Discussion of *A Pricing Measure to Explain the Risk Premium in Power Markets* by Fred Espen Benth and Salvador Ortiz-Latorre

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Outline

Power Markets

Special Features of Electricity Markets

- Electricity is an essential commodity
- Power is a (mostly) non-storable asset and has to be transported in a transmission network
- Delivery takes place over a time period (*swap contract*)
- Rather large price variations over short time periods observable in power markets (*spikes*)

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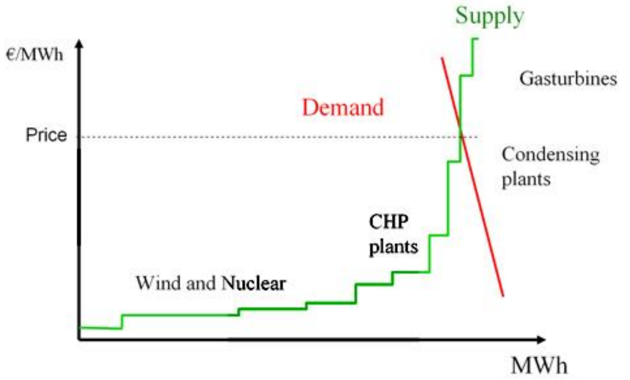
Consequences

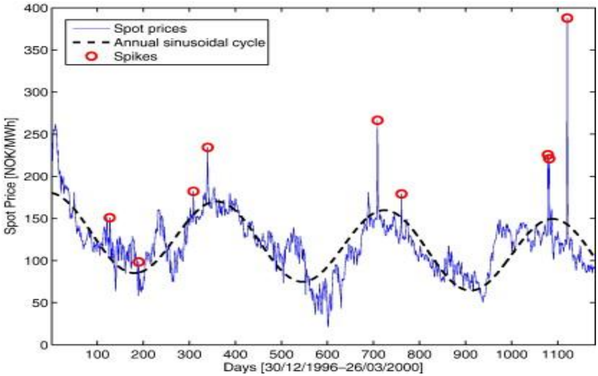
- Necessity for real-time balancing of supply and demand
- Electricity is a not directly tradeable asset
- Forward price of electricity cannot be derived by classical buy-and-hold hedging arguments

Supply and Demand Curve



Source: Risø DTU

NordPool Spot Prices



Nord Pool market daily average system price since December 30, 1996 until March 26, 2000.

Source: Rafał Weron (2008) **Market price of risk implied by Asian-style electricity options and futures**, Energy Economics 30(3): 1098-1115

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- second factor an OU process driven by pure jump Lévy process

$$Y(t) = Y(0) + \int_0^t (\mu_Y - \alpha_Y Y(s))ds + L(t),$$

where $L(t) = \int_0^t \int_0^\infty z N^L(ds, dz)$ with $N^L(ds, dz)$ a Poisson random measure,

$\Rightarrow$ models the characteristic spikes observed in power markets

Modelling Electricity Spot Prices

Arithmetic Spot Price Model

Models the spot price directly as two-factor dynamics

$$S(t) = \Lambda_a(t) + X(t) + Y(t), \quad t \in [0, T^*]$$

Geometric Spot Price Model

Models logarithmic spot price as two-facto dynamics

$$S(t) = \Lambda_g(t) \exp\left(X(t) + Y(t)\right), \quad t \in [0, T^*]$$

Λ_a, Λ_g : determ. processes accounting for seasonality in spot prices

Valuation of Forward Contracts

Forward Price

Forward price at time t for delivery in T with $0 < t < T < T^*$ is

$$\mathbb{E}_Q[S(T)|\mathcal{F}_t] = \mathbb{E}_P[S(T)|\mathcal{F}_t] + R_Q^F(t,T)$$

where Q is pricing measure, P is physical measure and $R_Q^F(t,T)$ denotes a risk premium.

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Risk Premium

- Producers are willing to pay a premium for hedging their production ⇒ creates a negative risk premium
- Consumers may want to hedge the price risk using forward contracts which are close to delivery ⇒ creates positive risk premium

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- can generate a stochastically varying risk premiums with stochastic non constant sign

Contributions Cont'd

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Approach allows for empirically observed facts like

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- Two-factor stationary spot price model can be directly fitted to power data

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Consequences

- Two-factor stationary spot price model can be directly fitted to power data
- Measure change can be calibrated by turning off (or slowing down) the speed of mean reversion

Questions

Spot Price Model

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   (for stochastic volatility models and NIG OU model see e.g. Collet, Duwig, Oudjane (2006))

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2. Are the trajectories generated by the model (after calibration) similar to those observed in the markets?
    - Can mean reversion really capture the rapid decline of electricity prices after a spike?
    - Using a time-inhomogeneous Lévy processes instead would allow to control for jump intensity (compare Weron (2008))

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   - Prices of green energy are then often much lower than those of nuclear power

   $\Rightarrow$ Distressed power industry of neighboring countries
   - On October 2nd, 2013, Focus reported that Doris Leuthard from Swiss Federal Council is asking for an energy agreement between Switzerland and the EU

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5. How good do model implied risk premia fit to ex-post premia observable in the market?
6. Can the model be used to identify the main economic factors which drive the risk premia in energy markets?

Thank you!