Methods for evaluation of the Nordic forward market for electricity

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Overview

• Background – FCA GL
• Methods – theory and practical applications
• Correlation analyses
• Efficiency analyses
• TSOs shall issue LTTRs unless competent regulatory authorities have adopted coordinated decisions not to issue LTTRs on a bidding zone border (Article 30 (1))

• Where LTTRs do not exist on a bidding zone border at the entry into force of this Regulation, the competent regulatory authorities shall adopt coordinated decisions on the introduction of LTTRs no later than 6 months after the entry into force of FCA GL (Article 30 (2))

• The decisions pursuant to paragraphs 1 and 2 shall be based on an assessment whether the forward market provides sufficient hedging opportunities in the concerned bidding zones (Article 30 (3))

• At least every 4 years, the competent regulatory authorities of a bidding zone border shall perform an assessment in cooperation with the Agency (Article 30 (8))
The forward market assessment shall include:

- **Consultation** with market participants about their needs for cross-zonal risk hedging opportunities (Article 30 (3))

- **Evaluation** that investigates the functioning of wholesale electricity markets and is based on transparent criteria which include at least: (Article 30 (4))
  - Analysis of whether the products or combination of products offered on forward markets represent an appropriate hedge
    - **Sufficient correlation** (Article 30 (4 a))
    - **Efficient** (Article 30 (4 b))
### Key indicators per market

<table>
<thead>
<tr>
<th></th>
<th>Germany</th>
<th>Netherlands</th>
<th>Great Britain</th>
<th>Nordic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production 2015 (TWh)</strong></td>
<td>580</td>
<td>104</td>
<td>325</td>
<td>397</td>
</tr>
<tr>
<td><strong>Day-ahead 2015 (TWh)</strong></td>
<td>264</td>
<td>28</td>
<td>144</td>
<td>352</td>
</tr>
<tr>
<td><strong>Share of production (%)</strong></td>
<td>45 %</td>
<td>30 %</td>
<td>45 %</td>
<td>90 %</td>
</tr>
<tr>
<td><strong>Financial market (TWh)</strong></td>
<td>5300</td>
<td>300</td>
<td>950</td>
<td>1350</td>
</tr>
<tr>
<td><strong>Traded at PX (%)</strong></td>
<td>20 %</td>
<td>33 %</td>
<td>1 %</td>
<td>60 %</td>
</tr>
<tr>
<td><strong>Cleared (%)</strong></td>
<td>30 %</td>
<td>45 %</td>
<td>1 %</td>
<td>100 %</td>
</tr>
<tr>
<td><strong>Churn rate</strong></td>
<td>10</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td><strong>Open interest (TWh)</strong></td>
<td>1000</td>
<td>25</td>
<td>6</td>
<td>350</td>
</tr>
</tbody>
</table>
Methods – theory and practical applications
IAS 39 as a method? (1/2)

- IFRS – EU decided in 2002 that this ’universal’ accounting standard applies from 2005 for listed companies
- Derivatives should be booked at mark-to-market value, with immediate effect on P&L
- IAS39 – hedge accounting
  - Exemption from the general rule for qualified hedging portfolios
    - Must demonstrate close correlation between value of hedging portfolio and value of hedged item (to ensure the companies don’t release misleading information to investors)
    - Focus on short-term changes in values
    - Must follow a ‘mechanical’ hedging strategy; hard to adapt to market views
    - If changes are well correlated and stability in hedging, hedge accounting can be ’granted’ by the auditors
    - The purpose: Accounts shall be comparable and reliable
IAS 39 as a method? (2/2)

• IAS39 – hedge accounting (cont.)
  • Hedge accounting preferred by most companies since P&L account is not affected by mark-to-market changes in the hedging portfolio
  • Hedge accounting not so important for companies with electricity as their main business. Own objectives regarding appropriate hedging strategy can govern the hedging
Theoretical perspectives to hedging

• Agricultural commodities dominated futures markets for a long time
• Traditional hedging theory emphasizes risk avoidance
• Newer theories emphasizes a portfolio approach
• Construct a portfolio of assets (futures positions and cash positions) that maximize the expected value of the hedger’s utility function
• A mean-variance function can be used for this maximisation
• Hedging a fraction of the portfolio yield the highest pay-off – complete elimination of risks is not preferable
• Proxy hedging can be advantageous
• Small number of futures markets in relation to the potential number (commodities, qualities, locations and time periods)
• Only a limited number of futures markets are economically justifiable
Methods and procedures actually applied

• Nordic electricity
• Jet fuel
• Aluminium

Basis for this section is our own experiences and interviews with market participants/experts
Acceptable risk levels at acceptable costs

• The analyses called for in the FCA GL mirrors the efforts made by market participants when developing hedging policies

• However, FCA GL focuses on price risks while market participants have a broader risk perspective

• Market participants try to reduce risks to an acceptable level – not to eliminate risks

• Costly to eliminate all risks, can eliminate all profit opportunities

• Larger concern for downward risks than upward risks (opportunities)

• Different market participants have different requirements for hedging (producers, retailers, industrial consumers)

• Mechanical hedging strategy – dynamic hedging strategy (hedging not dependent or dependent on price expectations)

• Pragmatic and informal – no clear thresholds or limits based on formal analysis
Nordic electricity  (1/2)

- Recognition that all risks are local
  - Multiple local risk positions if business in several bidding zones
  - Market coupling gives efficient physical cross-border trade
  - Cross-border hedging is done with contracts in the financial market
  - Cross border contracts might provide a substitute when/if local markets are insufficient or inefficient

- Basic hedging in SYS contracts

- Additional hedging in EPADs used when a significant downside risk is identified
  - Less volatility in EUR/MWh means EPAD hedges are not as urgent as SYS hedges
None of interviewed participants want to replace basic hedging in SYS with hedging in area price contracts

Liquidity not necessarily an issue

Limited use of hedge accounting among producers

Examples of auditors rejecting hedge accounting due to volume risk/optimal reservoir management; companies conclude they do not qualify anyway

Very different approaches to correlation analysis
Jet fuel hedging strategies in the aviation industry

![Graph showing IPE Brent versus Jet CIF NWE](image-url)
Jet Crack Spread

Yearly Standard Deviation for Jet - Brent Crack spread

- Yearly Standard Deviation
- Average over Period
Possible hedging portfolio

The resulting average price is based on 18 layers.

Each month, Hedging of 7.5% of the crack. The resulting average price consists of 6 layers.
Jet fuel hedging strategies in the aviation industry

- Brent – SYS, exchange traded
- Gasoil – Liquid area price, exchange traded
- Jet fuel – Less liquid area price, only OTC
- Jet crack spread – EPAD (however very illiquid), only OTC
- Brent preferred as proxy by some airlines, but often not accepted for hedge accounting
- Possible portfolio with Brent long term, short term partially substituted by Jet fuel (or complemented by Jet crack spread)
- The low-cost segment of the industry is generally hedged to a higher degree
- Locational risks (also purchases in other regions related to other indices) are generally ignored
- Hedging execution – policy driven rather than based on analysis
Hedging strategies in the aluminium industry

• Norsk Hydro wants to be recognised as an industrial, not a financial company
• Investors investing in Hydro expect an exposure to risks in the aluminium market
• Counterproductive to hedge the sale of aluminium
• Long horizon in hedging input costs such as electricity costs
• Hedges electricity costs long term by hydropower plants and power contracts (up to 20 years)
• Exchange contracts are too short term to be appropriate for this basic hedging
• Exchange contracts are used for mid term and short term adjustments of the long term portfolio
Correlation analyses
Perfect hedges exists in textbooks and gardens
Correlation analyses: what are the choices?

- Comparing prices or price changes
- Price changes is frequently the observation variable in hedge accounting tests
- Hourly, weekly, monthly, quarterly or yearly averages
- Observation period: weeks, months or years
- Threshold values: hedge accounting standards, actual PTR performance, no specific
Correlation between prices, not changes

• IAS39: exemption from general rule
  • Which is: mark-to-market valuation of all contracts
  • Exemption: rule may be disregarded if correlation is sufficient:
    - mark-to-market value of hedge portfolio, vs.
    - mark-to-market value of hedged item
  • What matters to market participants hedging power is correlation between
    • Average delivery price during hedge horizon, and
    • Average of the underlying for the hedge contracts in the same period
Which prices?

• If EPAD is efficient (i.e. liquid, ‘correct’ price, etc.) – no need to analyse

• Correlation between delivery price and SYS+EPAD = 1

• If EPAD is inefficient, there is an infinite number of potentially relevant hedge portfolios

• SYS

• SYS + x % adjacent EPAD1 + (1-x) % adjacent EPAD2

• Z % SYS + v % German forward

• Ask market participants what they consider as relevant alternatives

• Systematic search through a limited set of alternative combinations

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Time resolution and time horizon

• Hourly prices clearly not relevant

• Hedging horizons vary from month(s) to years
  • Years or months
    - Enables comparison with LTTRs

• Long observation period
  • Irrelevant history; it’s the future that matters
  • Black Swans
Key challenge with correlation analysis

- No threshold values exists
- Hedging decisions are the result of companies maximising their utility functions, not from maximising their profit
- Imperfect correlation may partly be compensated for by changing the hedge ratio
- Regulators to consider all sources; market participants, effectiveness and efficiency analyses

Possible inspiration
- Compare with correlation of PTRs, as PTRs is the fallback in the FCA GL
- Examples follows; assume local hedges were not available in either
  - Germany
  - The Netherlands
  - Great Britain
Correlation between prices and various hedges

Day-ahead prices, monthly average [EUR/MWh]

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Hedging German production by Dutch contracts

48 months moving average correlation

DE hedged by NL+PTR (NL→DE)  DE hedged by NL without PTR

Methods for evaluation of the Nordic forward market for electricity
Hedging German production by Dutch contracts

72 months moving average correlation

DE hedged by NL+PTR (NL→DE)
DE hedged by NL without PTR
Hedging German production by Dutch contracts

24 months moving average correlation

DE hedged by NL+PTR (NL→DE)  DE hedged by NL without PTR

Methods for evaluation of the Nordic forward market for electricity
Hedging Dutch production by German contracts

48 months moving average correlation

- 0,00
- 0,10
- 0,20
- 0,30
- 0,40
- 0,50
- 0,60
- 0,70
- 0,80
- 0,90
- 1,00

NL hedged by DE+PTR (DE->NL)
NL hedged by DE without PTR

Methods for evaluation of the Nordic forward market for electricity
Hedging Dutch production by German contracts

72 months moving average correlation

- NL hedged by DE+PTR (DE->NL)
- NL hedged by DE without PTR

Methods for evaluation of the Nordic forward market for electricity
Hedging Dutch production by German contracts

24 months moving average correlation

Methods for evaluation of the Nordic forward market for electricity
Hedging Dutch production by GB contracts

48 months moving average correlation

- NL hedged by GB+PTR (GB→NL)
- NL hedged by GB without PTR

Methods for evaluation of the Nordic forward market for electricity
Hedging GB production by Dutch contracts

48 months moving average correlation

GB hedged by NL+PTR (NL→GB)  GB hedged by NL without PTR

Methods for evaluation of the Nordic forward market for electricity
Understanding the correlation

Hedging GB by NL and PTR NL→GB, resulting energy price [EUR/MWh]

Methods for evaluation of the Nordic forward market for electricity
Correlation: our proposal

• Straight forward correlation analyses of correlation between delivery prices and potential hedge portfolios
• Do not look at price changes
• Compare yearly or monthly average prices
  • Hours or weekly averages are not relevant, as hedging horizons are longer
• Observation period: some years
  • Several rather than few
• No basis for defining knockout criteria/thresholds
  • Comparison with PTRs not unreasonable
Efficiency analyses
## Efficiency measures – three groups of measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Interpretation</th>
<th>Assessment</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trading horizon</td>
<td>Measures product design</td>
<td>Descriptive analysis</td>
<td>Evaluation of measures against individual contract timeframes</td>
<td>Not a direct measure of efficiency or liquidity</td>
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<td>Traded volume</td>
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<td>Descriptive and time series analysis</td>
<td>Data availability (daily returns and volume)</td>
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<tr>
<td>Risk premium</td>
<td>Measures hedging pressures</td>
<td>Time series analysis</td>
<td>Computationally straightforward</td>
<td>Needs further disentanglement</td>
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<tr>
<td>Amihud</td>
<td>Measures liquidity</td>
<td>Time series analysis</td>
<td>Data availability (daily returns and volumes); allows studying time series effects of liquidity</td>
<td>Not well defined for power derivatives markets</td>
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<tr>
<td>Long- and short-term market efficiency</td>
<td>Measures overall market efficiency</td>
<td>Time series analysis</td>
<td>Data availability; allows testing overall efficiency</td>
<td>Analytical complexity; more reliable estimates for shorter maturity</td>
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<tr>
<td>Bid-ask spread</td>
<td>Liquidity measure with pronounced effects on transaction costs</td>
<td>Descriptive and time series analysis</td>
<td>Measures the costs of hedging for market participants</td>
<td>Data availability of OTC bid-ask spreads (except for regulators)</td>
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<td>Roll’s measure</td>
<td>Measures transaction costs</td>
<td>Time series analysis</td>
<td>Infers a measure of effective bid-ask spreads from market prices</td>
<td>Relative ease of access to bid-ask spreads from market data</td>
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Open interest, SYS & EPAD contracts [TWh]
Nasdaq cleared SYS volume [TWh per month]

- Nasdaq trade
- OTC trade
Risk premium: Keep it simple

• Calculate the ex-post risk premium
• Compare the last recorded trading price with the actual delivery price
  - If last trade was at 33 EUR/MWh, delivery at 33.7, the risk premium is -0.7 EUR/MWh
  - Repeat for nearest year and month
• Easy to test if risk-premium is significantly different from e.g. zero (or some other value)
• There are no threshold values
  • If the risk is high, the risk premium may or may not be high
    - Depends on the balance between fundamentally short and long market participants
    - Depends on the volatility of the underlying
    - Depends on the realised vs. the forecasted price
  • At the time of hedging, it is the ex-ante risk premium that matters; i.e. the available market price vs. the market participant’s price expectations
Transaction costs: ask the brokers!

- 80% of EPAD trade is OTC
- Nasdaq bid-ask spread is presumably a measure of the maximum transaction cost in the market
- ‘Slow’ execution of hedging strategies; not necessarily immediate trades
  - Supported by the use of risk committees to decide on whether to hedge, when and how much
- Instead of best bid-ask per day, the best bid-ask per week seems to capture the reality better
- There is no threshold value
  - The bid-ask spread cannot be zero unless there are no relevant costs
Efficiency: our proposal

• Liquidity measures
  • Map traded volume and open interest across the trading horizon

• Price measure
  • Calculate ex-post risk premiums – per contract (Y2016 is not Y2015)
  • Compare with volatility of day-ahead price or price spread (area-sys)

• Transaction cost measure
  • Calculate best average bid-ask spread per contract per week
  • Study a 52 week moving average of the weekly averages
## Efficiency measures: our proposal

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- When preparing your final conclusion, note that there is a trade-off for the hedger between good correlation and low transaction cost
- Can be better to accept imperfect correlation if the alternative contracts are more liquid and/or are traded with lower risk premiums and transaction costs
- Lack of trade in some contracts might be a completely rational solution for an efficient market
- Operating markets are not costless; there are only a limited number of economically justifiable futures markets
## Motivation for not suggesting some of the other measures

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<td>Relative risk premium</td>
<td>Large percentage when denominator is small; not defined when EPAD price is zero</td>
</tr>
<tr>
<td>Amihud</td>
<td>No previous application on electricity markets; not easily applied</td>
</tr>
<tr>
<td>Market efficiency</td>
<td>Market, not contract efficiency, computationally intensive</td>
</tr>
<tr>
<td>Roll’s measure</td>
<td>No need to estimate bid-ask spreads if they are observable – from market places</td>
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Bransjerådgiver for kraftsektoren
Strategi – Bedriftsøkonomi – Samfunnsøkonomi