

Price Dispersion in the Norwegian Retail Electricity Market

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Outline

- Norwegian electricity market
- Theoretical approach
- Price development in electricity contracts
- Estimation of Cointegrated VAR-models
- Results
- Policy implications and conclusion

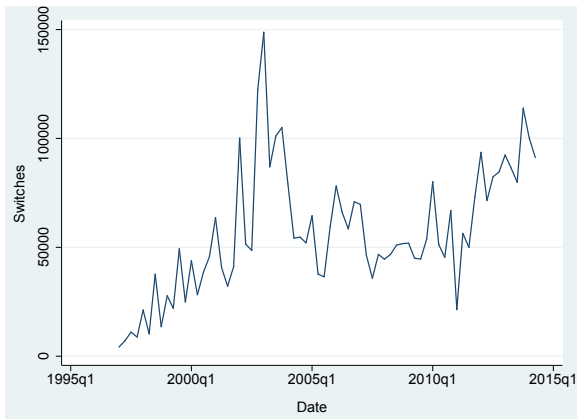
Background

From monopoly structure to competitive market structure in the early 1990s

- An independent electricity pool established
- Competition at the production level
- Competition in the retailing segment
- Prices available for comparison at an on-line information clearinghouse site

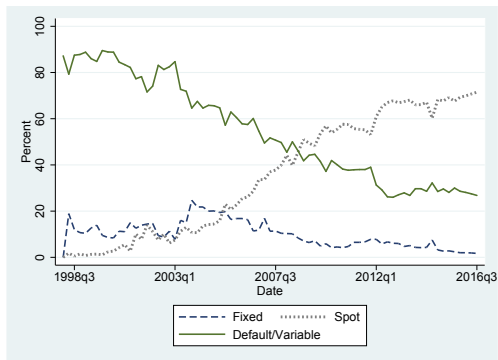
Development in households switching

Figure: Number of switches of electricity retailer



Electricity contract allocation

Figure: Contract allocation



Problem Statement

Although we have

- Homogeneous good and competitive market structure
- Price information available
- More than 20 years since switching fees were eliminated

Prices seem to vary...

Research questions

This study analyzes the presence of price dispersion from a two-pronged approach:

- 1 Development of price dispersion in electricity contracts
- 2 Identify factors of importance in explaining dispersion in prices by the Cointegrated VAR-framework

Theoretical approach

Two main approaches to rationalize price dispersion:

- Positive search costs as a rationale to explain dispersion in prices
 - Stigler (1961)
- Information clearinghouse perspective to rationalize price dispersion
- Salop and Stiglitz (1977), Varian (1980), Rosenthal (1980), Baye and Morgan (2002)

Theoretical rationalization of price distribution (Rosenthal (1980) -approach)

Theoretical expectations about price distribution in contracts can be expressed as:

Distribution of prices $F(p)$:

$$F(p) = 1 - \left(\frac{v - p}{p - m} \cdot \frac{L}{S} \right)^{\frac{1}{n-1}} \quad \text{on } [p_0, v] \quad (1)$$

Expectations of what to pay from consumers perspective

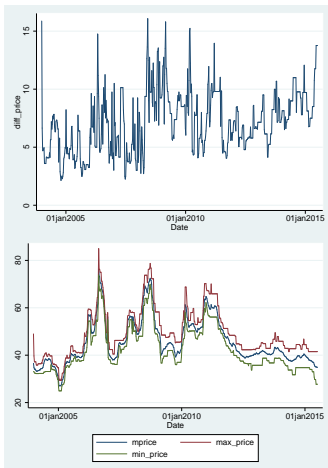
- Loyals expect to pay:

$$E(p) = \int_{p_0}^v p dF(p) \quad (2)$$

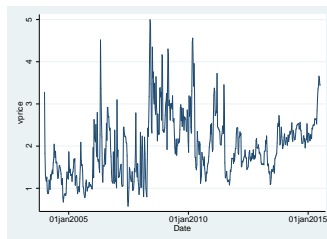
- Shoppers expect to pay:

$$E[p_{min^{(n)}}] = \int_{p_0}^v p dF_{min}^{(n)}(p) \quad (3)$$

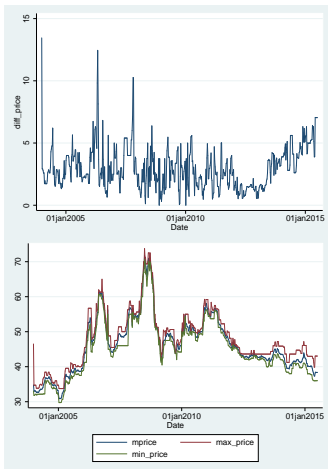
Fixed price 1 year contract



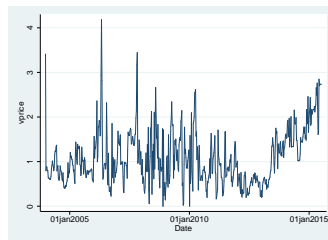
- 1 Dispersion over time
- 2 Max, Min Median
- 3 Variance



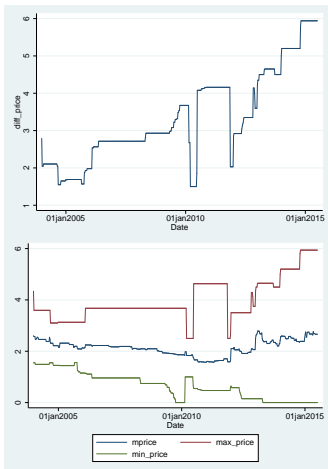
Fixed price 3 year contract



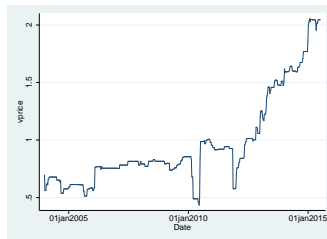
- 1 Dispersion over time
- 2 Min, max, median
- 3 Variance



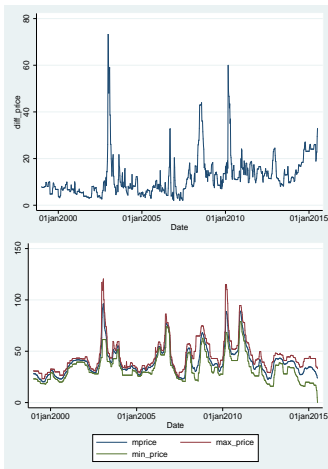
Market price contract



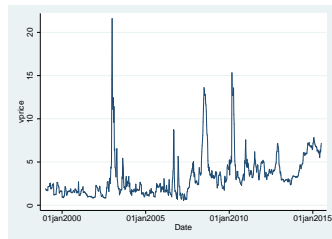
- 1 Dispersion over time
- 2 Min, max, median
- 3 Variance



Standard variable contract



- 1 Dispersion over time
- 2 Min, max, median
- 3 Variance



Three findings from price plots:

- Prices are trending over time
- Prices are not converging (the law of one price)
- Increased dispersion in prices over time (in all contract types)

Estimation approach

- Our approach to estimate price dispersion development in the short and long run is the the Cointegrated VAR model
- If there are one or more linear combinations of $I(1)$ variables that are $I(0)$, we have cointegration relationships
- estimate long-run equilibrium
- estimate speed of adjustment to equilibrium

$$Y_t = \Pi_1 Y_{t-1} + \dots + \Pi_k Y_{t-k} + \varepsilon_t \quad (4)$$

We reformulate (5) to a vector equilibrium correction model, such as:

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \dots + \Gamma_{k-1} \Delta Y_{t-k+1} + \alpha \tilde{\beta}' \tilde{Y}_{t-1} + \gamma_0 + \gamma + \varepsilon_t \quad (5)$$

From the cointegration rank test of a linear combination of price dispersion (*PD*), system price (*system*), and switch (*switch*) we determine:

- A cointegration rank of 1 in:
 - 1 year fixed price contracts
 - market price contracts
 - variable price contracts
- **No** cointegration rank in the 3 year fixed price contract

Estimation results

	Std.variable	Market price	Fixed price 1 year
	β	β	β
PD	1	1	1
switch	0.005 (0.0001)	0.0000071 (0.000017)	0.0001 (0.00004)
system price	0.05 (0.002)	0.012 (0.0031)	0.009 (0.0061)
trend	-0.664 (0.135)	-0.0619 (0.0211)	-0.034 (0.034)
	α	α	α
PD	-0.283 (0.086)	-0.120 (0.058)	-0.378 (0.135)
switch	-919.10 (245.92)	768.27 (2491)	-2852.65 (1084.49)
system price	-3.054 (1.294)	-40.13 (10.81)	-17.43 (5.64)

Estimated long run structure of models

The models after imposing rank $r = 1$ and including restrictions on β s yields the long run relationship for $\beta' Y_{t-1}$ for the three equations expressing price dispersion (PD) in market price contract (7), standard variable contract (8), and fixed price 1 year contract (9).

The estimated long run structure for the models:

$$PDmp_t = -0.000000707sw_{t-1} - 0.0122sy_{t-1} + 0.062t \quad (6)$$

$$PDsv_t = -0.005sw_{t-1} - 0.05sy_{t-1} + 0.664t \quad (7)$$

$$PDF1_t = -0.0001sw_{t-1} - 0.009sy_{t-11} + 0.034t \quad (8)$$

- Prices are not converging
- Our analysis detects heterogeneities among contracts in how changes in switching affects the distribution of prices
- Our analysis detects that a change in system price is more reflected in PD for the standard variable contract
- The direction of the estimated parameters is according to the theoretical model
- The significant trend estimate indicates that there are additional factors that are driving price distribution

Policy implications and further studies

Although...

- 1 The switching fee eliminated
- 2 A system in place for switching and comparing prices

This is not sufficient to eliminate price dispersion

Thank you!

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References I

- Baye, M. R. and Morgan, J. (2002). Information gatekeepers and price discrimination on the internet. *Economics Letters*, 76(1):47–51.
- Rosenthal, R. W. (1980). A model in which an increase in the number of sellers leads to a higher price. *Econometrica: Journal of the Econometric Society*, pages 1575–1579.
- Salop, S. and Stiglitz, J. (1977). Bargains and ripoffs: A model of monopolistically competitive price dispersion. *The Review of Economic Studies*, pages 493–510.
- Stigler, G. J. (1961). The economics of information. *Journal of Political Economy*, 69(3):213–225.
- Varian, H. R. (1980). A model of sales. *The American Economic Review*, 70(4):651–659.