

Work Package 3.1: Scaling and correlations in the Nordic spot electricity market data

Hugo Touchette

School of Mathematical Sciences, Queen Mary, University of London

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Description

Work Package

Report on the use of the Hurst coefficient and correlation with power law decay for the project data

Goals

- Obtain time series data
- Analyse the Hurst exponent
- Analyse correlations and stationarity
- Identify trends, periodicities

Collaboration

Queen Mary

- David Arrowsmith
- Hartmut Erzgräber*
- Wolfram Just
- Hugo Touchette

Long range correlations

LIUC-Università Cattaneo

- Fernanda Strozzi

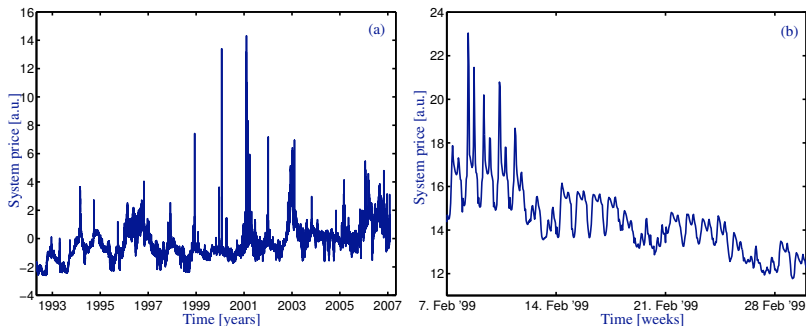
Stationarity

JRC, EU

- Eugénio Gutiérrez
- José-Manuel Zaldívar

Data, analysis

Spot price data



- Price per hour for the Nordic day-ahead exchange market
- Period: May 1992–January 2007
- Many countries joining in that period

Previous results

Scaling

- Weron, Przybylowicz (2000)
 - ▶ Hurst analysis: $H < 1/2$
 - ▶ Anti-persistent behavior
- Simonsen (2003)
 - ▶ Average wavelet method:
 $H = 0.41$
- Byström (2005)
 - ▶ Extreme-value statistics

Time series generation

- Perelló et al. (2006)
 - ▶ GARCH model
- Weron et al. (2004)
 - ▶ Jump diffusion
- Vehviläinen et al. (2005)
 - ▶ Mid-term modeling with climate factor

Long range correlations

- Autocorrelation:

$$C(\tau) = \langle s(t)s(t + \tau) \rangle \sim \tau^{-\beta}$$

- Power spectrum:

$$S(\omega) \sim |\omega|^{\beta-1}$$

- **Hurst exponent:**

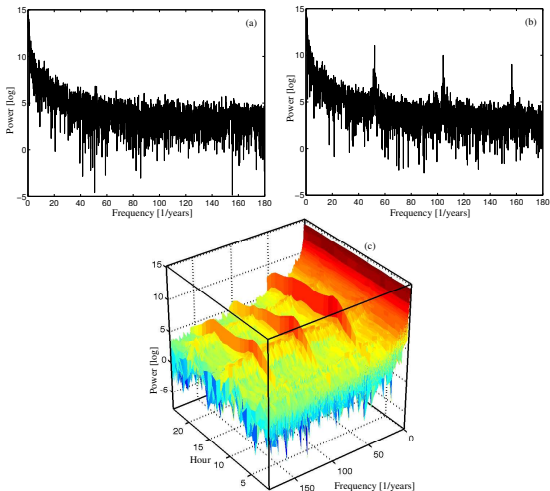
$$H = 1 - \frac{\beta}{2}$$

- R/S analysis:

$$R(\tau)/S(\tau) \sim \tau^H$$

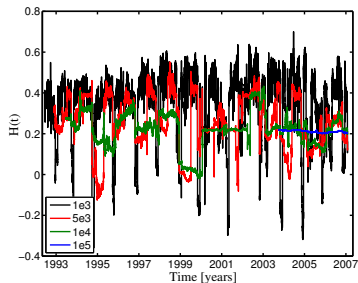
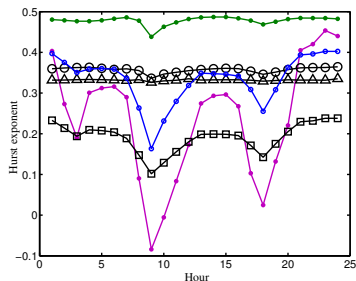
Anti-persistent	Uncorrelated	Persistent
$H < 1/2$	$H = 1/2$	$H > 1/2$

Manmade results: Periodicities



- Weekly periodic trends?
- Whole sample
 - ▶ No periodicity
- Fixed-hour sampling
 - ▶ Day: Periodicity
 - ▶ Night: No periodicity
- Effect on H ?

Manmade results: Time-varying correlations



- Fixed-hour samples:
 - ▶ H different for different methods
 - ▶ H dips at 9am and 6pm
- Time-varying window:
 - ▶ Longer time-window \Rightarrow less variation in H
 - ▶ Multiscaling properties: H changes at different time resolutions

Conclusions

- Long-range correlation: $H < 1/2$ (anti-persistent)
- Data not characterized by a single H
- Fixed-hour variations
- Time-window variations
- Multiscaling behavior of H
- Consequences for trading?

Publications



H. Erzgräber, F. Strozzi, J. M. Zaldívar, H. Touchette, E. Gutiérrez,
D. K. Arrowsmith

Time Series analysis and long range correlations of Nordic spot
electricity market data

To be submitted to *Physica A*, January 2008

QMUL report, July 2007



F. Strozzi, E. Gutiérrez, C. Noè, T. Rossi, M. Serati, J. M. Zaldívar

Application of non-linear time series analysis techniques to the Nordic
spot electricity market data

Submitted to *Physica D*, October 2007

LIUC report, October 2007