EMPIRICAL EFFECTS OF POLICY INDUCED COMPETITION IN THE ELECTRICITY INDUSTRY: THE CASE OF DISTRICT HEATING PRICING IN FINLAND 1996-2002

Päivi Peltola-Ojala
Mikael Linden

ISBN 952-458-737-8
ISSN 1795-7885
no 29

EMPIRICAL EFFECTS OF POLICY INDUCED COMPETITION IN THE ELECTRICITY INDUSTRY: THE CASE OF DISTRICT HEATING PRICING IN FINLAND 1996-2002 **

Päivi Peltola-Ojala & Mikael Linden*

Abstract

The household electricity markets in Finland were opened to the competition in the 1st of November 1998. At the same time, the electricity transmission and distribution networks were regulated by special legislation by the Act on Electricity Markets and by special regulator the Electricity Market Authority. The regulation was extended to limit the unreasonable pricing and to separate the different business units (production, distribution and sales). The district heating industry is regulated through the general Competition Laws. The district heating industry is considered to have a regional monopoly within its distribution network and the level of public ownership within the industry is high.

The aim of the study is to analyse how the policy induced competition in the electricity industry has affected the district heating industry. Some effects are expected since both industries compete in the same household heating goods markets. The effects are studied through pricing behaviour by using panel data models. The data consists of 76 district heating companies in Finland in years 1996 – 2002. The results indicate that the electricity market reform caused a slight decrease to the district heating price. However, the results imply that the effect was only short term. The price decrease was stronger in apartment houses than in small houses. The results indicate also that the large and market dominant firms have been more policy reform responsive than small firms.

Keywords: Household energy markets, deregulation, market shares

---

*) *University of Joensuu, Department of Economics and Business, Yliopistokatu 7,BOX 111, FIN - 80101. mika.linden@joensuu.fi, paivi.peltola@joesuu.fi.*

**) *Paper presented at the 28th IAEE International Conference, 3rd – 6th of June 2005 in Taipei, Taiwan.*

I. INTRODUCTION

District heating industry can be defined as production and distribution of hot water in heating network. Therefore, the core of district heating business is the distribution and the production. This study concentrates to the core areas of district heating business.

The production of district heating is divided to separate production, CHP production and industrial process heat production. In 2003, the total district heating production was 32.2 TWh[1]. The share of CHP production was 75 % and separate production 25 % of district heating (SKY ry, 2004). The number of CHP companies was about 20 % of total district heating companies. The district heating industry is quite heterogeneous, because in one hand there are only few large energy companies and on the other hand there is some small so called one-man companies, which run very small-scale district heating distribution business.

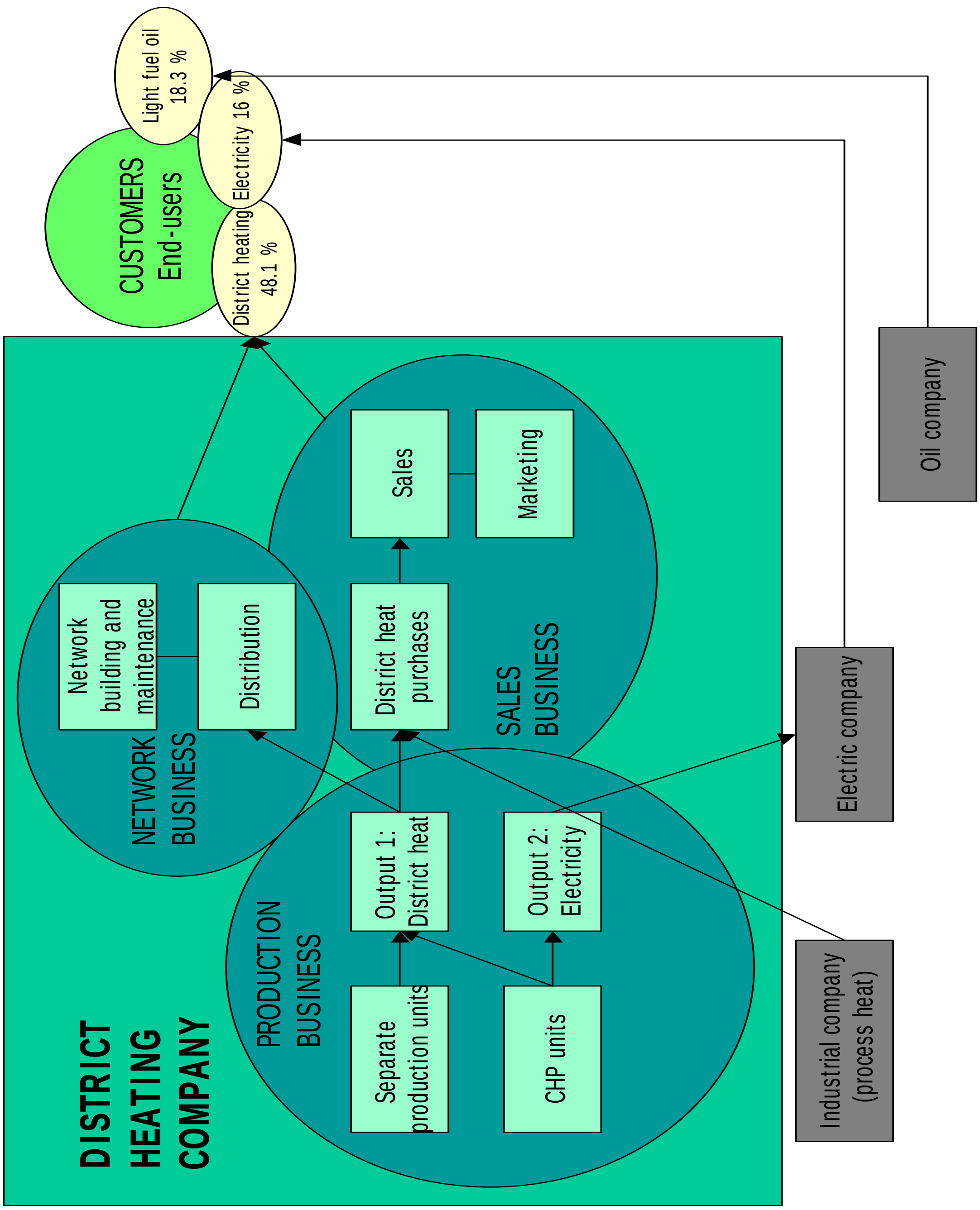
The Figure 1 illustrates operating of the district heating company. The district heating company can be theoretically divided to production, distribution, and sales business. Nowadays, most of the district heating companies are vertically integrated so all business elements belong to same company. In practice the division can be done by bookkeeping in large companies, but the division of small companies is difficult. In a small district heating company there is only few employers to take care of the production and distribution activities and the managing director handles the distribution and sales contracts. Especially in many small companies the maintenance services of the distribution network are outsourced. In some municipalities also the production business is separated to an own company so that the district heating water is produced in different industrial company, which production process produces hot water as side product, or production units are divided to an independent production companies. These independent production companies do not usually own any distribution network, because they only take care of the district heating water production.

The distribution network business includes network building and maintenance and the distribution of district heating. The sales business includes purchases of district heating and sales and marketing of district heating services to the customer. Only the sales business has a straight contact to the customer, because customer can not buy distribution service from one company, and district heating product (hot water) from another company (straight from a producer or other seller). The sales business is quite difficult to separate from distribution

[1] TWh = terawatt hour i.e. 1 TWh = 1 000 GWh = 1 000 000 MWh

business. Therefore, the most interesting part of the district heating business is, at least from this study's point of view, production and distribution.

Figure 1. The district heating company.



II. THE DEVELOPMENT OF THE ENERGY MARKET REGULATION

The energy markets have witnessed large changes during last 20 years. The most important change was deregulation of electricity markets in the 1990's. The prices of energy products were under state control until the end of 1980's. The price control was based on follow-up of production costs and advance notification of price increases. The follow-up of costs and development of pricing principles was done coordination with district heating and electricity sellers. Therefore, the pricing mechanisms of district heating and electricity are still quite alike. When the price control was ended in the end of 1980's there was a need to prevent excess pricing of energy products by promoting competition (Kauppa- ja teollisuusministeriö, 1994, 9). The deregulation of electricity markets took place gradually. In 1995 the Electricity Market Act game to force. It was based to the EU-legislation Directive 96/92. By the Electricity Market Act, the electricity markets were opened to competition. In the beginning, only the large customers with over 500 kW capacities per operational unit were entitled to buy the electricity from the competitive markets. In the beginning of 1997 all customers could by electricity from the competitive markets, but in practice, the small customers could not take part because of an expensive metering.

Situation of the small customers was improved in the autumn 1998 when balance-sheet clearance introduced so called type load system. Since September 1998 the households have not been needing electricity meter, which registers the consumption hourly basis, in order to buy electricity from competitive markets. Since November 1998 the electricity meter, which registers the consumption hourly basis, does not need also the customers which main fuse is maximum 3 x 36 ampere and order capacity maximum 45 kW (Energiamarkkinavirasto, 2004).

A special authority was founded to enforce the operation of the electricity markets. It was called Electricity Market Authority. Since the jurisdiction of Electricity Market Authority was extended to include natural gas markets the name was changed to Energy Market Authority in 1st August 2000. The Energy Market Authority does not have jurisdiction concerning district heating markets. In addition to the electricity markets the natural gas markets are also deregulated.

During last few years the Energy Market Authority has increased the regulation of electricity distribution and transmission network business. The Authority has introduced a control system for reasonable pricing (Energiamarkkinavirasto, 2004). The sales price of electricity power (the energy tariff) is determined in the competitive markets. In the end of September 2004, the Energy Market Authority has taken the initiative to the Ministry of Trade and Industry to reform the rules concerning the differentiation of electricity businesses and enforcement of reasonable pricing (Dnro 165/61/2004). In the end on 2004 the Parliament gave Acts which include rules limiting the level of reasonable profits from the electricity and the natural gas network business (L 1127/2004 and L 1293/2004).

In addition to the changes in the rules concerning electricity and natural gas markets the whole energy business has concentrated. Small energy companies have combined to regional energy companies. Even, some large foreign energy companies have bought Finnish energy companies and started their operations in Finland.

At the moment the district heating business has no special regulation. The operations of the district heating company is judged by general Competition Laws i.e. the Act on Competition Restrictions(L 480/1992) and Act on Improper Business Action(L 1061/1978). The Finnish Competition legislation has been harmonized with EU Competition Law, so the effect of EU case law will probably increase.

The special Competition Law concerning electricity and natural gas markets has the same aim but at some level the rules are stricter e.g. concerning unreasonable pricing. Therefore, the case law concerning these markets is not directly comparable.

III. THEORETICAL BACKGROUND AND RESEARCH QUESTIONS

Some studies have argued that the threat of regulation causes decrease in prices. The monopoly company behaves more competitive manner without any regulation, when the neighbouring business has been regulated. A German study described electricity markets, in which electricity transmission and distribution were unregulated but the electricity sales was regulated (Brunekreeft 2004. If the threat of regulation is real and credible, the threatened company has an incentive to limit its pricing. This leads to a situation where user price ends up to a lower level than if company freely maximises its profits (Brunekreeft 2004, 294).

The target of this article is to study whether the regulation of other energy markets through Electricity Market Act in 1997 has caused effects to the district heating pricing to the household customers. We have used two price variables: total district heating price to small houses and total district heating price to terraced houses and blocks. Also we study whether there was effects of 2001 Competition Council's decisions concerning the district heating pricing are under investigation (Kilpailuneuvosto, d:o 151/690/1999, Helsingin Energia and Kilpailuneuvosto, d:o 173/690/2000 Kuopion Energia). In 1999 the Competition Authority had proposed Competition Council to prohibit Helsingin Energia's abuse of dominance by unreasonable pricing and order sanctions. According to the Competition Authority the electricity and district heating pricing had been unreasonable since 1st September, 1992. Similar proposition was given in 2000 in Kuopio Energia case. According to the Competition Authority the electricity and district heating price has been unreasonable at least in 1997 – 1999. In 2001, the Competition Council gave a decision that it could not find enough evidence on abuse of dominance by unreasonable pricing.

(Driffield & Ioanniadis, 2000) analyzed the profit effects of investigation and regulation of the UK petrol industry. The study evaluated empirically the effects of 1979 and 1990 Monopolies and Mergers Commissions (MMC) investigations, Trade and Industry Select Committees investigations of 1988, and the petrol price marking order of 1981. The results showed clearly that the instigation of the 1979 MMC inquiry had a significant negative effect on the profit margins of the petrol companies. All other investigations, or attempts at regulation have been ineffective at reducing profitability (Driffield & Ioannidis 2000, 369-378). Since the effect has been long-term the study concludes, that the regulatory bodies in the UK had a significant effect on consumption efficiency within the petrol industry. This is despite the fact that the industry has never been found to act against the public interest (Driffield & Ioannidis 2000, 380). These investigations were self regulative since the industry had permanently reduced its profit level.

The third question involves the firm specific effects. We analyse which firm specific factors affect to the responsiveness on policy changes. Whether the large companies are more responsive to the regulatory threat than small companies, which can be an example of "regulatory threat hypothesis". Does join production companies, i.e. companies which produce both electricity and district heating, behave more responsively? Are companies which have large market share in the energy goods markets more policy response than many small firms?

Some studies have argued that firm specific effects matter. First, data from oil crisis of the late 1970s was used as a case study to explain the threat of regulation (Erfle, McMillan & Grofman 1990, 49). Grofman proposed the “regulatory threat hypothesis” which states, that ”when the threat of governmental price regulation is high, the larger, more visible firms in the threatened industry restrain price increases on those products where price changes are readily apparent to the public; the smaller, less visible firms do no exercised such price moderation. As the threat of governmental price regulation diminishes, firms which had previously exhibited price restraint (and thus whose products are underpriced relative to the market norm) rapidly increase prices to equalize with the industry average” (Erfle, McMillan & Grofman 1989, 136). The study used different dummy variables which described the amount of news time and reports concerning federal government’s interest on oil industry. The empirical study revealed three factors that affect the threat of regulation. 1) The intensity of public opinion demanding intervention, 2) the government’s capacity to react to that pressure, and 3) the availability of external scapegoats which deflect public attention from regulation (Erfle, McMillan & Grofman 1990, 60). They also find evidence to the “regulatory threat hypothesis”.

Second, Glazer and McMillan (1992) had studied factors affecting to company’s pricing behaviour when they are threatened with regulation (see also Block et al. 1981). Special interest was headed to changes in pricing marginal. They stated that separation of business units is important when changes in operational environment increase the probability of regulation and decrease the effects of price increases. They followed Peltzman’s (1976) idea in which the legislator prefers a product price lower than the monopoly price, but greater than the price at zero profit level. The legislator faces different problems. First, how to design methods so, that the regulator is not under industry’s control. Second, should cross-subsidisation be allowed and at what level. Third, how avoid changes in companies capital during the law is passed and it is executed (Glazer & McMillan 1992, 1089 – 1090). The study used game theory approach. They found that the increase in production costs decrease company’s profits, profits of regulation, and probability to carry out regulation. The existence of other legislative initiatives increases legislators’ costs and decrease probability of regulation. The monopoly’s price increases increase public pressure to decrease prices and increase profits from regulation. The results were as expected. The study examined also the costs of regulation more detailed. They discovered that the increase in the costs of regulation can cause both increase and decrease in companies’ prices (Glazer & McMillan 1992, 1093).

Threatened monopolist may try to avoid price rise if price rise increases the probability of regulation. But if regulator allows price rises to cover the increases in costs the threat of regulation may cause, the threatened monopolist to absorb cost increases. Therefore, the increase in production costs diminishes probability of regulation and increases expected profits. If average costs are constant, the monopoly sets the price to a level by which it only just avoids regulation. Then the company tries to increase price above average costs to level in which consumer welfare diminishes to the critical level. If demand curve is convex enough the difference between price and average costs causes increased effect to the profits. For example when demand is inelastic, the effect in consumer welfare equals the effect in profits and with more elastic demand the effects to the consumer welfare dominate. Then the company can earn higher profits at the same time it avoids regulation when production costs are high (Glazer & McMillan 1992, 1094 – 1095).

Third, Linden (2004) proposed a model where the incidence of regulation is an increasing function of monopoly price. It was also assumed that the regulator can identify the monopoly without knowing its cost structure and regulation threat imposes an implicit or explicit competitive price that deviates from observed (monopoly) supply price. Under the credible threat of regulation monopolist self-regulates its price on the level that is between the competitive and monopoly price. The risk of being regulated causes the monopoly to pay price premium to the consumers. The implications of the model for practical competition policy are clear. The authorities need not run extensive and costly regulation program. Some randomly chosen regulation cases and credible regulation threat may be more effective in cost-benefit terms.

IV. ECONOMETRIC MODEL, METHODS AND DATA

In the companion paper (Linden & Peltola-Ojala 2005) it was shown that the following dynamic panel data model based on SCP – framework familiar in industrial economics gives satisfactory results (for details see Appendix 1).

$$lnEprice_{it} = \alpha_i + \lambda_t + \beta_1 lnEprice_{it-1} + \beta_3 DPUB_{it} + \beta_4 lnMS_{it}$$

$$+ \beta_5 lnFUEL_{it} + \beta_6 lnSCALE_{it} + \beta_7 lnPRODS_{it} + \varepsilon_{it}$$

where

$lnEprice$ = firm's energy tariff for the district heat.

$DPUB$ = $0/1$ -dummy for the local public or state ownership of the firm.

$lnMS$ = the market share of district heat among the all heat products.

$lnFUEL$ = a proxy for firm's material input unit cost.

$lnSCALE$ = firm's output capacity, i.e. how much the firm has produced energy per year (measured in GWh).

$lnPRODS$ = firm's production share of district heat.

a_i is the firm specific variable for unobserved heterogeneity. λ_t is the common time effect for all firms describing the general business conditions. The price, ownership and production variables were collected by Finnish District Heating Association. The market share variables were collected by Statistics Finland. The data included 76 companies during seven years.

It was argued that model suffer from endogeneity bias problem. Variables like $lnMS$, $lnSCALE$, and $lnPRODS$ are typically non-exogenous for firm's pricing decision. The problem can be handled with instrumental variable estimation methods (IV) since technically question is of violation of so-called orthogonality conditions, i.e. non-correlation between the explanatory variables and error term. Main results from structural model estimation supported the non-competitive market structure: large market shares had a positive effects on energy tariff levels (see Appendix I, and Linden & Peltola-Ojala 2005).

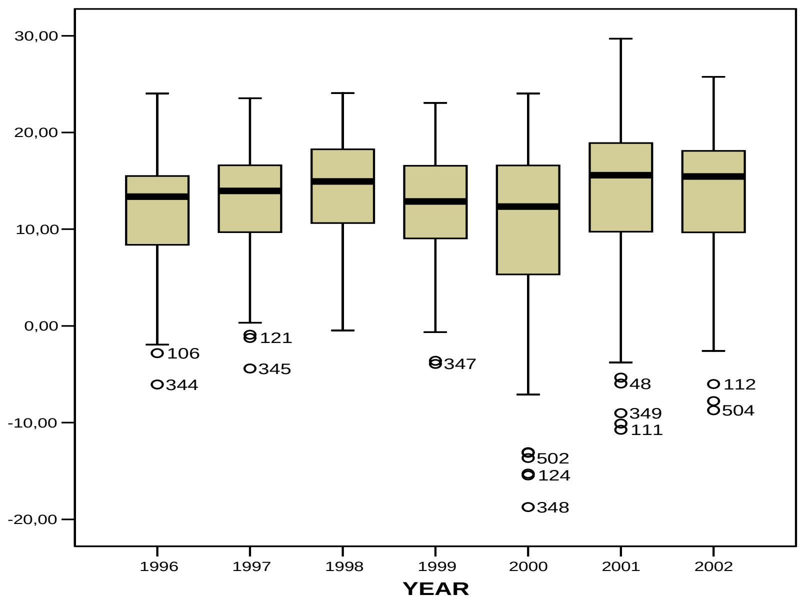
However the opening of energy markets for competition in the end of 1998 is an exogenous policy event that affects firm's market conditions. Following estimation strategy is used to analyse effects of this policy change. We estimate the above model in the pooled and in the two way fixed effects model form with IV- method. To secure true exogeneity of policy change the residual of these models are analysed with different dummy-variables. Another reason for this two step estimation procedure is the problems encountered with IV-estimation containing many yearly dummies. We use following dummies for OLS estimation of residuals of above structural estimation.

Constant gives the 1997 tariff level. The level is expected to zero since we analyse the residuals. Dummies *D98-D02* give the subsequent yearly exogenous (shock) effects on the tariff level. Naturally D99 is the most interesting case. Dummy DCOM analyses the case where policy change have permanent effects on the tariff pricing, i.e. has the tariff level been since 1999 at lower level than earlier due the competition. Note that the structural model contained both lagged endogenous variable and time effects variable. Thus all the trend effects are excluded from the residuals. However they can still include some non-modelled time specific firm effects. The firm's response to opening of markets for competition in year 1999 is a typical firm specific event. Depending on the firm's market position and share policy change can affect its tariff policy.

Table 1. Different yearly policy and shock dummies.

	1997	1998	1999	2000	2001	2002
Constant	1	1	1	1	1	1
DCOM	0	0	1	1	1	1
*D*98	0	1	0	0	0	0
*D*99	0	0	1	0	0	0
*D*00	0	0	0	1	0	0
*D*01	0	0	0	0	1	0
*D*02	0	0	0	0	0	1

Figure 2. The difference of the district heating energy tariff and estimated fuel costs 1996 – 2002.



The Figure 2 illustrates that the difference of the district heating energy tariff and estimated fuel costs difference fluctuates and it is at the lowest level in 2000. Since the fuel costs are estimated by market price of used fuel inputs, there are some negative values. Negative valeus can be explained with two reasons. First, companies can obtain some discounts when they are buying larger amounts, or second, costs and prices are not divided to different district heating services similarly in all companies. This is more probable since there are no binding rules stating how the tariffs should be formed.

V. RESULTS

Table 2. gives the OLS-estimations results of different time dummy models. D99 has a significant negative impact on the tariff level. However the market opening seems to be a one year shot only since the permanent effect dummy *DCOM* is not significant. However in years 2001 and 2002 we found tariff effects also. The positive tariff effect 2001 can be caused the Competition Council's acquittal. Tables 3. and 4 give the results for total tariff for small houses and apartment houses. Results are similar to Table 2. but for small houses both year 1999 policy and other year effects are smaller than for apartment houses. General result from analysis implies that policy change in 1999 to increase competition in energy markets has decreased the tariff prices. However the effect has been only temporary and quite small.

Table 2.Yearly time specific firm effects. OLS on residuals of structural district heating tariff model. Number of firms, N= 76. Years 1997 – 2002, T=6. (HCSE -corrected t-values in parenthesis).

	$POOLED_{IV}$				$PANEL_{IV}^{1FE}$
Constant	0.008 (1.56)	0.007 (0.82)	0.007 (0.83)	0.008 (0.77)	–
DCOM		–0.010 (-1.01)	0.002 (0.19)		
D98				-0.003 (-0.22)	–0.030 (-0.33)
D99	-0.047* (-3.83)		-0.048* (-3.69)	-0.048* (-3.11)	-0.044* (-3.79)
D00				-0.010 (-0.66)	-0.027* (-2.63)
D01				0.053* (3.42)	0.042* (3.26)
D02				-0.042* (-2.71)	-0.030* (-2.06)
R^2	0.031	0.002	0.031	0.101	0.107

Table 3. Yearly time specific firm effects. OLS on residuals of structural district heating total tariff (small houses) model. Number of firms, N=76. Years 1997 – 2002, T= 6. (HCSE-corrected t-values in parenthesis).

	$POOLED_{IV}$				$PANEL_{IV}^{1FE}$
Constant	0.004 (1.39)	0.003 (0.72)	0.003 (0.73)	0.007 (1.07)	–
DCOM		–0.005 (-0.88)	0.001 (0.19)		
D98				-0.006 (-0.68)	–0.004 (-0.45)
D99	-0.025* (-3.41)		-0.026* (-3.29)	-0.028* (-2.98)	-0.032* (-4.22)
D00				-0.007 (-0.80)	-0.019* (-2.61)
D01				0.025* (2.72)	0.022* (3.00)
D02				-0.023* (-2.56)	-0.015* (-2.06)
R^2	0.025	0.002	0.025	0.085	0.122

Table 4. Yearly time specific firm effects. OLS on residuals of structural district heating total tariff (apartment houses) model. Number of firms, N= 76. Years 1997 – 2002, T= 6. (HCSE-corrected t-values in parenthesis).

	$POOLED_{IV}$				$PANEL_{IV}^{1FE}$
Constant	0.007* (1.86)	0.007 (1.17)	0.007 (1.25)	0.010 (1.13)	–
DCOM		–0.010 (-1.45)	-0.003 (0.03)		
D98				-0.004 (-0.37)	0.004 (0.44)
D99	-0.043* (-4.57)		-0.043* (-4.32)	-0.045* (-3.81)	-0.038* (-4.24)
D00				-0.008 (-0.67)	-0.021* (-2.37)
D01				0.028* (2.36)	0.030* (3.30)
D02				-0.027* (-2.30)	-0.014 (-1.58)
R^2	0.044	0.005	0.044	0.090	0.130

VI. FIRM SPECIFIC EFFECTS OF PRICE ADJUSTMENT IN 1999

Preceding analysis showed that the firms reacted to opening of energy markets for competition in 1999. The effect of reform was decrease - albeit small - in tariffs. Next we analyse in details what are the firm specific determinants of year 1999 tariff cut. The analysis is conducted with the random coefficient model (RCM) estimation of panel data. We analyse once again the residuals $(\hat{\varepsilon}_{it})$ from structural model estimation (see Appendix I). Thus we estimated above model

$$lnEprice_{it} = \alpha_i + \lambda_t + \beta_1 lnEprice_{it\text{-}1} + \beta_3 DPUB_{it} + \beta_4 lnMS_{it}$$

$$+ \beta_5 lnFUEL_{it} + \beta_6 lnSCALE_{it} + \beta_7 lnPRODS_{it} + \varepsilon_{it}$$

to obtain $\hat{\varepsilon}_{it}$ that where analysed with policy change event dummies. Now we use year 1999 dummy for RCM approach for observations in $t = 1997, ..., 2002$

$$\hat{\varepsilon}_{it} = \alpha + \beta_i D99 + \mu_{it} \quad ,$$

$$E[\mu_{it}] = 0, \quad VAR[\boldsymbol{\mu}_i] = \sigma_i^2 \boldsymbol{I}$$

where $\qquad\qquad i = 1, ..., 76$

$$\beta_i = \beta + v_i \quad \text{with} \quad E[v_i] = 0 \quad \text{and} \quad VAR[\boldsymbol{v}_i] = \boldsymbol{\Omega}.$$

Thus we have

$$\hat{\varepsilon}_{it} = \alpha + \beta D99 + (\mu_{it} + D99 v_{it}) = \alpha + \beta D99 + w_{it},$$

where

$$E[w_{it}] = 0, \quad VAR[\boldsymbol{w}_i] = \sigma_i^2 \boldsymbol{I} + D99\boldsymbol{\Omega}D99.$$

This is a linear regression model where we allow for firm specific heteroskedasticity and correlation across the firms i. β_i for each firm is a random draw from a distribution with overall mean β. RCM enables us to estimate a two component reaction parameter for policy change in 1999. Parameter β_i includes common component for all firm β and firm specific component v_i.

Once we have obtained firm specific components β_i $(i = 1, 2, ..., 76)$ we can analyse their distribution and dependence on different firm characteristics in year 1999.

The results from RCM estimation was following (HCSE t-values in parenthesis)

$$\underset{}{\hat{\varepsilon}_{it}} = \underset{(1.52)}{0.0087} - \underset{(-3.76)}{0.052} D99, \quad \mathrm{R}^2 = 0.03, \quad \chi^2(150) = 1533.73,$$

where $\hat{\beta} = -0.052$ is the common reaction. The Chi-square test is for homogeneity $\beta_i = \beta_j$ for $i \neq j$. Clearly the firm specific components $\hat{\beta}_i$ are not equal. Figure 3. gives the distribution of $\hat{\beta}_i$'s. It is skewed to the left. This implies that some firms react quite strongly to policy change in 1999. Their tariff cut is more than on the average.

Figure 3. The firm specific components $\beta_i = \beta + v_i$.

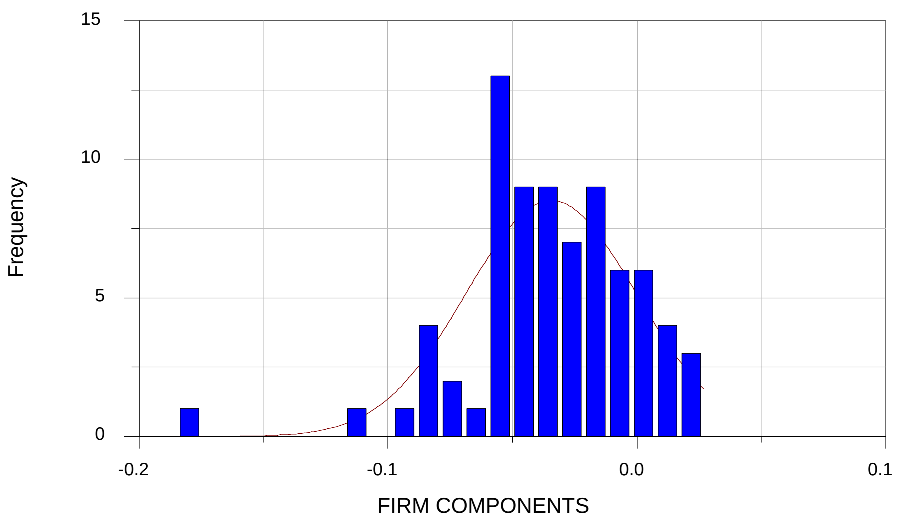


Table 5 gives regression result on $\hat{\beta}_i$'s with suitable firm characteristics. Note that we have used scaling $\ln(\hat{\beta}_i + 10)$ to preserve the logarithmic variables.

Table 5. Firm specific RCM components and firm characteristics in 1999. OLS estimation (BP: Breusch & Pagan test for residual hetero-skedasticity). N= 76 (HCSE-corrected t-values in parenthesis).

Constant	*DJOINT*	*DPUB*	*DCOMPANY*	$\ln FUEL$	*lnSCALE*	$\ln PRODS$
$2.313*$	$0.0028*$	–0.0008	$-0.0026*$	$-0.0041*$	–0.0038	$-0.0012*$
(13.12)	(2.44)	(–1.01)	(–3.61)	(–2.42)	(–1.07)	(–2.33)
$R^2 = 0.248$	$BP = 14.67*$					

The results are surprising and interesting. Only when the firm produces both electricity and heat *(DJoint)* the tariff decreasing effect of policy change in 1999 is attenuated. When the firm is a part of larger company ($DCOMPANY = 1,$ 0 otherwise) then the decreasing effects are confirmed. Similarly at the firm level large input costs *(lnFUEL)* and dominant market share *(lnPRODS)* are connected with larger than average tariff cuts. The state ownership *(DPUB)* and scale of energy production *(lnSCALE)* are non-significance for tariff reduction. Some firm specific heterogeneity is still present in residuals.

Generally the results imply that large and market dominant firms have been more responsive to year 1999 energy market reform. Their tariff cuts have been larger than average tariff reduction. The results with total tariff for small houses and apartment houses were similar to above (not reported).

VII. CONCLUSIONS

The results imply that the opening of electricity market for competition had short term effects on district heating pricing. The price effect lasted only about two years. The Competition Councils decision had an opposite effect to the district heating pricing. This was obvious since the decision was positive, no abuse of dominance through unreasonable pricing can be found.

The most interesting results were found when the firm specific components were analysed for year 1999 incidence. The large companies were found to be more responsive to the policy changes. This supports the “regulatory threat hypothesis”. Also the joint production companies reacted to the policy change. The companies with large input costs were also responsive. This is opposite to Glazer and McMillan (1992) view that regulatory threat is less probable if production costs are high. However the market share variable correlated with the company size variable and had a positive tariff level effect.

From the regulators and companies point of view the results are encouraging since the related industries regulation and competition authorities decision making have direct effects to the district heating pricing. The regulatory effects can be achieved without costly. The effects are quite strong since the 10 largest district heating companies sell about 50 % the total district heating sales (SKY ry, (2003)).

Until the end of 2004 the electricity and natural gas market regulation has not had specific rules on limiting the amount of profits from network business. It will be interesting to carry out a follow up study to find out whether this new profit level fixing will have more long term effects also to the district heating pricing.

REFERENCES

Block, M.K., Nold, F.C & Sidak, J.G. (1981). The Deterrence Effect of Antitrust Enforcement, Journal of Political Economy, Vol. 89, 429-445.

Brunekreeft, G., (2003). Regulatory Threat in Vertically Related Markets: The Case of German Electricity. European Journal of Law and Economics, Vol. 17, 285 - 305.

Driffield, N. & Ioannidis,C., (2000). Effectiveness and effects of attempts to regulate the UK petrol industry. Energy Economics, Vol. 22, 369 – 381.

Energiamarkkinavirasto, (2004). *Sähkömarkkinoiden avaaminen kilpailulle*. (www-dokumentti) http://www.energiamarkkinavirasto.fi/data.asp?articleid=105&pgid=38 (28.9.2004).

Energiamarkkinaviraston aloite Dnro 165/61/2004. Energiamarkkinaviraston aloite sähköliiketoimintojen eriyttämisestä annetun kauppa- ja teollisuusministeriön päätöksen (885/95) kumoamiseksi ja uuden asetuksen säätämiseksi. 17.9.2004.

Erfle, S., McMillan, H., & Grofman, B, (1990). Regulation via threats. Politics, media coverage, and oil pricing decisions. *The Public Opinion Quarterly*, Vol. 54, No. 1, Spring, 48 – 63.

Erfle, S., McMillan, H., & Grofman, B, (1989). Testing the regulatory threat hypothesis: Media coverage of the energy crisis and petroleum pricing in the late 1970s. *American Politics Quarterly,* Vol. 17, 132 – 152.

Glazer, A. & McMillan, H., (1992). Pricing by the Firm Under Regulatory Threat. *The Quarterly Journal of Economics*, Vol. CVII, Aug. 1992, Issue 3, 1089 – 1099.

Kauppa- ja teollisuusministeriö, Energiaosasto, (1994). *Sähkön ja kaukolämmön hintarakenteet. Energiansäästöohjelman taustaselvitys*. Kauppa- ja teollisuusministeriön tutkimuksia ja raportteja 77/1994.

Kilpailuneuvoston päätös, d:o 151/690/1999. Helsingin Energia. (18.6.2001).
Kilpailuneuvoston päätös, d:o 173/690/2000. Kuopion Energia. (18.6.2001).

KTMp 885/1995. Kauppa- ja teollisuusministeriön päätös sähköliiketoimintojen eriyttämisestä. (16.6.1995).

Laki maakaasumarkkinalain muuttamisesta 1293/2004. (30.12.2004).
Laki sähkömarkkinalain muuttamisesta 1127/2004. (21.12.2004).
Sähkömarkkinalaki 386/1995. (17.3.1995).
Laki kilpailunrajoituksista 480/1992. (1.9.1992).
Laki sopimattomasta menettelystä elinkeinotoiminnassa 1061/1978 (22.12.1978).

Linden, M. (2004). Regulation of Monopolies: A Randomized Approach. JoY/Business and Economics Discussion Papers N:o 19.

Linden, M. & Peltola-Ojala, P. (2005). Competition and Product Price Dynamics in the Finnish District Heat Markets, JoY/Business and Economics Discussion Papers N:o 28.

Peltzman, S., (1976). Toward a More General Theory of Regulation. *The Journal of Law & Economics*, Vol. XIX (2), Aug, 1976, 211 – 240.

Suomen Kaukolämpö ry (SKY ry), (2004). Kaukolämpövuosi 2003. Lehdistötiedote 5.1.2004. (www-dokumentti) http://www.energia.fi/page.asp?Section=401&Item=7740 (13.1.2004).

Suomen Kaukolämpö ry (SKY ry), (2003c). *Kaukolämpötilasto 2002*
Suomen Kaukolämpö ry, (SKY ry), (2002a). *Kaukolämpötilasto 2001*.
Suomen Kaukolämpö ry, (SKY ry), (2001a). *Kaukolämpötilasto 2000*.
Suomen Kaukolämpö ry, (SKY ry), (2000a). *Kaukolämpötilasto 1999*.
Suomen Kaukolämpö ry, (SKY ry), (1999a). *Kaukolämpötilasto 1998*.
Suomen Kaukolämpö ry, (SKY ry), (1998a). *Kaukolämpötilasto 1997*.
Suomen Kaukolämpö ry, (SKY ry), (1997a). *Kaukolämpötilasto 1996*.
Suomen Kaukolämpö ry, Hintatilastot 1996 – 2002.

APPENDIX 1a. IV (2SLS) estimation results for district heat energy tariff in Finland $(lnEprice)$. Number of firms $N = 76$. Years 1997-2002, $T = 6$. (HCSE -corrected t-values in parenthesis).

	$POOLED_{IV}$	$PANEL_{IV}^{2FE}$
Constant	-9.293 (-1.63)	0.125 (0.188)
TIME	0.005* (1.76)	-
$lnEprice_{-1}$	0.701* (15.71)	0.212* (3.13)
DPUB	0.012 (0.127)	0.138* (2.74)
lnMS	-0.013 (-1.02)	0.094 (0.94)
lnFUEL	0.101* (3.52)	0.105* (2.64)
lnSCALE	-0.005 (-0.23)	0.380* (2.92)
lnPRODS	0.017 (1.28)	0.038 (0.82)
R^2	0.697	0.813
DW / AC	2.16/-0.08	2.08/-0.05
Hausman	1.12	2.73

*) significant at 10% critical level or below

$POOLED_{IV}$: Instrumental variables (IV) estimation. Instruments: all exogenous variables (TIMEr, DPUB, lnFUEL) and one year lagged values of lnFUEL and endogenous variables (lnMS, lnSCALE, lnPRODS).

$PANEL_{IV}^{2FE}$: 2-way fixed effect (2FE) panel data instrumental variable estimation (IV).

Instruments: (DPUB, lnFUEL) and one year lagged values of lnFUEL and endogenous variables (lnMS, lnSCALE, lnPRODS).

DW/AC: Durbin-Watson test statistics and estimated residual 1st order autocorrelation

Hausman: Orthogonality test for valid instruments (H_0: $Corr(X_{IV}, \varepsilon)=0$)

APPENDIX Ib. IV (2SLS) estimation results for district heat energy total tariff in Finland (Small houses, $lnEprice^{SM}$). Number of firms $N = 76$. Years 1997-2002, $T = 6$. (HCSE -corrected t-values in parenthesis).

	$POOLED_{IV}$	$PANEL_{IV}^{2FE}$
Constant	-5.314 (-1.48)	1.769 (4.63)
TIME	0.003* (1.63)	-
$lnEprice_{-1}^{SM}$	0.816* (19.23)	0.242* (4.42)
DPUB	0.031 (0.424)	0.017* (0.57)
$lnMS^{SM}$	-0.002 (-0.69)	-0.029 (-0.67)
lnFUEL	0.059* (2.85)	0.071* (3.05)
lnSCALE	-0.002 (-0.12)	0.195* (2.44)
lnPRODS	0.006 (0.67)	0.050* (1.76)
R^2	0.798	0.881
DW / AC	2.27/-0.14	2.12/-0.07
Hausman	0.78	2..83

*) significant at 10% critical level or below

$POOLED_{IV}$: Instrumental variables (IV) estimation. Instruments: all exogenous variables (TIME, DPUB, lnFUEL) and one year lagged values of lnFUEL and endogenous variables ($lnMS^{SM}$, lnSCALE, lnPRODS).

$PANEL_{IV}^{2FE}$: 2-way fixed effect (2FE) panel data instrumental variable estimation (IV).

Instruments: (DPUB, lnFUEL) and one year lagged values of lnFUEL and endogenous variables ($lnMS^{SM}$, lnSCALE, lnPRODS).

DW/AC: Durbin-Watson test statistics and estimated residual 1st order autocorrelation

Hausman: Orthogonality test for valid instruments (H_0: $Corr(X_{IV}, \varepsilon)=0$)

APPENDIX Ic. IV (2SLS) estimation results for district heat energy total tariff in Finland (Apartment houses, $lnEprice^A$). Number of firms $N = 76$. Years 1997-2002, $T = 6$. (HCSE -corrected t-values in parenthesis).

	$POOLED_{IV}$	$PANEL_{IV}^{2FE}$
Constant	-10.179 * (-2.21)	2.140 (3.17)
TIME	0.005* (2.34)	-
$lnEprice_{-1}^A$	0.750* (10.81)	0.175* (3.32)
DPUB	-0.085 (-1.07)	0.041 (1.19)
$lnMS^A$	0.001 (0.11)	-0.142 (-0.95)
lnFUEL	0.049* (2.01)	0.086* (3.11)
lnSCALE	0.014 (0.71)	0.229* (2.55)
lnPRODS	0.024 * (2.68)	0.058* (1.77)
R^2	0.691	0.838
DW / AC	2.17/-0.09	2.09/-0.06
Hausman	2.76	3.70

*) significant at 10% critical level or below

$POOLED_{IV}$: Instrumental variables (IV) estimation. Instruments: all exogenous variables (TIME, DPUB, lnFUEL) and one year lagged values of lnFUEL and endogenous variables ($lnMS^A$, lnSCALE, lnPRODS).

$PANEL_{IV}^{2FE}$: 2-way fixed effect (2FE) panel data instrumental variable estimation (IV). Instruments: (DPUB, lnFUEL) and one year lagged values of lnFUEL and endogenous variables ($lnMS^A$, lnSCALE, nPRODS).

DW/AC: Durbin-Watson test statistics and estimated residual 1st order autocorrelation

Hausman: Orthogonality test for valid instruments (H_0: $Corr(X_{IV}, \varepsilon)=0$)