An analysis of the bid-ask spread in the German power continuous intraday market

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Context

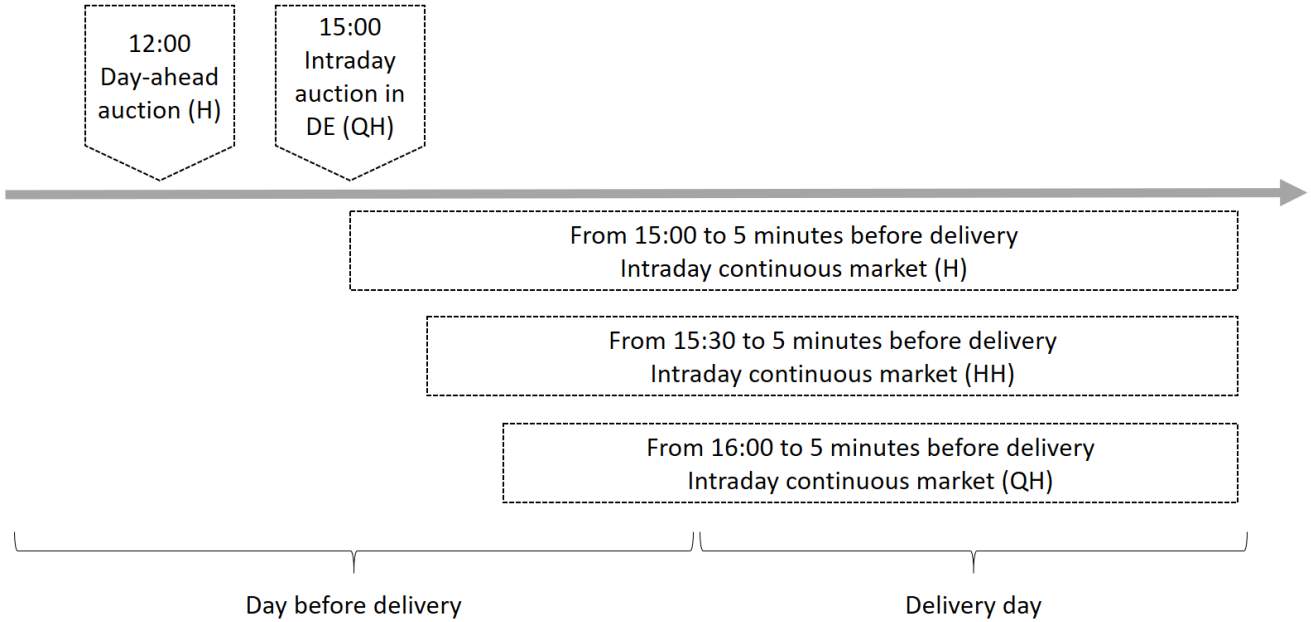


Figure: The German power spot market

- The German market is the most liquid continuous power market in Europe where about 53% of the German consumption was traded on in 2015.
- The same year, almost 20 millions of euros were traded each week on the market.

Context

The orders book

Ask		Bid	
Quantity	Price	Price	Quantity
20	35	32	4
5	36	31	15
12	39	29	7
3	42	28	9
		25	30

- The bid-ask spread is the difference between the lowest price for which a seller is willing to sell a MWh of power and the highest price that a buyer is willing to pay for it.
- Market depths are the total volume available in the orders book on the ask (sell depth) and on the bid (buy depth) side.

Motivation

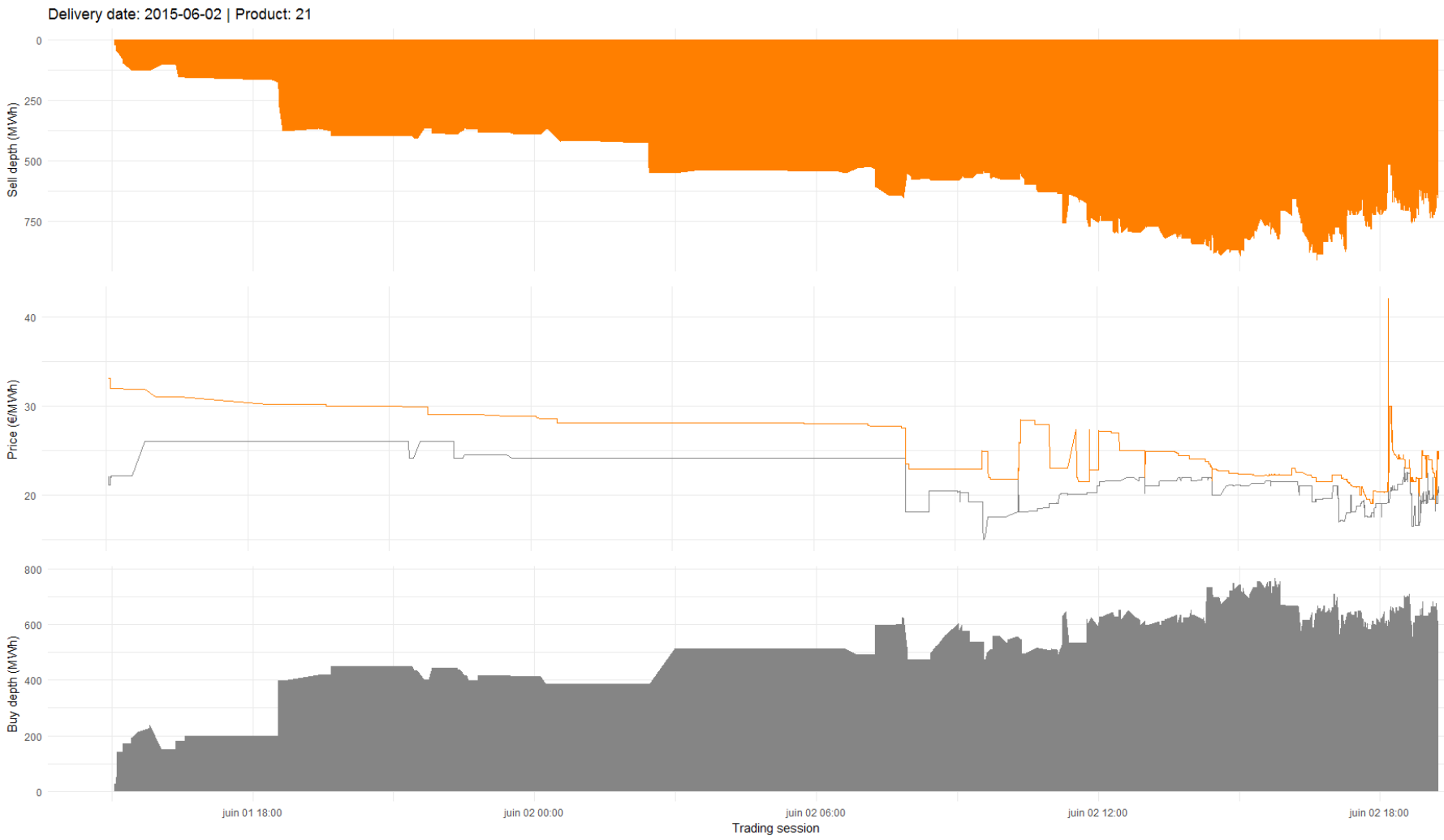
- There exists a large literature on the bid-ask spread but not applied on power market
- The German power market is one of the most volatile market due to the large share of renewable in the energy mix

Research questions

- How are the bid-ask spread and the market depths behaving over an average trading session?
- What are the main drivers of the bid-ask spread on the power spot markets?

Context

Example of a trading session



Market depths over an average trading session

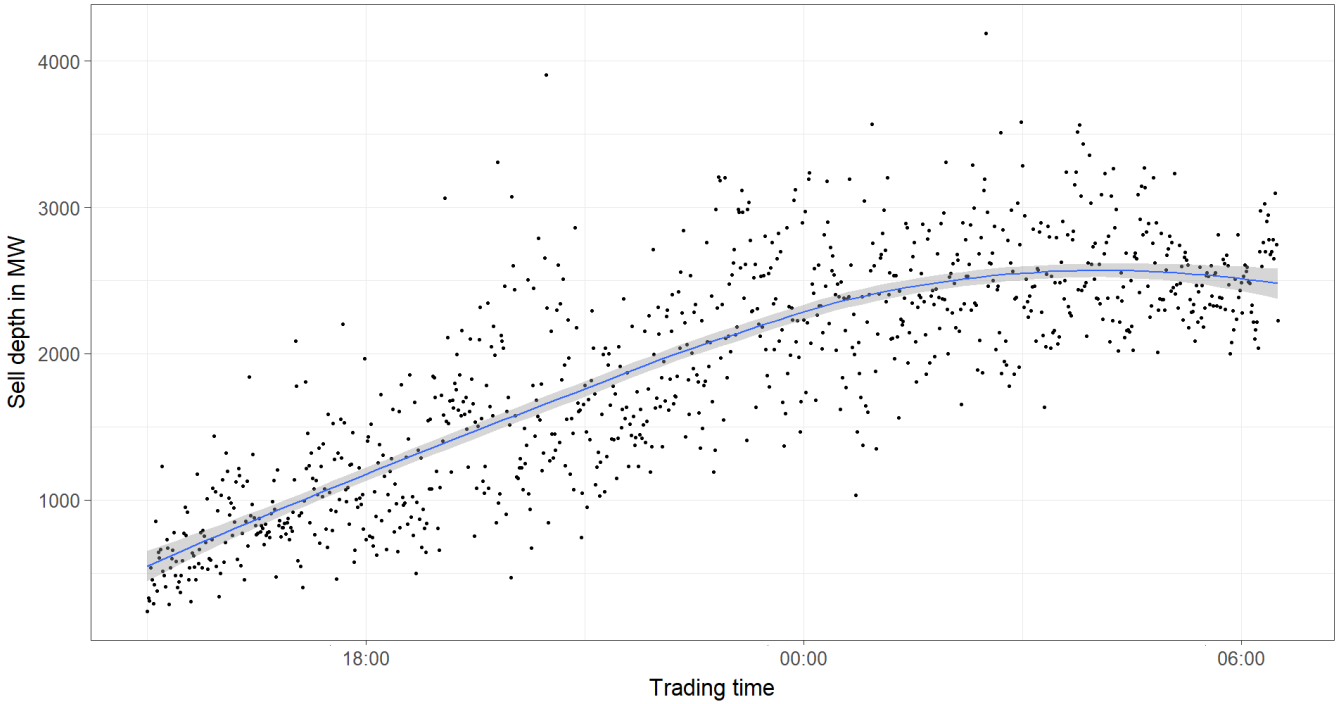


Figure: Sell depth over an average trading session for contract 8

- Both the buy and the sell depths increase along the trading session
- The average local buy (resp. sell) depth over a trading session is 2600 MW (resp. 2200 MW)

Quoted spread over an average trading session

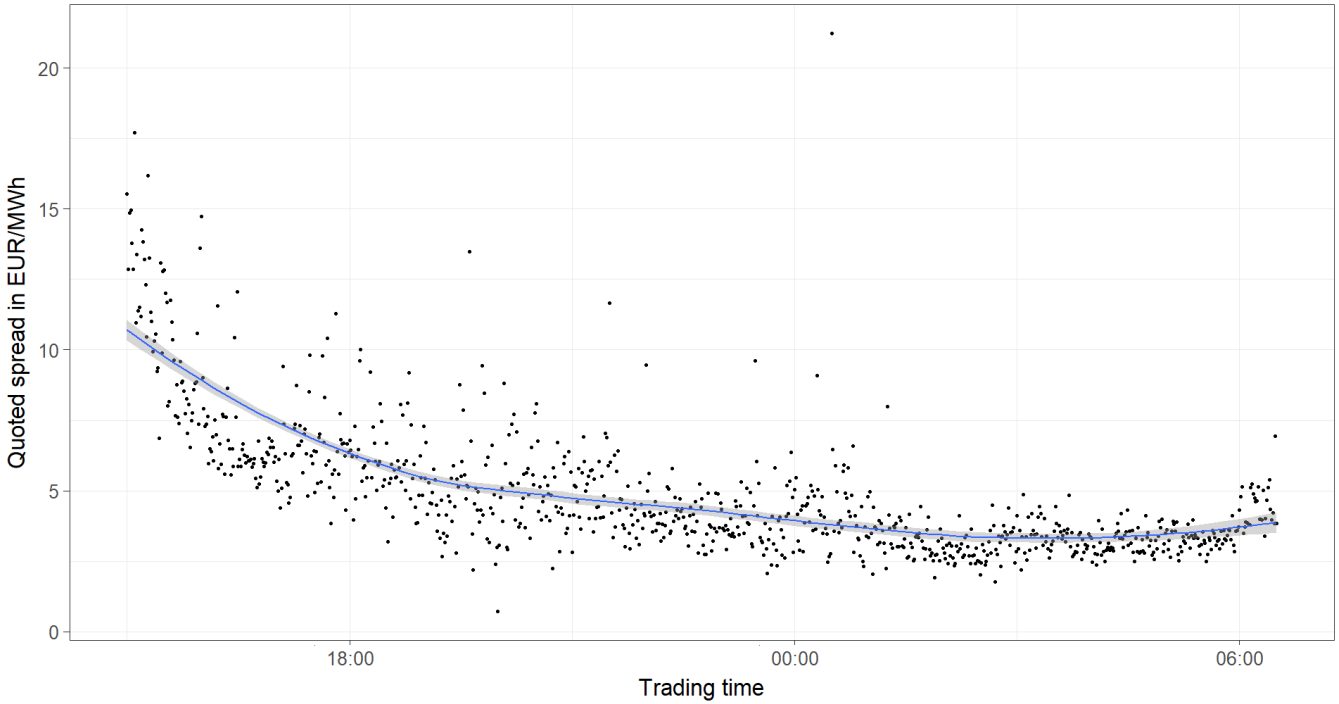


Figure: Quoted spread over an average trading session for contract 8

- The quoted spread has a "L-shape" over the trading session
- The average (local) bid-ask spread of the German power continuous market is 3.5 EUR/MWh

Econometric specification

- The aim of the econometric specification is to find the main drivers of the bid-ask spread of the German continuous power market.
- All data is aggregated at the contract level (delivery date, delivery hour) for a 12 months period from January to December 2015.

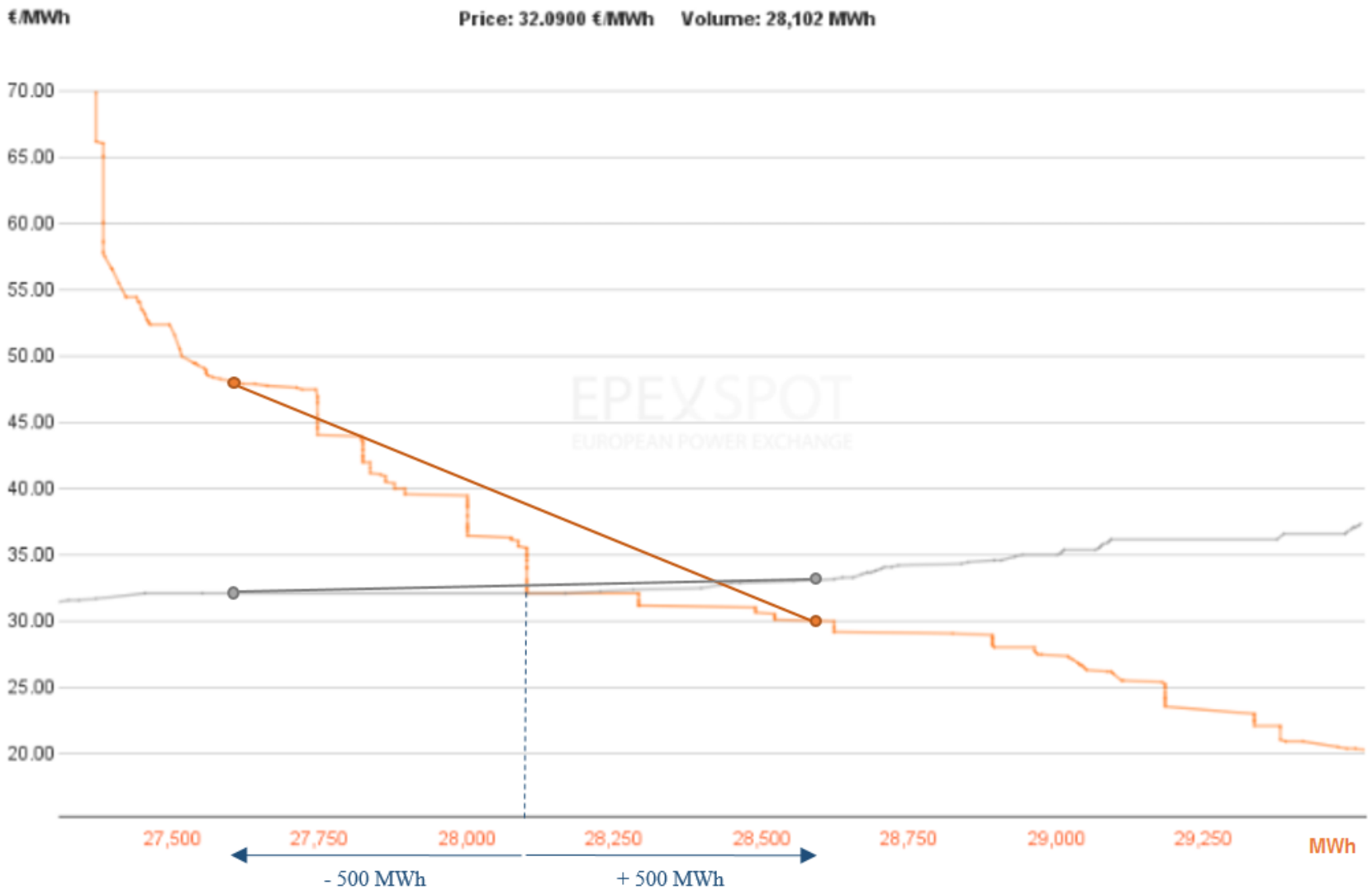
Hypothesis and data

Hypothesis 1: There is a positive relation between the bid-ask spread and the volatility in the market.

- When the volatility is high, there is more risk and uncertainty on the market; in this situation, the buyers are willing to buy at a lower price and the sellers are willing to sell at a higher price in order to hedge the risk linked to the volatility.
- The volatility is measured by:
  - The elasticity of the supply curve of the day-ahead market,
  - The elasticity of the demand curve of the day-ahead market ;
  - The weighted price standard deviation of the transaction.

Hypothesis and data

The elasticity of the demand and the supply curve of the DAM



Hypothesis and data

Hypothesis 2: There is a negative relationship between the bid-ask spread and the need for adjustments.

- When the demand or the supply diverge from their initial forecasts, the positions of the market participants may change, and they need to adjust them.
- The renewable generation forecast error is measured as followed for g as {solar, wind}:

$$\Delta_{it}^{g} = \frac{gG_{it} - gF_{it}}{gF_{it}}$$

$$\Delta_{it}^{g+} = max\{\Delta_{it}^{g}, 0\}$$

$$\Delta_{it}^{g-} = min\{\Delta_{it}^{g}, 0\}$$

- The load forecast error is measure as followed:

$$\Delta_{it}^{L} = \frac{LG_{it} - LF_{it}}{LF_{it}}$$

$$\Delta_{it}^{L+} = max\{\Delta_{it}^{L}, 0\}$$

$$\Delta_{it}^{L-} = min\{\Delta_{it}^{L}, 0\}$$

Hypothesis and data

Hypothesis 3: There is a negative relationship between the bid-ask spread and the activity on the market.

- When the activity on the market increases, the bid-ask spread should be narrowed.
- The forecasted load is used as a proxy for the activity on the market.

Hypothesis and data

Hypothesis 4: There is a negative relationship between the bid-ask spread and the competition in the market.

- When the concentration of the market decreases, the competition increases and there is less asymmetry of information due to the smaller market shares.
- The competition in the market is measured as the Herfindhal index:

$$HHI = \sum_{i=1}^{m} s_i^2$$

where

$$s_i = \frac{v_i}{\sum_{i=1}^{m} v_i}$$

Equation

The daily average bid-ask spread per contract is expressed as a function of the volatility (weighted price standard deviation and elasticities), the need for adjustments (relative wind, solar and load forecast errors), the activity (load) and the competition (HHI) on the market and estimate the equation below:

$$
\begin{aligned}
\triangle BAS_{it} = \alpha_i & \\
& + \beta_1 \triangle \sigma_{it} + \beta_2 \triangle ES_{it} + \beta_3 \triangle ED_{it} \\
& + \beta_4 \triangle W_{it}^{FE+} + \beta_5 \triangle S_{it}^{FE+} + \beta_6 \triangle W_{it}^{FE-} + \beta_7 \triangle S_{it}^{FE-} \\
& + \beta_8 \triangle L_{it}^{FE+} + \beta_9 \triangle L_{it}^{FE-} \\
& + \beta_{10} \triangle L_{it} \\
& + \beta_{11} \triangle HHI_{it}^{D} + \beta_{12} \triangle HHI_{it}^{S} \\
& + \mathbb{1}_{summer} + \mathbb{1}_{winter} + u_{it}
\end{aligned}
$$

Results using the panel FGLS estimator

	Dependent variable: Bid-ask spread		
	All		
	Estimate	Std. Error	Pr(>—z—)
Weighted price std. dev. (EUR/MWh)	0,03180	0,00343	***
Demand elasticity	0,66791	0,16232	***
Supply elasticity	9,74710	0,82758	***
Positive load f.e. (%)	-0,01387	0,00359	***
Negative load f.e. (%)	0,02317	0,00339	***
Positive solar f.e. (%)	0,00000	0,00000	**
Negative solar f.e. (%)	-0,00216	0,00045	***
Positive wind f.e. (%)	-0,00515	0,00029	***
Negative wind f.e. (%)	-0,00219	0,00053	***
Load forecast (MWh)	-0,00001	0,00000	***
HHI - demand	0,00009	0,00001	***
HHI - supply	0,00034	0,00001	***
Winter dummy	-0,01540	0,22450	
Summer dummy	0,07826	0,66582	
Note:			*p<0.1; **p<0.05; ***p<0.01

Results

- The risk and volatility of the market increase the bid-ask spread.
  - When the volatility increases by 1 EUR/MWh, the bid-ask spread tends to increase by 3 cents.
  - When the slope of the supply curve increases by 0.1, the bid-ask spread increases by 97 cents per MWh while an increase of the slope of the demand curve by 0.1 increases the spread by only 7 cents per MWh.
- A fundamental (wind, solar or load) forecast error leads to a decrease of the bid-ask spread by bringing more liquidity to the market except for the case of a negative load forecast error which has a positive effect on the bid-ask spread probably due to the strategy of the suppliers.
  - When the wind positive (resp. negative) forecast error increases by 1%, the bid-ask spread tends to decreases by 0.5 cent/MWh (resp. 0.2 cent/MWh).
  - A 1% negative solar forecast error have an impact of 0.2 cent per MWh on the bid-ask spread while a positive solar forecast error has a negative but negligible impact on the bid-ask spread.
  - When the load positive forecast error increases by 1%, the bid-ask spread tends to decreases by 2 cent/MWh.

Results

- When the activity on the market increases, the spread tends to decrease, in line with the positive relationship between the concentration on the market and the bid-ask spread.
  - When the load increases by 1 GWh, the bid-ask spread decreases by 1 cent per MWh.
  - When the concentration on the sell side increases by 100, the bid-ask spread increases by about 3 cents/MWh while it only increases by 1 cent/MWh when the concentration on the buy side increases by 100.

Key take aways

Based on the study of the orders books of the German intraday power market in their finest details, we first study the evolution of the bid-ask spread and the market depths over an average trading session. We then characterize the determinants of the daily bid-ask spread.

- In line with the market microstructure literature, the bid-ask spread has a "L-shape" over the trading session
- The bid-ask spread is strongly (and negatively) correlated with the market depths
- The mean bid-ask spread is 3.5 EUR/MWh over the period studied
- We find a positive relationship between the volatility and the bid-ask spread and a negative relationship between the bid-ask spread and the adjustment needs, the activity and the competition on the market.

Thank you!