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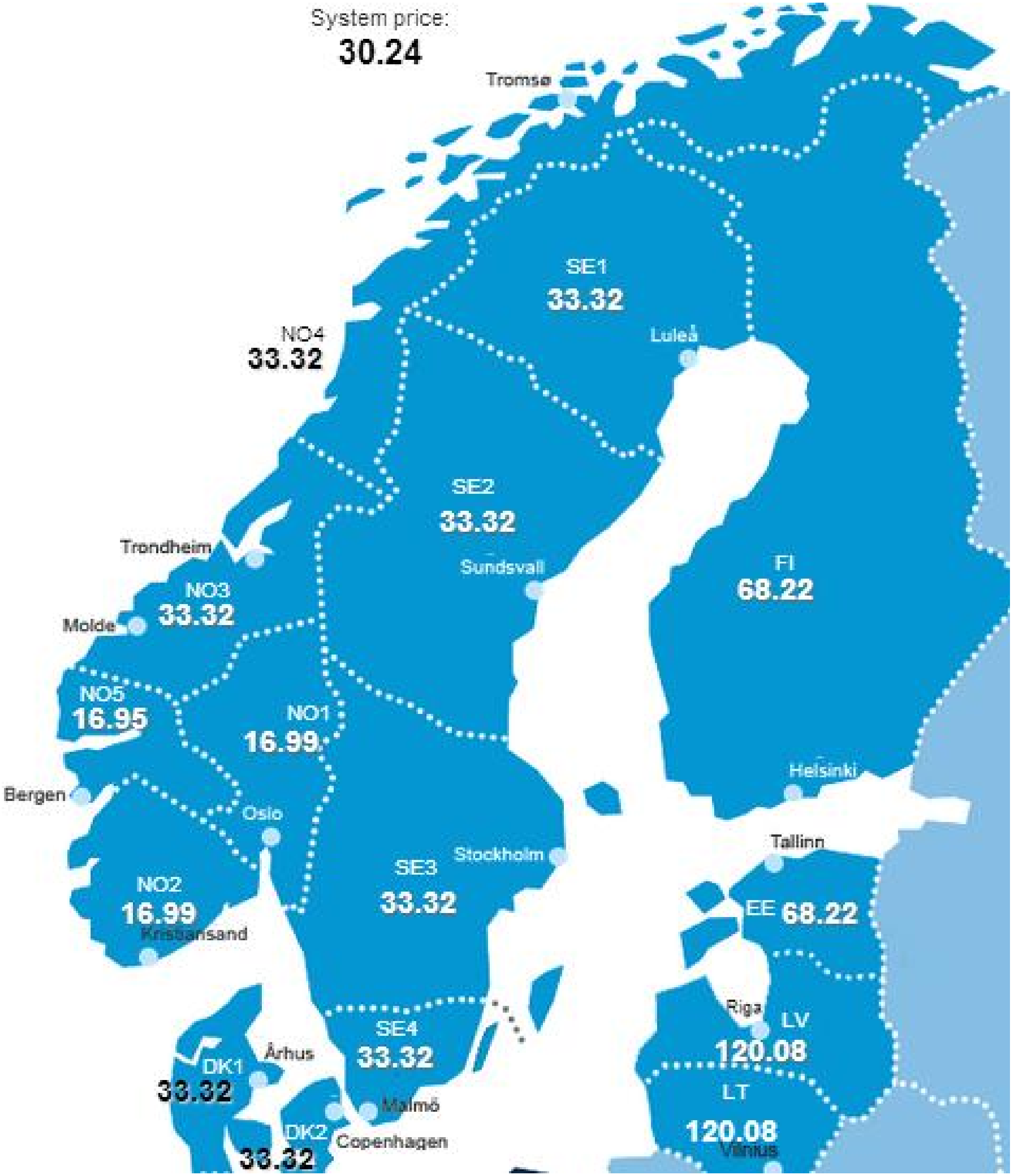
Efficiency of Contracts for Differences (CfDs) in the Nordic Electricity Market

Petr Spodniak, Nadia Chernenko & Mats Nilsson

LUT Energy & LUT School of Business

Tiger Forum 2014, Toulouse



The Nordic electricity market

June 6th, 2014, hour 10-11

Nord Pool Spot

Outline

1. Motivation – Why study EPADs?

2. Research agenda
   - Risk premium, role of hydro, efficiency

3. Study results
   - Risk premia statistically significant
   - Limited efficiency of EPADs
   - Market maturity matters

4. Implications & limitations

Why study EPADs?

Market/Policy

- EPADs to facilitate the achievement of European Internal Energy Market (IEM)
- Spatial and temporal price variations a reality

Research

- Spatial price risks in electricity markets
- Efficiency and determinants of realized risk premia in forward markets
- Mixed results on CfD’s efficiency

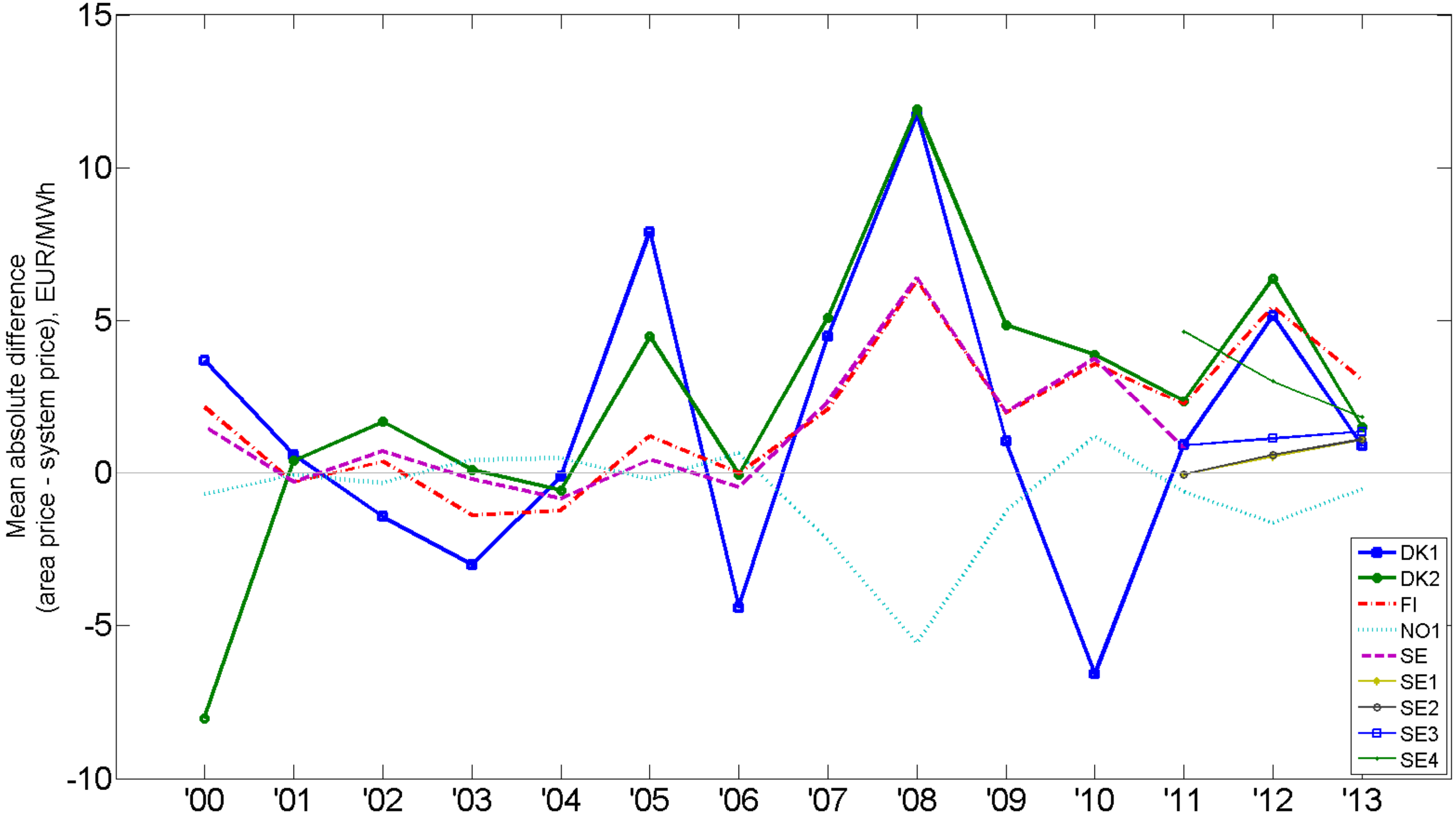
Research agenda

1. *Ex-post* risk premia
− significance, direction, and magnitude
− location, delivery period, and time-to-maturity

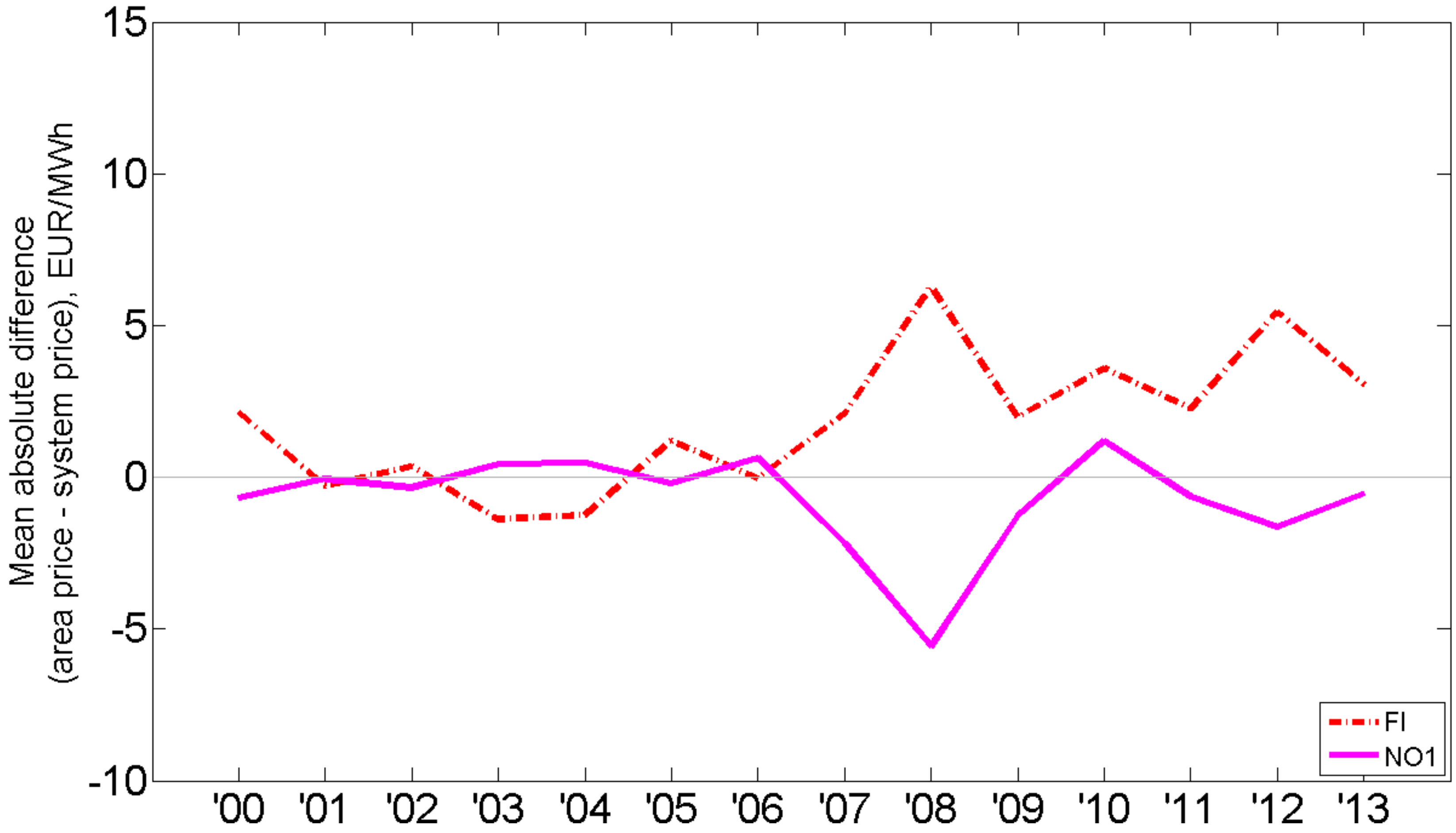
2. Underlying factors on risk premia
− open interest (liquidity), time-to-maturity, zone splitting
− water availability in the hydro reservoirs

3. Integration between EPADs price and spot price difference
− VAR model
− Granger causality, impulse response, variance decomposition

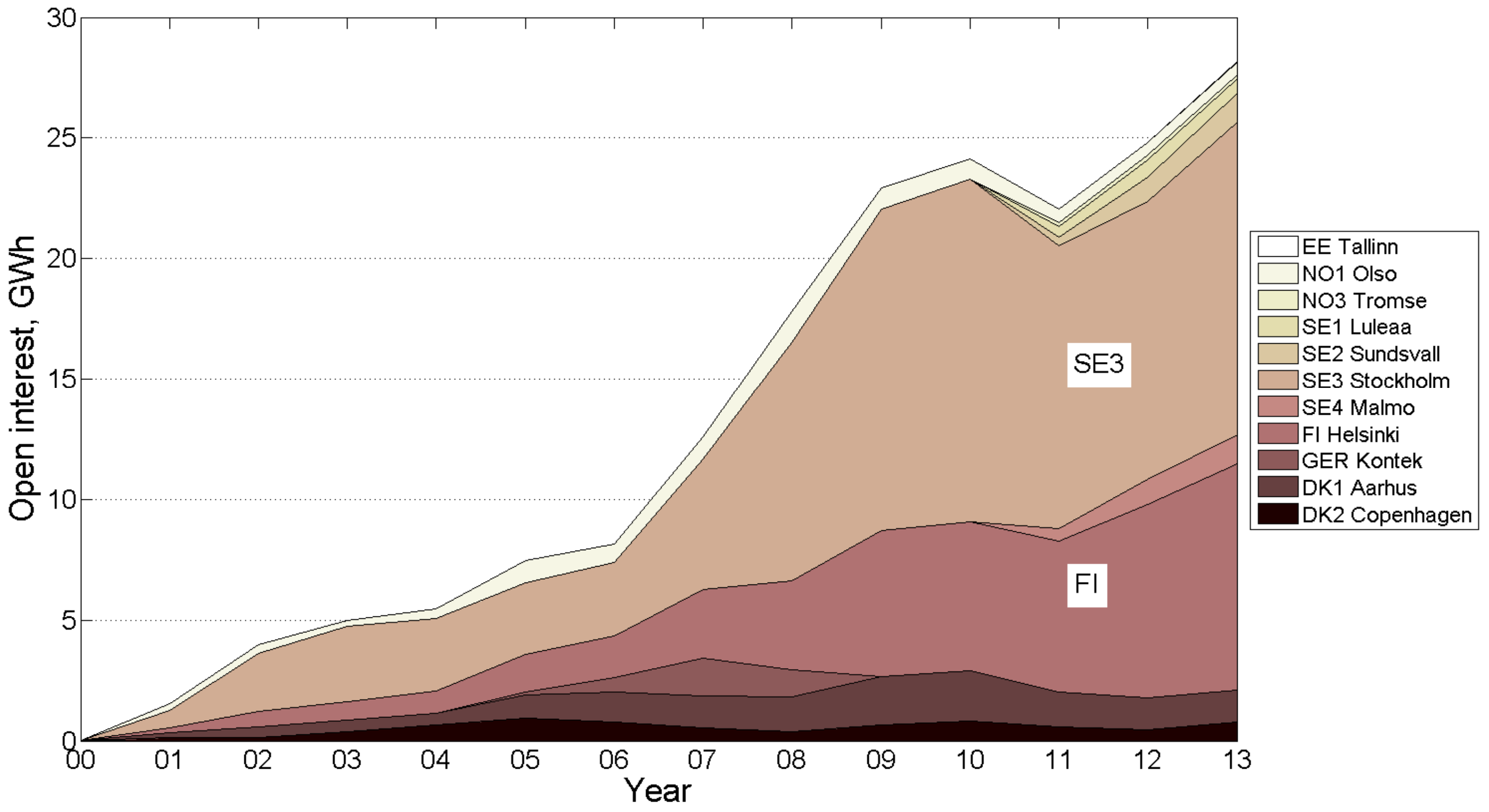
Locational price spreads



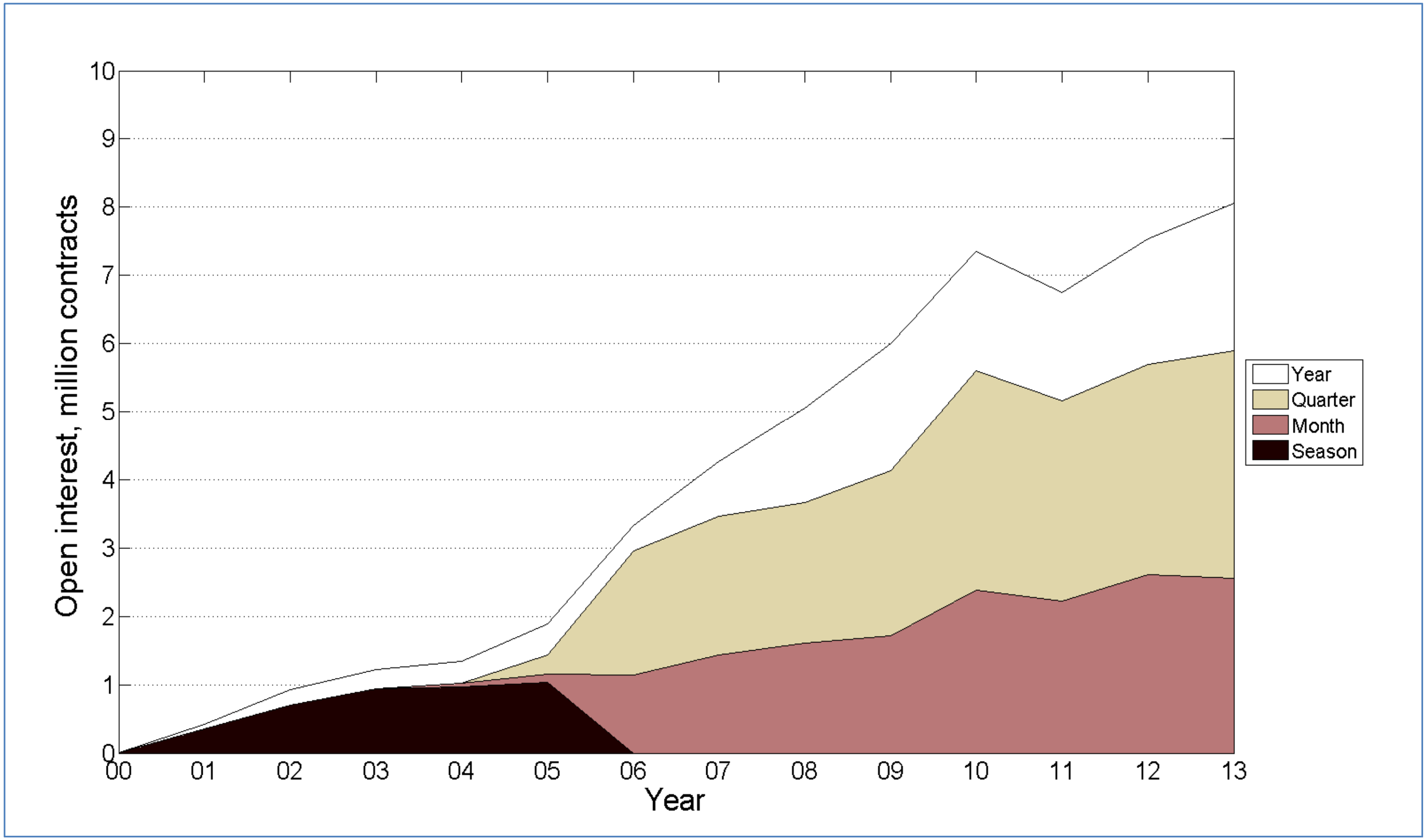
Locational price spreads
FI (Helsinki) and NO1 (Oslo)



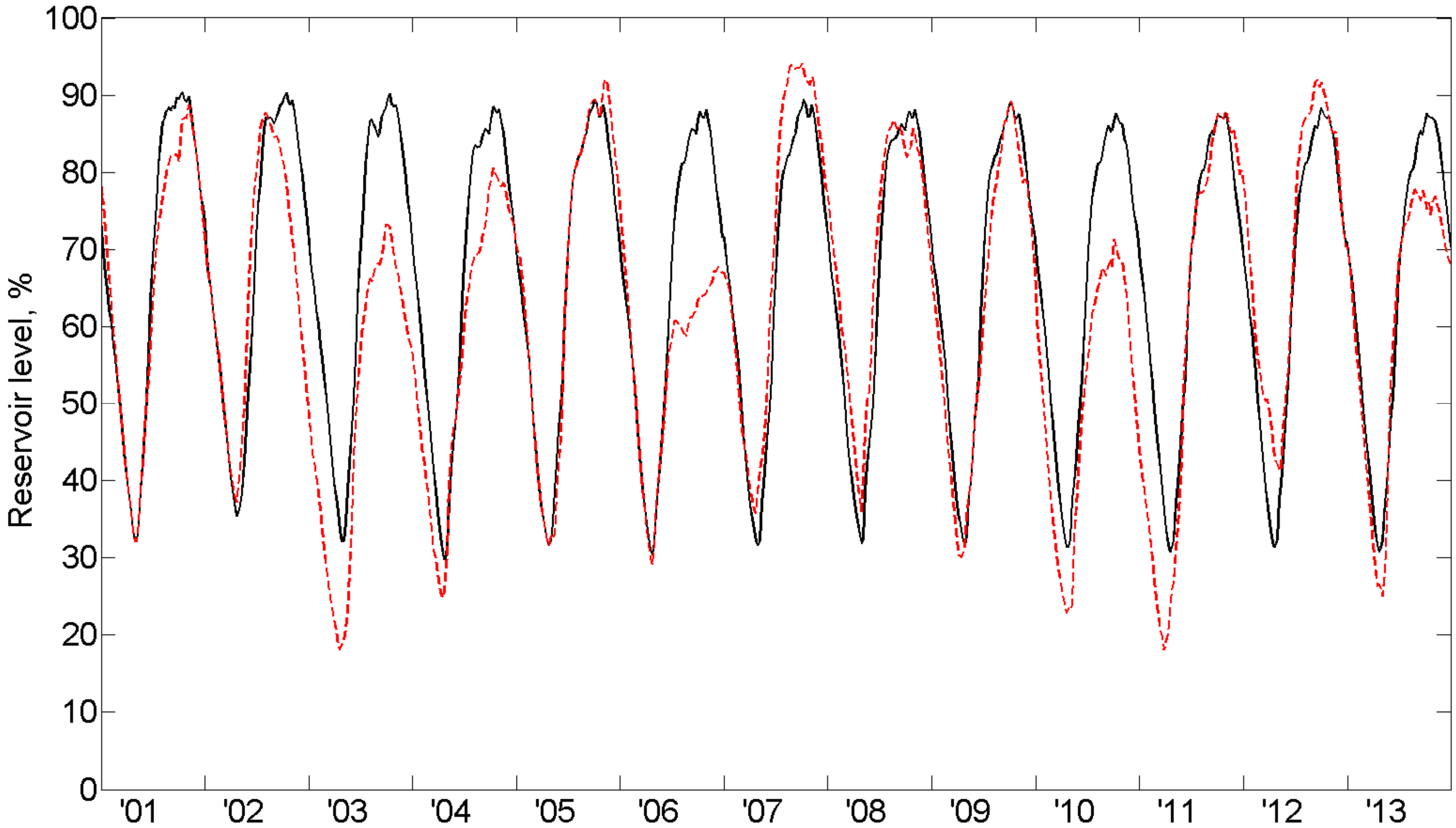
Open interest: volume GWh and area



Open interest: number of contracts and types



Hydro reservoir levels



Impact of hydro on area price spreads

- 2000-13 sample
- Sweden splitting in 2011 insignificant

- Finnish hydro insignificant in Aarhus and Oslo, but significant in Copenhagen

Compared to shorter sample 2001-06:

- Area price spreads tend to be on average larger (higher constant
- Response of price spread to hydro level deviations (especially in Norway and Sweden) tends to be stronger (higher coefficients)

Time-to-maturity

- Average risk premium = constant + beta * time-to-maturity +error term
- H: Risk premia are a negative function of time-to-maturity (beta<0)

- The average risk premium at the expiration date statistically different from zero

- However, many equations have an insignificant coefficient on time-to-maturity

- Consistent results for: Aarhus/year, Copenhagen/season and year, Helsinki/year, Luleå / month, quarter and year, Malmö/month, Olso/season and quarter, SE3/month, quarter and year, Sundsvall/month and year, Tallinn/year, and finally Tromsø /quarter

Time-to-maturity: Monthly EPADs

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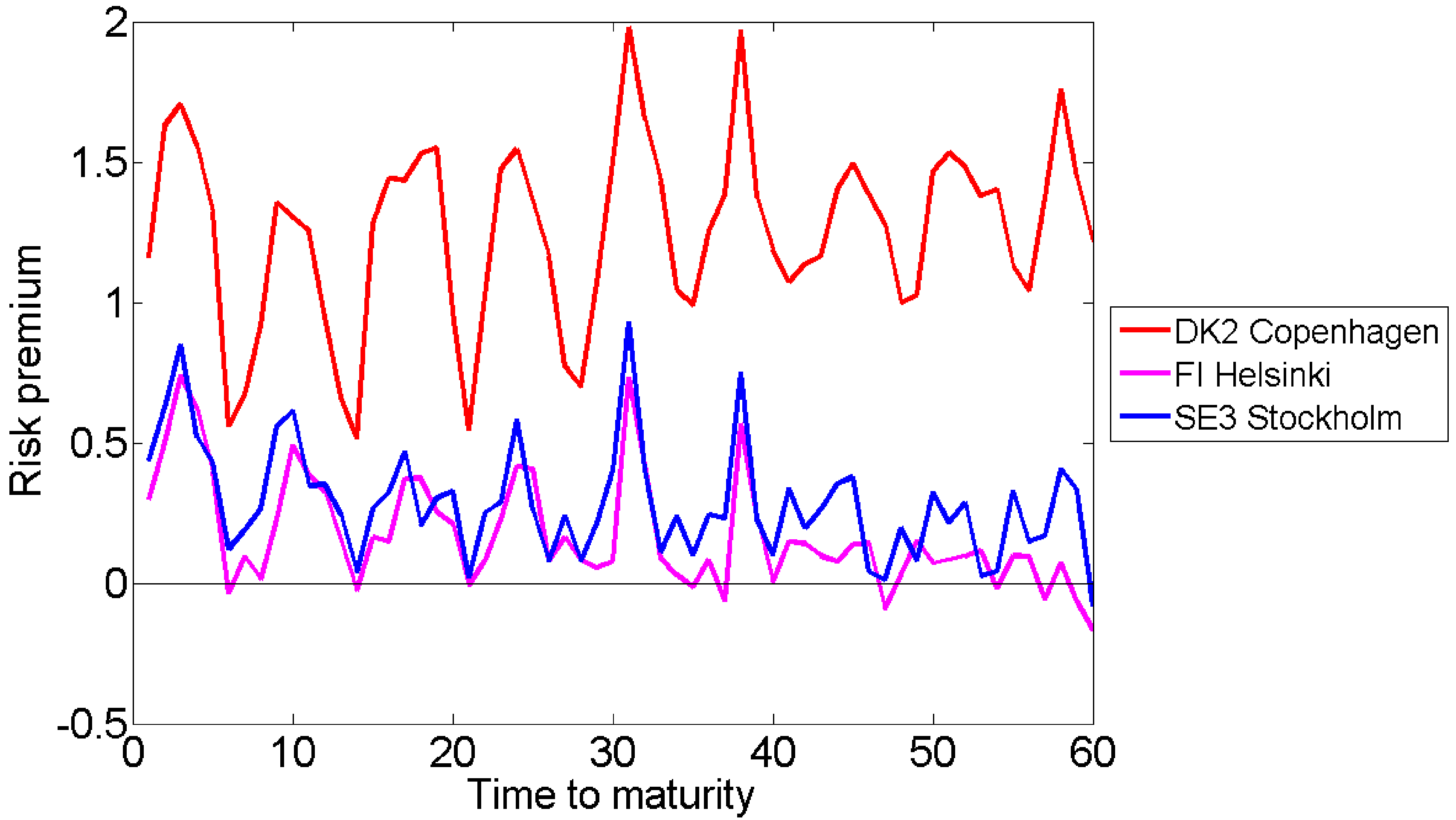

Vector Autoregression Model

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- We examine the relationship between spot and forward markets to test the efficiency of EPADs

- Consecutive monthly futures EPAD prices, 1 month to maturity, and the area spot price differences (area price – reference system price)

- Monthly EPAD contracts
  - The highest price variability, shortest-term delivery period, lower forecasting errors of market participants
  - One of the most liquid contract types

- Granger causality
- Impulse response functions (IRF) - direction of the causality effects
- Variance decomposition - magnitude of the causality

VAR results

- Granger causality – we reject the null hypothesis for all except:
  - Sweden 4 (Malmö) in both directions
  - Norway 3 (Tromsø) in EPAD to spot price direction
    - the interdependence of spot and future price seems limited
    - past changes of futures and spot prices do not contribute to the prediction of the other variable

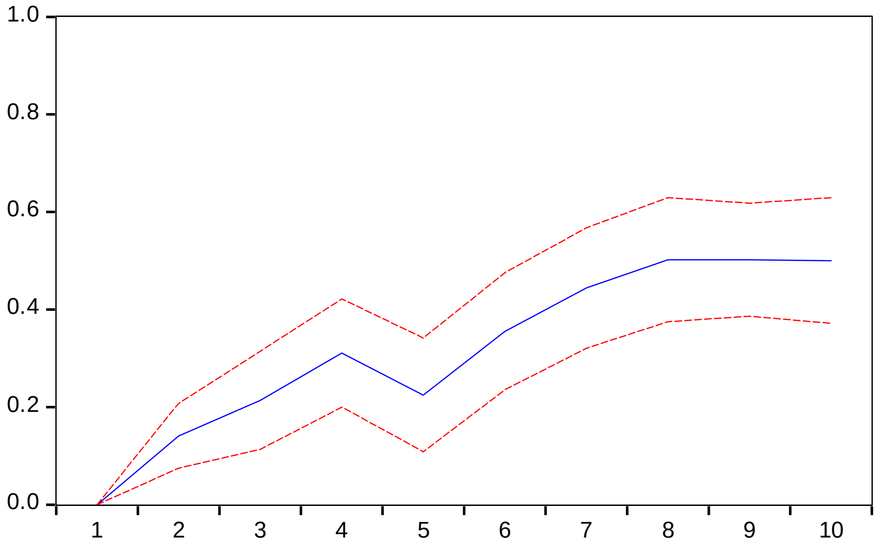
- Impulse response functions (IRF)
  - significant positive effect of spot price shocks on EPAD futures for NO1, FI, SE3 (10 days), and with shorter significant duration for DK2 (7 days), DK1 (5 days)
  - Significant positive effect of EPAD futures prices on the spot price differences, especially pronounced for NO1, DK2, and with fluctuating duration and magnitude for FI, SE3, SE1, SE2, and DK1 (≈ 5 days).

- Variance decomposition
  - Spot prices in DK1, NO1, and SE3 respond most strongly to EPAD futures shocks. Likewise, EPAD prices respond most strongly to spot price shocks in NO1, FI, and SE3

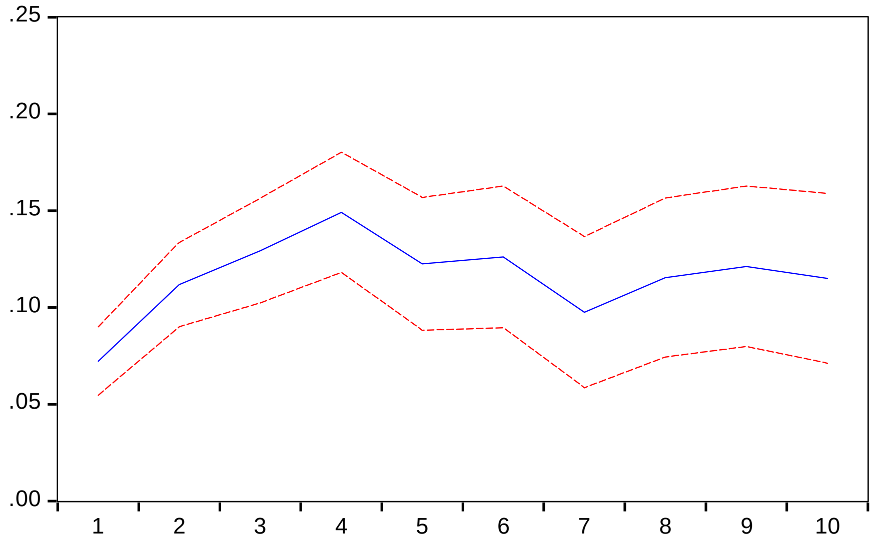
Direction & magnitude of shocks

Price area	Variation in the spot price explained by a shock in the EPAD price	Variation in the EPAD price explained by a shock in the spot price
DK2	4,2%	3,6%
FI	2,8%	5,7%
NO1	12%,	10,7%

Response of NO1_DSPOT to NO1_MF



Response of NO1_MF to NO1_DSPOT



Implications

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- Risk premia are an important part of EPAD prices
  - deviation of the water level in hydro reservoirs from its historical median impacts the local area prices, the system-wide price, as well as the difference of the two prices

- Larger price spreads and larger response to hydro levels changes => indirect evidence of higher price variation on the Elspot market

- Negative relationship between risk premia and time-to-maturity partially confirmed

- Market maturity may be the main driver as efficiency seems to increase with longer trading history (Helsinki, Stockholm, Oslo)

- Proportion of fixed price contracts in retail market

Limitations

- Ex-post approach to risk premia
  - Price of risk vs. error in rational expectations (Redl & Bunn, 2013)
- Accounting for transaction costs (Wimschulte, 2010)

Next Steps

- Role of skewness (+) and variance (-) in risk premia (Bessenmbinder & Lemmon, 2002)
- Further determinants of risk premia – market power, price spikes in spot market....

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Thank you!

Questions?