
- Incremental MRP

	Period 1					Period 2				
	Obs	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max
ENBW	334	86.97	92.76	19	520.7	913	31.63	60.94	.78	750.1
EON	334	87.44	91.90	18.47	508.36	913	24.94	36.60	2.02	251.92
RWE	334	86.91	96.84	17.72	551.11	913	28.40	44.49	2.07	361.42
Vat	334	92.94	99.59	18.82	519.97	913	26.42	40.05	2.05	304.6

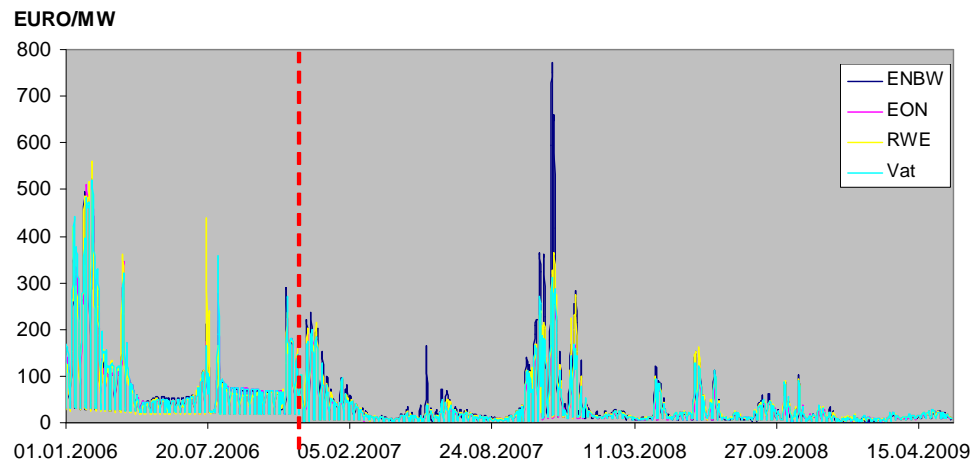
Data Set and Descriptive Statistics

- Most important descriptive statistics of both time series for each control area
- Period 1: From January 1, 2006 to November 30, 2006
- Period 2: From December 1, 2006 to May 31, 2009
- Decremental MRP

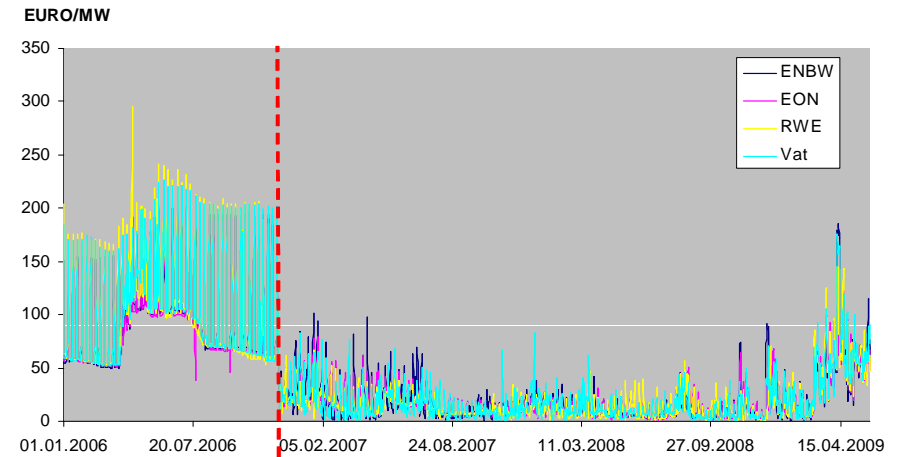
	Period 1					Period 2				
	Obs	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max
ENBW	334	94.37	41.98	49.42	206.03	913	19.38	22.25	.1	185.05
EON	334	92.61	41.39	38.79	204.23	913	18.01	18.15	.38	128.75
RWE	334	100.07	50.45	52.4	292.33	913	17.92	19.18	.41	145.08
Vat	334	99.90	47.72	52.05	226.81	913	18.78	21.24	.35	173.98

Data Set and Descriptive Statistics

Incremental MRP



Decremental MRP



Interrelationship between Regional Reserve Markets I

- Estimate VAR-models to test the interrelationship between regional reserve markets via Granger causality.
- Important: Is there a structural break in the data?
- Problem: Reasonable assumption that there is a structural break as well as non-stationarity.
- Solution: applying test developed by Clemente, Montanes, and Reyes: joint test of unit root and structural break.

Interrelationship between Regional Reserve Markets II

- Result: there is a structural break at December 1, 2006 after new market design was introduced.
- To take account of this problem, we estimate the VAR's separately for the time periods before and after the break.

Interrelationship between Regional Reserve Markets III

Table 5: Granger Causality Tests for Positive Prices before Structural Break:

Lags	H_0	Granger-Causality
4	enbw \rightarrow rwe	0.248 (0.619)
4	enbw \rightarrow eon	0.273 (0.602)
4	enbw \rightarrow vat	0.796 (0.372)
4	rwe \rightarrow enbw	1.106 (0.293)
4	rwe \rightarrow eon	0.785 (0.376)
4	rwe \rightarrow vat	1.118 (0.290)
4	eon \rightarrow enbw	0.662 (0.416)
4	eon \rightarrow rwe	0.197 (0.657)
4	eon \rightarrow vat	1.978 (0.160)
4	vat \rightarrow enbw	0.356 (0.551)
4	vat \rightarrow rwe	0.030 (0.863)
4	vat \rightarrow eon	0.547 (0.459)

Interrelationship between Regional Reserve Markets IV

Table 6: Granger Causality Tests for Positive Prices after Structural Break:

Lags	H_0	Granger-Causality
4	enbw \rightarrow rwe	45.268 (0.000)*
4	enbw \rightarrow eon	56.443 (0.000)*
4	enbw \rightarrow vat	32.428 (0.000)*
4	rwe \rightarrow enbw	48.289 (0.000)*
4	rwe \rightarrow eon	49.213 (0.000)*
4	rwe \rightarrow vat	39.942 (0.000)*
4	eon \rightarrow enbw	39.325 (0.000)*
4	eon \rightarrow rwe	15.960 (0.000)*
4	eon \rightarrow vat	42.690 (0.000)*
4	vat \rightarrow enbw	33.547 (0.000)*
4	vat \rightarrow rwe	22.228 (0.000)*
4	vat \rightarrow eon	52.675 (0.000)*

Interrelationship between Regional Reserve Markets V

Table 7: Granger Causality Tests for Negative Prices before Structural Break:

Lags	H_0	Granger-Causality
4	enbw \rightarrow rwe	0.920 (0.337)
4	enbw \rightarrow eon	0.319 (0.572)
4	enbw \rightarrow vat	0.882 (0.348)
4	rwe \rightarrow enbw	0.017 (0.898)
4	rwe \rightarrow eon	0.429 (0.513)
4	rwe \rightarrow vat	1.069 (0.301)
4	eon \rightarrow enbw	0.015 (0.903)
4	eon \rightarrow rwe	1.018 (0.313)
4	eon \rightarrow vat	1.060 (0.303)
4	vat \rightarrow enbw	0.054 (0.816)
4	vat \rightarrow rwe	0.541 (0.462)
4	vat \rightarrow eon	0.372 (0.542)

Interrelationship between Regional Reserve Markets VI

Table 8: Granger Causality Tests for Negative Prices after Structural Break:

Lags	H_0	Granger-Causality
4	enbw \rightarrow rwe	0.248 (0.618)
4	enbw \rightarrow eon	4.117 (0.042)*
4	enbw \rightarrow vat	1.318 (0.251)
4	rwe \rightarrow enbw	0.514 (0.473)
4	rwe \rightarrow eon	0.478 (0.490)
4	rwe \rightarrow vat	1.837 (0.175)
4	eon \rightarrow enbw	0.811 (0.368)
4	eon \rightarrow rwe	0.573 (0.449)
4	eon \rightarrow vat	4.497 (0.034)*
4	vat \rightarrow enbw	2.423 (0.120)
4	vat \rightarrow rwe	1.300 (0.254)
4	vat \rightarrow eon	1.447 (0.229)

Interrelationship between Regional Reserve Markets VII

- Stronger interrelation between regional markets after regulatory reform.
- This result especially holds for positive reserve prices.
- In the case of negative prices effects are rather weak.

Determinants of Minute Reserve Prices I

- Estimating panel models including fixed effects for the regional markets.
- Relationship of EEX spot prices on minute reserve prices.
- Instrumenting EEX spot prices with temperature data from different cities in Germany.

Determinants of Minute Reserve Prices II

Table 9: Determinants of positive Electricity Reserve Prices

positive price	before structural break		after structural break	
	coeff	std. err.	coeff.	std. err.
EEX spot price	14.142***	5.712	0.905***	0.374
Oil price	2.952	4.973	-0.043	0.089
Price for natural gas	-1.077	8.477	-0.036	0.445
Price for coal	22.934**	11.444	0.029	0.112
Feed in of wind energy	0.008	0.007	0.0003	0.0002
time	-0.135	0.160	-0.0004	0.002
Obs.	1,248		3,412	
R^2	0.12		0.11	
Weak identification test	8.636 (bias about 10%)		19.260 (bias less 5%)	

*, **, *** statistically significant on the 10, 5, and 1% level. Standard errors are heteroskedasticity robust.

Determinants of Minute Reserve Prices III

Table 10: Determinants of negative Electricity Reserve Prices

negative price	before structural break		after structural break	
	coeff	std. err.	coeff.	std. err.
EEX spot price	-1.771	1.458	-0.927***	0.263
Oil price	-0.395	0.907	-0.010	0.055
Price for natural gas	0.965	1.640	0.306	0.225
Price for coal	-2.110	1.771	-0.084	0.072
Feed in of wind energy	-0.0003	0.001	0.0002	0.0002
time	0.029	0.027	0.0008	0.002
Obs.	1,248		3,412	
R^2	0.09		0.32	
Weak identification test	2.491 (bias about 20%)		10.427 (bias less 15%)	

*, **, *** statistically significant on the 10, 5, and 1% level. Standard errors are heteroskedasticity robust.

Conclusion

- Regulatory change has effects on minute reserve prices (detected as structural break).
- Interrelationship between regional markets increased after introduction of new procurement design.
- There are also some smaller changes in the determinants of minute reserve prices.
- Data generating process is different between positive and negative prices.

Thank you for your attention.

Dr. Ulrich Heimeshoff
Heinrich-Heine-Universität Düsseldorf
Düsseldorf Institute for Competition Economics
Universitätsstr. 1
40225 Düsseldorf, Germany

Fax: + 49 211 81 15495

email: ulrich.heimeshoff@uni-duesseldorf.de

<http://www.dice.uni-duesseldorf.de>