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# 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

# FCA GL regarding forward market assessment

- 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 are 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

| | Germany | Netherlands | Great Britain | Nordic |
|---|---|---|---|---|
| **Production 2015 (TWh)** | 580 | 104 | 325 | 397 |
| **Day-ahead 2015 (TWh)** | 264 | 28 | 144 | 352 |
| ***Share of production (%)*** | *45 %* | *30 %* | *45 %* | *90 %* |
| **Financial market (TWh)** | 5300 | 300 | 950 | 1350 |
| ***Traded at PX (%)*** | *20 %* | *33 %* | *1 %* | *60 %* |
| ***Cleared (%)*** | *30 %* | *45 %* | *1 %* | *100 %* |
| **Churn rate** | 10 | 3 | 3 | 4 |
| **Open interest (TWh)** | 1000 | 25 | 6 | 350 |

# 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

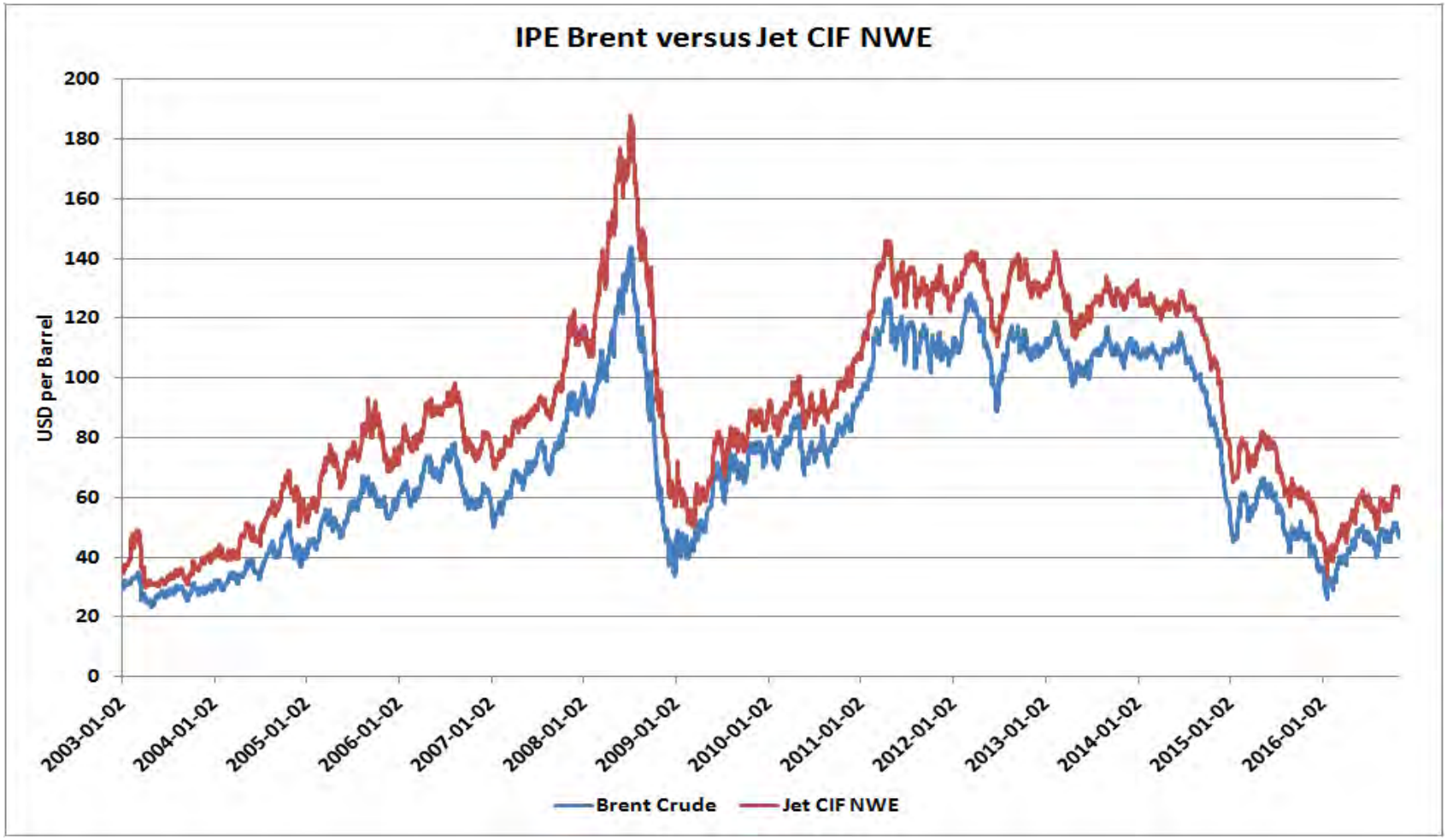
# Nordic electricity (1/2)

- 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

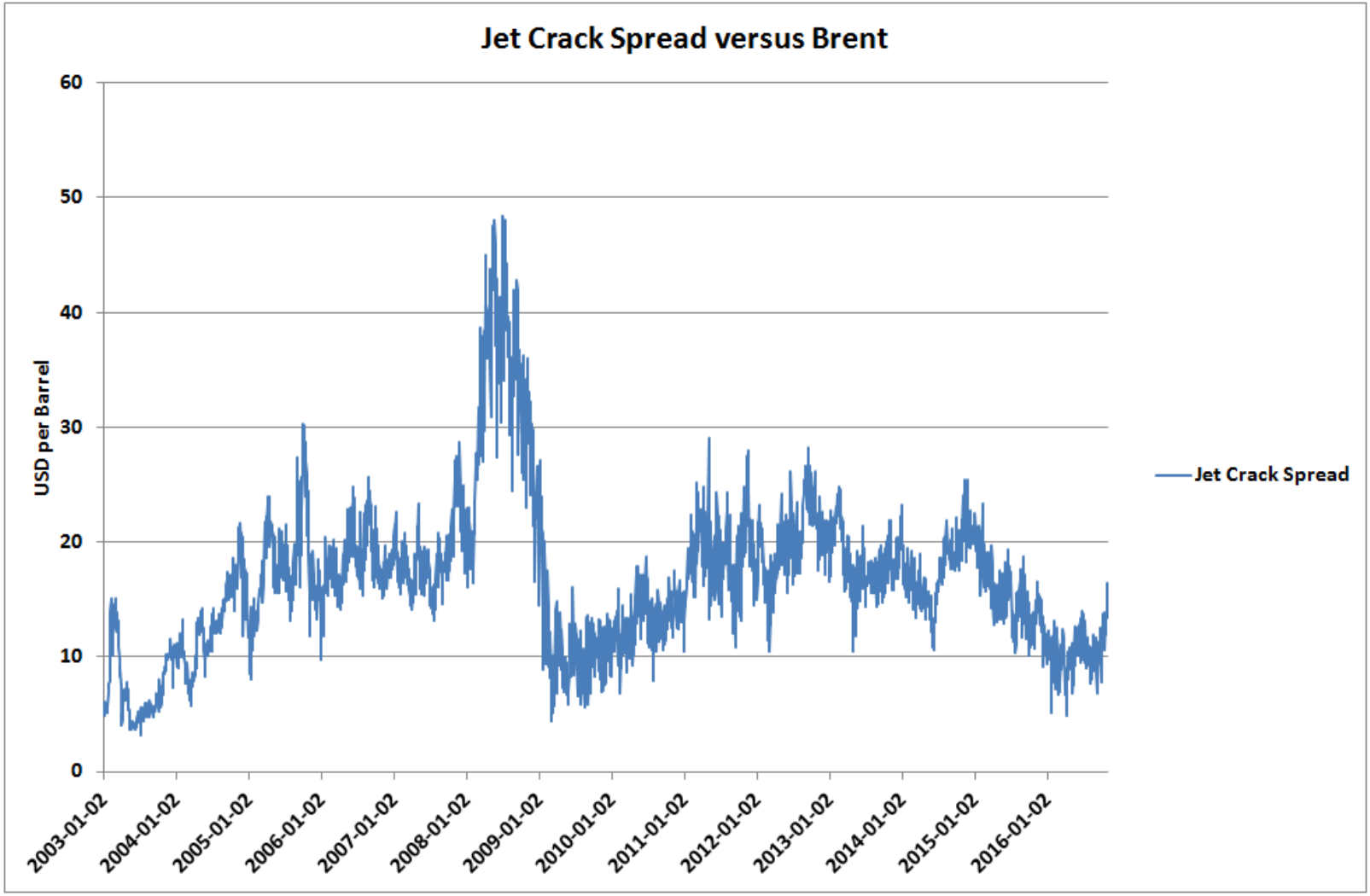
# Nordic electricity (2/2)

- 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



# Jet Crack Spread



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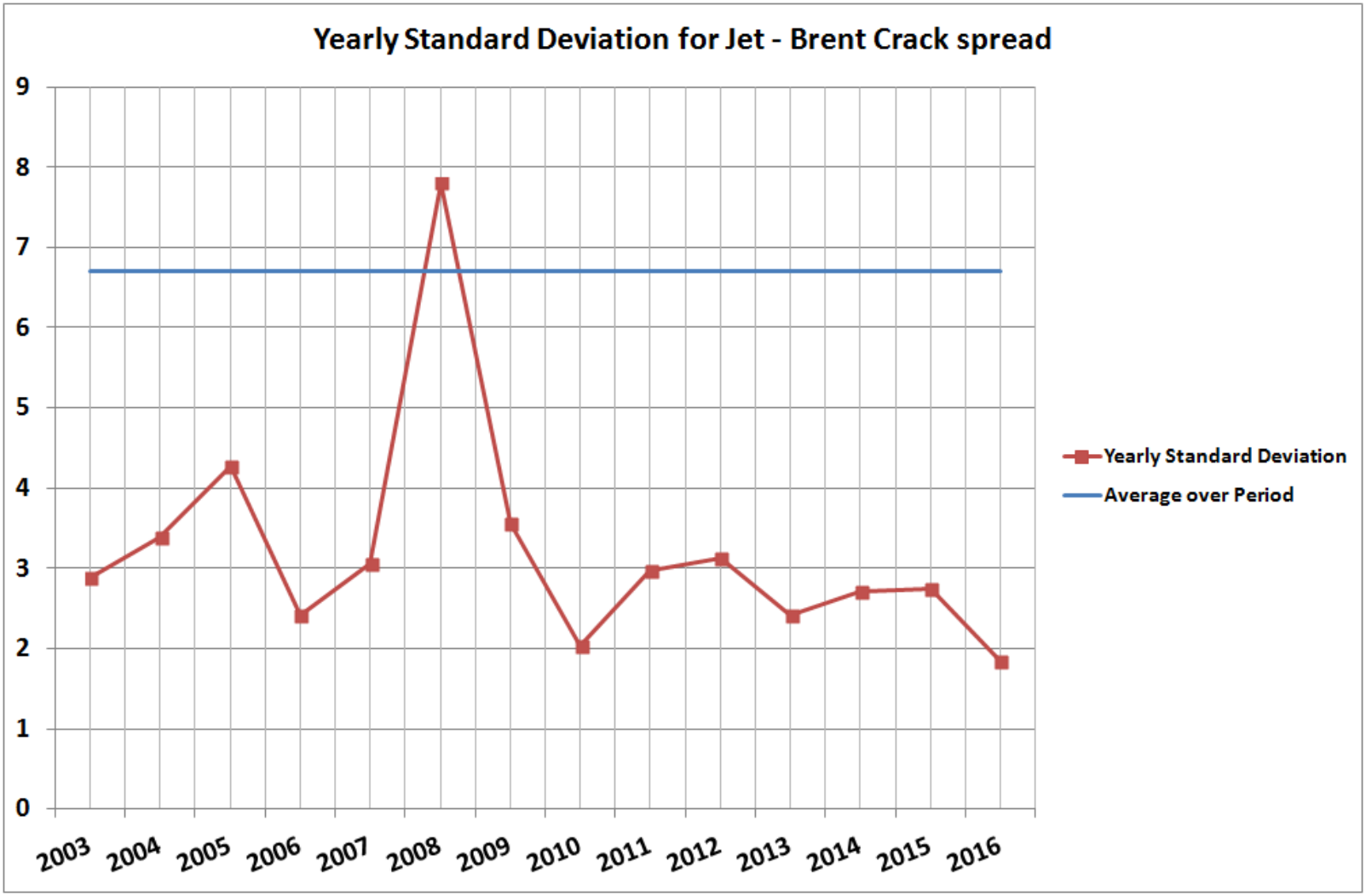
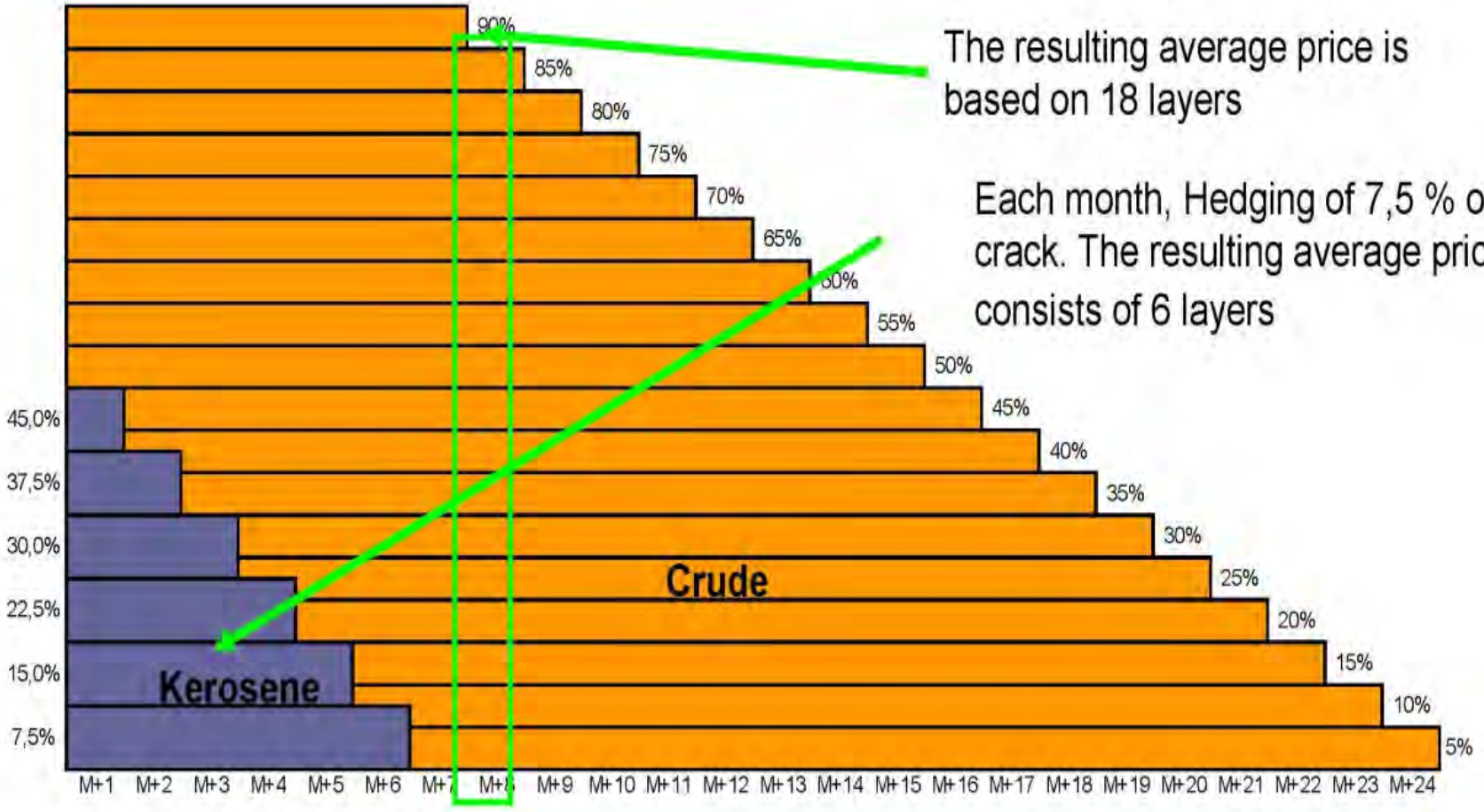


# Possible hedging portfolio



# 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

# Time resolution and time horizon

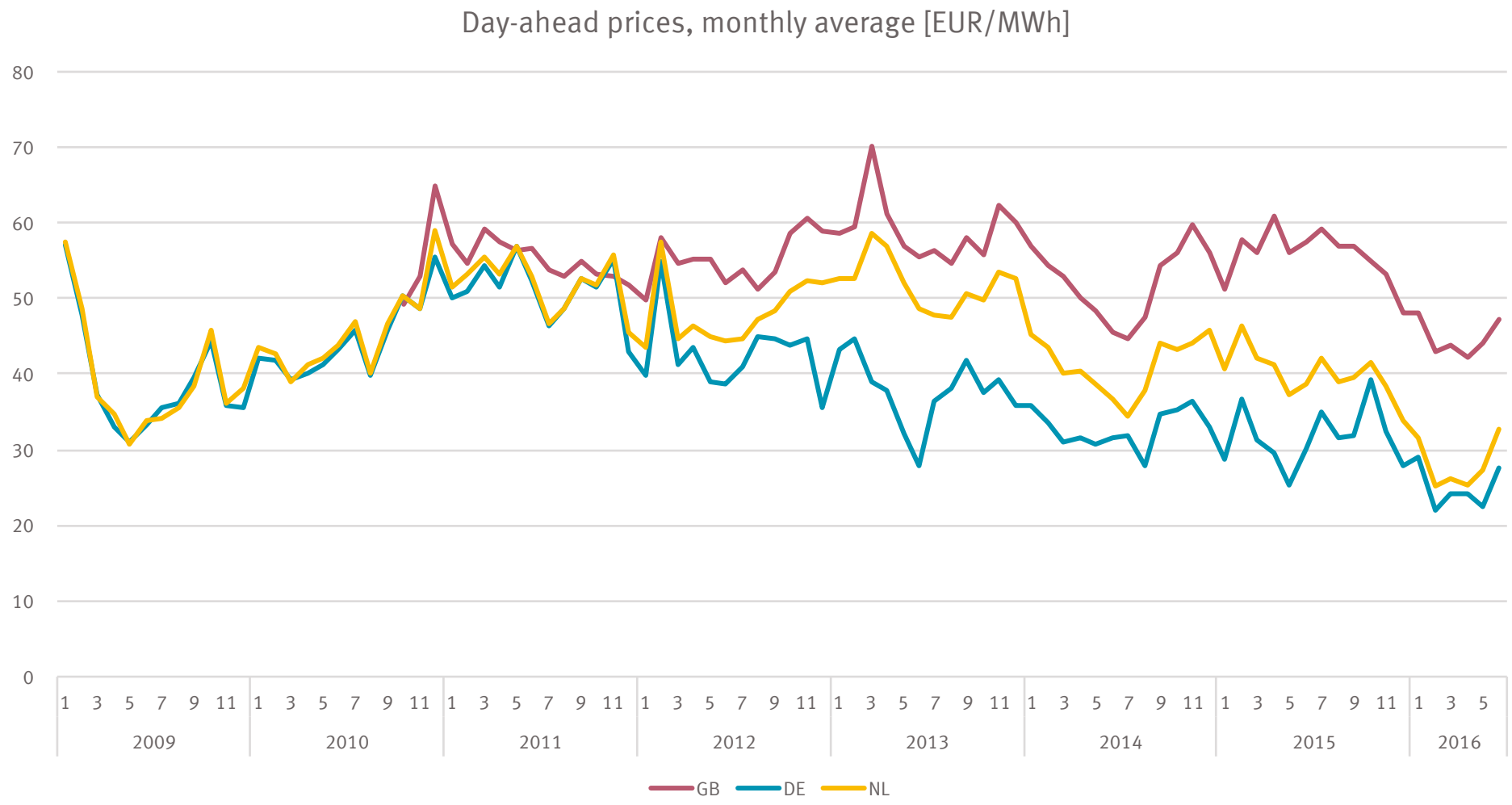
- Hourly prices clearly not relevant
- Hedging horizons vary from month(s) to years
  - Years or months
  - -Enables comparison with LTTRs
- Long observation period
  - Irrelevant history; it's the future that matters
  - Black Swans

# Key challenge with correlation analysis

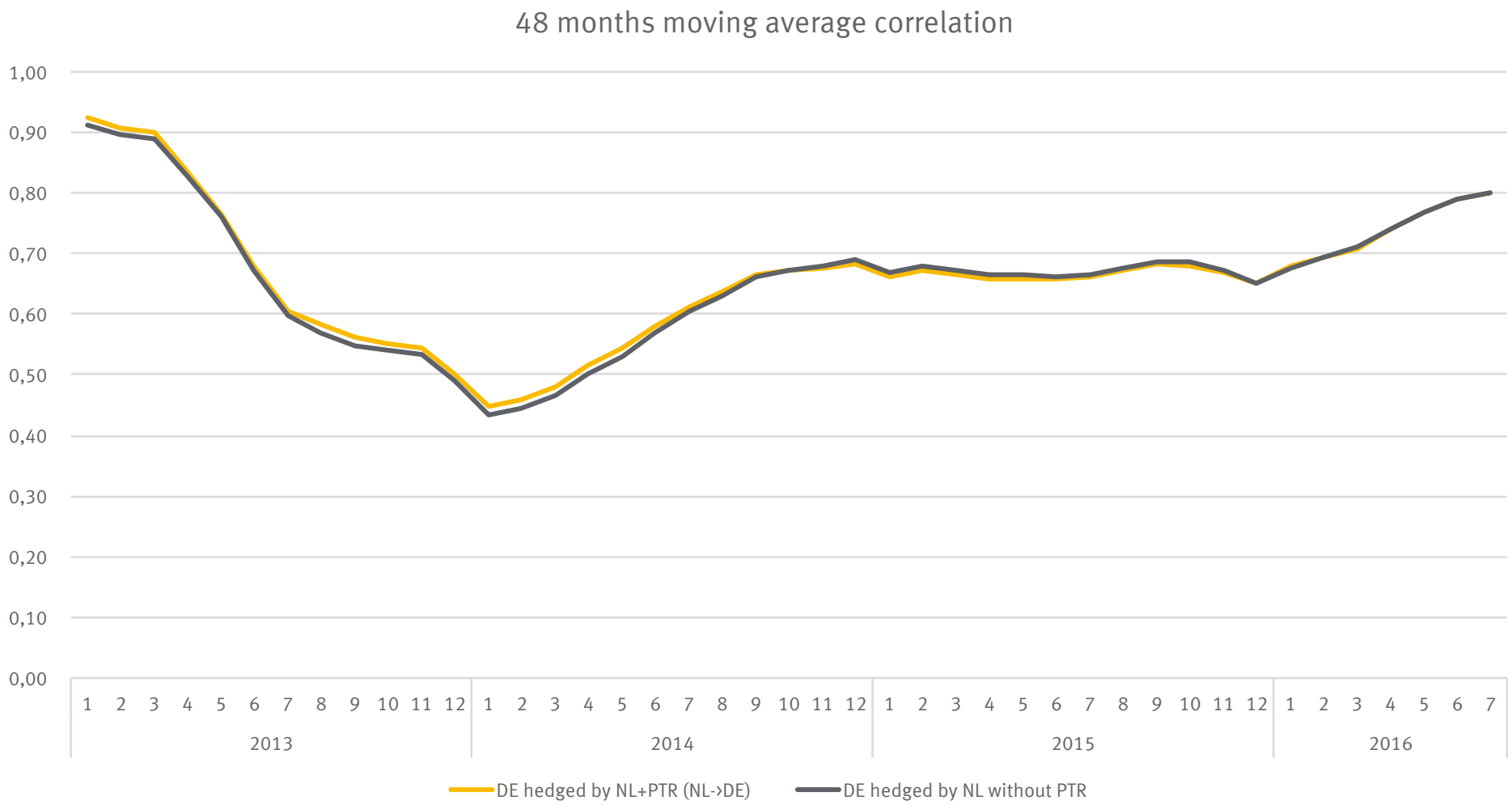
- No threshold values exists
  - Hedging decisions are the result of companies maximising their utility functions, not from maximising their profit
  - Imperfect correlation may partly be compensated for by changing the hedge ratio
  - Regulators to consider all sources; market participants, effectiveness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



# Hedging German production by Dutch contracts



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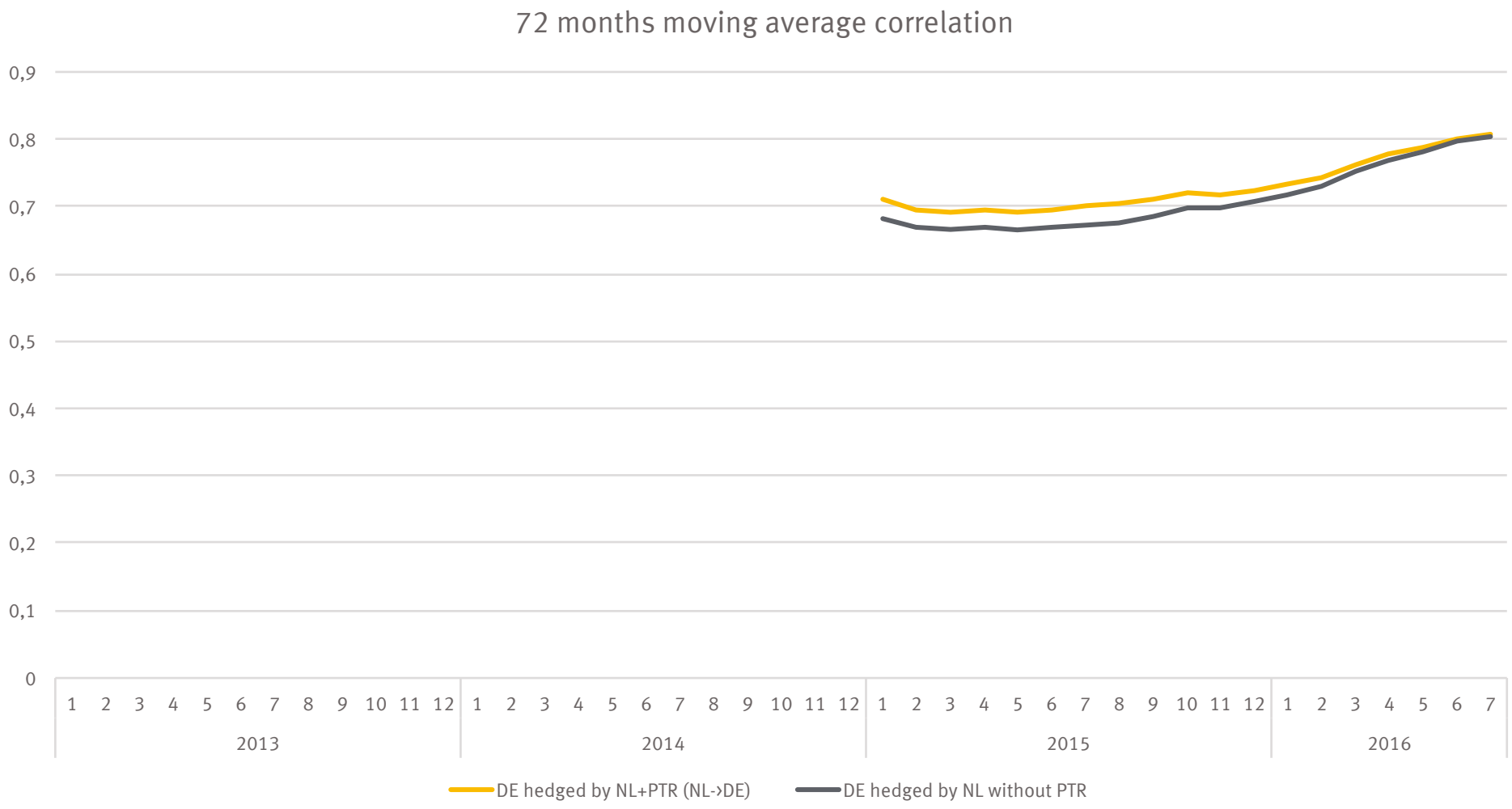

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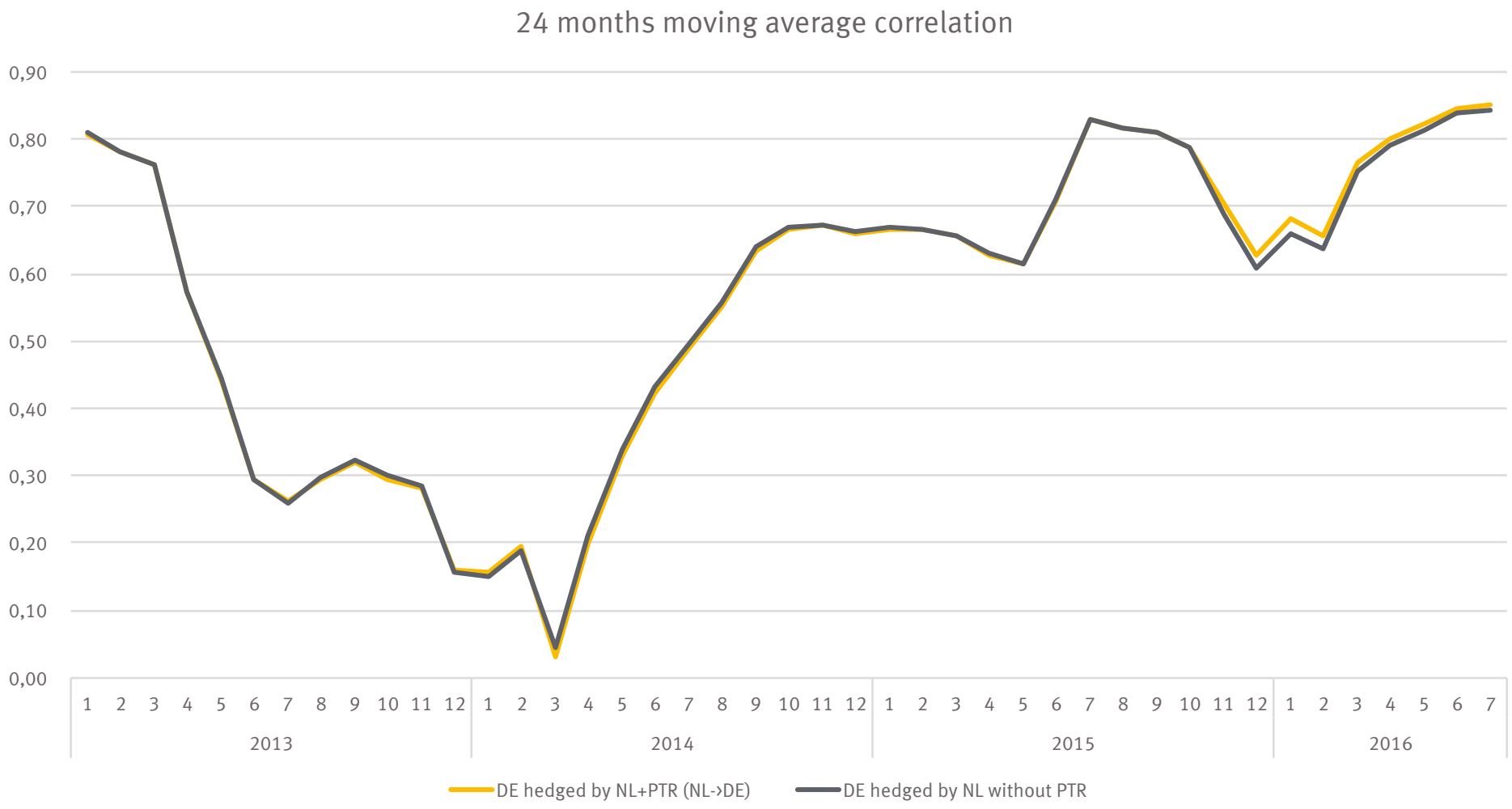

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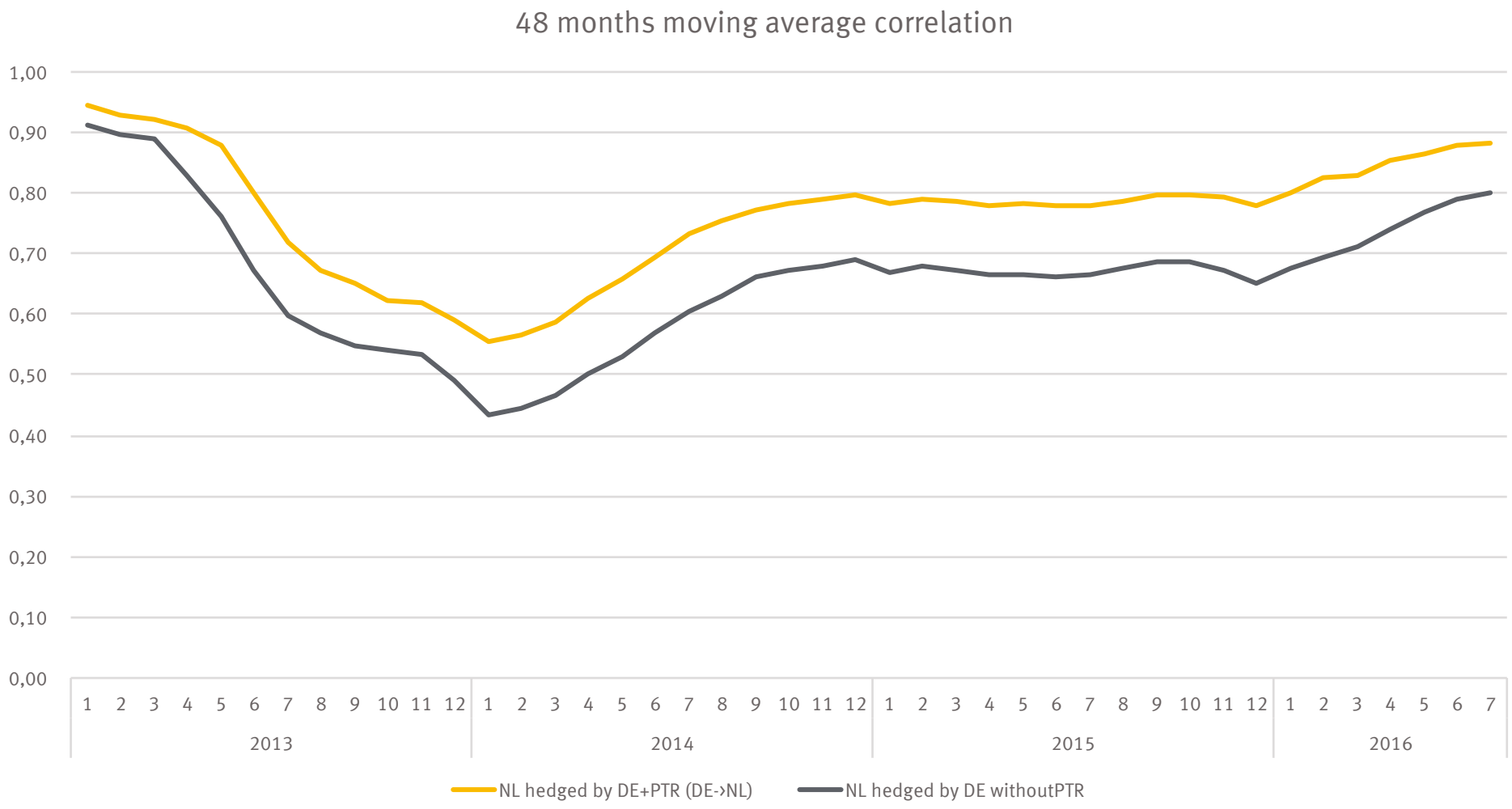

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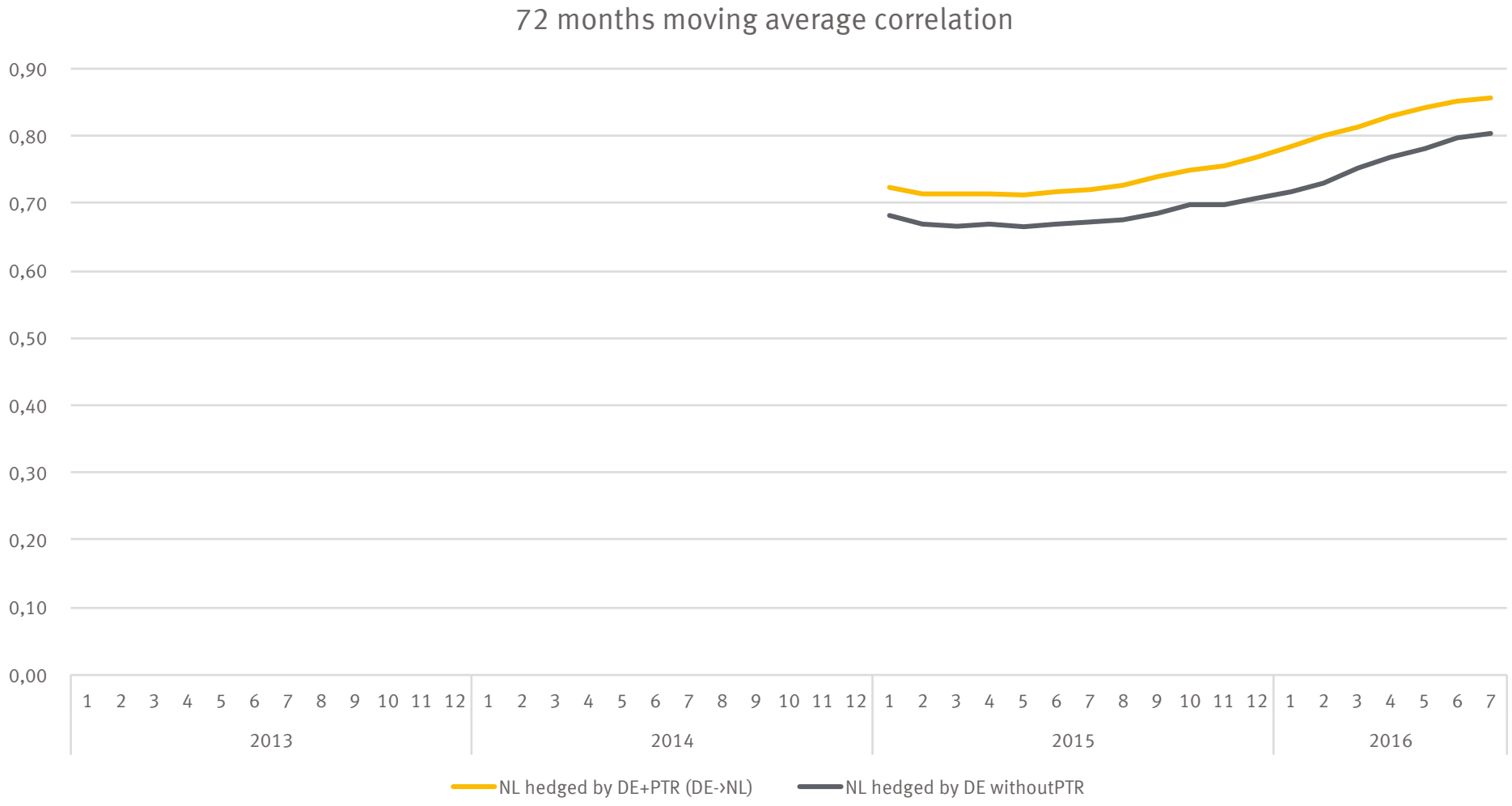

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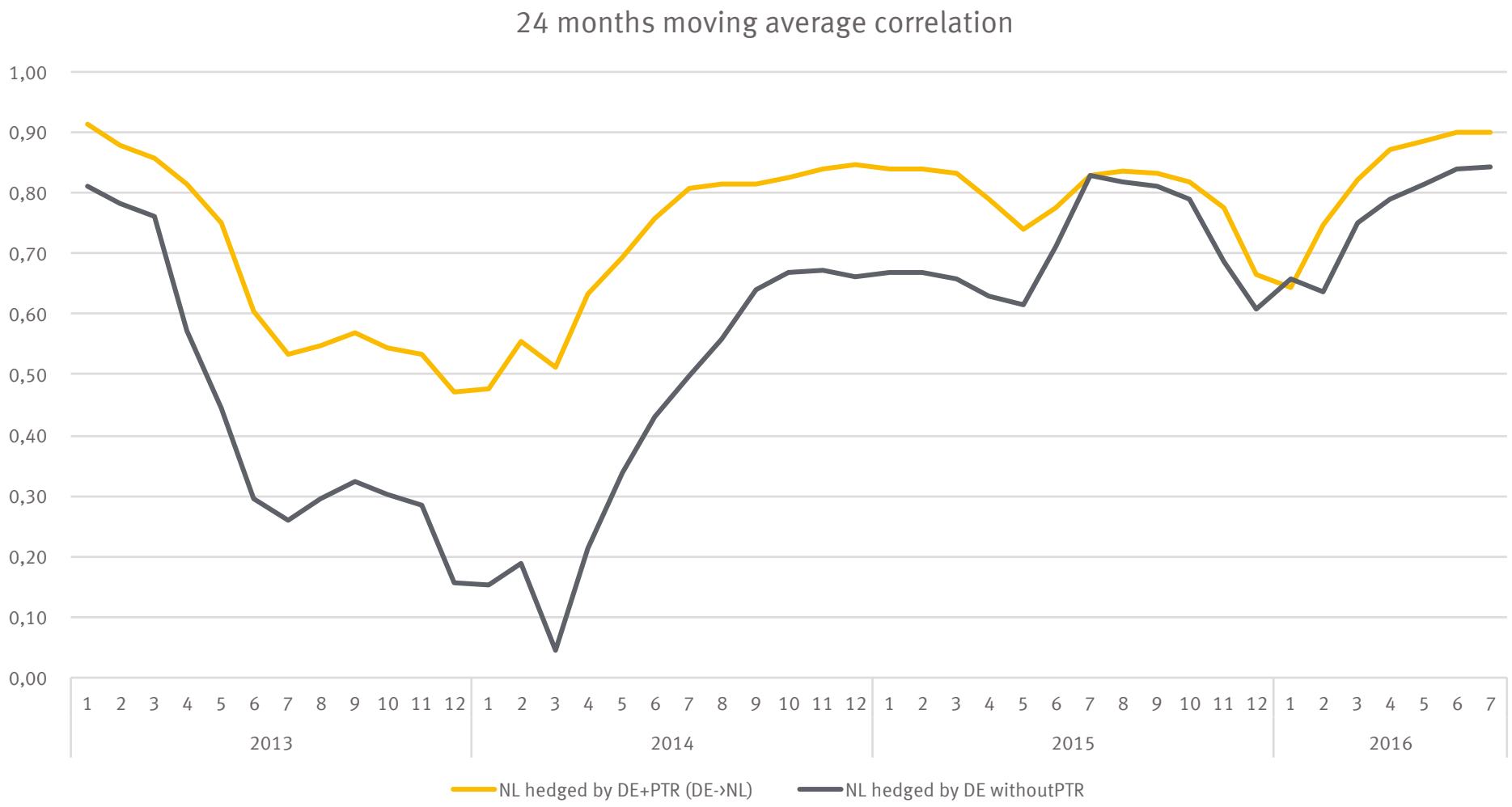
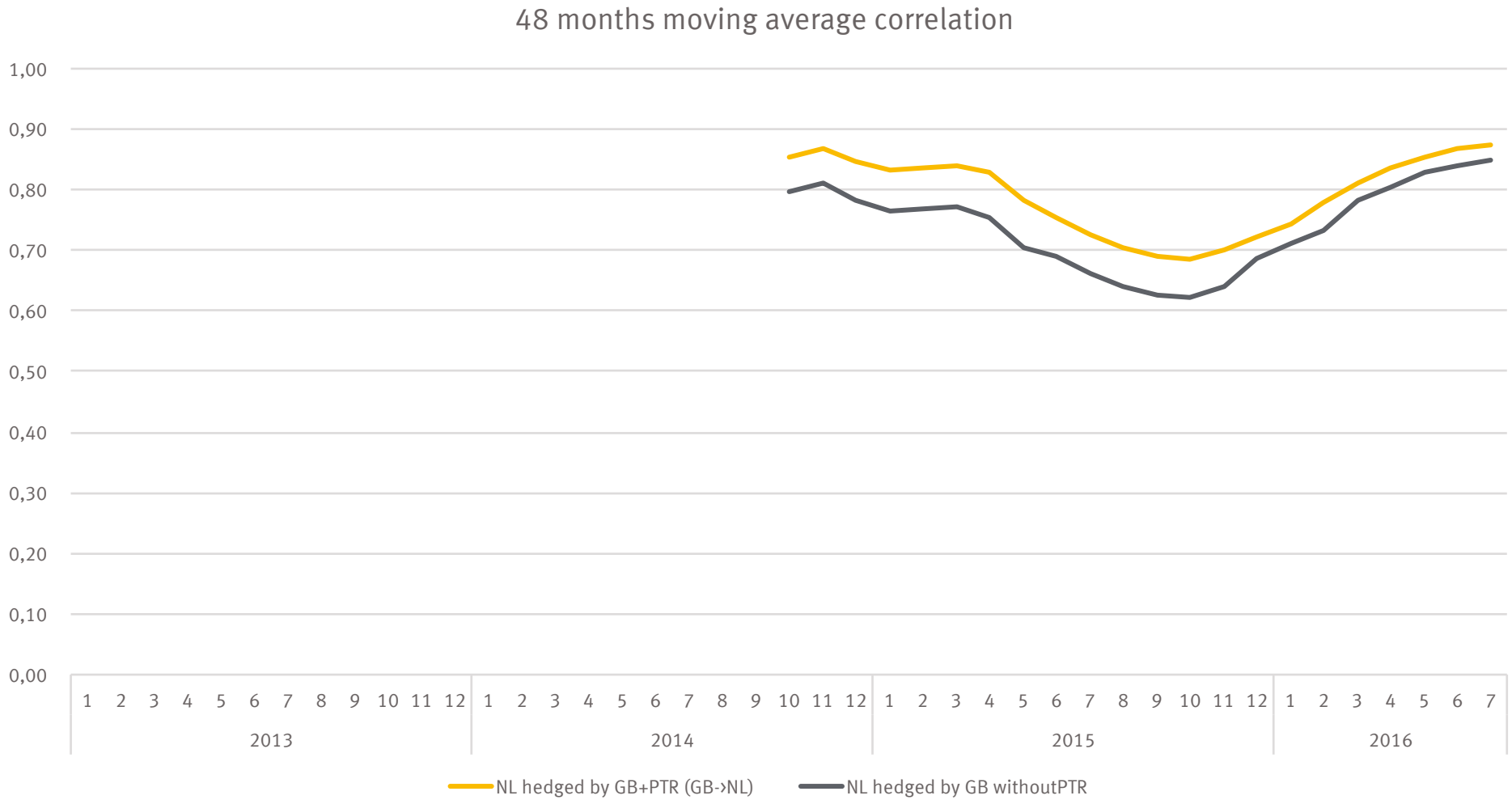
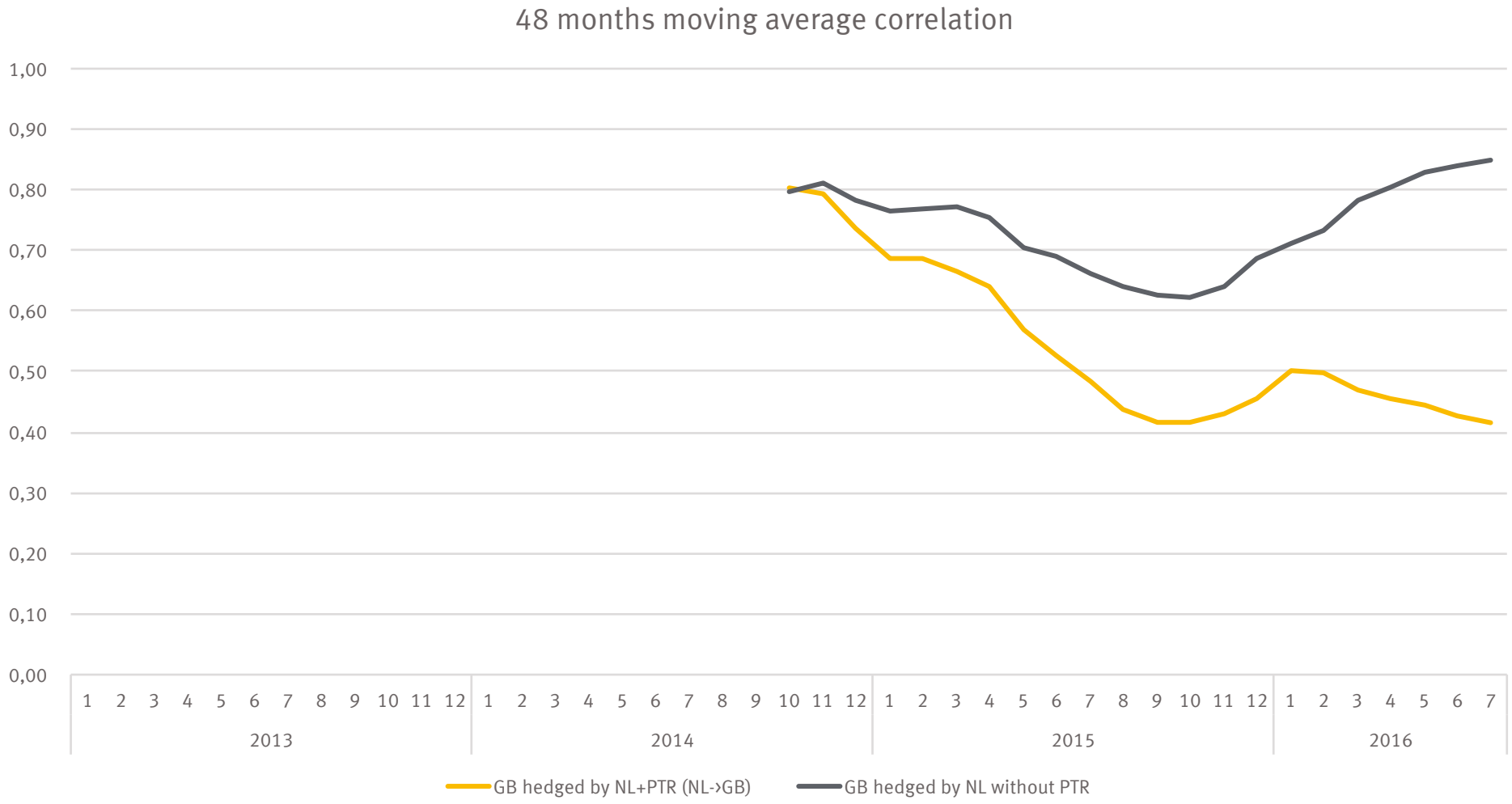


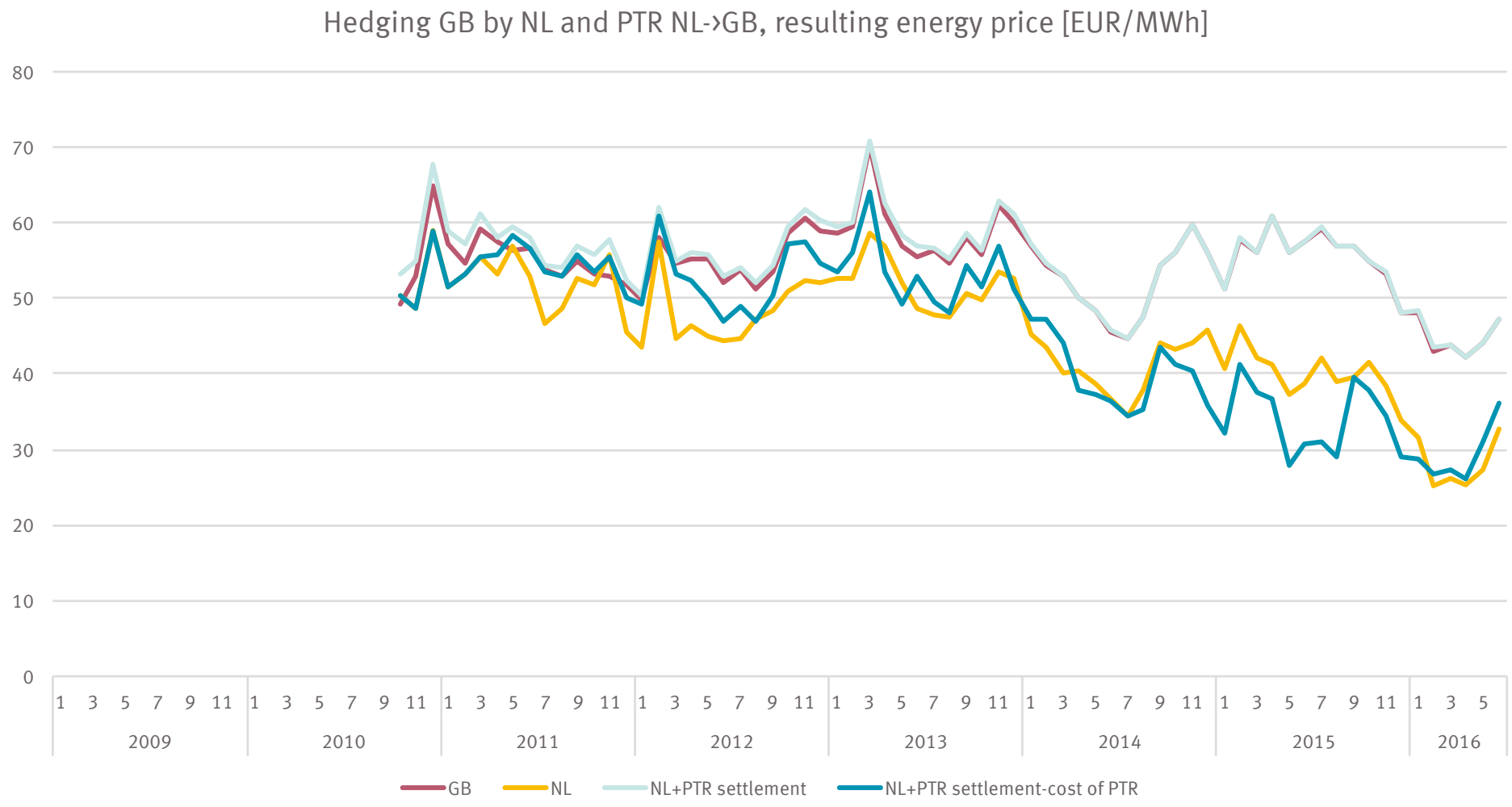
# Hedging Dutch production by GB contracts



# Hedging GB production by Dutch contracts



# Understanding the correlation



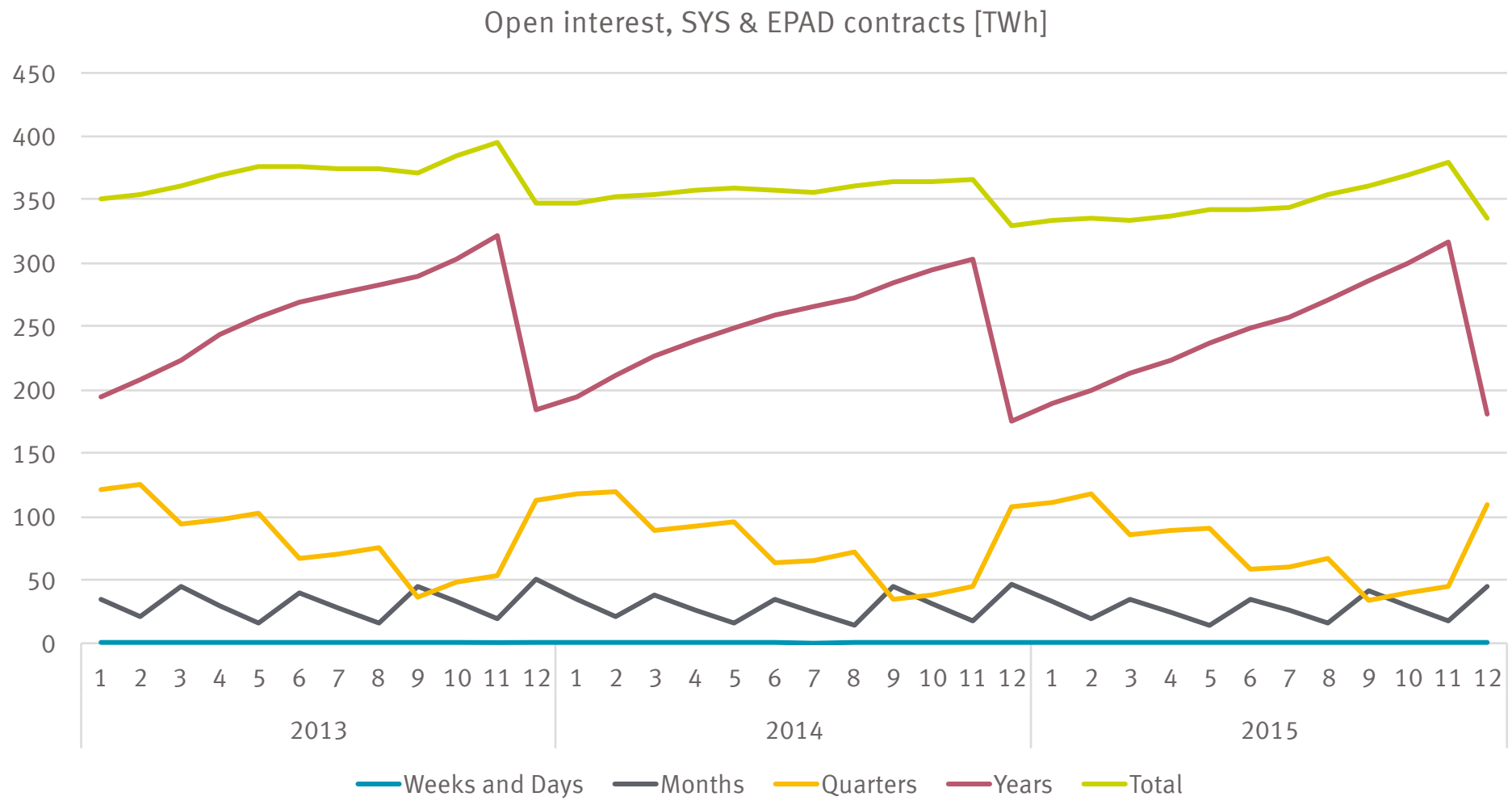
# Correlation: our proposal

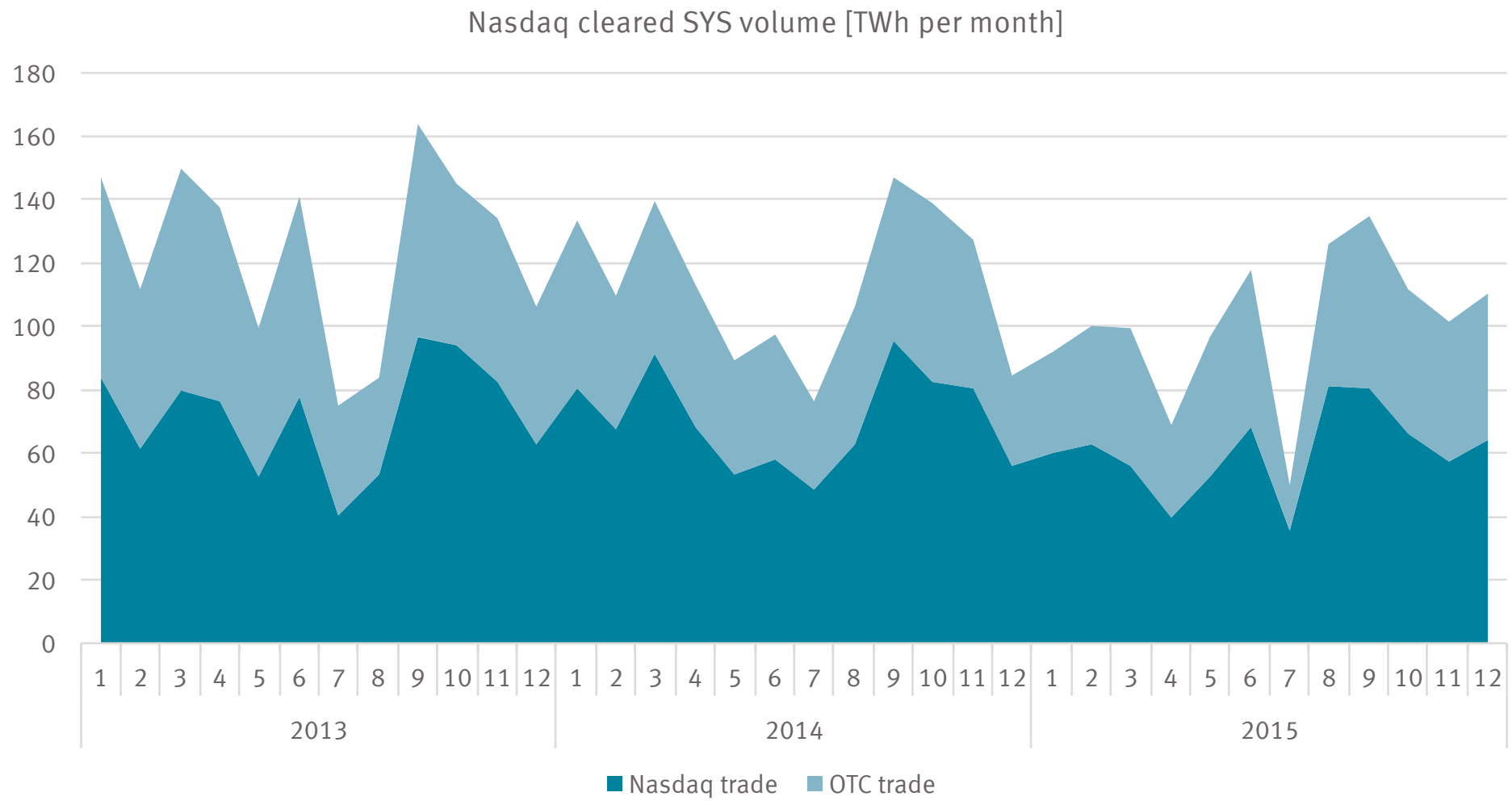
- Straight forward correlation analyses of correlation between delivery prices and potential hedge portfolios
  - Do not look at price changes
- Compare yearly or monthly average prices
  - Hours or weekly averages are not relevant, as hedging horizons are longer
- Observation period: some years
  -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

# Efficiency analyses

# Efficiency measures – three groups of measures

| Measure | Interpretation | Assessment | Pros | Cons |
|---|---|---|---|---|
| **Trading horizon** | Measures product design | Descriptive analysis | Evaluation of measures against individual contract timeframes | Not a direct measure of efficiency or liquidity |
| **Traded volume** | Measures liquidity | Descriptive and time series analysis | Data availability (daily returns and volume) | Partial measure of liquidity |
| **Open interest** | Measures liquidity and importance for hedging | Descriptive analysis | Dynamic measure of liquidity and importance for hedging | Partial measure of liquidity |
| **Risk premium** | Measures hedging pressures | Time series analysis | Computationally straightforward | Needs further disentanglement |
| **Amihud** | Measures liquidity | Time series analysis | Data availability (daily returns and volumes); allows studying time series effects of liquidity | Not well defined for power derivatives markets |
| **Long- and short-term market efficiency** | Measures overall market efficiency | Time series analysis | Data availability; allows testing overall efficiency | Analytical complexity; more reliable estimates for shorter maturity |
| **Bid-ask spread** | Liquidity measure with pronounced effects on transaction costs | Descriptive and time series analysis | Measures the costs of hedging for market participants | Data availability of OTC bid-ask spreads (except for regulators) |
| **Roll's measure** | Measures transaction costs | Time series analysis | Infers a measure of effective bid-ask spreads from market prices | Relative ease of access to bid-ask spreads from market data |


Open interest, SYS & EPAD contracts [TWh]
450
400
350
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
2013
2014
2015
Weeks and Days
Months
Quarters
Years
Total


Nasdaq cleared SYS volume [TWh per month]
180
160
140
120
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
2013
2014
2015
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

| Measure | Interpretation | Assessment | Pros | Cons |
|---|---|---|---|---|
| **Trading horizon** | Measures product design | Descriptive analysis | Evaluation of measures against individual contract timeframes | Not a direct measure of efficiency or liquidity |
| **Traded volume** | Measures liquidity | Descriptive and time series analysis | Data availability (daily returns and volume) | Partial measure of liquidity |
| **Open interest** | Measures liquidity and importance for hedging | Descriptive analysis | Dynamic measure of liquidity and importance for hedging | Partial measure of liquidity |
| **Risk premium** | Measures hedging pressures | Time series analysis | Computationally straightforward | Needs further disentanglement |
| **Bid-ask spread** | Liquidity measure with pronounced effects on transaction costs | Descriptive and time series analysis | Measures the costs of hedging for market participants | Data availability of OTC bid-ask spreads (except for regulators) |

- 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

| Measure | Reason |
|---|---|
| Relative risk premium | Large percentage when denominator is small; not defined when EPAD price is zero |
| Amihud | No previous application on electricity markets; not easily applied |
| Market efficiency | Market, not contract efficiency, computationally intensive |
| Roll's measure | No need to estimate bid-ask spreads if they are observable – from market places |

# Bransjerådgiver for kraftsektoren
# Strategi – Bedriftsøkonomi – Samfunnsøkonomi

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