Aalto University
School of Science

Impact of renewable energy on electricity prices – comparative analysis of Denmark and Germany

Presentation of the subject of the thesis

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Agenda

1. European renewable energy policies and electricity spot markets in Denmark and Germany
2. Research objectives
3. Data
4. Methodology
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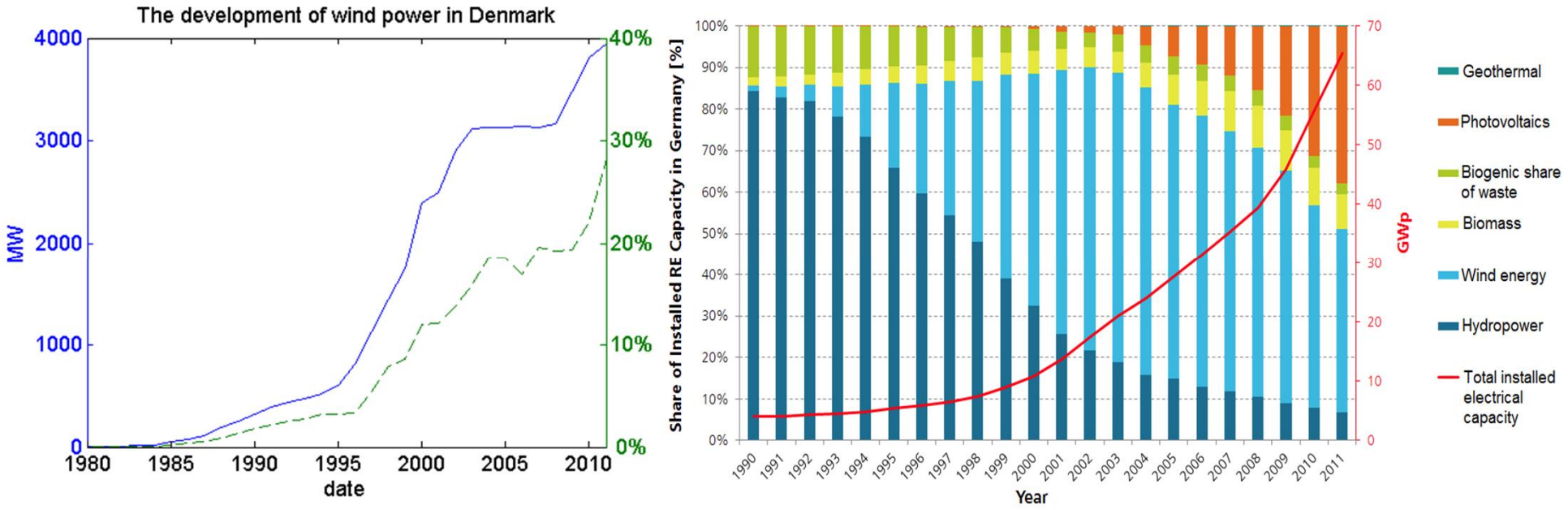
Renewable energy policies in the EU

- "**20-20-20**" targets for 2020
  1. Reduce 20 % EU greenhouse gas emissions from 1990 levels
  2. Raise the share of EU energy consumption produced from renewable resources to 20 %
  3. Improve 20 % the EU's energy efficiency
- **Share of renewable electricity** is a key measure

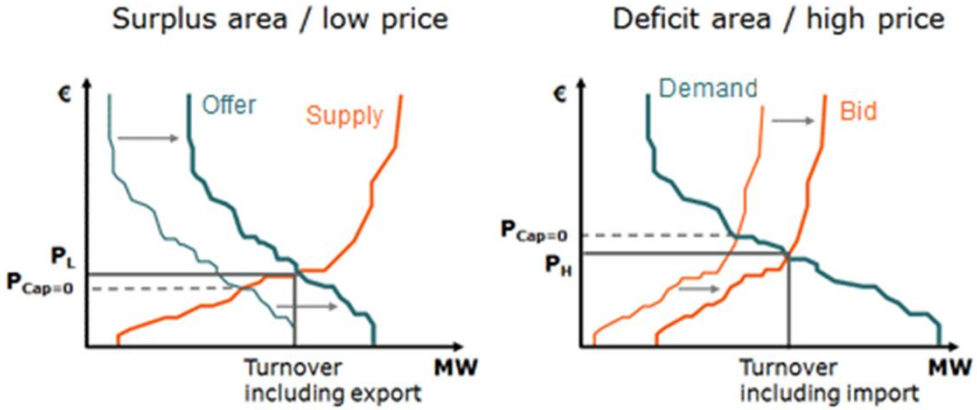
Country	2008 (%)	2009 (%)	2010 (%)	2020 (%)
Denmark	26.7	27.49	33.11	51.9
Finland	30.78	25.77	26.52	33.0
Germany	14.63	16.2	16.9	38.6

Trends in renewable electricity production in Denmark and Germany



Nord Pool and EEX

- Nord Pool operates in the Nordics, EEX in France, Germany, Austria, and Switzerland
- Majority of the volume is traded on the **day-ahead spot market**
- **System price** (Nord Pool) and **ELIX** (EEX) are the equilibrium prices of aggregated supply and demand curves without transmission constraints
- **Area prices** are usually more relevant



P_L and P_H → Prices for each area when full utilization of trading capacity

$P_{Cap=0}$ → Price in area with isolated price calculation.

Research objectives

- Estimate the impacts of intermittent renewable electricity production on **electricity price levels** and **volatility**
- Assess if there is a difference in **short-term** and **long-term** impacts
- Explain reasons for the results
- **Denmark and Germany** are good test beds because of substantial share of renewable generation and availability of data

Data

- Price data from Nord Pool and EEX
- Danish wind power data from Energinet.dk
- German wind and solar power data from EEX Transparency

- The **dependent variable** is **daily or weekly volatility of prices**
- $V_D = \sqrt{\frac{1}{24}\sum_{h=1}^{24}(P_h - P_d)^2}$, where

V_D is daily volatility, P_h price in hour h, and P_d daily price

- $V_W = \sqrt{\frac{1}{7}\sum_{d=1}^{7}(P_d - P_w)^2}$, where

V_W is weekly volatility, P_d price on day d, and P_w weekly price

Methodology

- Methodology from Mauritzen [1]
- Daily price volatility data for both Denmark and Germany is modeled as a SARMA process
- Weekly price volatility data is modeled as an ARIMA process
- In both cases, the best specification for the volatility is found by looking at ACF and PACF plots. The specification is validated by checking that the coefficients are statistically significant and by testing the model residuals with a Ljung-Box test
- Wind and solar power are **exogenous variables** for price volatility.
- Hence, the coefficients for wind and solar power show their impact on the price volatility
- All variables are transformed into the natural logarithm form
- Implementation using Excel, Matlab and R

Timetable

- 11/2012 acquire data, descriptive statistics
- 12/2012 models for Nord Pool
- 1/2012 models for EEX
- 3/2013 return the thesis

References

1. Mauritzen J. *What happens when it's Windy in Denmark? An Empirical Analysis of Wind Power on Price Volatility in the Nordic Electricity Market.* Norwegian school of economics and business administration; 2010.
2. Ketterer J. C., *The Impact of Wind Power Generation on the Electricity Price in Germany.* Ifo Institute, Leibniz Institute for Economic Research at the University of Munich; October 2012.
3. Jónsson T., Pinson P., Madsen H. *On the market impact of wind energy forecasts.* Technical University of Denmark; 2009.