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The analysis of liberalisation of the electricity market in Slovenia

1. Introduction

The electricity markets in Europe are undergoing considerable economic and technological restructuring (Stoft, 2002; Nillesen et al., 2004; Bojnec and Papler, 2016; Cialani and Mortazavi, 2018; European Commission, 2019). The increasing dependency on electrical energy, along with continued economic growth, has caused electricity consumption to be raised as an important economic and ecological question for our common future at a global level (e.g. Pearce and Warford, 1993; Nordhaus, 1994; Blok, 2005; Stern, 2007; Wagner et al., 2007; Bojnec and Papler, 2011a, 2011b; Damm et al., 2017). On the one hand, the electricity markets are in a process of economic deregulation and market liberalisation. On the other hand, the aim is to strengthen the importance of sustainable development in electricity supply management with an increase in alternative, renewable sources of electrical energy that is driven both by ecological standards and by the introduction of new technological changes and restructuring in more efficient electricity supply and its uses. The rapid increases in electricity supply in developed countries have been caused by increasing industry, public lighting and household electricity demands during the last decades. A systematic approach to supplier improvement in marketing management between wholesalers and retailers in the electricity supply chain management is growing, and more competitive electricity markets have gained an increasing importance.

Slovenia, similar to most other European countries, has undergone electricity market deregulation and price liberalization. Prior to 2001, the Slovenian electricity market was monopolized by a single large regional market supplier (Papler and Bojnec, 2006, 2007, 2012). Trade in electrical energy is limited by

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cross-border transfer capacities. When prices of electrical energy were high, some export was also supplied to Austria and Germany. For example, in 2006 Slovenia was a net importer of electrical energy, as export from Slovenia was 5,027 GWh, while import was 7,706 GWh. The net import represents around 20% of total Slovenian electrical energy consumption.

This paper focuses on wholesale-to-retail-sale electricity supply chain management in Slovenia in association with the economic, management and social issues, which lie behind the electricity supply chain management. The main wholesale supplier in the Slovenian electricity distribution supply chain management is organized as a systemic provider of electricity networks, which is balancing the wholesale electricity supply with different segmented demands on the domestic Slovenian markets (industry, public lighting and households). As a part of the systemic provider of electricity networks, there is also the nuclear electricity power station in Krško as a producer of electrical energy. The systemic provider of electricity networks is a main provider of electrical energy to retailer electricity distribution enterprises, which then sell electricity further to final consumers in industry, public lighting, and households. The wholesale-to-retail-sale electricity marketing and electricity supply chain management have also been to a lesser extent developed through the stock exchange of electrical energy called "Borzen", which has been introduced since the electricity market deregulation in 2001. The retail electricity distribution enterprises are also purchasing electrical energy from small electricity producers/suppliers, which have a relatively small market share in the wholesale electricity supply in Slovenia.

At the retail electricity marketing level, the Slovenian public retail electricity distribution enterprises, which are organized on a regional basis, have maintained the greatest market share. They are organized as a share holding company: four enterprises within the Holding of the Slovenian electricity suppliers (HES), which is balancing electricity supply within the HES, while the fifth one is organized as a spin-off enterprise, with the majority state ownership. Their role has been in mitigating transmission of electrical energy from wholesale distribution network enterprises to final consumers as well as development of electricity distribution systems. The market share of these five retail electricity distribution enterprises in the Slovenian electricity consumer markets is around 80 percent.

We specifically focus on the electricity supply chain management in the relation between the electricity producers/wholesalers and the retail electricity distribution enterprises. More specifically, we are using Electro Gorenjska, which is one of the retail electricity distribution enterprises in Slovenia, as a case study. This retail electricity distribution enterprise is compared with other retail electricity distribution enterprises in Slovenia to illustrate that Electro Gorenjska is not an exception in the Slovenian retail electricity distribution market. The retail electricity distribution enterprises are purchasing electrical energy from different

electricity producers and wholesale electricity suppliers, but it is identified clearly that the HES has increased its share to around 90 percent, whereas the remaining electricity purchases by the retail electricity distribution enterprises have shifted towards small private electricity suppliers that particularly are producing electrical energy from local renewable sources of electrical energy.

The rest of the paper is structured in the following way. We first present some empirical facts on the structure of electricity purchases by the retail electricity distribution enterprises from producers/wholesalers of electrical energy to provide a basis for understanding the wholesale-to-retail-sale electricity supply chain management. Then we present briefly the Slovenian stock exchange "Borzen" of electrical energy as an issue of electricity market liberalisation and as a market outlet for regional electricity market cooperation. The next section presents the methodology and empirical results. The case study of the retail distribution enterprise of the Electro Gorenjska is used to provide in-depth analysis and comparisons of structures of electricity purchases and electricity supply management from producers/wholesalers-to-retailers. The final section derives the main conclusions and policy implications.

2. Empirical evidence on the Slovenian wholesale-to-retail-sale electricity markets

Since 2001, the Slovenian electrical energy markets have been gradually deregulated (Papler and Bojnec, 2006, 2007). The purchases of electrical energy at the organized stock exchange "Borzen" have also started since 2001, and the peak in its size was in 2003. The most important wholesale supplier of electrical energy for the retail electricity distribution enterprises is the HES, through long-run closed contracts on the purchases of electrical energy. As a starting point into the analysis of the Slovenian electricity wholesale-to-retail-sale markets, we present four items of empirical evidence that have occurred as a result of the electricity market deregulation and electricity price liberalisation.

First, to examine electricity wholesale-to-retail-sale supply chain management in Slovenia, we start our analysis with the size of the electricity distribution markets to the final consumers in Slovenia, which are covered by the five largest Slovenian retail electricity distribution enterprises (Fig. 1). Due to increasing electricity demands, the electricity supply has increased. The increases in the market size as measured by the size of electricity sales are recorded for each of the retail electricity distribution enterprises. However, the sizes of electricity sales and their dynamics between the individual retail electricity distribution enterprises vary.

Electro Ljubljana is the largest single retail electricity distribution enterprise with its further sale increases. On the other hand, Electro Gorenjska is – by the size of sales – the smallest one.

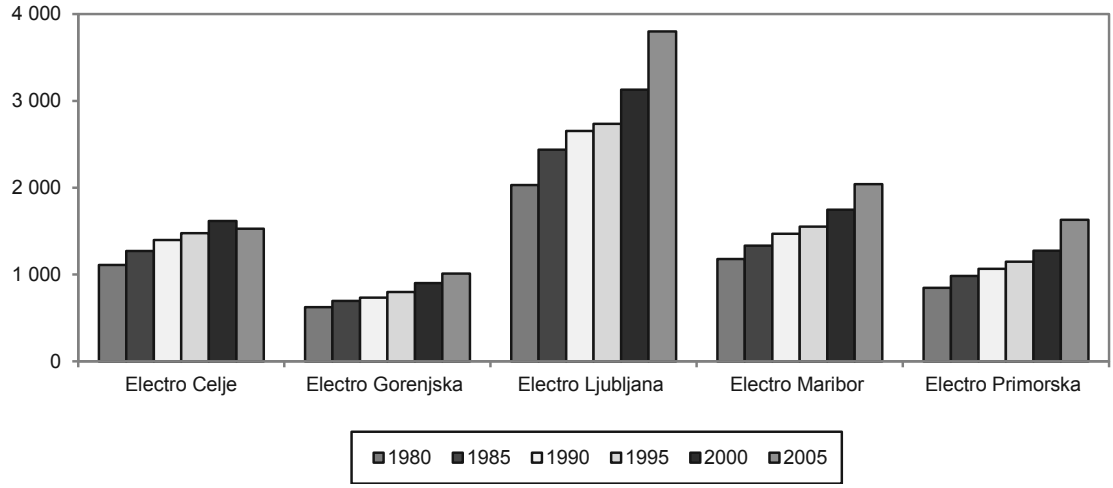

Figure 1. Supply of electricity by the retail distribution enterprises in Slovenia by selected years, 1980–2005 (in GWh)

Source: own calculations

Second, we present the changing patterns and structures in the density of the purchases of electrical energy per square kilometer by the main retail electricity distribution enterprises. This indicator is the highest, and with an increasing tendency for Electro Ljubljana, and the lowest with yearly variations for Electro Celje (Tab. 1).

Table 1

Purchases of electrical energy per square kilometer in Slovenia by the electro--distribution enterprises, 1990–2005 [MWh/ km^2]

Year	Electro Celje	Electro Gorenjska	Electro Ljubljana	Electro Maribor	Electro Primorska	Slovenia
1990	321.5	351.1	507.2	377.5	245.4	367.8
1991	315.0	356.6	503.0	379.9	237.5	364.6
1992	305.7	341.6	486.6	367.5	228.7	352.4
1993	311.8	350.8	496.1	382.2	235.7	361.5
1994	324.2	364.7	506.5	386.2	249.2	372.2
1995	339.4	381.5	522.8	398.7	264.9	387.4
1996	339.6	391.4	541.6	405.2	265.9	394.9
1997	354.1	400.0	557.0	414.5	265.7	404.8

Table 1 cont.

1998	363.4	413.6	582.5	428.4	286.3	422.2
1999	360.0	415.0	587.9	439.3	288.1	425.5
2000	371.7	430.6	598.0	437.7	294.1	433.4
2001	387.3	438.6	619.9	451.4	303.0	448.0
2002	369.7	448.5	667.0	465.7	315.5	463.1
2003	425.5	463.5	670.2	486.2	327.6	484.4
2004	399.3	475.3	695.9	495.3	354.2	494.2
2005	351.9	483.4	726.2	510.9	376.4	500.6

Source: own calculations

Third, we present the density in the purchases of electrical energy per capita by main retail electricity distribution enterprises. We expect that electricity consumption per capita is associated with the level of technological development of industry and the level of overall economic development, which cause demands for electrical energy by the different economy sectors, public lighting, and households. The consumption of electrical energy per purchase place and per capita has increased over time (Fig. 2 and Tab. 2). The electrical energy consumption per capita is the highest for Electro Primorska and the lowest for Electro Maribor, while Electro Celje, Electro Gorenjska, and Electro Ljubljana have a consumption of electrical energy per capita which is close to the Slovenian average.

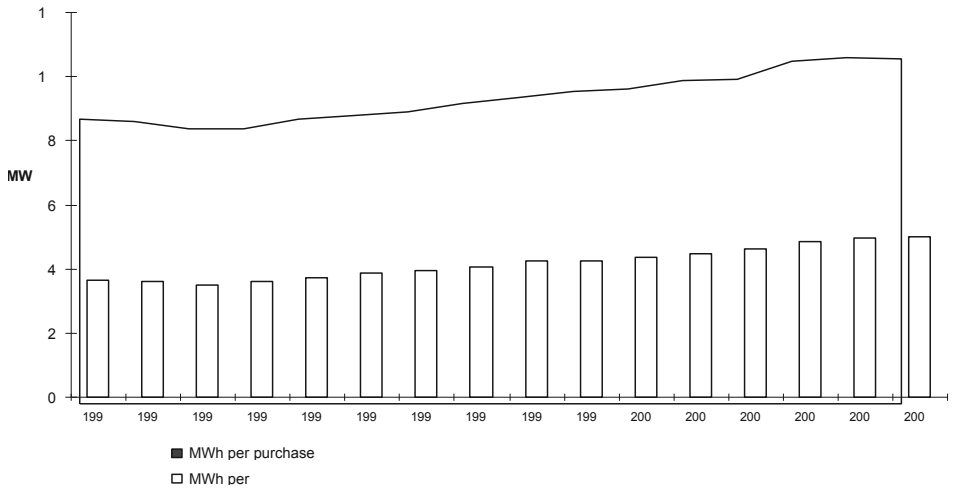

Figure 2. Purchases of electrical energy in MWh per purchase place and MWh per capita, 1990–2005

Source: own calculations

Table 2

Purchases of electrical energy per capita in Slovenia by the retail electro distribution enterprises, 1990–2005 (MWh per capita)

Year	Electro Celje	Electro Gorenjska	Electro Ljubljana	Electro Maribor	Electro Primorska	Slovenia
1990	4.1	3.7	3.6	3.0	4.4	3.7
1991	5.0	3.8	3.4	3.1	3.9	3.6
1992	5.1	3.6	3.3	3.0	3.7	3.5
1993	4.2	3.7	3.6	3.1	3.8	3.6
1994	4.5	3.8	3.6	3.1	4.1	3.7
1995	4.6	4.1	3.7	3.2	4.4	3.9
1996	4.7	4.2	3.9	3.3	4.4	4.0
1997	5.0	4.2	4.0	3.4	4.3	4.1
1998	5.2	4.4	4.2	3.5	4.7	4.3
1999	5.1	4.4	4.2	3.6	4.7	4.3
2000	5.2	4.5	4.3	3.6	4.8	4.4
2001	5.4	4.7	4.4	3.7	5.0	4.5
2002	5.1	4.8	4.7	3.9	5.2	4.6
2003	5.8	4.9	4.8	4.0	5.4	4.9
2004	5.5	5.0	4.9	4.1	5.9	5.0
2005	5.0	5.1	5.1	4.2	5.9	5.0

Source: own calculations

Fourth, the increases in purchases of electrical energy by the retail electricity distribution enterprises and their sales for different consumption of electrical energy tend to move in the same direction with the increases in gross domestic product (GDP) per capita (Fig. 3). This implies that the increases in GDP per capita, which is one of the main aggregates for measuring the level of economic development, are positively associated with the greater use of electrical energy for intermediary consumption and greater demands for electrical energy for final consumption by households.

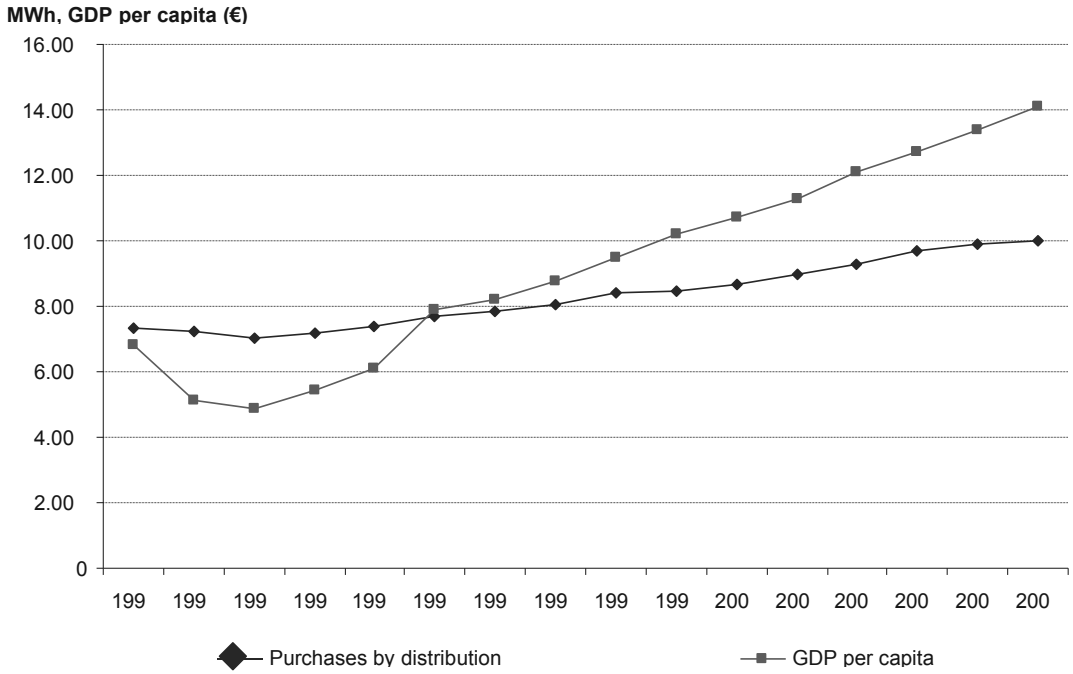

Figure 3. Purchases of electrical energy by the retail electro distribution enterprises and gross domestic product per capita, 1990–2005

Source: own calculations

3. Stock exchange "Borzen" of electrical energy

The purchases of electrical energy at the stock exchange "Borzen" of electrical energy are introduced as a measure to increase market competition and to improve efficiency in the marketing and functioning of the wholesale electricity supply as well as to serve as a market outlet for entering foreign competitors on the Slovenian electricity markets, and for broader regional integration of electricity markets in South-Eastern Europe.

Up to 2001, before the electricity market deregulation in Slovenia was introduced, the retail electricity distribution enterprises in Slovenia were purchasing electrical energy on the basis of the evaluated electro energy balances and programs of the electro energy system by the Electro Slovenia enterprise (Eles). Since 2001 there has been an aim towards strengthened liberalisation in an emerging market of electrical energy, but with a prevailing role of the HES. That has been the main reason for the less promising role of the stock exchange "Borzen" of electrical energy on the Slovenian electricity markets. Since 2004, four retail electricity distribution enterprises (Electro Celje, Electro Gorenjska, Electro Ljubljana

and Electro Primorska) have purchased electrical energy from the HES in order to then further supply electrical energy to electricity consumers (industry, public lighting and final consumption by households).

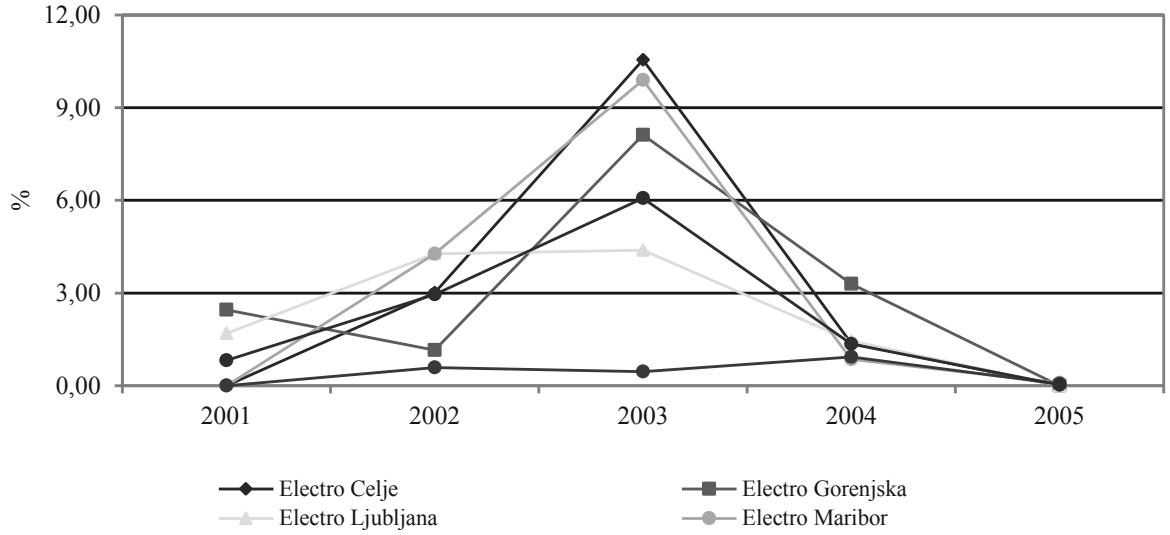

Figure 4. The role of the stock exchange "Borzen" of electrical energy in the purchases of electrical energy by the retail electricity distribution enterprises in Slovenia (in percent of total purchases of electrical energy), 2001–2005

Source: own calculations

In 2001, at the weekly meetings of the stock exchange "Borzen" of electrical energy they started with the sale of electrical energy to the retail electricity distribution enterprises in Slovenia (Fig. 4). An increase in electricity transactions is seen by 2003. In 2005, there was a considerable decline in purchases on the stock exchange of electrical energy "Borzen" by the retail electricity distribution enterprises. Since then, the importance of the stock exchange of electrical "Borzen" in the purchases of electrical energy by the retail electricity distribution enterprises, as well as in general, has been given rather low importance.

4. Methodology

As the methods of analysis we apply the Lorenz curve, Gini coefficient of concentration, regression analysis, and multivariate factor analysis (e.g. Kachigan, 1991; Hair et al., 1998; Gujarati, 2003). The analysis of market structures and market concentrations is one of the bases of the economic business analysis

and economics of industrial organization (e.g. Chrystal and Lipsey, 1997; Cabral, 2000; McAleese, 2004). We analyse market structures, and specifically the structures of electricity purchases by the retail electricity distribution enterprises, in order to illustrate the structures in the wholesale-to-retail-sale electricity supply chain management. The most commonly used measures of distributional inequalities in the literature are Lorenz curves and Gini coefficients of concentration. By using statistical methods, we analyse frequency in the distribution of electricity supply or purchases by the retail electricity distribution enterprises in quantity and value terms. The frequency distribution is calculated in the following way:

$$K = 1 + 3.3 \log N \tag{1}$$

$$F_k = f_{k1} + f_{k2} + \ldots \tag{2}$$

$$F_k\% = \frac{F_k}{N} = 100 \tag{3}$$

$$x_k = \min + \frac{(\max - \min)}{2} \cdot F_k \tag{4}$$

$$X_k\% = \frac{x_{k1}}{\sum x} \cdot 100 \tag{5}$$

$$\phi_k\% = x_{k1}\% + x_{k2}\% \tag{6}$$

Symbols:

N – number of observations of variables,
K – number of distribution or quintile groups,
f_k – frequency,
F_k – cumulative frequency,
$F_k\%$ – share of cumulative frequency [%],
x_k – mean value for distribution or quintile group,
$x_k\%$ – share of the mean value of distribution or quintile group [%],
$\phi_k\%$ – cumulative of relative totals.

For graphical presentation of relative frequency distribution by quintile groups and its cumulative relative frequency concentration we use the Lorenz curve. The graphical presentation of the Lorenz curve has a quadratic form. On the horizontal axis is a scale for cumulative relative frequency expressed in percent ($F_k\%$). On the vertical axis is a scale for cumulative of relative quintile group totals expressed in percent ($\phi_k\%$). In such a quadratic chart there are included pairs of

both variables. The obtained pair points in the chart are then connected from the bottom left corner. The obtained curve is the Lorenz curve, which expresses the concentration of the wholesale suppliers in the purchases of electrical energy by the retail electricity distribution enterprises. The more the shape of the Lorenz curve moves to the right bottom corner, the greater is the concentration, and vice versa when the Lorenz curve is situated closer to the diagonal of the chart. Therefore, the Lorenz curve is derived from the calculated frequency distribution. In our analysed cases, the Lorenz curve shows the concentration of electricity purchases, which is expressed by the share of different wholesale electricity suppliers in total electricity purchases by the electricity distribution enterprises. It indicates the importance of strategic suppliers with the greatest share in total electricity purchases by the retail electricity distribution enterprise. This equality can be shown by the straight line of perfect equality, which captures the cumulative share of electricity supply (vertical axis) by each quintile group and particularly the ones below it (horizontal axis). The first quintile group receives a 0.2 share or 20 percent of total electricity supplies, the first and second quintiles receive 40 percent of total electricity supply, and so forth. If the distribution of electricity supply is not equal for each quintile group, then the Lorenz curve connecting the cumulative percentages of electricity supply by the cumulated quintiles lies below the line of perfect equality, as it is in our case of the wholesale electricity supply to the retail electricity distribution enterprises.

The second measure of concentration is the Gini coefficient of concentration, which expresses the degree of market concentration. Therefore, in our case, concentrations of electricity suppliers in the electricity purchasing structures by the electricity distribution enterprises is also analysed using the Gini coefficient of concentration. The Gini coefficient is defined as the ratio of the area between the Lorenz curve and the line of perfect equality to the total area under the line of perfect equality. When there is perfect equality, then the Gini coefficient would equal zero. More specifically, the Gini coefficient of the degree of market concentration is calculated in the following way:

$$G = 1 - \frac{\sum_{k=1}^{K} f_k\%(\phi_k\% + \phi_{k-1}\%)}{10\,000} \tag{7}$$

Symbols:

G – Gini coefficient of concentration,
$f_k\%$ – share of cumulative frequency [%],
$\phi_k\%$ – cumulative of relative flows.

When the Gini coefficient is equal to 0, then there is no market concentration, and when it is equal to 1, then there is full market concentration.

We estimate the demand function for purchases of electrical energy by the retail electricity distribution enterprise, which is explained by the real purchase electricity price and GDP:

$$D_w = f(P_w, GDP)$$

where D_w is the demand for electrical energy defined as the purchased quantity of electrical energy by the retail electro distribution enterprise, P_w is the real purchase price of electrical energy, and GDP is gross domestic product. Moreover, the dummy variable equal to 1 for the liberalisation years with the start in 2001 is included, and zero otherwise.

We also estimate the total real revenue function for electricity sales by the retail electricity distribution enterprise, which is explained by the real purchase wholesale electricity price, expenses for paid taxes and expenses for paid wages:

$$\text{Revenue}_w = f(P_w, C_{tax}, C_{wages})$$

where Revenue_w is total real revenue from the sale of electrical energy by the electro-distribution enterprise, P_w is the real wholesale purchase price of electrical energy by the electricity distribution enterprise, C_{tax} are the real expenses paid by the electricity distribution enterprise for taxes, and C_{wages} are the real expenses paid by the electricity distribution enterprise for wages.

The regressions are estimated using the ordinary least square (OLS) method.

The multivariate factor analysis (Norušis, 2002) is applied in the analysis of the unique survey evidence to identify common factors important in wholesale-to-retail-sale electricity supply chain management, which is important for wholesale suppliers and for the retail electricity distribution enterprise.

5. Empirical results

5.1. Lorenz curve

The Lorenz curve presents the concentration of the wholesale electricity suppliers in total purchases of electrical energy by the retail electrical distribution enterprise. The wholesale suppliers of electrical energy are segmented by the quantity of the supplied electrical energy. Figure 5 indicates that 3% of the largest

wholesale electricity suppliers out of 91 wholesale electricity suppliers have a 95% share in total purchases of electrical energy by the retail electricity distribution enterprise. The Lorenz curve in the right hand bottom corner clearly confirms the very high concentration of the wholesale electricity suppliers (108) in Slovenia: 6% of the largest wholesale electricity suppliers supply 98% of total electrical energy to the retail electricity distribution enterprises, and 1% of the largest ones supply 72% of electrical energy. The HSE is the largest single wholesale electricity supplier. The Gorenjska electricity plant is also one wholesale electricity supplier with its 17 electricity plants. A slightly lower concentration of electricity supply is seen for private and industrial small hydro-electricity plants.

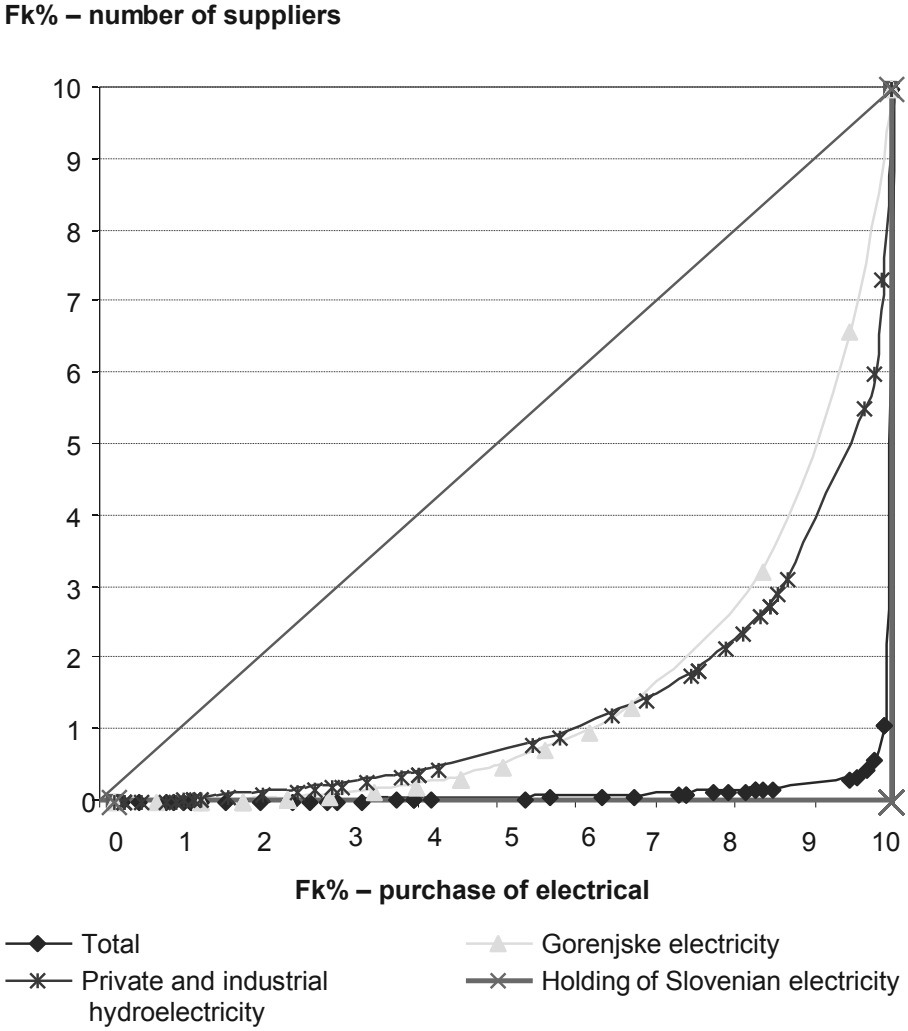

Figure 5. Lorenz curve of concentration of suppliers of electrical energy, 2006

Source: own calculations

5.2. Gini coefficient of concentration

The Gini coefficient for the concentration of the purchases of electrical energy by the retail electro distribution enterprise is 0.97028, which implies a very high concentration of wholesale electricity suppliers to the retail electro distribution enterprise. The HSE is the largest wholesale supplier of electrical energy to the retail electro distribution enterprise on the basis of long-run agreements and contracts.

Among the number of the wholesale electricity suppliers, those prevailing are the smallest wholesale electricity suppliers (Fig. 6). The greatest number of the wholesale electricity suppliers comprises the smallest suppliers, with an annual electricity supply from 160 GWh to 600 GWh (36.3%). In second place is ranked the group of the wholesale electricity suppliers from 50 to 160 GWh (26.4%), and in third place are ranked from 1,200 GWh to 2,000 GWh (9.9%). The smallest number of the wholesale electricity suppliers represents the largest wholesale electricity suppliers of sizes greater than 2,000 GWh annually.

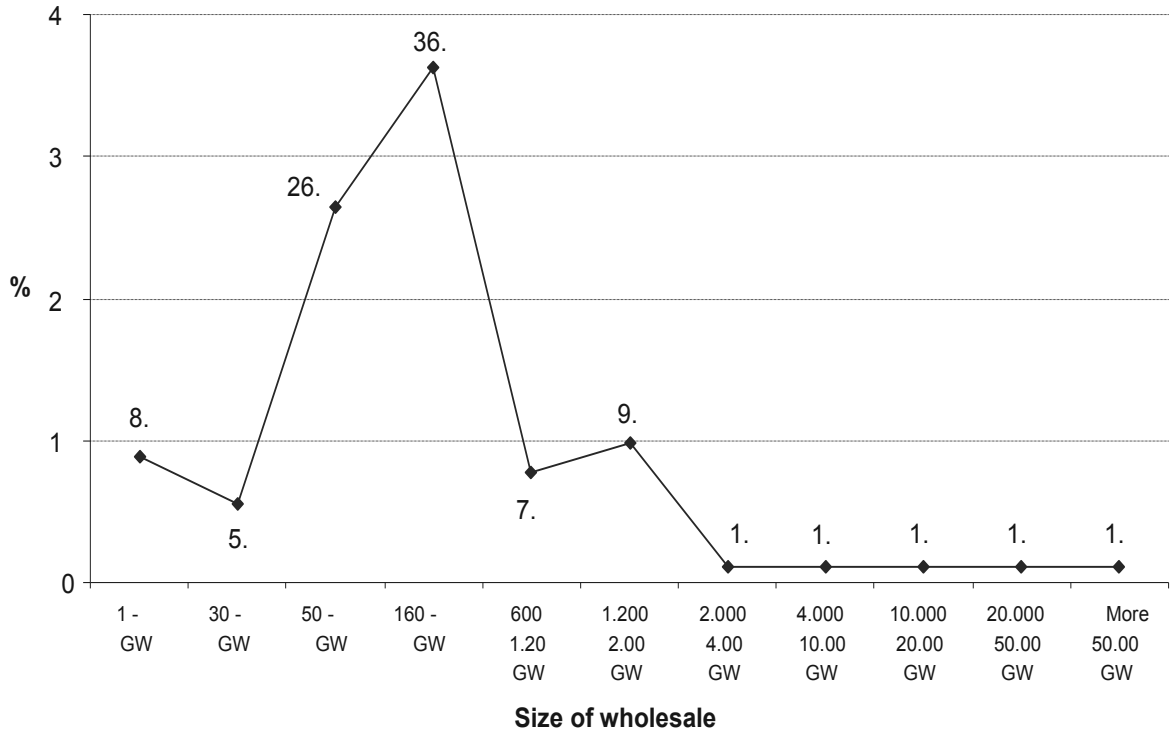

Figure 6. The share of the frequency distribution of the number of wholesale electricity suppliers of electrical energy by the annual size of supply, 2006

Source: own calculations

5.3. Demand functions

Demand functions for the purchases of electrical energy by the retail electro distribution enterprise from the wholesale electricity suppliers are estimated in the logarithm forms by the OLS method (Tab. 3). The increase in the real wholesale purchase price of electrical energy causes a reduction in demands for purchases of electrical energy. The coefficient of elasticity pertaining to the real wholesale purchase price is estimated at −0.59. On the other hand, the increase in real GDP increases purchases of electrical energy by the retail electricity distribution enterprise. The coefficient of elasticity is estimated at 0.18. The impact of market deregulation and liberalisation on demands for electrical energy by the retail electricity distribution enterprise is not found to be statistically significant.

Table 3

Estimated demand functions, 1998–2008

Model	**Dependent variable: electricity demand**	**ln(Constant)**	**Real purchase price: ln(*Pw*)**	**Gross domestic product: ln(*GDP*)**	**Dummy: ln(*dummy*)**	***AdjR*²**	***F***
1	$\ln(D_w)$	9.745	−0.590	0.181	–	0.974	63.697
		(8.840)	(−10.786)	(2.410)			
2	$\ln(D_w)$	9.804	−0.598	0.181	−0.020	0.948	36.448
		(7.188)	(−5.376)	(2.234)	(−0.088)		

Note: ln – natural logarithm. In the brackets are *t*-statistics.

Source: own calculations

During the analysed period the real GDP increased, and also purchases of electrical energy by the retail electricity distribution enterprise tended to increase, while the real wholesale purchase price of electrical energy cyclically oscillated: first, it declined with the electricity market deregulation, and since 2006 it has increased (Fig. 7). This clearly illustrates only the temporary decline in the real wholesale price of electrical energy, following the market deregulation and price liberalisation.

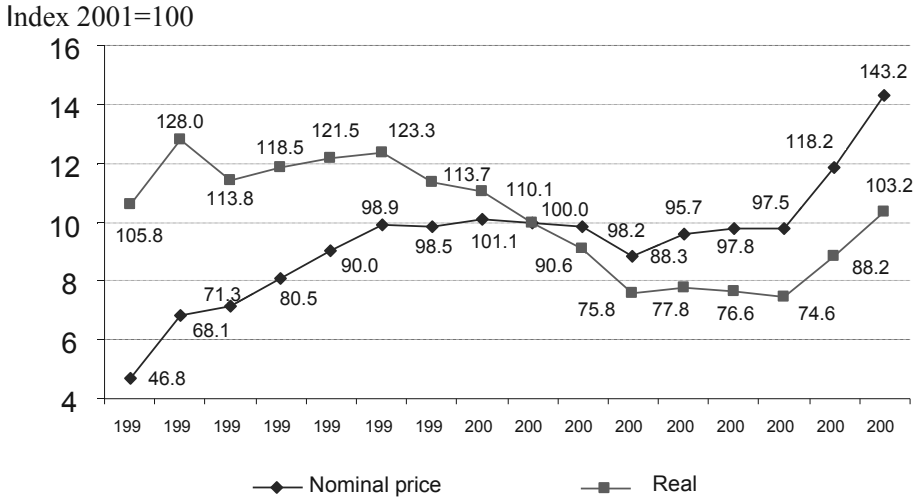

Figure 7. Index of nominal and real purchase *It* prices of electrical energy, 1993–2008 (2001=100)

Source: own calculations

5.4. Revenue function

The increase in the real wholesale purchase price of electrical energy by 1% increases the electro distribution enterprise's total revenues for its further sale of electrical energy by 0.685% (Tab. 4). This suggests that the retail electricity distribution enterprise is not able to fully transmit the increased costs for the purchased electrical energy to the final consumers of electrical energy, i.e., industry, public lighting and households. At the same time, the retail sale of electrical energy is associated with some other costs that are a part of the retail electricity price or total revenues from the sale of electrical energy to consumers such as costs of wages and expenses for taxes.

Table 4

Estimated total real revenue function, 1993–2005

Dependent variable: real revenue	ln(Constant)	Purchase real price: ln(*Pw*)	Tax costs: ln(*Ctax*)	Costs for wages: ln(*Cwages*)	*AdjR*^{2}	*F*
ln(Revenue)	4.702	0.685	0.062	0.264	0.564	6.596
	(1.457)	(2.758)	(1.140)	(1.301)		

Note: ln – natural logarithm. In the brackets are *t*-statistics.

Source: own calculations

6. Opinions on quality management of wholesale electricity supply

The increasing competitive pressures in the electricity markets are forcing the electricity distribution enterprises to compete in both price and quality of supply. We investigate the important elements on wholesale-to-retail-sale chain supply management as seen by the participants and customers in these relations. We have conducted surveys with the respondents by using the own developed written questionnaire to gain insights into opinions on factors of quality management in wholesale-to-retail-sale electricity supply chain management. The answers to nine questions were obtained in a form of the Likert scale, where 1 means not important at all, and 5 means very important. In addition, we include control questions to gain additional insights into important determinants for competitive electricity supply chain management. Among the respondents in the surveys, several are experts in energy supply chain management. We obtained 72 completed surveys out of 150. By education, there are 5.6% with a Master's degree or higher, 41.7% with a graduate degree, 22.2% with a higher education degree, 23.6% with secondary education, and 6.9% with vocational education. By gender, 83.3% are male and 16.7% female.

The correlation analysis of variables for the set questions confirms a positive association between development recognition and business trust in the wholesale-to-retail-sale electricity supply chain management (Pearson correlation coefficient 0.622), development products and those still to be known (0.599), references and long-term cooperation (0,554), references and relations with suppliers (0.537), references and local patriotism (0.514), but less for other pairs of variables.

Table 5

Matrix of different estimation methods (2 common factors)

Variables of the set of nine questions	Maximum likelihood method – Factor Matrix[a]		Maximum likelihood method with Kaiser normalization – Pattern Matrix Factor[b]		Maximum likelihood method with Kaiser normalization – Structure Matrix Factor		Maximum likelihood method with Varimax Kaiser normalization – Rotated Factor Matrix[c]	
	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2
Developmental products	0.370	0.617	0.139	0.645	0.439	0.709	0.660	0.286
Price supply	0.202	–0.004	0.214	–0.031	0.200	0.069	0.023	0.200

Table 5 cont.

Commercial conditions	0.316	0.668	0.061	0.709	0.391	0.737	0.704	0.226
Reference	0.999	–0.002	1.054	–0.133	0.993	0.358	0.129	0.991
Long-term cooperation	0.555	0.232	0.491	0.188	0.578	0.416	0.302	0.520
Local-patriotism	0.515	0.150	0.481	0.102	0.529	0.326	0.216	0.491
Relations with suppliers	0.537	0.226	0.474	0.184	0.560	0.405	0.294	0.503
To be known	0.334	0.596	0.109	0.625	0.400	0.676	0.634	0.253
E-communication	0.146	0.732	–0.145	0.803	0.229	0.735	0.745	0.049

Note: [a] 6 iterations, [b] 2 iterations, [c] 3 iterations.

Source: own calculations

The multivariate factor analysis was conducted in order to identify common factors on opinions about wholesale-to-retail-sale electricity supply chain management. The Scree plot suggests two common factors. The first common factor explains 40.0% of variance, while the second common factor additionally explains 14.5% of variance. The method of principal axis factoring does not provide estimates of factor weights nor of communalities. The maximum likelihood method without factor rotation estimates two common factors (Tab. 5). The first common factor is related to trust, with higher weights for variables in the electricity enterprise references, long-term cooperation, relations with suppliers, and local patriotism. The second common factor is identified as recognition, with higher weights for the variables of e-communications, commercial conditions, and development of new products and services, and those still to be known. The maximum likelihood method with Oblimin with Kaiser normalisation strengthened two common factors. For the first one, the important weights for variables has not changed. The second one has the highest weights for the variables of commercial conditions, e-communications, development of new products and services, and recognition. The maximum likelihood method with Varimax with Kaiser normalisation has given similar results. Development recognition and business trust are found as the two common factor components, which are important for improving wholesale-to-retail-sale supply chain management within the existing Slovenian wholesale-to-retail-sale electricity distribution market.

7. Conclusion and policy implications

The demand for electrical energy has increased and has largely been driven by economic growth in the economy and real income increases of households. Due to this, during the most recent recession period, there has been a slight decline in demand and consumption of electrical energy.

As electrical energy is a crucial input into intermediary and final consumption, its real price and quality of supply are also crucial for production costs, competitiveness of the economy, and living standard of the population. As the electricity energy markets in the past were traditionally monopolized by the local suppliers, the objective of the deregulation and liberalisation of the electricity energy markets in Europe and in Slovenia is to induce and to encourage market forces and restructuring towards more dynamic market transactions with the abolishment of critical inefficiencies, and to establish competitive supply of electrical energy to industrial users and to other final electricity consumers such as for public lighting and for final household consumption.

The deregulation and liberalization of the electro energy system in Slovenia has aimed towards market restructuring with more dynamic market transactions in the wholesale-to-retail-sale electricity markets, abolishment of critical inefficiencies and competitive supply to final electricity consumers. We have focused on the analysis of the market structures and competition in the wholesale-to-retail-sale electricity markets in Slovenia. The empirical evidence confirms the entry of new suppliers into the wholesale markets, but their role is less significant vis-à-vis the prevailing wholesale electricity supplier. The objective of the electro energy sector is restructuring in order to improve efficiency and to adjust to a greater role of market forces in the wholesale electricity market. The crucial factor is the abolishment of critical inefficiencies in order to achieve a more competitive wholesale supply of electrical energy to the retail electricity distribution enterprises as an intermediary in more efficient and competitive electricity supply chain management for the final electricity consumers. However, the empirical evidence suggests that the institutional and organisational changes in the Slovenian wholesale electricity market so far have not resulted in substantial changes in the number of suppliers, and particularly not in their market structures. While the competition in the wholesale electricity market is encouraged by the entry of new suppliers, the state role in the wholesale electricity enterprises and in the wholesale-to-retail-sale electricity management is still important. The Lorenz curve and Gini coefficient of concentration clearly reveal a relatively high concentration of the wholesale suppliers in the electricity market. As expected, the retail electricity distribution enterprises and final consumers of electrical energy are rational in their responses and economic decisions to the increasing role of market forces,

as suggested by the statistically significant negative association between electricity demands and real electricity price. The regression analysis for the price or revenue function for the retail electricity distribution enterprise also confirms the crucial role of direct price elasticity, which is measured by the real wholesale purchase price for the purchased electrical energy at the wholesale market. The multivariate factor analysis, which is based on the unique survey data, shows the increasing importance for long-term business development recognition and business trust between participants on the wholesale and retail sale electricity distribution market. All these, in a spite of the slow path, indicate the emerging and increasing role of market forces into the previously monopolised and government regulated wholesale-to-retail-sale electricity supply chain management and electricity markets.

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