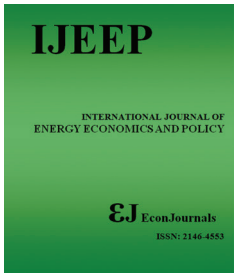

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Factors of Electricity Prices in Selected Eu Member States after the Financial Crisis and During Significant Market Distortions

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ABSTRACT

Analysis of the electric power market in a region of five EU countries (Austria, Croatia, Hungary, Italy and Slovenia) with one-sixth of the EU population reveals that in the period following the last financial crisis growth of 1% in electricity consumption led to 0.9% higher electric power prices for industry and 0.6% higher electricity prices for households. The situation on the German electricity market also holds a statistically significant influence. An increase in taxes in the German price of electricity (collected to raise funds intended for power generation from renewable sources) of 1% leads to 0.25% reduction in electricity prices for industrial use and 0.12% reduction in electricity prices for households in the analyzed group of EU Member States. From 2010 to 2015, Germany opened the subsidization of electricity generation from renewable sources from 12 to 24 billion euros per year (0.8% of gross domestic product in 2015). This has had the impact of increasing the supply of electricity and providing only intermittent information about the actual cost of production of these goods. Between 2011 and 2015, the electric power price on the German energy exchange (Phelix) fell 38%.

Keywords: Electricity Market, Electricity Prices, Production of Electricity, Energy and the Economy
JEL Classifications: D40, L94, Q43, F00

1. INTRODUCTION

In this article we give an analysis of the situation regarding the liberalized electricity market in the European Union and the dynamics of price factors during the period of economic recovery after the last financial crisis and the onset of large-scale state intervention - subsidies to producers of electricity from renewable sources. These subsidies have been particularly large in Germany, with measurable effect on the wider EU electricity market (Sattich, 2016). We start with an economic theory approach, and we then describe the situation in the electric power market in five EU Member States (Austria, Croatia, Italy, Hungary and Slovenia). This is followed by empirical analysis of the factors that influence electricity prices in the region. The end of the article presents the research conclusions, as well as the list of literature and data sources.

2. CONTEMPORARY DISTORTIONS ON THE EUROPEAN ELECTRICITY MARKET

The role of prices in establishing a balance between the supply and demand of the individual items and then a group of n-goods has already been specified by classical economists from Smith (1776) to Walras (1874-7). We could further include mention of Von Neumann (1937) who mathematically solved the problem of how excess supply can lead to free goods (i.e., a price equal to 0). The classics also explained the role of prices in product factors allocation: It is constituted by the impact of relative prices on the engagement of a variety of factors in the production of different goods (Sraffa, 1960). Bagwati (1971) explained market distortions as a deviation from equilibrium between the marginal rate of transformation (production) and the marginal rate of substitution (consumption) of the same pair of goods.

This deviation is caused by a transfer or via some instrument of redistribution, and the consequence is the suboptimal (in terms of Pareto optimum) allocation of production factors and unfulfilled prosperity versus the case under normal function of competition on the market (Srinivasan, 1994). If we limit ourselves to the electricity market and within the European Union, we can see that the sector transitioned from an infrastructure provider to that of market activity (Haas et al., 2013). Fiorio and Florio (2011) on the basis of empirical analysis demonstrated that liberalization of the electricity market increased consumer benefit due to reduction of these goods' prices[1]. Electricity market liberalization first caused a reduction of prices which then started to adapt to a changing balance on the electricity power market. During the period of recession and reduced demand for electricity, prices declined, while one would then expect their growth during economic recovery. The period also witnessed a tendency of electricity price convergence among EU Member States (Križanič and Oplotnik, 2013).

As a side effect of the electricity sector transition to market activity, an increased risk of instability in the power supply appeared (Pompei, 2013; Lau et al., 2011). This risk can be noted in the deterioration of the "reserve margin deviation" - the difference between the actual and optimal levels of electric power production, transmission and distribution capacities (Erdoglu, 2011). Furthermore, Kaserman and Mayo (1991) noted that the electricity sector's separation of the production and transmission activities increased uncertainty and transaction costs.

3. ABOUT THE ELECTRIC POWER MARKET IN FIVE EU MEMBER STATES AFTER THE LAST FINANCIAL CRISIS

In the process of the electricity sector's transition from infrastructure to market activity from the 1990s onward the relevant market of these goods spread beyond the borders of individual EU Member States. In our analysis, we observe the functioning of this market in a group of five EU Member States spanning the crossroads between western and Eastern Europe, as well as between central and southeastern Europe. As mentioned, this group of countries consists of Austria, Croatia, Italy, Hungary and Slovenia. Changes in production, consumption, exports and imports of electric power after 2009 in the analyzed countries are shown in Table 1 (data are also included on Germany and whole EU). Here, we can see that despite the economic growth recovery, production and the final electricity consumption from 2009 to 2014 in general did not increase. Among the analyzed countries generation of electricity decreased in Austria, Italy and Hungary, while in the same period electricity production in Slovenia and Croatia increased. Compared to the level of consumption at its lowest point during the economic and financial crisis in 2009, by 2014 the final consumption of electricity had fallen in Croatia (4%) and in Italy (3%), and increased in Austria (5%), Hungary (5%) and Slovenia (10%). Among the analyzed countries Slovenia is the only net exporter of electricity. Austria and Hungary between 2009 and 2014 significantly increased their net imports of these goods as the result of very low prices of heavily subsidized imported electric power. The decline of final electricity consumption following the financial crisis in 2009 apparently led to an increase in net exports of electricity from Italy and Croatia. In the last column of Table 1 we see that the Germany increased electric power generation and more than doubled its net export of electricity between 2009 and 2014.

The results in Table 2 show how in the five analyzed EU Member States, Germany and whole EU electricity prices for final consumers changed from the lowest point of the economic recession in 2009-2015. Here, we take into account the differences between household consumers (with annual consumption from 2.500 kWh to 5.000 kWh) and industrial consumers (with annual consumption from 500 MWh to 2.000 MWh), as well as the electric power wholesale price in energy exchanges (last row in Table 2). For each type of consumption (households, industry), Table 2 presents the percentage change of final prices from 2009 to 2015, the share of energy cost in the final price (the difference is composed of electric power network costs and taxes) in 2009 and 2015 as well as the change in this share from 2009 to 2015. In Table 2 we see that the price of electricity for households in the analyzed countries, with the exception of Hungary, increased considerably; this growth was, however, lower than the EU average or in Germany. Electricity prices for Austrian households increased the least among the analyzed countries. In Table 2 we also see that from 2009 to 2015 the share of energy costs in the final electricity price for households decreased by 12 percentage points. In 2015, energy cost ranged around one-third of the total price while in Germany it represented just 25%.

The results in Table 2 show divergent tendencies among the analyzed countries in the changes of electricity prices for industrial consumers from 2009 to 2015. In Hungary they decreased by 30%, similar to prices for households. In Slovenia and Austria these prices fell by a tenth and were countered by increases in Croatia of 7% and in Italy of 11%. If we consider the EU average and the electric power prices on the German market as a relevant environment in which the electricity prices for industry develop in the analyzed group of EU Member States, we see a tendency for rapid growth. In the EU these prices from 2009 to 2015 increased on average by 16%, while on the German market they rose by up to 30%. In the structure of the electricity price for final use in industry the share devoted to payment of energy decreased much more than the comparable share in electricity prices for households. In Croatia it fell by 6 percentage points, in Hungary by 14 percentage points, in Slovenia by 17 percentage points, in Austria by 19 in Italy by 24 percentage points, and in Germany by 29 percentage points (to account for 34% of the total final electricity price for industrial use).

The electricity market in the analyzed group of EU Member States is strongly affected by the large state subsidies to producers of electricity from renewable energy sources in Germany (being a large electric power exporter). The data in Table 3 show that this

1 Favorable effects of the electric power sector transition are also shown in the analyses of other cases. For example, Mansur and White (2009) estimated that the integration of the market across the eastern part of the United States (PJM AEP) resulted in a 42% increase in business transactions.

Table 1: Production and final consumption of electric power (Percentage change: 2014 versus 2009)

Indicator	Slovenia	Croatia	Austria	Hungary	Italy	EU	Germany
Net production	7	1	−6	−19	−4	−1	6
Final consumption	10	−4	5	5	−3	0	3
Imports	−7	−8	37	74	−1	29	−3
Exports	−8	1	−7	4	44	33	37
Net exports-GWh (absolute in 2014)	2.743	−3.953	−9.275	−13.390	−43.716	−15.497	33.885
Net exports-GWh (Δ 2009-2014)	−316	1.050	−8.495	−7.877	1.243	4.647	21.612

Source: Eurostat (2016)

Table 2: Electric power prices (Percentage change: 2015 versus 2009)

Indicator	Slovenia	Croatia	Austria	Hungary	Italy	EU	Germany
Households							
% change of final price	20	14	5	−28	19	28	29
Share of energy in the total price 2009	40	48	38	53	52	-	35
Share of energy in the total price 2015	36	45	35	41	43	-	25
Δ 2009-2015	−4	−4	−3	−12	−9	-	−10
Industry							
% change of final price	−13	7	−11	−30	11	16	30
Share of energy in the total price 2009	75	59	61	76	70	-	63
Share of energy in the total price 2015	58	53	45	62	45	-	34
Δ 2009-2015	−17	−6	−16	−14	−24	-	−29
% change of wholesale market price[1] (based in 2010)	−13	-	−29	−24	−18	-	−29

Source: Eurostat (2016), Borzen (2016), [1]Borzen - Slovenia, CROPEX - energy exchange in Croatia established in 2014, EXAA - Austria, HUPX - Hungary, GME - Italy and PHELIX - Germany

Table 3: German subsidies intended for renewable electricity production

Year	Millions of euros	% of GDP	PHELIX €/MWh
2010	12.324	0.48	44.49
2011	16.053	0.59	51.12
2012	20.066	0.73	43.23
2013	19.378	0.69	37.90
2014	21.513	0.74	32.76
2015	24.113	0.80	31.72

Source: Netz-Transparenz.de (2016), Borzen (2016), Eurostat (2016)

country from 2010 onwards subsidized the electricity generation from renewable sources from 12 to 24 billion euros.

The subsidization program is clearly a significant effort on account of such subsidies also growing in proportion with nominal gross domestic product (GDP) growth. By the end of the observation period (2015) it had reached 0.8% of GDP. This is almost as much as Germany's gross contribution to the EU budget. Subsidies have an impact on increasing the supply of electricity and interrupt the transparency of information about the actual cost of production of these goods (their relative scarcity). It is thus a typical market distortion. What is unusual is its size. From 2011 to 2015, these subsidies caused a reduction in electric power wholesale prices on the German energy exchange (PHELIX) of 38%. This effect is transmitted to Germany's neighbors and beyond. In consideration of our group of analyzed countries, we can see that from 2011 to 2015 the electric power prices on the Austrian energy exchange (EXAA) fell by 39%, on the Italian energy exchange (GME) by 39%, on the Slovenian energy exchange (Borzen) by 28% and on the Hungarian energy exchange (HUPX) by 27%.

We acquired detailed data on German subsidies to producers of electricity from renewable sources in 2013 showing that the average subsidy stood at 144.15 €/MWh (Borzen, 2016). Almost 122 TWh of electricity was produced with the help of these subsidies. It accounts for 20% of Germany's total electric power production and 23% of the final consumption of these goods. German subsidies to electricity producers from renewable energy sources were increased a further 24% from 2013 to 2015.

4. FACTORS OF ELECTRICITY PRICES IN THE GROUP OF FIVE EU MEMBER STATES

4.1. Methodology

Slovenia, Croatia, Austria, Hungary and Italy have almost 86 million inhabitants, and they are located at the crossing of the energy, transport, communications and other key infrastructure flows between East and West, and North and South of the European continent. At the present stage of the electricity market creation in the EU the area across the five analyzed countries faces similar factors in supply and demand for electricity. The functioning of a single market is limited on the supply side by restrictions in electric power transmission and especially by small cross-border capacities. Still, market forces here prevail over the influence of accidental shocks or one-off events.

In the analysis of the electric power market in the group of five analyzed EU Member States the changes in demand are represented by electricity consumption, exports and, indirectly, also the dynamics of GDP. We assume that GDP growth and then the growth of electricity consumption show a corresponding growth in demand for electricity that leads to an increase in its prices for the final consumer, and vice-versa. Reduction in demand for electric power influences the decline in final prices of these goods. In addition, we take into account another relevant parameter in forming electric power prices: The German state subsidies

Table 4: Factors of electricity prices in the area of five EU Member States: Slovenia, Croatia, Austria, Hungary and Italy (estimated on growth rates from 2010 to 2014)

Consumption of electricity	Electricity price for industrial use	Electricity price for use in households
Constant	0.0658 (2.7)	0.0465 (4.8)
The dynamics of total consumption of electricity	0.9319 (2.4)	
The dynamics of consumption of electricity in households	0.0421 (1.2)	0.6162/-1/(3.1)
Economic growth		
The dynamics of GDP		0.9279/-1/(3.3)
External influences - a proxy for the market distortion		
The dynamics of taxation in the German electricity price for industrial use	−0.2488 (-3.3)	−0.1216/-1/(−4.4)
R^2	0.66	0.88
DW	2.7	2.5

GDP: Gross domestic product

to producers of electricity from renewable sources - mainly to wind power plants. The data suffers unit root limitations related to German state support for electric power producers: The proxy in our analysis which presents this effect forms the dynamics of taxation in the German price of electricity for industrial use, as this is a source for financing German subsidies to renewable electric power producers (greater subsidies to the producers of electricity demand higher charges in the final price of these goods). We must also mention that this analysis is limited by the available data and to the period following the last global financial crisis.

The connection between the growth rates of final electricity prices for industry or households (data changes in 5 countries: Slovenia, Croatia, Austria, Hungary and Italy) and growth rates of the variables (electricity consumption and exports, GDP, German taxation in the final electric power price for industrial use) that influence these prices is estimated by panel analysis (the annual growth rates of different variables across these five countries). This is shown by the equation (here, the estimation the factors that influence the price of electricity for industrial use):

$$[100\ (ies/ies\_(-1)-1)] = f\{[100\ (fse/fse\_\ (-1)-1)]+X+u\}$$

Where:

ies shows the final electric power price for industry (in €/kWh) in each of the five analyzed countries; a given country is indicated by?

ies (−1) represents 1 year lagged variable ies, meaning the final electric power price for industrial use in the previous year;

fse shows the final electricity consumption (in GWH) for each countries in the group; a given country is indicated by?

fse (−1) represents the variable fse? lagged 1 year, being the final electricity consumption in the previous year;

X indicates other variables which statistically significantly influence the dynamics of electricity prices for use in industry; these variables are designed similarly to final electricity prices for industry or final electricity consumption;

u represents the residual in the regression, i.e., the unexplained variance of the final electric power price for industrial use.

Specifics of the individual EU States in our analysis are taken into account by the introduction of fixed effects in regression equations (Davis, 2002), and the heteroskedasticity was eliminated by the introduction of generalized least squares cross-section weights (EViews 7).

Our equations are estimated on annual data (Eurostat, 2016), and all series were tested for a unit root. We used the following tests: Levin, Lin and Chu (Levin et al., 2002) for a common unit root process and Im et al. W-stat (Im et al., 2003), ADF-Fisher and Chi-square and PP - Fisher Chi-square (Maddala and Wu, 1999) for individual unit root processes. Any variable where the existence of a single root hypothesis could not be rejected was excluded. This particularly affected our choice of the proxy variable to show distortion on the German electricity market.

4.2. The Results

The equations explaining the factors that influence the changes in final electricity prices on the market covering area of five EU Member States (Slovenia, Croatia, Austria, Hungary and Italy) are presented in Table 4. In the last row of the table we can see the determination coefficient (R-squared), that shows how much of the growth rates of electric power prices for industrial use and for household consumption is explained in the equations. This row also shows the results of the Durbin-Watson statistic, which indicates that there is no first-order serial correlation (Johnson and DiNardo, 1997) in the equations (results are close to 2). The calculated explanation of the final price of electricity for use in industry and in households is a good one: R-squared from 66% to 88%.

Equations that explain the dynamics of electric power prices for industry and for households are presented in last two columns of Table 4. The individual variables that affect these dynamics (the total electricity consumption, etc.) are presented from the second to sixth row of this table. For each explanatory variable, a regression coefficient is displayed that shows the percentage change in final electricity price for industrial use or households consumption based on a 1% change in that given independent variable (for example, the total electricity consumption). Time lag (years) is shown in parenthesis on the right side of the regression coefficients in cases where it was revealed in our analysis. In soft parenthesis under the regression coefficients are the "t-values" presenting the statistical significance of a given explanatory variable's influence.

The results presented in Table 4:

- An increase in the total electricity consumption of 1% in the current year influences growth by 0.9% in electric power prices for industrial use in the analyzed group of five EU Member States, and vice-versa. The reduction of total electricity consumption leads to a corresponding decline in the prices of these goods.
- An increase of electricity consumption in households of 1% lagged for 1 year yields a 0.6% rise of the electricity prices for households in the analyzed group of countries, and vice-versa.
- An increase in GDP of 1% after 1 year leads to a 0.9% increase in the electricity prices for households in the analyzed group of countries; conversely, a decline in GDP after a 1 year time lag results in a corresponding decline in prices.
- The situation on the German electricity market has a statistically significant effects on the electric power market in te analyzed group of EU Member States. An increase in taxes in the German final price of electricity for use in industry by 1% leads to a 0.25% reduction of electricity prices in the observed countries. In the electric power price for households a similar effect occurs after 1 year. It is slightly smaller: −0.12%. The possible elimination or significant reduction of German electricity market distortions would lead to the opposite effect. In this case, we could expect a sharp increase in electric power prices in the five analyzed EU Member States.

5. CONCLUSION

To sum up, in the observed group of countries the share of energy costs in final electricity price declined after the end of the last financial crisis. Strong and specific regulation of the sector creates conditions such that electric power suppliers, despite the rising final electricity prices, find themselves facing difficulties of how to cover their production costs. A typical indicator of this situation is the decline in wholesale prices on the energy exchange in Germany and in the analyzed countries.

Due to the low level of stimulation to invest in new electricity production from non-renewable sources and the quantitatively limited opportunities for spreading electric power production from renewable sources, we can already in the medium term expect a reversal on the wholesale electric power market and for prices to begin to rise. The electric power producers who will withstand the present pressures connected with the electricity market distortions will easily cover their production costs, which currently seem to not be recognized on the market.

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