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Transformation of Slovenia's Electricity Distribution System Toward Market Competition

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Abstract: In this paper the authors first analyse the readiness of electricity consumers for increased competition between the electricity suppliers and study their expectations regarding additional provision of electricity (non-)related services and products. The authors focus on such expectations of household customers and define main determinants of consumer choices by analysing demand and consumers' willingness to switch electricity supplier and willingness to pay. The authors then analyse the ability of existing electricity distribution companies for operating in a more competitive environment. They show how the differences in performance and efficiency affect their ability to operate in a more competitive environment.

Keywords: electricity, market competition, electricity distribution, Slovenia

JEL Classification: K23, L94

Introduction

In countries, in which the electricity systems are the successors of former state and plan controlled systems, there is a challenging task of establishing a more contemporary electricity system, where the market, competition and private ownership play an important role. This task is challenging not only because the needed changes are significant but also because such countries have less experience

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in implementing market-oriented reforms compared to West European countries. In the last decade, all East European transition countries attempted to modernise, privatise and regulate their electricity sectors with varying degrees of success (EBRD, 2004). The need for such changes can sometimes be questioned as these state controlled systems provided relatively reliable electricity supply. However, some studies show lower efficiency of electricity distribution companies compared to West European countries (e.g. Cullmann, von Hirschhausen, 2008).

In this paper the authors use the case of the Slovenian electricity distribution companies to describe the transformation of the ex state-owned electricity systems into more contemporary systems, in which the competition leads to more efficient and customer oriented network operators and suppliers. Following Gaunt (2008) the authors take into account five dimensions of transformation of the electricity distribution sector. These include (a) the issue of offering single or multiple services (e.g. electricity, water, other), (b) vertical integration or unbundling, (c) technical, cost and scale efficiencies, (d) ownership and (e) competition and regulation. Authors discuss these topics for the case of electricity distribution system in Slovenia and analyse the environment which requires such transformation, suitability of the Slovenian electricity system for such transformation, possible forms of transformation, and also the results that could be achieved by such transformation.

Slovenian electricity distribution system consists of five predominantly state owned firms, which are regionally distributed, are the owners of the electricity distribution network and operate both on the wholesale and retail electricity markets. Besides these five firms a new firm, supplying electricity on the retail market, was established. The ownership of the new firm is mixed – half private, half state. Although the existing electricity distribution companies divide the electricity market regionally, the legislation and the European directives enable horizontal mobility of both business consumers and households. This is a precondition for establishing competition between the electricity suppliers. However, even though a single company has a formal role of a system operator, the electricity distribution companies that are supposed to be competing are all in large part state owned and are still owners of regional electricity distribution networks and infrastructure. Consequently the competition between them is weak and is not achieving the desired effects.

In this paper the authors first analyse the readiness of electricity consumers for increased competition between the electricity suppliers and study their expectations regarding additional provision of electricity related services and products. The authors focus on such expectations of household customers and define main determinants of consumer choices regarding the electricity purchases. They analyse what consumers would expect of such companies in case competition strengthened. The authors then analyse the ability of existing electricity distribution companies for

operating in a more competitive environment. They do so by analysing their business performance and by evaluating their technical and cost efficiency. They show how the differences in performance and efficiency affect their ability to operate in a more competitive environment. Authors use standard financial performance analysis and data envelopment analysis to evaluate performance and efficiency. In the last part of the paper the authors outline the needed legal, institutional and organisational changes for increasing competition between the existing electricity distribution companies. These changes relate to the issues of separating activities related to the network operation from the activities of selling electricity, the issues of privatisation of the existing electricity distribution companies, the issues of regulating their business operations and the electricity market in order to assure competition between existing and new players engaging in selling electricity to end customers.

Horizontal Mobility in Households' Electricity Market in Slovenia

As we mentioned earlier in the paper, we examine customers' preferences regarding competition among electricity suppliers and competition strategies that would allow suppliers meeting those expectations. We measure preferences by customers' willingness to switch electricity supplier (i.e. willingness to choose other electricity supplier) and willingness to pay for products and service, supplied by electricity distribution companies. The availability of data allows us to limit our analysis to household customers.

Goals and Hypotheses

The goal of our analysis is to answer the following questions:

1. whether and to what extend households are willing to switch electricity supplier in the circumstances of price differences among electricity suppliers;
2. whether willingness to switch electricity supplier is influenced by electricity price and non-pricing factors such us additional provision of electricity (non-) related services and products, reliability of electricity supply, and time-consuming administrative procedure of switching electricity supplier;
3. what is household's probability of switching electricity supplier under various differences in price of electricity among electricity suppliers and whether this probability is influenced by demographic characteristics of households;
4. whether probability of switching electricity supplier is different in the presence of the additional provision of products and services and reliability of electricity

supply and than in the presence of complicated and time-consuming administrative procedure of switching electricity supplier;

5. what are possibilities for product differentiations regarding products and services that are not (closely) linked with electricity supply and which factors influence households' willingness to pay for these products and services.

We test the following hypotheses we formed on the basis of literature review (Choynowski 2002; Ek in Söderholm, 2008; Gamble et al. 2009; Goe et al. 2000; Giulietti et al. 2005; Pomp in Shestalova, 2007; Rowlands et al. 2004):

H1: Households' willingness to switch electricity supplier in Slovenia is influenced by price of electricity and the following non-prising factors: additional provision of electricity (non-) related products and services, reliability of electricity supply, and complicated and time-consuming administrative procedure of switching electricity supplier.

H2: Households' probability of switching electricity supplier in Slovenia is influenced by price of electricity and non-pricing factors.

H3: At each difference in electricity prices among suppliers, households' probability of switching electricity supplier in Slovenia is influenced by socio-economic characteristics of households, households' satisfaction with current electricity supplier and households' predisposition to foreign electricity producer.

H4: Households are willing to pay for additional electricity non-related products and services from current electricity supplier in Slovenia. However, willingness to pay for those products and services is relatively low and depends on socio-economic and demographic characteristics of households.

Methodology

In order to examine households' willingness to switch electricity supplier and factors that influence it, we analysed households' preferences and point price elasticity of switching electricity supplier. We calculated point electricity under the following circumstances: i) there is a certain difference in electricity price between household's current and potential supplier, ii) household's current electricity supplier offers favourable electricity price and additional electricity (non-) related products and services in comparison to potential supplier, iii) household's potential supplier offers lower reliability of electricity supply that current supplier, iv) administrative procedure of switching electricity supplier are complicated and time-consuming, v) household's current and potential suppliers offer the same electricity price and additional products and services. Under each of those circumstances, we calculated

point price elasticity of switching electricity supplier at differences in electricity prices among suppliers of 2, 5, 8, 10, 15 and 30 percent.

We use a binomial model of discrete choice (Greene 2003, Gujarati 1995) to represent the choice of a particular household to switch electricity supplier. The model is specified as

$$SWITCH_{i,\Delta p} = \beta_{\Delta p} Z_{i,\Delta p} + \varepsilon_{i,\Delta p} \quad (1)$$

where $SWITCH_{i,\Delta p}$ denotes a discrete dependent variable with value of 1, if a particular household i would switch electricity supplier at observed difference in electricity price between current and potential supplier Δp (Δp = 2,5,8,10,15 or 30), and value of 0, if a particular household would not switch electricity supplier at observed difference in electricity price. $Z_{i,\Delta p}$ denotes a vector of factor affecting the decision to switch supplier. $\varepsilon_{i,\Delta p}$ is an error term and $\beta_{\Delta p}$ a vector of parameters. In order to test hypotheses, we specified 24 models, which differ according to observed price differences and observed non-pricing factors, i.e. socio-economic characteristics of household, households' satisfaction with current electricity supplier and households' willingness to purchase from foreign electricity producer.

We examine possible product differentiation regarding additional provision of electricity (non-) related services and products with analysing households' preferences regarding supply of those products and services and with estimating willingness to pay for selected products and services (see for example Choynowski 2002). We use a binomial model of discrete choice to examine determinants of willingness to pay for selected additional product/service. The model is specified as:

$$PRODUKT_{i,s} = \alpha_0 + \alpha_s Z_i + \varepsilon_{i,s} \quad (2)$$

where $PRODUKT_i$ denotes a discrete dependent variable with value of 1, if a particular household *i* would be willing to pay for selected additional product/service *s* , and value of 0, if a particular household i would not be willing to pay for selected additional product/service s. $Z_{i,s}$ denotes a vector of factors affecting willingness to pay, $\varepsilon_{i,s}$ is an error term and α_s denotes the manner in which independent variables impact dependent variable.

We estimate parameters of models, specified as it is shown with equations 1 and 2, with logistic regression. We use the method of maximum likelihood.

Sample

We use an unbalanced sample of households, which were purchasing electricity from one of five electricity distribution companies in Slovenia (Supplier X). 497 households of supplier x were interviewed in October and December 2007, when all households were able to choose their electricity supplier but choice was still novel.

Table 1 shows the sample of households. The structure of sample indicates that the sample is representative as the share of interviewed households in a particular area corresponds to the share of supplier's households living in that area.

Table 1: The sample of households

Geographical area of electricity supply	Frequency	Percent of responses	Percent of households
1	202	41.74	40.32
2	70	14.46	13.97
3	52	10.74	10.38
4	83	17.15	16.57
5	77	15.91	15.37
6	491	100	96.61
7	10	-	3.39
Total	501	100	100

Source: Own calculation.

Specification of Independent Variables

We presume that non-pricing determinants of electricity supplier switching and willingness to pay are socio-economic and demographic characteristics of households, households' satisfaction with current electricity supplier and households' willingness to purchase from foreign electricity producer. We use households' purchasing power (i.e. expense for electricity in a year), employment status and type of residence (house/flat) as indicators of socio-economic characteristics of households. We use household size, education, age structure, gender structure and location of residence (city/countryside) as indicators of demographic characteristics of households. Descriptive statistics of independent variables are listed in Table 2.

We selected independent variables with the analysis of correlation between all indicators. Correlation coefficients indicate no significant correlation between variables with exception of the number of household's members older than 60 years and number of pensioners in household (correlation coefficient is 0.77). We choose the number of pensioners in household as indicator of socio-economic characteristic of household as it is believed that this variable express this characteristic of household to the largest extend.

Table 2: Independent variables of binomial logit models of switching electricity supplier

Variable	N	Mean value	Standard deviation	Min value.	Max. value
Satisfaction with current electricity supplier	496	3.8	0.99	1	5
Household's costs for electricity in a year	480	45.46	27.42	0	320
Number of household's member	496	3.44	1.42	1	8
Number of household's member under 18 years old	497	0.72	0.95	0	7
Number of male household's member	497	1.56	0.85	0	5
Number of household's member with high education	496	0.79	0.99	0	6
Number of household's member that are full time employed	496	1.34	0.99	0	6
Number of household's member that are part time employed	494	0.38	0.64	0	3
Number of pensioners in household	497	0.62	0.8	0	3
Dummy variable for city (countryside)					
Dummy variable for residence in house (apartment)					
Dummy variable for households' preferences regarding electricity, produced by Austrian producer					
Dummy variable for households' preferences regarding electricity, produced by Croatian producer					

Source: Own calculation.

Results

Results from the analysis of price elasticity and the willingness of households to switch electricity supplier are reported in Table 3. Considering only price competition (Columns 2-4) results indicate high price elasticity of switching as almost 50 percent of households are willing to switch electricity supplier if competitive i.e. potential) supplier would offer them 15 percent lower electricity prices than current supplier (Column 3). Price elasticity of switching increases up to differences in electricity price between current and potential supplier for 10 percent, when point price elasticity of switching reaches its maximum value. This result indicate that households respond to an increase in differences in electricity prices to the largest extent when difference in electricity price between current and potential supplier increases from 8 to 10 percent. Results are the same if we consider price and non-price competition in the form of provision of additional electricity (non-) related services and products at reasonable prices from current supplier (Columns 5-7), and reliability of electricity supply (Columns 8-10), as well as duration and the difficulty of administrative procedures of switching. However, the value of point price elasticity of switching indicates that electricity suppliers have a power (or possibility) to decrease the willingness of its households to switch to competitive supplier that offers lower electricity price if they supplement electricity supply with additional products/services at preferable prices. The importance of non-price competition is also reflected by the result that 40 percent of households are willing to switch electricity supplier if there would be no differences in electricity prices between current and potential supplier, yet potential supplier would offer them additional products/services not related directly to electricity supply at preferable price. Moreover, willingness to switch electricity supplier is higher at same differences in electricity prices if administrative procedures for switching are complicated and time-consuming.

The estimation results from logit models of switching electricity supplier show that specified models can be used to investigate determinants of probability to switch electricity supplier. The exceptions are models which incorporate electricity price differences among competitive supplier for 30 percent.

Households' probability of switching is significantly influenced by all analysed non-price determinants of competition. The most significant for households is reliability of electricity supply; the influence of supplier's reliability of electricity supply on households' willingness to switch is significantly larger than the influence of the additional provision of non- electricity services and products. The influence of administrative obstacles on willingness to switch electricity supplier is larger under circumstances of significant increase in electricity price in comparison to electricity price of competitive supplier.

Table 3: Willingness to switch electricity supplier under price and non-price competition

	Households' willingness to switch electricity supplier											
	if competitive (i.e. potential) electricity supplier would offer lower electricity price than current electricity supplier …											
	… considering only differences in electricity price	… but current electricity supplier would offer supply of additional product/services at preferable prices	… but current electricity supplier would assure higher reliability of electricity supply	… and administrative procedures for switching electricity supplier would be complicated and time-consuming								
Difference in electricity price (in %) (1)	Share of households that would switch supplier (2)	Cumulative share of households that would switch supplier (3)	Point elasticity of switch (4)	Share of households that would switch supplier (5)	Cumulative share of households that would switch supplier (6)	Point elasticity of switch (7)	Share of households that would switch supplier (8)	Cumulative share of households that would switch supplier (9)	Point elasticity of switch (10)	Share of households that would switch supplier (11)	Cumulative share of households that would switch supplier (12)	Point elasticity of switch (13)
0	34.15	-	-	39.8	-	-	42.63	-	-	40.16	-	-
2	4.67	4.67	2.43	2.63	2.63	1.34	2.42	2.42	1.23	5.07	5.07	2.64
5	6.1	10.77	2.2	4.24	6.87	1.47	3.84	6.26	1.32	6.49	11.56	2.36
8	12.2	22.97	4.93	8.89	15.76	3.29	6.87	13.13	2.46	9.53	21.09	3.77
10	17.48	40.45	13.35	16.16	31.92	10.8	11.11	24.24	6.67	13.39	34.48	9.3
15	10.57	51.02	3.78	11.92	43.84	3.71	15.35	39.59	4.45	10.75	45.23	3.44
30	14.84	65.86	2.25	16.36	60.2	2.12	17.78	57.37	2.15	14.6	59.83	1.88
	100			100			100			100		

Source: Own calculations

Furthermore, results demonstrate that households' willingness to switch electricity supplier is additionally influenced by socio-economic and demographic characteristics of households. At lower electricity price changes (increase of 2 percent with regard to electricity price of competitive suppliers) probability of switching electricity supplier is significantly negatively influenced by the households' number of pensioners and number of part-time employed members. The probability of switching is higher in household from the countryside and not from the city, living in apartment and not in house and willing to pay for electricity, produced by Austrian producer. At electricity price increase for 5 percent with regard to electricity price of competitive suppliers, basic factors that influence probability of switching electricity supplier are the same as at electricity price increase for 2 percent, yet the influence of area of living (countryside or city) and residence (apartment or house) becomes insignificant. At electricity price increase for 8 percent with regard to electricity price of competitive suppliers, households' willingness to switch electricity supplier is additionally positively influenced by number of household's members and negatively influenced by number of full-time employed members. Probability of switching at larger electricity price increases is significantly influenced only by the number of household's members and household's number of pensioners; the influence of both characteristics is negative.

The influence of households' socio-economic and demographic characteristics on probability of switching is lower in the presence of non-price determinants of competition at all analysed electricity price increases with regard to competitive suppliers. These determinants make behaviour of households with different socio-economic and demographic characteristics uniform. However, for each of the determinants of competition we can identify a particular households' characteristic which increases their probability of switching electricity supplier. The probability of switching is higher if analysed electricity supplier would provide households with additional services and products and if households would live in apartment and not in house. The influence of electricity supply reliability has larger influence on probability to switch if a household would be willing to pay for electricity, produced by Austrian producer and not by Croatian producer. Result is the same if the model incorporates administrative obstacles in switching electricity supplier.

Results of the product differentiation analysis demonstrate that households are most interested in advices regarding electricity savings, setting up modern electricity meters, buying in their electricity supplier's shop, and discounts to customers who buy various product and services in selected shops. Households are indifferent to buying the following services and products from electricity suppliers: planning and realization of electricity installation, electricity appliances services, television and radio repairs, customer's reward games, electricity supplier's newspaper and internet

services. Households are not interested in provision of home delivery of food and medicine, as well as funeral services, from electricity supplier.

Table 4: Products and services that matter to households and are not directly related to electricity supply

Service/product	N	Mean value	Share of responses with mark 5 or 4	Buy: NO (in %)	Buy: YES (in %)
Advises on reduction in electricity use	465	3.94	78.28		
Installation of modern electricity meters	454	3.89	75.33	33.55	66.45
Maintenance and repair of electricity installation (24/7)	482	3.66	67.22	30.96	69.04
Discounts and other benefits for various products and services	464	3.61	62.28		
Buying electric devices in electricity supplier's shop	453	3.50	56.74	43.37	56.63
Planning and installation of electricity in new constructions and reconstructions	447	3.46	58.17	46.57	53.43
Electricity appliances services	456	3.29	51.97	48.71	51.29
Repair of television and radio devices	443	3.26	50.11	50.00	50.00
Customer's reward games	448	3.12	39.29		
Monthly electricity supplier's newspaper	442	3.08	40.27		
Internet services	448	3.06	39.73		
Home delivery	442	2.11	9.73		
Delivery of medicine	443	2.07	9.37		
Delivery of food	440	2.06	9.48		
Funeral services	436	2.03	10.55		

Source: Own calculations

The analysis of households' preferences regarding the additional provision of electricity (non)related services and products from electricity supplier shows that households are interested in the supply of internet services, home appliances' repair, repair of television and radio, home delivery and delivery of food and medicine. More detailed analysis of willingness to pay for those services shows households with more members under 18 years old and more full time employed members are

more interested in buying internet service from electricity supplier than other households, while households with more male members are less interested in this service. Households are willing to pay for internet service on average 11.62 EUR, while maximum price is 17.95 EUR. The willingness to pay is significantly influenced by average costs of electricity supply in a year and number of employed household's members. The influence of both variables on willingness to pay is significantly positive. Moreover, the maximum price of internet service (i.e. the price that would avert households from buying this service) is significantly positive influenced by average costs of electricity supply in a year, number of employed household's members, and numbers of household's members with higher education.

More than half (54.71 percent) of households are interested in buying service of organizing home appliances' repair and TV repair from electricity supplier. Around 30 percent of households are willing to pay 2 EUR monthly for this service and 15 percent of households are willing to pay 5 EUR. Maximum price for this service is 7.66 EUR. The probability of buying this service is significantly positively influenced by number of full time employed household's member. Maximum price is significantly positively influenced by number of household's member with high education and significantly negatively influenced by number of household's member under 18 years.

More that 60 percent of households are not interested in food delivery service, provided by electricity supplier. 26 percent are willing to pay 2 EUR per month for this service and only 6 percent of households are willing to pay 5 EUR in month. Maximum price that would definitely discourage household from buying this service is 4.75 EUR and is significantly negatively influenced by number of member under 18 years. The model of willingness to buy food delivery services from electricity supplier is insignificant.

Differences in Efficiency and Economic Performance of Slovenian Electricity Distribution Firms

In the second part of the paper we analyse and asses the capability of existing Slovenian electricity distribution firms for entering into competitive market. We apply economic performance analysis, based on traditional financial and other business ratios, as well as technical and cost efficiency analyses, based on Data envelopment analysis (hereinafter DEA). This allows us first, to investigate the differences in economic performance and efficiency and second, to make inference about the capability of the analysed firms to conduct business in competitive circumstances.

Methodology

In economics, firms are inefficient, when they are not able to achieve the highest possible production – output with a given quantity of production resources - inputs. Such inefficiency is called technical inefficiency (Griffiths and Wall, 2000). Moreover, firms are alocatively inefficient, when they do not employ inputs in the proper relationship according to their price and the technology. While a particular level of output can be produced by using different combinations of inputs, a firm is alocatively efficient only if it employs inputs in such relationship that allows the output to be produced with the lowest production costs. Farrell (1957) defines technical and allocative efficiency as two components of economic efficiency, often called also cost efficiency. A firm that is not technically and allocatively efficient, does not produce its output with lowest possible production costs (Björkgren et al., 2001; Coelli et al., 1998). In economic theory and practice, two major approaches for efficiency analysis exist; parametrical, which is based on econometric method SFA (Stochastic Frontier Analysis), and nonparametrical DEA, which uses linear programming for the calculation of data envelopments.

In case of the efficiency analysis of Slovenian electricity distribution firms, a small number of firms and thereby units of observations is the main reason for choosing the data envelopment analysis, DEA. As it is a linear programming method, we estimate a relative efficiency based on the investigation of the relationship between inputs and outputs of the production process. We presume that inputs and outputs of all units of observations are of the same quality. Accordingly, smaller volume of inputs does not change the quality of output. In the model, as described by Charnes, Cooper and Rhodes (1978), a particular unit of observation is inefficient, if such a linear combination of units of observations in the sample that uses less input than the observed unit and produces at least the same level of output, can be found. Units, that form such a linear combination, are references for the inefficient unit. By calculating the technical and cost efficiency with DEA, a particular assumption about the returns to scale is considered. In case of the assumption of the constant returns to stale (hereinafter CRS) it is supposed that there is only one optimal volume of production, while with the assumption of the variable returns to scale it is believed that the investigated units are all of the comparable size according to their volume of production (see for e.g. Coelli et al, 1998, Griffiths and Wall, 2000). In the case of the efficiency analysis of Slovenian electricity distribution firms we apply CRS models for two reasons: first, we investigate whether these firms are capable to compete with each other on competitive electricity market, and second, the liberalisation of the electricity market allows firms to adapt in the direction of the optimum size.

Performance analysis is based on the traditional business analysis, based on accounting and financial ratios. We calculate only ratios that relate to the capability of firms for competing on the liberalised and competitive electricity market.

Data

Efficiency and performance analyses are based on data reflecting physical quantities and data in values for five Slovenian electricity distribution firms in the 2005-2007 period. Main data source are firms' annual reports. Balance sheets and income statements for individual activities within the analysed electricity distribution firms were acquired from the Agency for energy of the Republic of Slovenia.

Efficiency analysis requires data on inputs and outputs. Because our aim is to analyse the efficiency of the electricity distribution firms as a whole as well as the efficiency of particular organisational departments and activities within these firms, we measure output separately for individual activities within firms as well as for the firm as a whole. When possible, inputs and outputs are measured in physical quantities as well as in values. Output is measured with the electricity sales in GWh, value of sales in EUR and with the number of firm's customers. Inputs are defined with the value of fixed assets and with the number of employees according to their hours of work. For the cost efficiency estimates, the price of fixed assets is defined as a ratio between the sum of depreciation and cost of financing and the sum of fixed assets and inventories. Price of labour is calculated as a ratio between annual gross payroll and average number of employees.

For the performance analysis we use data from the original accounting statements, published in annual reports of the analysed electricity distribution firms and data from the Agency for energy of the Republic of Slovenia for the year 2007. We calculate financial and other business ratios based on the simplified analytical balance sheets and income statements of the analysed firms as a whole and for individual activities within these firms.

Results

In Table 5 the estimated measures of technical and cost efficiency for several DEA models with various specifications are presented. The models are based on data on five Slovenian electricity distribution firms for three years in the 2005-2007 period, that is on fifteen observations. All described models are estimated under the assumption of CRS. In all models inputs are described with the number of employees and with the value of fixed assets, while output is measured in three ways: with the

quantity of electricity sold in GWh (model 1), with the number of customers (model 2) and with the business revenues in EUR (model 3). The analysis is in most cases carried out on the firm level; model 4, however is estimated on the level of organisational departments for electricity sales within the analysed firms. For each model technical and cost efficiency are calculated. The estimation of the cost efficiency is based either on actual or on average input prices of the analysed firms. In Table 5 the average value of the estimated efficiency measures, together with their range and minimum value are presented. In the last column the number of efficient units of observations is shown.

Table 5: Specifications and results of the efficiency models

Input		Output	Level of analysis	Input prices	Efficiency	Efficiency measure			No. of efficient units
						Average	Range	Minimum	
Number of employess and value of fixed assets	1	Electricity sales in GWh	Firm	/	Technical	0.8737	0.3003	0.6997	2
			Firm	Actual	Cost	0.8327	0.3591	0.6409	1
	2	Number of customers	Firm	/	Technical	0.8892	0.1788	0.8212	2
			Firm	Actual	Cost	0.8264	0.2704	0.7296	1
	3	Electricity sales in EUR	Firm	/	Technical	0.9241	0.1790	0.8210	2
			Firm	Actual	Cost	0.8626	0.2792	0.7208	1
	4	Electricity sales in GWh	Department for electricity sales	/	Technical	0.5923	0.7105	0.2895	1
				Actual	Cost	0.2827	0.9792	0.0208	1
	5	Electricity sales in GWh	Firm	Single (average level)	Cost	0.8286	0.3629	0.6371	1

Results from the table above show that in model 1 the average technical efficiency measure, where output is measured by the electricity sales in GWh, is 0.87. It means that the analysed units use on average 13 per cent more inputs for a given output than they would if they were technically efficient. In the technically least efficient unit, the production process uses 30 per cent too much inputs for a given output. Only two out of 15 units of observation are technically efficient.

The range of the technical efficiency measures is smaller in models 2 and 3, it amounts approximately for 0.18 and indicates that the use of inputs for a given output is on average 18 per cent larger than in technically efficient unit. The difference in ranges of the technical efficiency measures between model 1 and 2 show that a relatively large part of technical inefficiency of units in model 1 is a consequence of differences among the analysed firms in size of an average customer, measured by the quantity of electricity purchased. Because the size of the average customer is an exogenous factor, mostly under influence of general economic conditions and the

geographical distribution of households and business customers, electricity distribution firms are not able to impact it to a large extent. A comparison of ranges of technical efficiency measures between model 1 and 3 indicates that the differences in technical efficiency among analysed firms are even smaller, when other activities of electricity distribution firms, besides electricity sales, are included into the output measure by defining output with the value of business revenues. The results therefore show that different activities, conducted in the electricity distribution firms, represent different shares in the firms' outputs.

Range of the technical efficiency measures is considerably larger in model 4, where technical efficiency of organisational units for electricity sales is analysed and it amounts for 0.71. We can establish that Slovenian electricity distribution firms do not differ much according to their technical efficiency, when they are observed as a whole; however these discrepancies become larger, when only particular organisational units are analysed. This leads us to the conclusion that the analysed firms differ in formal and organisational distribution of resources among organisational departments and activities. Accordingly, the differences in technical efficiency among Slovenian electricity distribution are small and as such allow these firms to successfully compete with each other, however, organisational changes and adjustments are essential for these firms to establish the necessary competitiveness.

A firm is cost efficient, when it is able to produce a given output with the lowest possible costs at given input prices. Such a firm is technically and allocatively efficient at the same time. In models from Table 5, for all model specifications the cost efficiency measures are lower compared to technical efficiency measures. This indicates that the analysed firms on average do not employ neither minimal nor proper combinations of inputs with regard to input prices. In model 1 the average cost (in)efficiency measure is 0.837, which means, that the analysed firms could produce their output with on average 16.3 per cent lower costs of inputs. Excess costs are a consequence of technical inefficiency, i.e. using too many inputs, and allocative inefficiency, i.e. employing unsuitable input combinations. Similar results are obtained from model 2 and 3. Differences in technical and allocative efficiency are considerably larger in model 4, where only organisational departments for electricity sales are analysed. Obviously also a pretty large allocative inefficiency in model 4 is a consequence of differences in formal allocation of resources among activities and organisational departments within the analysed firms.

Specification of model 5 is equal to the specification of model 1, but in model 5 we use average input prices instead of the actual ones. Namely, a review of input prices shows that several deviations in input prices exist among the analysed firms, which consequently influences the size of the estimated cost efficiency measures. On the other hand, deviations in input prices across firms indicate that input markets are not perfectly competitive and that individual firms exert a certain degree of market power

over the input prices. Because imperfect competition might conceal the true source of the cost (in)efficiency, we introduce a premise of perfect competition by using single input prices for all analysed firms on the level of average price for each of the defined inputs. A comparison of cost efficiency measures between model 1 and 5 shows, that the application of single input prices on average increases the cost inefficiency of the analysed firms. Namely, under the assumption of single input prices the electricity distribution firms could produce a given output with on average more than 17.2 per cent lower production costs, while the range of cost efficiency measures is 6 percentage points wider than in model 1. It follows that a part of the cost efficiency of Slovenian electricity distribution firms is achieved through the adaptation of input prices by firms themselves. The latter is possible because these firms obviously hold a certain degree of the market power over input prices. Electricity market liberalisation in Slovenia is strengthening the competition also in input markets, which forces the analysed firms to accept and to adapt to input markets by employing proper input combinations and at the same time to search for other sources of increasing their cost efficiency.

Performance analysis of Slovenian electricity distribution firms is based on the selection of financial and other business ratios, related to the ability of firms to successfully compete in liberalised market. The results are presented in Table 6 and show that the performance and other characteristics of the business process of the analysed firms are quite similar. All firms have profit, with return on assets and return on equity being relatively small, not exceeding 1 per cent. Share of debt financing of firms ranges from 19 to 31 per cent. Average cost per GWh of electricity sold is also comparable, with highest exceeding the lowest by 12 per cent. Similar conclusion can be drawn for the ratio of capacity utilisation, while labour productivity in a firm with the most productive labour exceeds labour productivity in firm with least productive labour by 25 per cent.

We can therefore conclude that the differences in efficiency and performance of Slovenian electricity distribution firms are relatively small, with large similarities among their business operations' characteristics. The latter, together with relatively favourable profitability ratios indicates that the analysed Slovenian electricity distribution firms are able to conduct their business in competitive markets.

Table 6: Financial ratios of electricity distribution firms in year 2007

Business ratios	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5
Return on sales in %	0.25	1.92	0.39	1.08	0.89
Return on assets in %	0.18	0.82	0.28	0.74	0.61
Return on equity in %	0.21	1.00	0.38	0.86	0.88
Share of equity in %	81.5	79.7	72.6	83.3	69.0
Leverage	0.23	0.25	0.38	0.20	0.39
Average cost per GWh sold in EUR	94,192	85,252	85,387	86,849	83,776
Capacity utilisation (sales/fixed assets)	0.84	0.65	0.80	0.81	0.90
Capacity utilisation (KWh/fixed assets)	8.9	7.5	9.3	9.2	10.6
Productivity of labour (sales/employees)	219,598	286,242	287,861	236,634	269,169
Productivity of labour (MWh/employees)	2,326	3,294	3,358	2,696	3,185

Organisational Adaptation of Slovenian Electricity Distribution System and Distribution Companies to Increased Competition

As we previously demonstrated, the characteristics of business operations and attained levels of technical and cost efficiency do not restrict Slovenian electricity distribution companies to successfully execute their business activities under conditions of strengthened competition that resulted from electricity market opening and increased demands of electricity consumers. However, the Slovenian electricity distribution companies have to adapt both there strategic orientation and organisation to the changed environment that was brought about by electricity market liberalisation to prevent potentially large disturbances to their business operations. The reasons for organisational adaptation of Slovenian electricity distribution companies to increased competition are twofold.

First, their organisational adaptation is necessary because of regulatory changes being implemented within the Slovenian electricity distribution system. In the past, the business operations of electricity distribution companies consisted of managing, operating and maintaining the distribution network, electricity distribution, electricity production and operations related to purchasing and selling electricity to

end users. In 2007, the responsibility to manage, operate and maintain the distribution network was transferred from 5 regional electricity distribution companies in mixed ownership to one state-owned company SODO. However, the transferral of this regulated operation was carried out without the transferral of ownership of the distribution network from 5 regional electricity distribution companies to the mentioned state-owned company established to manage, operate and maintain the distribution network. As we describe in the following section this arrangement created a complex relationship between 5 regional electricity distribution companies and the state-owned company SODO and maintained the involvement of regional electricity distribution companies in carrying out the operations transferred to the company SODO. This is why the transferral of ownership of the distribution network from the regional distribution companies to the company SODO is planned to establish a clear division of regulated and market operations within the Slovenian electricity distribution system especially in light of the mixed ownership of the electricity distribution companies. Exclusion of the distribution network capacities from the assets of regional distribution companies will clearly demand their organisational adaptation and create different relations with other key players on the electricity market.

Second, organisational adaptation of electricity distribution companies is a necessary precondition for implementing strategic changes that will divert their focus from operations related to managing, operating and maintaining the network and operations related to electricity distribution to operations related to purchasing and selling electricity and operations related to the provision of other customer-oriented energy-related products and services. It is important to note that these operations are already carried out by the Slovenian electricity distribution companies. This means that the electricity distribution companies are not facing the challenges related to development of new operations and activities but are facing the challenges of achieving higher growth in such market operations.

Inadequacy of Existing Organisation

As mentioned, a radical reorganisation of electricity distribution companies is needed because these companies failed to adapt both their focus and organisational structure to their changed role that was brought about by the establishment of a state-owned company SODO that took over the responsibility to manage, operate and maintain the distribution network. Under normal circumstances the exclusion of an important activity (managing, operating and maintaining the network generate a considerable share of revenues) from the portfolio of activities leads to organisational changes almost automatically. However, because the transferral of operations related to

managing, operating and maintaining the distribution network to one state-owned company SODO was not accompanied by the transferral of distribution network ownership, the circumstances that would normally lead to a radical reorganisation of regional electricity distribution companies did not emerge. With the exclusion of the mentioned activities from the electricity distribution companies without the exclusion of the distribution network from their assets the operations related to managing, operating and maintaining the distribution network changed from own-account operations to contract operations. Namely, 5 regional electricity distribution companies and the state-owned company SODO signed contracts that enable the company SODO to lease the distribution network from electricity distribution companies and hire the employees of electricity distribution companies to carry out activities that enable normal functioning of the network such as maintaining and extending the electricity distribution network.

The described arrangement has two important consequences. First, the exclusion of operations related to managing, operating and maintaining the distribution network from the electricity distribution companies did not affect their revenues significantly because only the source of the revenues changed. Electricity distribution companies now generate revenues by charging rent to the company SODO and also by charging for services of maintenance and other activities that enable normal distribution network operation. Second, the organisational structure of electricity distribution companies still consists of departments that are responsible for carrying out activities that were formally transferred to the state-owned company SODO. Such departments employ the majority of employees of electricity distribution companies. This is also why the described arrangement could not support the change of focus from operations related to managing, operating and maintaining the network and operations related to electricity distribution to operations related to purchasing and selling electricity and operations related to the provision of other customer-oriented energy-related products and services.

The above discussion demonstrates that no significant organisational changes emerged within the electricity distribution companies despite their changed role brought about by electricity market opening and the transferral of operations related to managing, operating and maintaining the distribution network to one state-owned company SODO. Organisational structures of regional electricity distribution companies therefore still consist of (1) departments that carry out activities aimed at assuring normal distribution network functioning and are linked through contracts with the company SODO, (2) departments that engage in purchasing and selling electricity to end users, (3) departments that engage in electricity production and (4) supporting departments.

Such organisational structures, however, will no longer be appropriate once the principal aim of establishing the company SODO is attained. This principal aim is to

ensure a suitable functioning of the distribution network that is independent of organisations that engage in purchasing and selling electricity for end users thereby creating equal conditions for competition between such organisations. Considering that electricity distribution companies are important players in electricity sales to end users, this aim obviously can not be achieved without the transfer of ownership of the distribution network from electricity distribution companies to one state-owned company SODO. Under the current organisation the distribution network is divided in five regions covered by individual regional electricity distribution companies and this creates conditions in which the sale of electricity to end consumers is also in large part regionally distributed. The current arrangement and ownership of the distribution network does not enable all companies engaging in electricity trading to compete for end users on equal terms. The transfer of the network to a single state-owned company would strengthen competition between sellers of electricity and create the supply that is in line with expectations of consumers in terms of price, quantity and array of provided services and products. It would also increase competition between existing electricity distribution companies considering the change in their core business operations from network related operations to selling electricity to end users. Increased competition would result also because new players could enter the market on more equal terms.

Reorganisation of the Electricity Distribution System and Distribution Companies

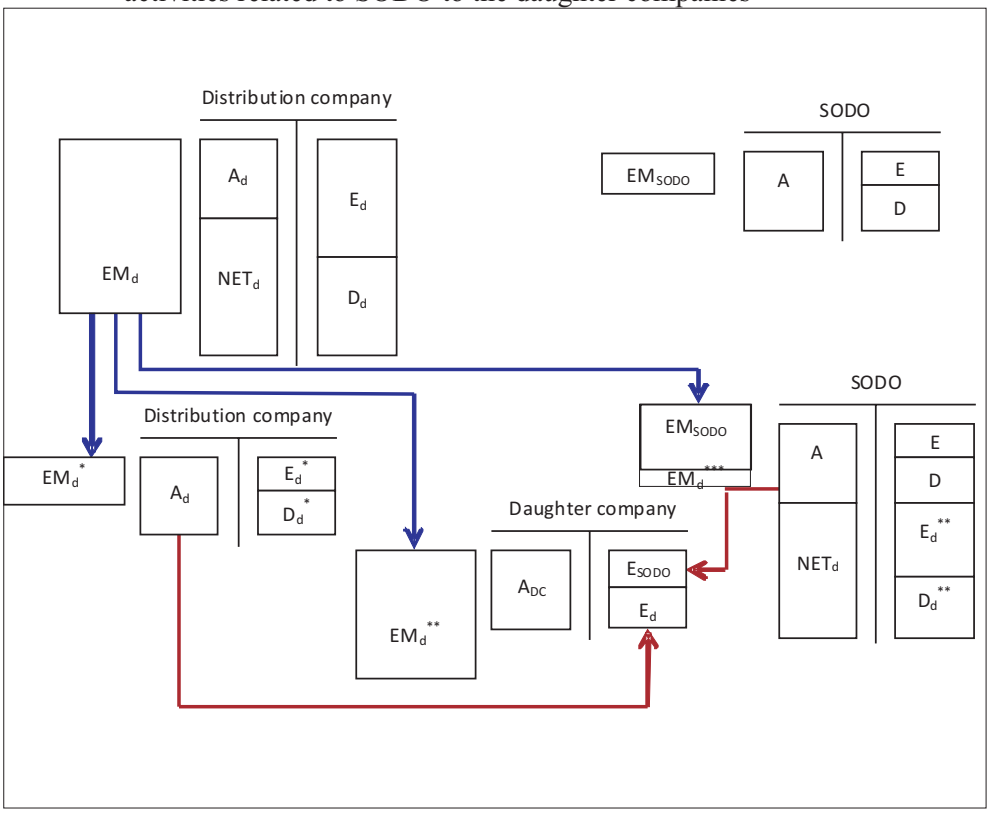
Because the reorganisation of electricity distribution companies involves the exclusion of the distribution network from their assets, the reorganisation of electricity distribution companies has to be accompanied with the reorganisation of the entire electricity distribution system. A coordinated reorganisation of both the electricity distribution system and distribution companies has to attain two aims. First, with this reorganisation electricity distribution companies have to be transformed into efficient, competitive and customer-oriented companies with business operations in the fields of electricity production, purchase and sales to end users and other operations related to the provision of energy-related products and services. Second, this reorganisation that involves the exclusion of the distribution network from the assets of electricity distribution companies has to maintain such management, control and maintenance of the network that enables reliable and high quality supply of electricity to all users.

Both aims can be achieved with the model of reorganisation proposed in this paper based on prior research and consultancy work of the authors (Tajnikar et al., 2009c). According to the proposed model, the electricity distribution system would consist of three instead of the existing two groups of companies (electricity distribution

companies and company SODO). The transformation of the current two groups of companies into three groups is depicted by Figure 1. Figure 1 demonstrates those changes brought about by reorganisation that would emerge in the structure of employees of reorganised companies and in the structure of balance sheets of all companies with changes of ownership being particularly emphasised.

Following the reorganisation the first group of companies would consist of only one company – a state-owned company SODO responsible for carrying out the regulated business operations related to management, operation and maintenance of the distribution network. Following the reorganisation accompanied by the exclusion of the distribution network from the assets of electricity distribution companies the company SODO would own the entire electricity distribution network of Slovenia (NET_d) and employ both existing employees of SODO (EM_{SODO}) and employees that are currently employed by the electricity distribution companies for developing and expanding the network and assuring its coordinated operation (EM_d***). Only a small number of employees are currently employed for such activities in electricity distribution companies and the proposed model of reorganisation suggest their transferral to SODO. The second group of companies in the proposed model of reorganisation would consist of restructured electricity distribution companies that no longer own the distribution network. Such companies would comprise of departments for purchase and sales of electricity, departments for electricity production and departments for the provision of other energy-related products and services. These departments would maintain the employees that carry out such activities in existing companies (EM_d*) and assets currently used for such business operations (A_d). The third group of companies in the proposed model of reorganisation would consist of newly established companies responsible for maintaining and building the distribution network. Such companies would contract with SODO for its activities. They would be established by both SODO and existing electricity distribution companies that would be sole owners (E_{SODO} in E_d). The newly established daughter companies would employ those employees that are currently employed by electricity distribution companies for activities such as maintenance (EM_d**). Considering the current organisation of the electricity distribution system that divides maintenance and similar activities related to assuring the normal functioning of the distribution network into five regions five such daughter companies could be established. However, there are grounds to merge five regions into three and establish only three daughter companies responsible for maintaining and building the distribution network – one for the region of Ljubljana, one for the western part of Slovenia and one for the eastern part of the country. Assets of such daughter firms would not be substantial (A_{DC}). These assets would be transferred from existing electricity companies.

Figure 1: Balance sheets following the transferral of the distribution network from electricity distribution companies to SODO and employees carrying out activities related to SODO to the daughter companies



The described model of reorganisation has the following advantages compared to the current arrangement:

1. The distribution network is owned by a single company in full state-ownership that holds the concession for performing the public service of the system operator.
2. Employees that carry out activities of network maintenance and building and other activities needed for normal functioning of the network are employed by daughter companies established by SODO and electricity distribution companies.
3. Newly established daughter companies that are founded by SODO and electricity distribution companies and do not own the network can contract with SODO for activities of network maintenance and building without public tenders.
4. Only those assets that represent the distribution network have to be transferred to SODO from electricity distribution companies. Assets currently used by electivity

distribution companies to carry out activities of network maintenance and expansion do not have to be transferred to SODO but to a daughter company.

5. Newly established daughter companies are independent legal entities and their business operations are transparently separated from business operations of SODO and the restructured electricity distribution companies. This makes monitoring of their efficiency and performance easier.

A detailed study of relations between companies under the current arrangement shows that the implementation of the described model of reorganisation is possible. However, if the newly established daughter companies generated revenues in the amount equal to rent and payment for services existing electricity distribution companies receive from SODO and incurred costs equal to cost that existing electricity companies allocate to departments caring out activities for SODO, some daughter companies would generate losses. A successful implementation of the proposed reorganisation would therefore demand funding based on actual costs incurred for services that assure normal network functioning. At the same time under the proposed reorganisation different cost allocation schemes could not be used to influence the results of business operations because this reorganisation establishes a clear division of regulated and market operations.

Conclusions

1. Slovenian households are highly sensitive to and expect price competition between electricity suppliers. Price elasticity of switching electricity supplier is high. Therefore, any excessive increase in electricity price of current supplier in comparison to electricity price of competitive electricity supplier would decrease the number of households, buying electricity from a current supplier. Yet, electricity suppliers have a power to influence the households' choice not to switch supplier even if the electricity price is relatively high. They can provide their households with products/services not directly related to electricity supply at reasonable price. Under this circumstance household customers are willing to buy electricity from supplier despite of relatively high electricity price.

2. Slovenian households are highly sensitive also to non-price competition between electricity suppliers. Non-price competition appears in different forms. Electricity suppliers can provide their household customers products/services that are not directly related to electricity supply, they can assure higher reliability of electricity supply than their competitive suppliers and/or they can lower administrative barriers of horizontal household mobility. The importance of additional provision of services and products is also reflected by result that 40

percent of households are willing to switch electricity supplier if there would be no differences in electricity prices among suppliers, yet potential supplier would offer them lower electricity price compared to the current supplier. Basic non-price competition in electricity distribution market for households is related to quality of electricity supply, yet the provision of additional products/services that are not directly related to electricity supply is also important. Modern electricity supplier in Europe is, therefore, a company with product differentiation in supply of electricity and products/services that are not directly related to electricity supply, yet there is a certain level of synergy among electricity and non-electricity supply. It is essential that electricity distribution companies develop such products or/and services that enable them reestablishment of contact and relationship with household customers.

3. Households' willingness to switch electricity suppliers is relatively high in Slovenia if competitive supplier would offer customers lower electricity price than current electricity supplier. Households are willing to switch electricity supplier at the largest extent if they live near to competitive suppliers' geographic area, live in apartments and are willing to purchase the electricity produced by Austrian producer. The sensitivity to price differences is positively influenced by number of household members, number of pensioners and number of part-time employed household members.

4. The differences in efficiency and performance of Slovenian electricity distribution firms are relatively small, with large similarities among firms in the characteristics of their business operations. The latter, together with relatively favourable profitability ratios indicates that the analysed Slovenian electricity distribution firms are able to conduct their business in competitive markets. However, some organisational changes and resource redistribution within the analysed firms might be necessary to secure the competitiveness of particular firms.

5. A part of cost efficiency of Slovenian electricity distribution firms is achieved through the adaptation of input prices. The latter is possible because the analysed firms hold a certain degree of the market power on input markets and are able to adjust the input prices according to their interest. However, electricity market liberalisation in Slovenia leads to stronger competition also in input markets. This forces the analysed firms to accept given input prices and to adapt to the input market conditions by employing proper input combinations and at the same time to search for other sources for increasing their cost efficiency.

6. Consumers expect a change in the strategic orientation of existing electricity distribution companies. The characteristics of business operations and attained levels of technical and cost efficiency do not restrict Slovenian electricity distribution companies to implement such changes in the strategic orientation that will divert their focus from operations related to managing, operating and maintaining the network and operations related to electricity distribution to operations related to purchasing

and selling electricity and operations related to the provision of other customer-oriented energy-related products and services.

7. A radical reorganisation of existing electricity distribution companies is a precondition for diverting their focus from operations related to the functioning of the network to operations related to purchasing and selling electricity and operations related to the provision of other customer-oriented energy-related products and services. A radical reorganisation of existing electricity distribution companies is thus a precondition for developing the supply that is demanded by consumers in circumstances of electricity market opening. Currently, the implementation of such a reorganisation is hindered because important players in electricity sales to end users are also owners of the distribution network. Business operations of system operators have characteristics of a natural monopoly and as such they hinder the development of competition if they are linked to business operations relating to electricity trading.

8. The transfer of the network to a single state-owned company would strengthen competition between sellers of electricity and create the supply that is in line with expectations of consumers in terms of price, quantity and array of provided services and products. Sellers of electricity could carry out their business operations in ways that are to a greater extent in line with the expectations of consumers. Such an arrangement would increase competition between existing electricity distribution companies considering the change in their core business operations from network related operations to selling electricity to end users. Increased competition would result also because new players could enter the market on more equal terms.

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