MASTERARBEIT

Titel der Masterarbeit

„The Influence of the European Energy Market Reform, on the End-User Electricity Prices in the new European Union Member Countries"

(An Empirical Panel Data Study)

Verfasst von

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I, Roland Frindt, hereby confirm that my thesis entitled “The Influence of the European Energy Market Reform, on the End-User Electricity Prices in the new European Union Member Countries” is the result of my own work. I did not receive any help or support from commercial consultants. All sources and/or materials applied are listed and specified in this thesis. Furthermore, I confirm that this thesis has not yet been submitted as part of another examination process neither in identical or similar form.

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Abstract

In 1996 the European Union Energy Market Reform started with the introduction of the first Energy Package 96/92/EC Directive. Since then also the second and third Energy Package was introduced with the aim to create one efficient liberalized energy market with common rules in the whole European Union. Parts of these Directives are related to the electricity market and are obligatory for all member countries.

In this thesis is examined the impact of the Energy Market Reform on the end-user electricity price in the new European Union Member Countries. For the examination it was used a Regression Panel Data Model. In this model was examined the effect of various indicators and variables (directly and indirectly related to the market reform) on the end-user electricity prices.

The goal is to show, how the end-user electricity prices for the industrial and household customers are affected by the reform and if the effects are positive, negative or both.

German Abstract

Die Europäische Energiemarkt-Reform startete spätestens mit der Einführung der 96/92/EC Direktive die auch, als das Erste Energiepaket bekannt ist. Seit dem wurden zwei weitere Energiepakete eingeführt, dessen Ziel es ist einen gemeinsamen liberalisierten Energiemarkt mit gleichen Regeln für die ganze Europäische Union zu kreieren. Teil dieser Energiemarkt-Reform betrifft direkt auch den Markt für Elektrizität.

In dieser Arbeit werden die Auswirkungen dieser Energiemarkt-Reform auf die Endbenutzer Elektrizitätspreise in den neuen Ländern der Europäischen Union untersucht. Die Auswirkungen würden mittels eines Regression Panel Data Models untersucht wobei verschiedene Variablen und Indikatoren, mit direkten und indirekten Zusammenhang mit der Reform genutzt worden sind.

Das Ziel ist es zu zeigen wie die Reform die Endbenutzerpreise für Elektrizität in den Sektoren Industrie und Haushalte beeinflusst hat.

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ACER - The Agency for the Cooperation of Energy Regulators
CHP- Combined Heat and Power
CR- Concentration Ratio
DAM- Day Ahead Market
DSO- Distribution System Operator
ENTSOE- European Network of Transmission System Operators for Electricity
FIT- Feed In Tariffs
HHI- Herfindahl–Hirschman Index
IEA- International Energy Agency
LCOE- Levelized Cost of Energy
O&M- Operating and Maintenance
PV- Photovoltaic
RES-E- Renewable Energy Sources for Electricity
TGC-Tradable Green certificates
TPA-Third Party Access
TSO- Transmission System Operator

1. Introduction

In the late 90s in the European Union an energy market reform started through the introduction of the 92/96/EC Directive, which firstly introduced some common rules in the energy sector for all European Union member countries. With the 92/96/EC Directive the dream about one common European Energy Market for gas and electricity with common rules for all member countries started to be real. The trigger for this energy market reform was the successful energy liberalization market reform of the United Kingdom in the late 80s and 90s, where a split was done between generation networks and retail, which on the end lead to lower end-user electricity prices. The European Union has same expectations from the European Union energy market reform. That is also why already several studies have examined the impact of the reforms in the western European Union countries for example (Steiner, 2000) and (Hattori and Tsusui, 2002). On the other hand, there is a lack of studies which would examine the reform impact on the end-user electricity prices in the so called new European Union member states as Slovenia, Czech Republic, Hungary, etc. That is why the reform impacts on these countries will be examined in this thesis. More precisely the goal of this thesis is to examine the impact of the European Union energy market reform on the end-users consumers from the industrial and household sector in the first place. In this study a group of 9 countries with a post-socialism background, which are today fully-members of the European Union, are examined with the exception of Bulgaria. The countries are examined for a time-period from 2000 to 2012. The second goal of this study is to examine the impact of the profitability of the TSO Transmission grid operator companies on network tariff levels, which are a crucial component of the end-user prices. The motivation for this examination was the comparison of the network tariff levels with the financial results of companies active in the new member states. In some cases the connection of tariff levels and TSO profitability was at least very suspicious. Some TSO companies especially in countries with high tariff levels were extremely profitable and companies from countries with low tariffs much less. It was especially the case of state owned TSO companies. In this second study group of 13 TSO companies of various European Union members, but with focus on the old ones are examined for a time period of 2006-2012. Basically this thesis can be divided into two studies, while one is examining the energy market reform impact on end-user prices, the other one examines the impact of profitability of the TSO companies on the tariff levels. In both studies an empirical econometric panel data model has been used which is very similar to the (Steiner 2001) model. The thesis is divided into the following parts. In the first part of the thesis a short history and the cornerstones of the European Union energy market reform is presented. In the second part the examined countries and their electricity markets are presented and described. The focus of the third part is on the econometric regression panel data model. In the fourth respectively fifth part the results of both studies are presented and discussed and on the end a short conclusion highlighting the main results and problems of both studies was done.

2. The Electricity Market Reform in the EU

In most cases the goal of the energy markets liberalization is economically driven. It is expected that the energy market liberalization increase the cost efficiency through the introduction of competition between market players (see Sioshansi and Fereidoon, 2006). According to Pollitt (2009), the electricity energy market reform has four main elements

1. The public utility privatization
2. The unbundling of vertical integrated companies (into TSO, DSO, RETAIL and GENERATION companies)
3. The TPA (Third party access)/ full market opening
4. The introduction of an fully independent regulator

In the European Union the energy market liberalization started with the introduction of the energy market reform packages. This energy packages are described in the next part.

2.1 Short History of the Electricity Energy Market Reform

(The three energy packages 1996, 2003 and 2009)

First Package 96/92/EC

The liberalization of the electricity market began with the introduction of the 96/92/EC Directive, this Directive which is also called as the first energy package has firstly introduced common rules concerning the generation, supply, retail, transmission and distribution of electricity. The energy package has also established the first common rules for TSO and DSO networks unbundling and regulation. The most crucial aim of this directive was to unbundle the former vertically integrated energy companies, and to introduce some competition in the market for electricity.

Second Package 2003/54/EC

Later the second energy package (Directive 2003/54/EC) came into force. The second package brought big changes concerning the retail market and ordered the full market opening for all industrial companies until July 2004 and the full market opening for all households till July 2007. Under the full market opening we understand here the unlimited third party access.

Third Package 2009/72/EC

On the end in September 2009 the third package (2009/72/EC) was adopted. The third package concerns mostly the legally unbundling of the TSO companies. According this Directive all Member countries have to legally unbundle their TSO companies until March 2012. There has been no Directive introduced which would have force the countries to start privatize their energy holdings.

2.2 Features of the EU Market Liberalization

- TPA Third Party Access (2004/2007)
- Unbundling TSO (Accounts/Legally)
- Unbundling DSO (Accounts/Legally)
- Introduction of Independent Regulators

The unbundling of the TSO network companies is necessary and is one of the most important features of successful energy market reforms. According to Pollitt (2008), the unbundling of TSO should be associated with good energy regulatory work and well-functioning competitive retail and wholesale energy markets.

TSO theoretical effects of ownership unbundling

- Positive effect on competition
- Easiness and effectiveness of regulation
- Facilitation of privatization

- Security of supply
- Synergy/focus effects
- Double marginalization not an issue
- Foreign takeovers more likely
- Reduced risk of arbitrary government interventions
- Negative effect on the transaction costs of unbundling

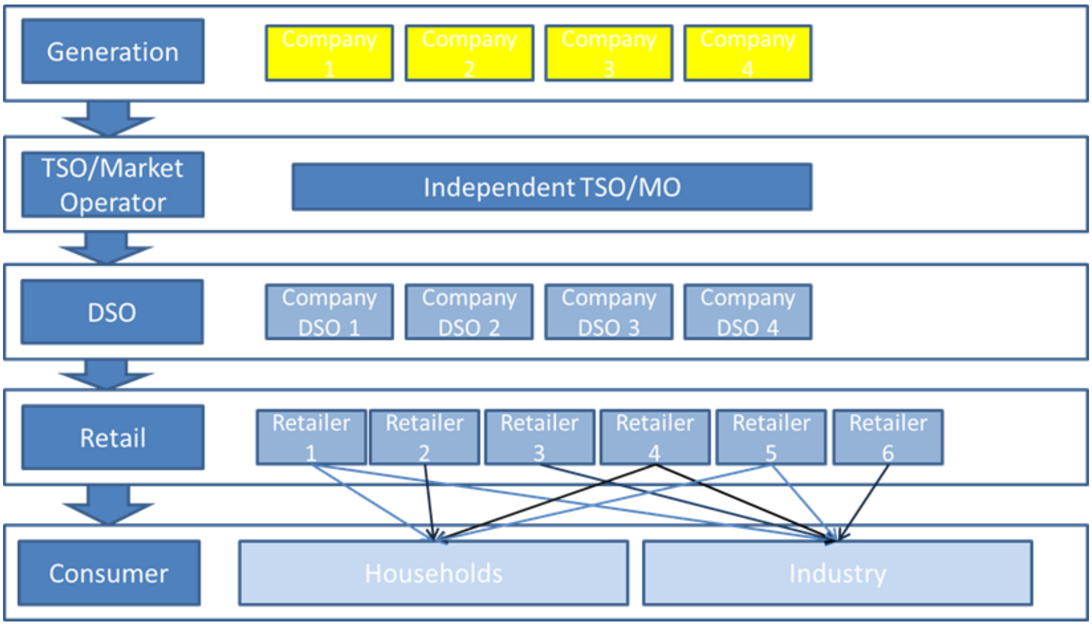


Figure 1 European Energy Market Reform Scheme

2.3 Electricity Price Components

In this part of the thesis the components of the end-user electricity prices are described. To make it more evident for what all a consumer has to pay in order to make use of electricity. It is also important to describe the components, to understand why some parts of the price have to be regulated and another one not.

Price Components

- Network charges: network charges includes all regular payments for connection to and use of the electricity network system, including transmission and distribution charges, payments for system services etc., which are charged to the consumers.[1] Network

[1] http://www.eurelectric.org/PublicDoc.asp?ID=38520

charges have to be regulated, since the electricity network market is some kind of monopoly owned almost always by one company and it must be secured that also other companies may use these electricity networks under non-discriminative conditions. This means that there has to be a fair regulated tariff for third parties using the network, which would on the one hand support competition on the electricity market, but on the other hand enables also the full cost recovery and adequate investments for the network operator (see Brunekreeft, 2009).

- Taxes, levies and surcharges: this includes taxes, official levies and other surcharges that are imposed by regulatory decisions. These components are limited to those costs that can be directly allocated to the end user prices of electricity. An example would be here the obligation to purchase renewable energy or CHP. These costs are not always explicitly invoiced to the customer; they can be sometimes included in the network tariffs or are paid by the suppliers or generators.[2]

- Residual costs: this is the so-called energy component; it is the residual share, which cannot be allocated to the both components above. This is why these costs could be considered as the price that is actually paid to the supplier for the energy delivered.[3]This part of electricity price should be not regulated, and should be the outcome of non-discriminative competition on the market. Firstly the wholesale market actors should offer here electricity production capacities to the retail companies, in a competitive market, where the more effective producers can beat the less effective which leads on the end to lower purchasing prices for the retailers, which are offering electricity for end-users. The retailers should than again offer the electricity to the end-users in a competitive market, because again the most effective retailers could offer electricity for lower prices, what in the end would lead to lower prices also for the end-users.

[2] http://www.eurelectric.org/PublicDoc.asp?ID=38520
[3] http://www.eurelectric.org/PublicDoc.asp?ID=38520

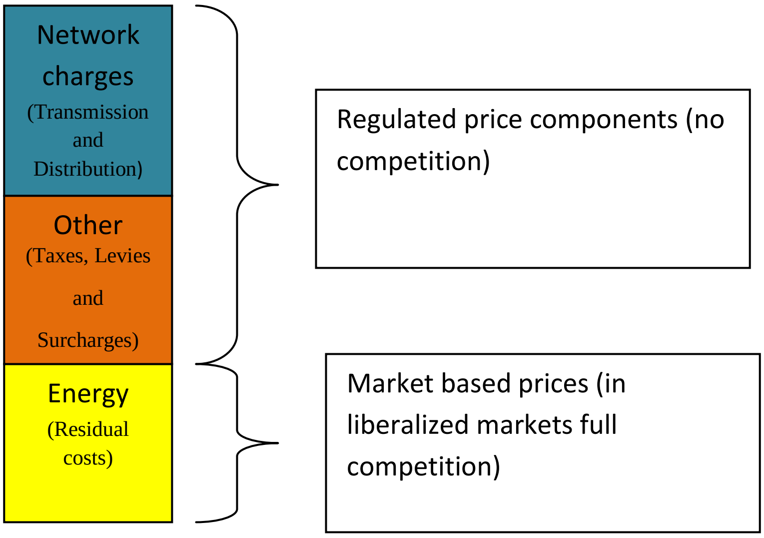


Figure 2 Electricity Price Components *Source.:KEMA (Review of European Electricity Prices2005)*

Taxes are not considered in the panel data study. In the panel data study the prices without taxes are taken into the model, to examine the effects influencing the electricity end user prices more properly.

3. Market Descriptions of the Examined Countries

In this part of the thesis the electricity markets of the examined countries are shortly described. We can divide all the examined countries according to the electricity market size into 3 Groups.

1. Small electricity markets
2. Medium-sized electricity markets
3. Large electricity markets

This division was done, to show that in small countries with small electricity markets, one company almost always dominates the market; in the larger markets the probability of one dominating company is lower in the case of this thesis. The consideration here is that in countries with small markets it is much harder to introduce a well-functioning competition as in larger markets under the same regulative conditions. Under the same regulative conditions the three energy packages are thought. An example could be here the TSO unbundling, the small TSO and DSO operators of small countries with small markets cannot reach the economics of scales of similar TSO and DSO operating in bigger countries, but here maybe the privatization of these companies through bigger TSO and DSO might be the solution. The same applies for the wholesale markets of small countries, where it would be hard to install at least three wholesale electricity-producing companies, which would reach a relative big economics of scales, here could be the solution a strong interconnection with other countries, to decrease dependence on the one or two local companies. These examples should show us that it might be much harder to create an effective competitive market in small countries than in larger ones and that this might be the reason for not such competitive markets in small countries.

Under a small electricity market in this thesis a market with a consumption which is not bigger than 20 000 GWh is understood. A market is considered to be medium-sized in case of an annual consumption from 20 000 GWh up to 50 000 GWh and is considered as large one in a case when consumption exceeds 50 000 GWh of electricity. As mentioned before, this classification was created just on the basis of data which were collected for this thesis and was presented just for a better understanding of particular markets of the examined countries.

Small-sized electricity markets are Estonia, Latvia, Lithuania, and Slovenia, countries considered to have medium-sized markets are Slovakia, Hungary and Czech Republic as countries with large-sized markets are considered Romania and Poland.

Market/Country	Market Size	Consumption Gwh	Dominant Company Wholesale
CZ	Medium	63040	Yes
EE	Small	7827	Yes
LT	Small	10362	Yes
LV	Small	7264	Yes
HU	Medium	40142	No
PL	Large	145720	No
RO	Large	54916	No
SI	Small	12558	Yes
SK	Medium	26780	Yes

Table 1 Country Consumption in GWh according to ENTSOE 2011.

All the examined countries have the commonality that, they are former countries with Soviet Union influence, and now the entire can be considered as members of the European Union. All of these countries went through a transition to market economies and privatization waves. All data and information about the markets and countries are collected from EUROSTAT, Regulatory Office national reports, Regulatory Office reports, Yearly reports, ACER reports and EU reports to energy market reforms.

3.1 Czech Republic

The Czech Republic has today one of the strongest economics of the new European Union member countries with a GDP of 14 600 €/inhabitant by market prices. According to ERO which is the Energy Regulatory Office of the CZ the net electricity generation in the CZ reached 81 088,4 GWh in 2012 of which 58 798,6 GWh were consumed in the CZ and the rest was exported. This makes the CZ to one of the largest exporters of electricity in the EU. The majority of the electricity is produced in coal powered and nuclear powered power plants as the figure Energy mix in the CZ shows us. RES-E is produced from Wind, Hydro, Solar and Other renewable sources in the CZ and the share of RES-E is relative low.

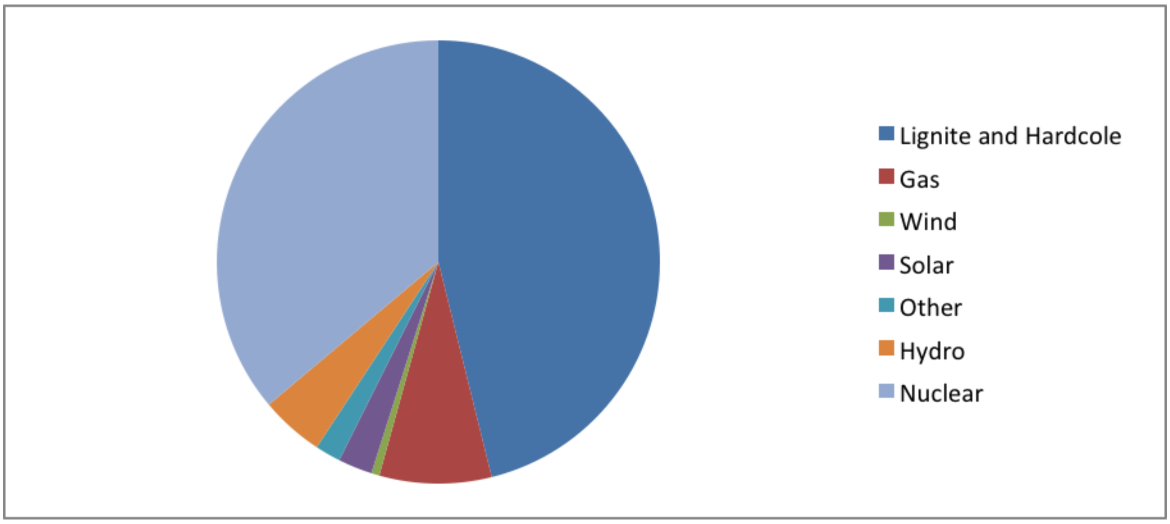


Figure 3 Energy Mix in the CZ *Source.: ENTSOE*

It is also important to mention that the share of coal fueled power plants is connected with the large coal stocks of the Czech Republic and that the electricity producers are in many cases also owners of the coal mining companies as CEZ for example. The wholesale market is highly concentrated with one dominant player which is CEZ company .The company had a market share of around 70% in 2012. Here it is important to mention that CEZ is the former vertically integrated state owned company, which was successfully unbundled. Today CEZ is an international but still state owned company with activities in generation, distribution and retail. The TSO operator CEPS is ownership unbundled since 2003. In the CZ 3 main legally unbundled DSO (since 2005) exists. One of this DSO is owned by the state CEZ Company the second is EON, which is a German company, and the third is PREdistribucie the electricity distribution company for the Prague region. Recently there is also a strong electricity market coupling with Slovakia and Hungary. The retail market is controlled by 3 retailers of which all have a market share higher than 5 % (CEZ;PRE;EON), this companies are also the owners of the DSO, the customer switching rate between retailer reached 3,3% in 2011 and there is no end-user price regulation for the households and either for the industry. The market opening in the CZ was not accompanied with struggles and the market is **full opened since 2006.** The Czech Republic is using Feed-in Tariffs premiums to support RES-E. In the CZ still the majority of the electricity is produced in conventional power plants, and the share of RES- Electricity is still relative low and deep under the average share of the EU, even if share of RES-E is each year higher as the RES-E Share Development figure shows us.

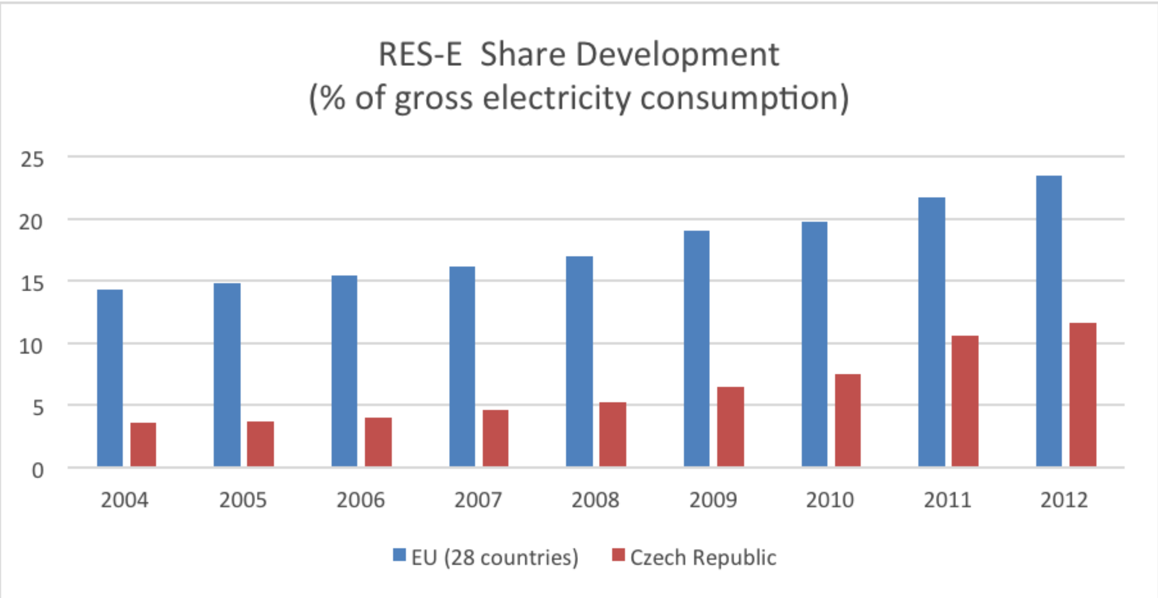


Figure 4 RES-E Share CZ&EU *Source.: Eurostat*

3.2 Estonia

This state is the richest one of the Baltic countries with a GDP of 13 000 €/inhabitant by market prices in 2012. Estonia is also a country which has a positive electricity balance and is an electricity exporter (2,2 GWh), the market consumption is relatively small with 8 139 GWh. The Estonian total output was 10 459 GWh in 2012.

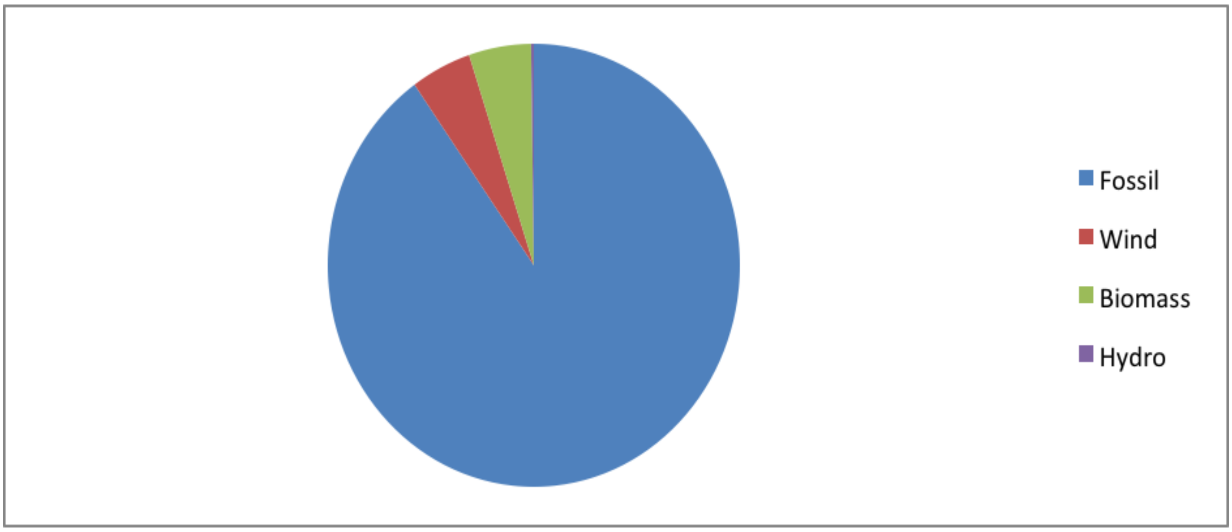


Figure 5 Energy Mix in EE *Source.: ENTSOE*

The energy mix is presented in Energy Mix in EE Figure above and is showing that Estonia generates 87% of electricity in fossil fuels powered power plants. Especially shale oil is commonly used, which is mined in the Estonian see coast. The rest 13 % of electricity are produced from renewable sources as wind and biomass. The Estonian wholesale market is highly concentrated with a HHI of 7500. The vertical integrated state-owned company Eesti Energia with a market share arround 87% dominates the market. Eesti Energia AS is almost a monopolistic corporation that controls companies from generation, distribution and retail. The TSO Elering has been successfully unbundled in 2010 (see Laur et al.,2003) . The electricity market is strongly connected with other Baltic States and Finland through an undersea cable, which has enabled to participate on the Nordpool exchange market. The retail market itn Estonia is also not very competitive with a HHI higher than 9000. The Market is opened for all customers since 2013, and is dominated by the state-owned company Eesti Energia with a 76% share. Several infringement processes against Estonia were leaded by the European Commission because of the adoption of the third energy package, which was successfully adopted in 2011. The end user electricity prices electricity prices are still regulated for both the industry and the households. There is one independent TSO operator which was successfully unbundled and one strong DSO company Elektrilevi owned by Eesti Energia which is controlling 87, 5% of the DSO network. To support green electricity a feed in tariff premium scheme is used.

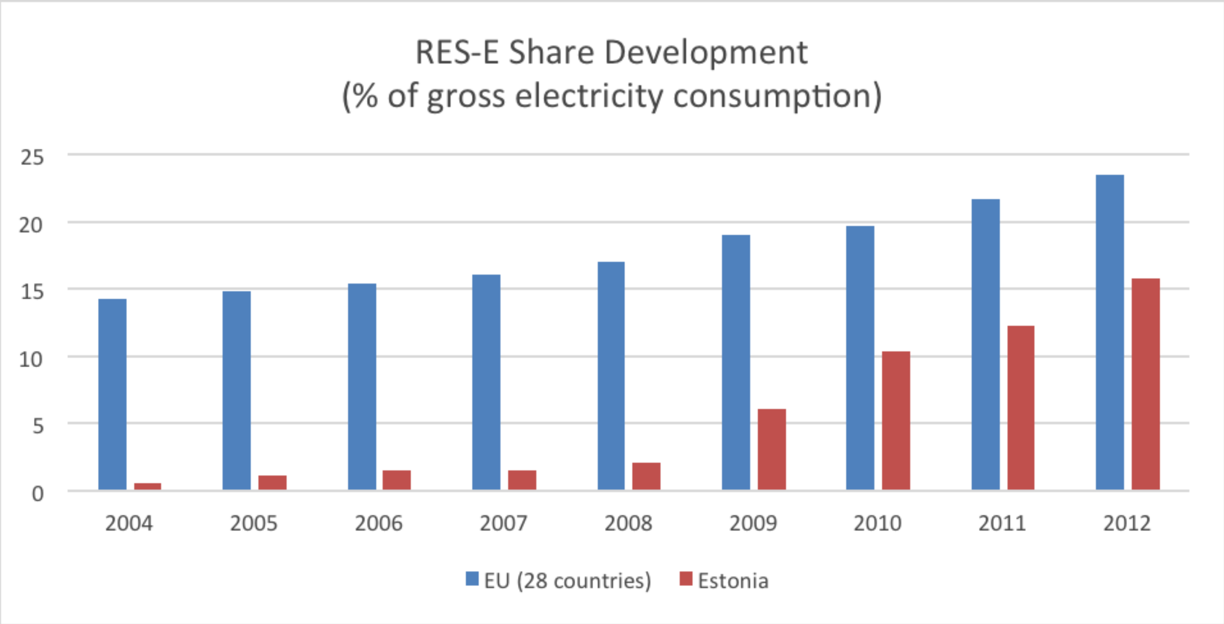


Figure 6 RES-E Share EU&EE *Source.: EUROSTAT*

As the figure representing the RES-E share is showing us the share of RES-E , which is relatively fast growing and has almost reached the EU average, for the fast growing are responsible mainly wind farms and biomass power plants as mentioned before.

3.3 Latvia

Latvia has a GDP of 10 900€/inhabitant by market prices. The electricity market is relatively small. The electricity national consumption reached 7 398 GWh in 2012. The Latvian electricity energy mix is shown in Energy MIX Figure. In Latvia more than the half of the produced electricity is generated from the renewable energy sources especially from hydro energy, which is very dominant in Latvia, there are also some production capacities installed in gas, fossil, wind and biomass fuelled power plants.

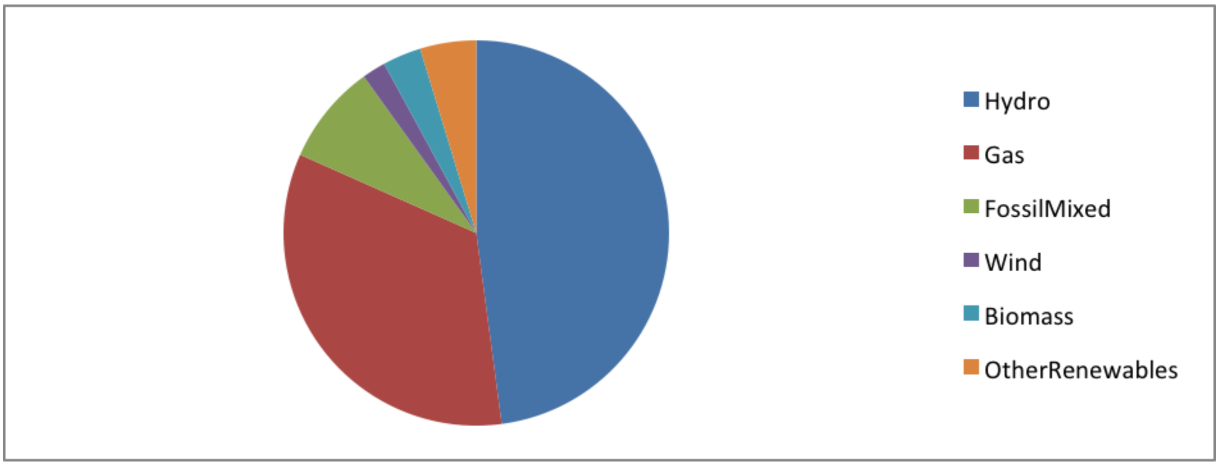


Figure 7 Energy Mix in LV *Source.: ENTSOE*

Latvia is a net electricity importer. The wholesale and retail electricity market is similarly highly concentrated HHI 7000 as in Estonia; the main reason for this is also the vertically integrated state-owned company Latvaenergo with a market share of around 90% in the wholesale and also retail market. The DSO Sadales tīkls controls 99% of the market and is legally unbundled but in full ownership of Latvaenergo. The TSO Augstsprieguma tīkls is since 2012 a separate and ownership unbundled company in the state hands. From the 2013 year a strong market coupling with other Baltic countries has been started. The full TPA was introduced in the 2007, so that each market participant can freely decide from which supplier he wants to buy electricity. The Latvia government has chosen feed in tariff premiums scheme for the support of green electricity. The share of RES-E is stable and is highly over the average of the EU as shown in RES- Share Development figure.

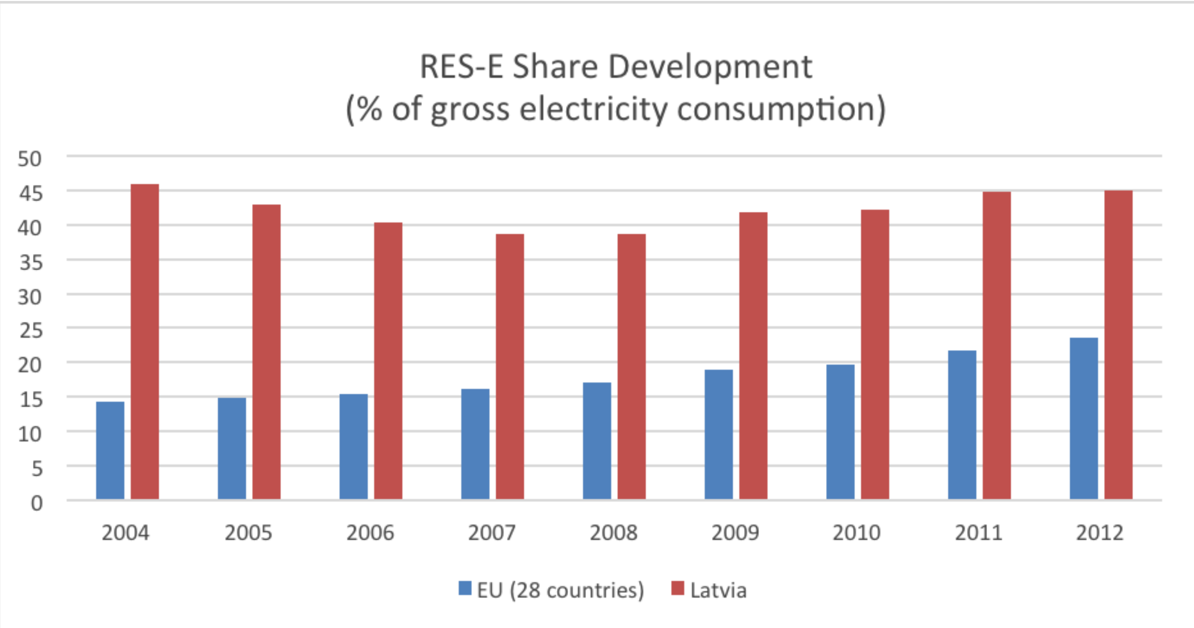


Figure 8 RES-E Share EU&LV *Source.:EUROSTAT*

3.4 Lithuania

Lithuania is the largest of the Baltic countries and has a GDP of 11 000 €/Inhabitant by market prices. Lithuania market consumption was 10 552 GWh in 2012. As shown in the Energy Mix Figure the majority of electricity in Lithuania is produced in fossil fueled power plants. Most of the RES-E electricity is generated in hydro, biomass and wind powered plants.

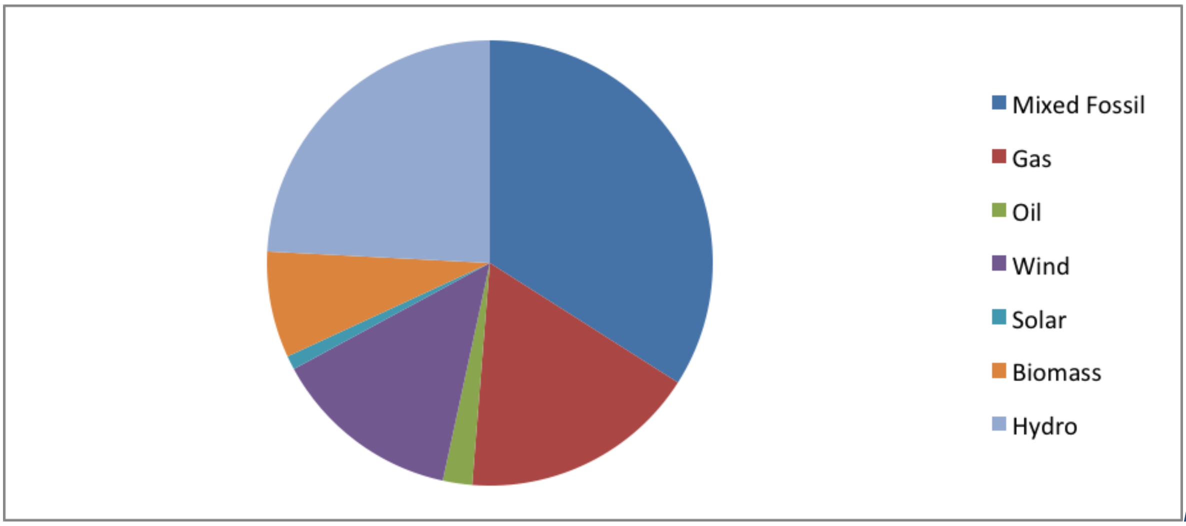


Figure 9 Energy Mix in Lit *Source.: ENTSOE*

Lithuania is a large electricity importer; almost half of the electricity consumption must be imported from abroad, and after the Ignalina Nuclear Power plant in 2009 has been closed. Between 2002 and 2006 the state-owned Lietuvos Energia (LE) was reorganized and the DSO and TSO became unbundled. (see Milciuviene et al., 2011) There is now one legally unbundled TSO LITGRID (since 2010 also ownership unbundled) company and one major DSO AB LETSO company which is legally unbundled but in Lietuvos Energija ownership. The wholesale market is dominated by the state owned company LE with a share of 35% after the nuclear Power Plant was closed. There are also at least 4 other players with a share of 5% and more; the market is much less concentrated with a HHI 4092. These 3 companies control the retail market; here the State owned AB Letso holds a 44% market share and the other two key players have over 5% of the market. The HHI of the retail market is 5000. The end user prices in Lithuania are regulated for the households but not for the industry. The market is coupled with Baltic and North European markets through the participation on the Nordpool market.

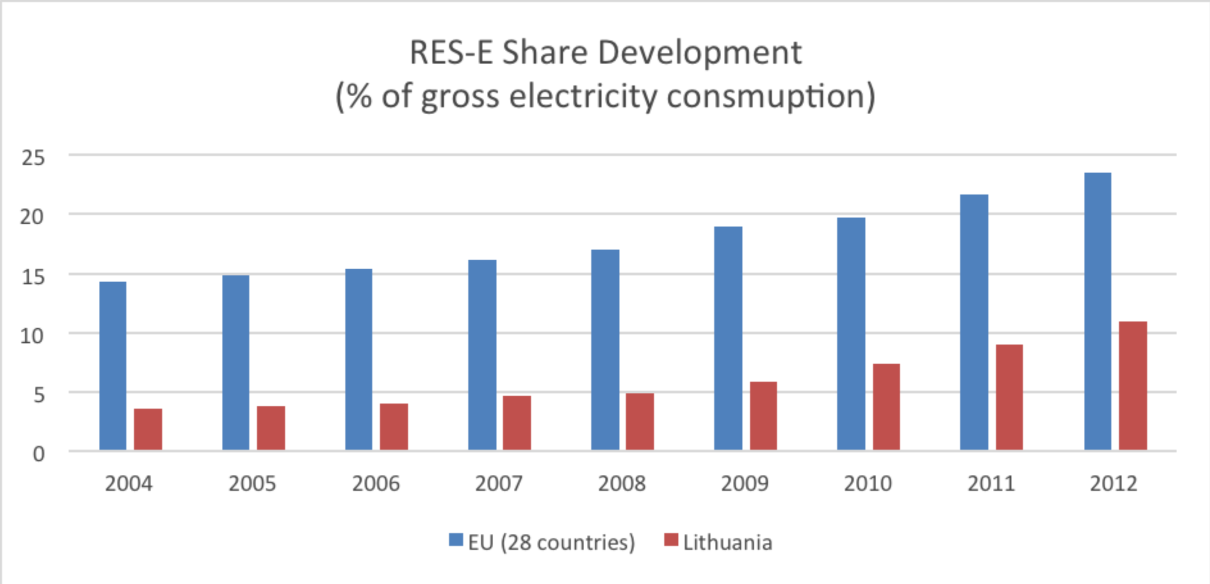


Figure 10 RES-E Share EU&Lit *Source.:EUROSTAT*

In the Figure RES-E Share Development it is shown that the RES-E share is under the average of the EU, even if there is some increase during the time. This figure is a little bit in contrary to the Energy Mix Figure, where is shown that more 35% of electricity is produced from RES. The reason for this is that in the mix figure just power plants active in Lithuania are taken into account and Lithuania imports around 50% of electricity needed from abroad.

3.5 Hungary

The market liberalization in Hungary started relative early in the late 90 when a new legislative and privatization was adopted (see IEA, 1999). Foreign international companies including DSO, Retail and some power generation companies control today more than 60% of the whole electricity market. Hungary had a GDP of 9800 €/Inhabitant by market prices in 2012. The national net electricity consumption in Hungary reached 36 265 GWh in 2012. The energy mix is shown in the Energy Mix Figure. The majority of electricity is produced in conventional power plants, which are gas, lignite, coal or nuclear powered. RES-E has a very little share and is produced mainly in wind farms and biomass power plants, despite the fact that many strong rivers as Danube or Tisza are flowing through Hungary.

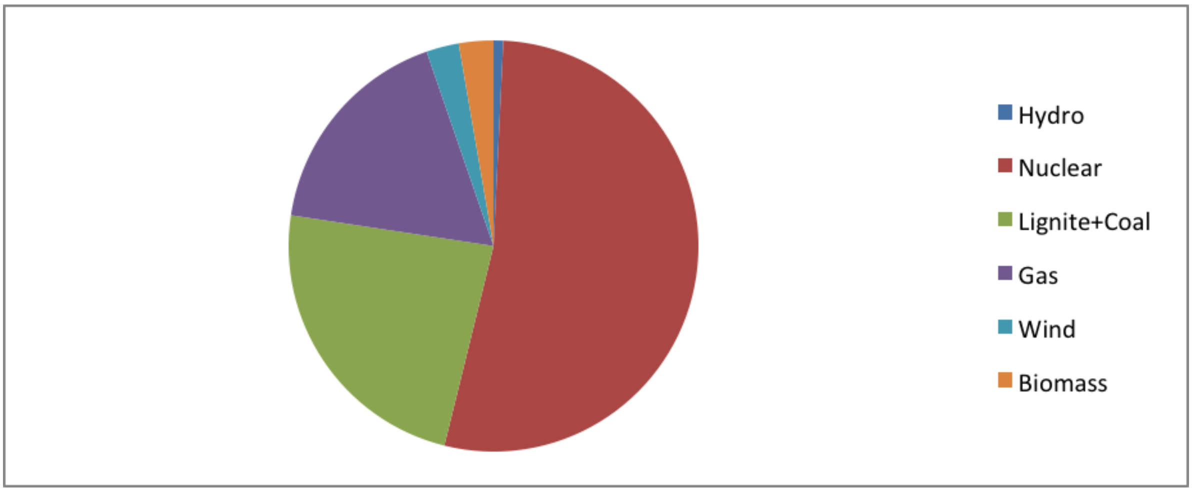


Figure 11 Energy Mix in HU *Source.:ENTSOE*

The wholesale market is dominated by three power generation companies of which each has a market share of more than 5% . According to the HHI of 1400-1800 the market is slightly concentrated. One of these companies is the state owned MVM with a market share of 42, 1%. MVM produces the majority of the electricity output in the Paksi nuclear power plant. The second crucial player in the generation market is the Matrai Erömü ZRT, of which the majority is owned by the RWE Group. Another important fact about the generation market is that Hungary is a net importer of electricity because lack of generation capacities. Since 2011 Hungary coupled their Day-Ahead electricity market with the Czech Republic and Slovakia. The majority of the wholesale market is still controlled by the state-owned companies. On the market one TSO Mavir and six DSO are active. The TSO is legally unbundled and state-owned and integrated in the MVM (generation, TSO, retail) Company. The six DSO are fully in foreign investor hands (RWE, EON, EDF,), legally unbundled and were privatized in the late 90s. In the retail market 5 companies are active with a market share of over 5%, four of these companies are active also as DSO and the last one is the state-owned MVM. According to the HHI index, which is 950, the retail market is moderate competitive. Feed in tariffs is the RES-E electricity support scheme used in Hungary. As shown in the RES-E Development Figure the share of RES is deeply under the EU average, and no progress can be seen.

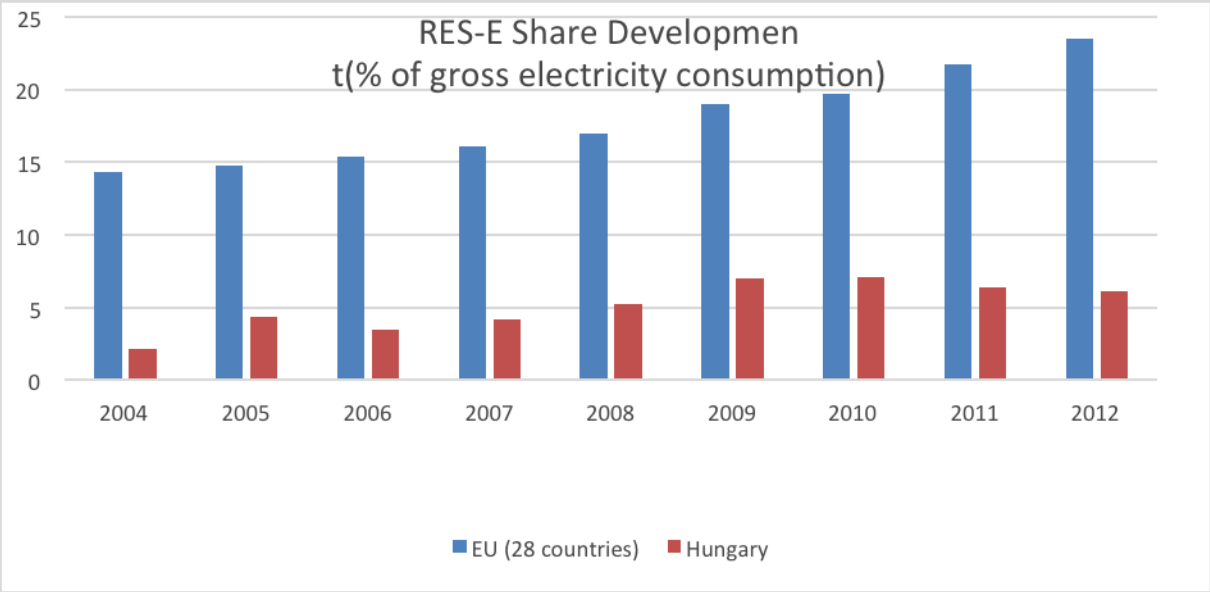


Figure 12 RES-E Share HU&EU *Source.: EUROSTAT*

3.6 Poland

The Polish electricity market is the largest one of all examined countries. In 2012 the national consumption of electricity in Poland was 157 013 GWh. Poland had a GDP of 9 900€/Inhabitants by market prices. Poland has chosen another way of privatization as the other examined countries and in my opinion the most effective. Poland slowly privatizes the state owned companies through IPO most of the public companies are partly privatized but still more and more shares of the companies are sold on the stock markets on the other hand all companies are more or less still under the state control. The wholesale market is dominated by mainly state owned companies with exception of EDF. The largest 3 companies are PGE, TAURON and EDF. They control around 60% of the wholesale electricity market.

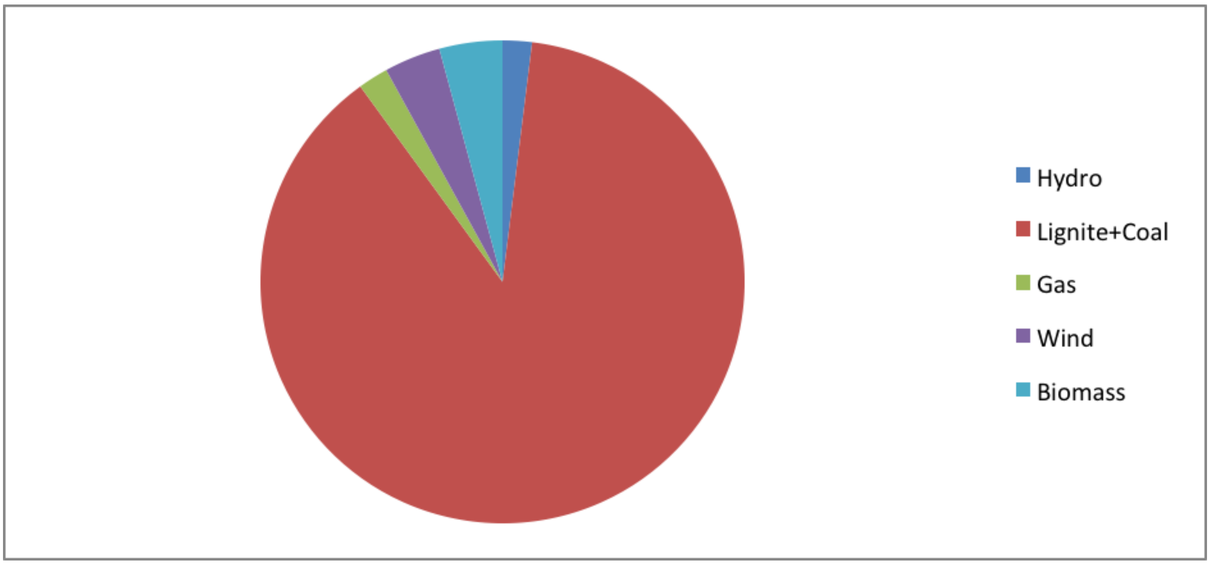


Figure 13 Energy Mix in Pl *Source.: ENTSOE*

As shown in the Energy Mix Figure the electricity in Poland is mainly generated from fossil fuels, the reason for this are large coal resources of Poland. In Poland the electricity share of renewables is relative low with 13 % of which 6% comes from hydro power plants and 7% from wind and other sources. Poland is a relative flat country with sea access and good wind energy potential, to build out further their wind power plants, which is recently happening as shown in the RES-E share development figure. The generation of green electricity is supported by the Green Certificate scheme. In Poland one legally and ownership unbundled TSO (PSE) exists and legally there are unbundled 5 DSO but they are vertically integrated in the mostly state-owned companies TAURON, ENEA, STOEN, ENERGA and PGE. All of these companies are active in generation, distribution and retail with the exception of STOEN, which is foreign owned by RWE, and active in distribution and retail. In the retail market 7 companies with a share of more than 5% are active, 5 of this 7 are also DSO companies. According to HHI both the retail and also the wholesale market is on an edge between moderate and high concentration. In Poland the end user prices are regulated for the households but not for the industry.

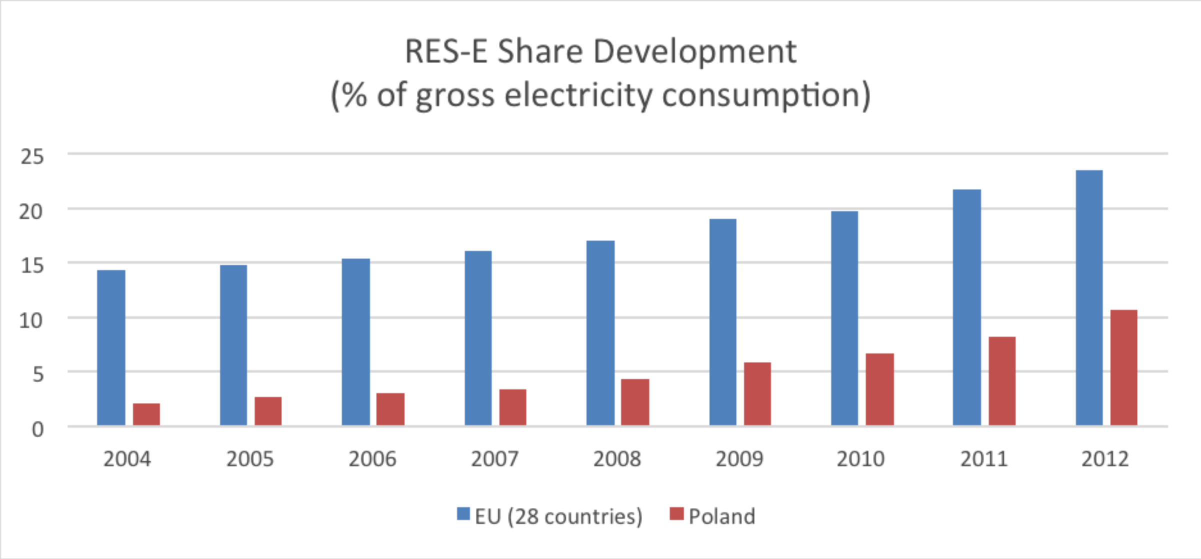


Figure 14 RES-E Share PL&EU *Source.: EUROSTAT*

3.7 Romania

Romania had a GDP of 6 200 €/inhabitant by market prices in 2012. According to the GDP Romania is the weakest economy among all examined countries. The electricity market is the second largest among examined countries and the consumption reached 54 427 GWh in 2012. Romania went through a successful market reform, which was started between 1998 and 2000, when the vertical integrated state owned company was split into 5 independent companies. The generators Nuclearelectrica, Hydroelectrica, Thermoelectrica, the independent TSO (Transelectrica with her subsidiary OPCOM Market Operator) and the distribution / retail company Electrica. Electrica was later further divided into 8 DSO of which 5 were privatized and owned by foreign investors ENEL, CEZ, and EON(see Diaconu et.al., 2009) . The wholesale market is dominated by Romanian state owned companies. Six power-generating companies have a market share larger than 5%, which dominate, in the wholesale market. The strongest one of these companies has a share of 30% and the HHI of 1914 indicates that the market is on the boundary between the moderate concentration and the high concentration.

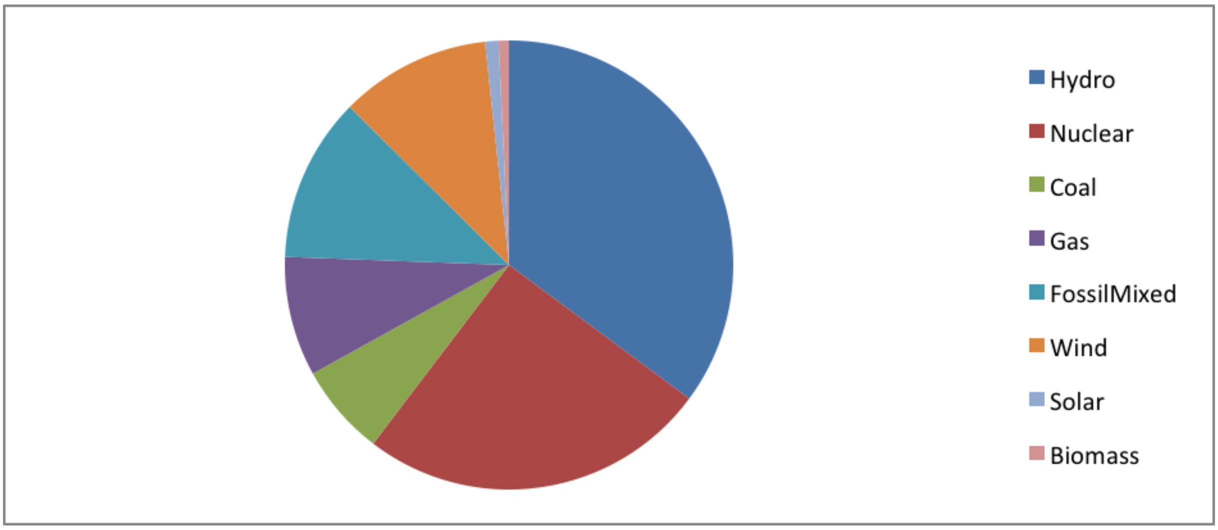


Figure 15 Energy Mix in RO *Source.: ENTSOE*

Romania has also a very balanced electricity generation mix as shown in the Energy Mix Figure 54% fossil fuels, 20% nuclear, 21% hydro and 5% other renewables sources which are supported by green certificates. The retail market is according the HHI of 530 highly competitive; this can be also supported with the market share of the largest retailer, which is just 12%. The end-user prices in Romania are still regulated for the households and also for some industrial companies.

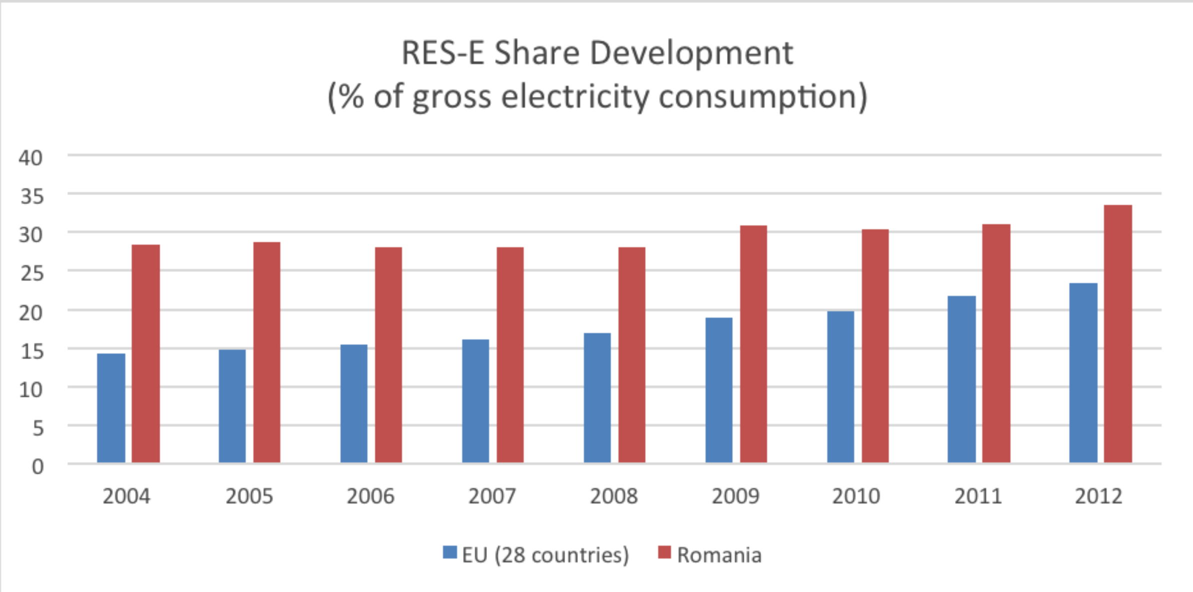


Figure 16 RES-E Share RO&EU *Source.: EUROSTAT*

The RES-E share in Romania is highly over EU average, since Romania uses all RES available in Romania and is still investing further in RES as shown in the RES-E Development Figure.

3.8 Slovenia

Slovenia has the strongest economy of all examined countries in terms of GDP, the GDP/inhabitant by market prices was 17 200 € in 2012. On the other hand Slovenia is a small country with a small electricity market of 12 631 GWh electricity in 2012. The first electricity market reform began in 1991 after becoming an independent country. In the 1991 the vertical integrated company was divided into generation, TSO and in 5 DSO with retail function. The second reform began in the 1999 after the directive 96/92/EC the so-called first energy package was adopted. In Slovenia there was no successful privatization until now and the majority of electricity companies are still state-owned (see Hrovatin et.al.,2009). The wholesale market is dominated by two state owned generation companies (HSE with a market share of 57,9% and a GEN Energija with market share of 23,4%).

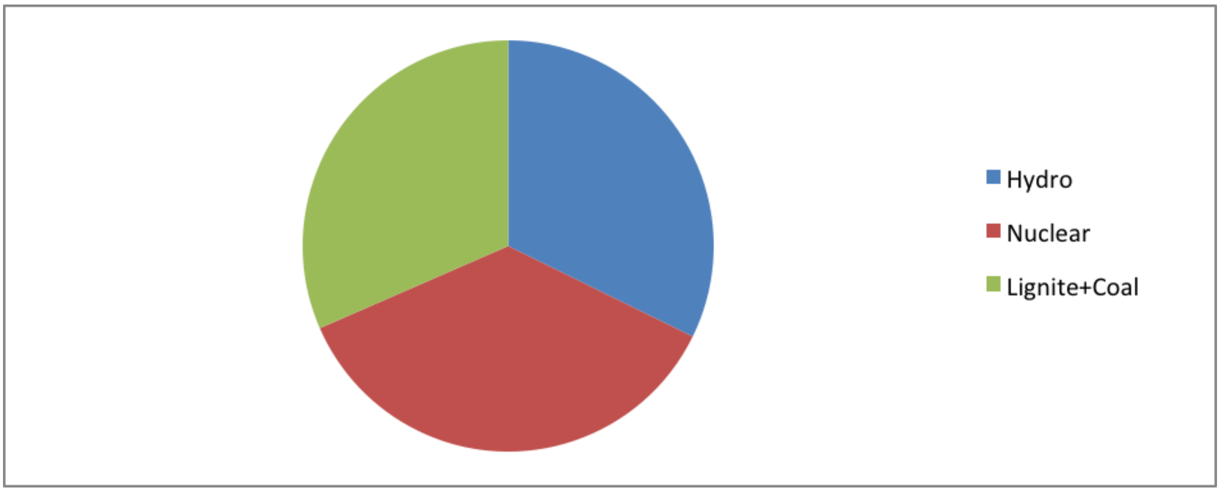


Figure 17 Energy Mix in SI *Source.: ENTSOE*

Slovenia is a net electricity exporter and produces their electricity in nuclear 35,3% , fossil 32% and hydro 25,7% powered power plants as shown in Energy Mix Figure .The energy mix is well balanced. There is also a strong market coupling with Italy. The HHI index of the wholesale market is 5503 and indicates a very concentrated market. In the retail market the HHI index is 1575, and indicates a moderate market concentration, further there are 8 companies on the market with a market share over 5% on the retail market. Five of these companies are also owners of the legally unbundled DSO. The end-user prices in Slovenia are not regulated and a feed in tariffs system has been established to support green energy. The share of RES is over the average of the EU and is not stable since RES-E is the product of mostly hydro powered power plants that are volatile as shown in the RES-E Development Figure.

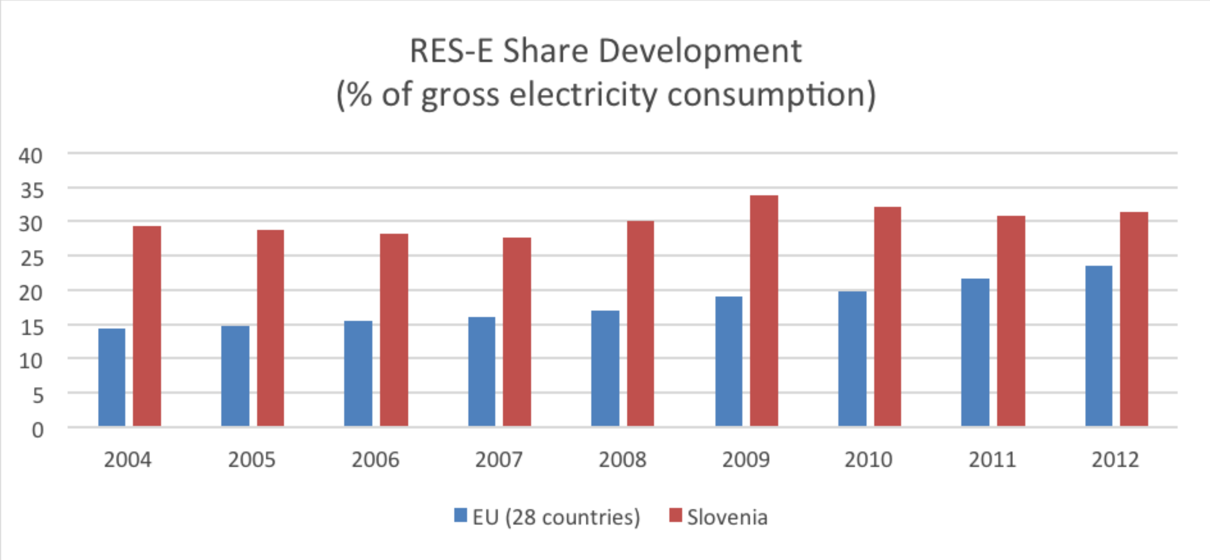


Figure 18 RES-E Share SI&EU *Source.: EUROSTAT*

3.9 Slovakia

The GDP of Slovakia was 13 200 €/inhabitant by market prices in the 2012. The national consumption of electricity reached 28 786 GWh of electricity in 2012. After Slovakia became independent, the electricity market composition was almost the same as today. One generation company Slovenske Elektrarne (SE) dominated the electricity generation market, which was also the owner of the transmission network until 2002. In 2002 the TSO was separated from Slovenske Elektrarne and a new ownership unbundled TSO company SEPSAS was founded. In 2004 the electricity generation company was privatized and the major owner became the Italian ENEL Group. The distribution network was owned by 3 similar large DSO companies VSE, ZSE, SSE which were also the retailers since 1990. In 2002, 49% of each DSO Company has been sold to foreign companies RWE, EON, EDF, even if the majority ownership left in the state hands, the management was fully left over to the foreign investors. The legal unbundling of the DSO took place in the year 2007. As mentioned before the wholesale market is dominated by one power generating company SE with a market share of 80%, on the other hand there is a strong market coupling with Hungary and the Czech Republic. Slovakia has been for a long time a net electricity exporter until on the end of 2006 the Jaslovske Bohunice nuclear power plant has shut down two nuclear reactors.

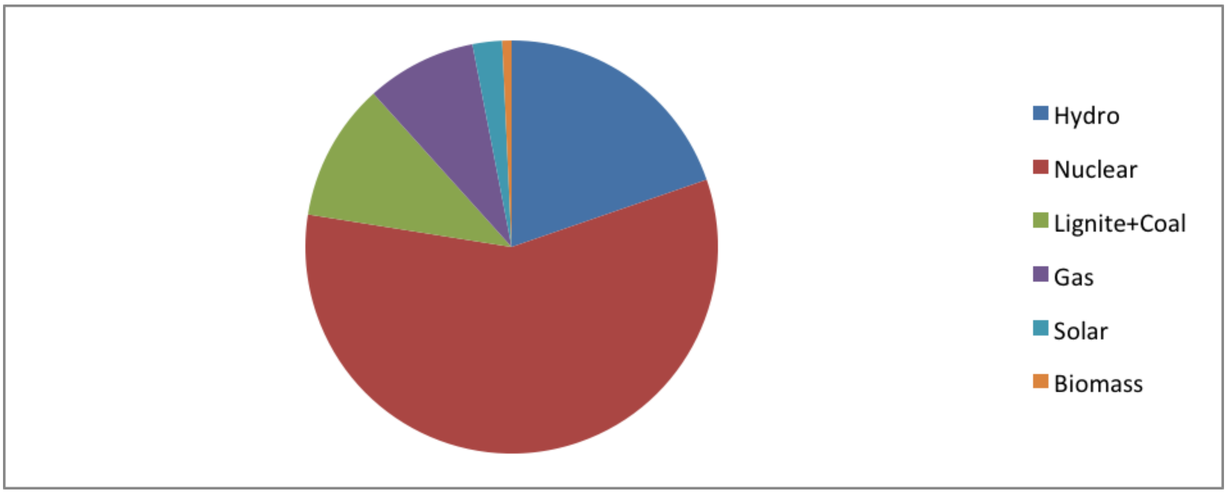


Figure 19 Energy Mix in SK *Source.: ENTSOE*

Slovakia produces their electricity mainly form hydro, fossil and a nuclear energy sources as shown in the Energy Mix Figure. The share of other renewables is 9 %. According the HHI index the generation market is strongly concentrated. On the other hand the retail market is dominated by 5 companies with a market share higher than 5% , 3 of these companies are in ownership of the DSO according the HHI index the retail market is moderately concentrated. The end user prices are regulated for the households and small companies. To support green electricity Feed-in Tariffs Schema has been introduced.

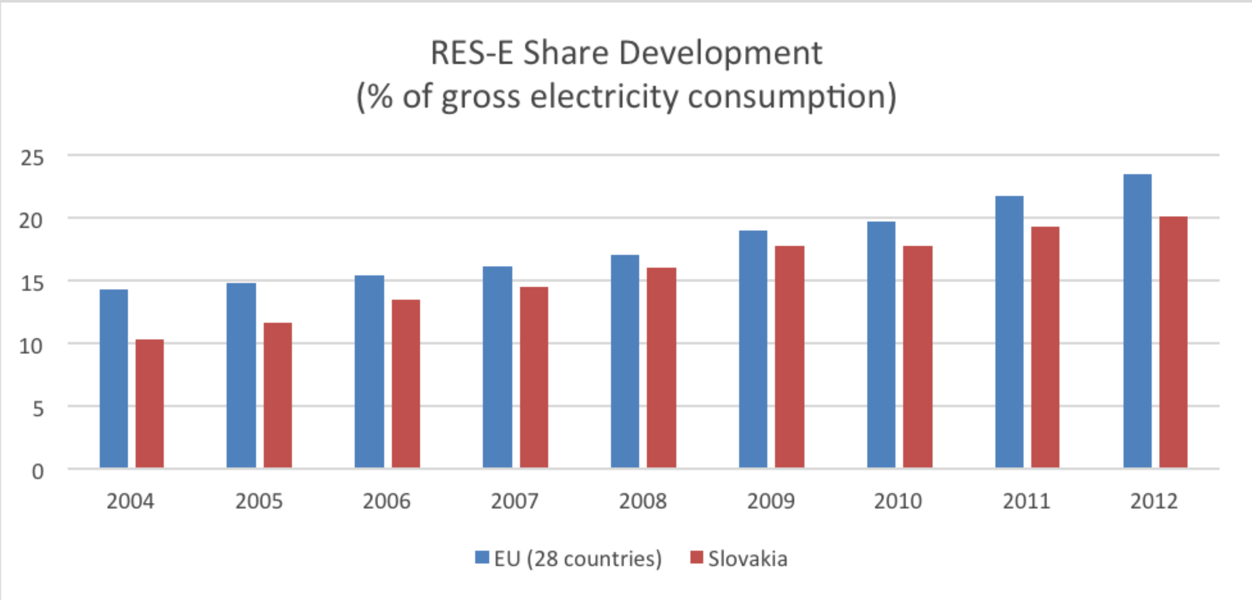


Figure 20 RES-E Share SK&EU *Source.: EUROSTAT*

As shown in the RES-E share development figure the share of RES is slightly under the EU average and is slowly increasing during the years.

GEO	Excluding Taxes and Levies		All taxes and Levies Included	
Type	**Household**	**Industry**	**Household**	**Industry**
Czech Re	0,12 €	0,10 €	0,15 €	0,12 €
Estonia	0,08 €	0,07 €	0,11 €	0,10 €
Latvia	0,11 €	0,11 €	0,14 €	0,13 €
Lithuania	0,10 €	0,11 €	0,13 €	0,14 €
Hungary	0,12 €	0,09 €	0,16 €	0,12 €
Poland	0,12 €	0,09 €	0,15 €	0,12 €
Romania	0,08 €	0,08 €	0,11 €	0,11 €
Slovenia	0,12 €	0,09 €	0,15 €	0,11 €
Slovakia	0,14 €	0,13 €	0,17 €	0,16 €

Table 2 Overview End-User Prices In 2012 *Source.:EUROSTAT*

4. Electricity End-User Price Model

Various authors have already used panel data models to examine the price effects of the liberalization electricity market reform. The first one who has used a panel data model to examine the electricity price effects of electricity market reforms was Steiner (2000). Steiner has used panel data from 19 OECD Member Countries. He has used data between 1987 and 1996 to examine the effects of the electricity market reform. Steiner has used a panel data model with fixed effects to examine the energy market reform impact on the industrial and household electricity prices separately using the same model. He also used an industrial price household price ratio to examine the possible price gap change between the household and industrial prices. Later Hattori and Tsusui (2004) have used the same OECD panel data as Steiner again from the same 19 OECD Countries and the observed time period in this case was between 1987 and 1999. They have also modified some indicators as the indicator for the TSO unbundling, since in the Steiner study a TSO was supposed to be unbundled as soon as it was separated through accounts from the vertical integrated company in the Hattori and Tsusui the TSO has to be legally unbundled to be seen as unbundled. There is also a difference in the private ownership indicator since Steiner has used different levels of ownership and Hattori and Tsusui levels. In both studies the same regression equation was used and a country specific effect was assumed. Another difference between these two studies was that Hattori and Tsusui have used two different panel data estimation techniques, the one-way fixed effect model and one-way random effect model, while Steiner has used just the one-way random effect model. A Hausman test was then used to decide what results should be preferred. Hiroaki Nagayama (2009) has done another panel data observations studies concerning the price effects of electricity market reforms. Nagayama had used panel data to examine the price effects of reforms in developing countries between 1985 and 2002. He has written also a similar paper concerning the price effects of electricity reforms in developing countries (see Nagayama, 2007). In this paper especially the end-user retail prices were examined. In each of the above described studies the energy market reform effect on the end-user retail prices was examined.

4.1 Model Set-Up

The panel data model, which has been used in this thesis for examining the price effects of the liberalization electricity, market reform and other indicators and variables is an adaption of the Hattori panel data regression model (see Hattori and Tsutsui.,2004). In this thesis the same regression equation is used once for the household, industrial prices and the industrial price/household ratio. It is also important to mention that the same regression equation has been used for the examination of the network tariffs.

$$y_{it} = \alpha + X^{'}\beta + Z^{'}\gamma + u_i + v_{it}$$

In the regression equation used here y_{it} denotes the price level of the Industrial price/household price ratio, the household or industrial price and in the case of the network tariff model the network tariff price. X represents a set of various market liberalization reform indicators and Z is the set of various independent indicators, which are not directly related to the energy market reform but may have an influence on the electricity price. In the case of the network tariff model X represents all independent variables used in the model. Subscripts i and t are indicators for the countries and the time period. All unobservable time invariant country specific effects are accounted by u_i, and v_{it} represents the normal disturbance term. The network tariff model is more precisely described in the part where the profitability indicators impact on the network tariff is examined. The model of Hattori assumes the existence of country specific effects and uses the one way fixed and random estimation technique to examine the panel data. The estimation results of both models are then used for a Hausman test that is indicating which model should be preferred. The same approach is used in this thesis. It is also crucial to say that β and γ are identical across all examined countries. In the next part of the thesis a subchapter is dedicated for the better understanding of differences between a fixed and random effect models.

4.1.1 Fixed vs. Random Effect Regression Model

When examining panel data, there are basically two standard possibilities how to address the error components in linear regressions model. The one standard possibility is to use a fixed effect panel data model and the other one is to use a model with random effects. While the fixed one, models time and individual effects conditionally, the random effect model treats them unconditionally. More precisely in the random effect regression model the time effects and individual effects are treated as a part of the regression error (Schroeder,2010).

In a fixed model it is assumed that the omitted effects u_i are correlated with variables, which are included in the model. In general the model with fixed effects implies that differences across groups can be captured in differences in a constant term u_i.(Green,2012) According to this is all the country specific effects have to be assumed as fixed parameters to be estimated in a fixed effect model.

While in the fixed model it is allowed that the unobserved country specific effects are correlated with the included variables, in the case that the individual effects are strictly uncorrelated with the regressor, it may be better to model the country specific term as randomly distributed across the cross-sectorial data. The country time-invariant specific effect u_i is here not fixed as a constant term but is random specific to the ieth observation and is constant through the time (Green 2012). In other words the country specific effects are treated randomly.

4.1.2 The Hausman test

As mentioned before in this thesis, once the fixed effect model and then the random effect model is used for estimations. That is why here a test has to be done to make it possible to choose the estimation of the model which fits better. Since the 80s the most application in economics have made their choice between a fixed effect and random effect model based on the Hausman test (Baltagi, et.al,2002). The Hausman is "*an asymptotic test chi-sq test which is based on the quadratic form obtained from the difference between a consistent estimator* *under the alternative hypothesis and an efficient estimator under the null hypothesis*"(Holy,1982). More precisely, the Hausman test compares the fixed effects against the random effects under the null hypothesis that the individual effects are uncorrelated with other regressors (variables) in the model. In the case that the individual effects are correlated the null hypothesis is rejected and the fixed model is preferred (Green, 2012).

4.2 Electricity End-User Price Model Variables

Dependent and Independent Variables

Here in the first part the dependent variables of the panel data model will be described. In second part the independent variables will be explained and presented.

4.2.1 Dependent Variables

The goal of this thesis is to examine effects of various indicators on the electricity end-user retail prices; the dependent variable used in the model is the electricity end-user-prices in Eur per MWh of electricity. The electricity prices used in the thesis are collected from the Eurostat Database[4] for most of the countries and time periods. For the Czech Republic, Hungary, Poland and Slovenia, the yearly electricity prices for the whole examined time period 2000-2012 are collected from Eurostat. The electricity data for Slovakia, Romania and Lithuania are gathered from Eurostat for the time period 2004-2012 and data older than 2003 are gathered from the IEA Energy prices and Taxes[5]. Latvian electricity prices are collected from Eurostat for the time period 2004-2012 and from the Latvian Energy Regulatory Office for the years 2000-2003. Further from the Eurostat also data for Estonia for the time period 2002-2012 are collected, the data for the period 2000-2001 were provided by the Estonian Energy Regulatory Office. All electricity prices collected are average annual EUR electricity prices per MWh electricity without taxes and levies. Prices from the IEA "Energy prices and taxes" and from the Latvian Energy Regulatory Office were gathered in national currencies

[4] EUROSTAT
[5] IEA

and they needed to be converted to euros. For the conversion to euro, conversion rates of the EUROSTAT database for the end of a given year have been used.

So once again under the end-user electricity prices we understand the price for consuming 1MWh of electricity, which is paid by industrial and households' consumers. In the price all costs are included with the exception of taxes.

4.2.2 Independent Variables

In this thesis it is possible to divide the variables into indicators that are directly connected to liberalization market reforms and into variables that may affect the electricity retail prices.

4.2.2.1 Variables Directly Connected to Market Reforms

TSO Indicator

One of the major goals of the European energy packages was the unbundling of the vertical integrated companies. That is why the existence of an unbundled TSO is a proper indicator; to measure the effects of unbundling of the TSO from the vertical integrated companies. The indicator used in the model is a dummy variable which takes a value of 1 if the TSO is ownership unbundled and otherwise 0. Ownership unbundled means that the owner of the TSO is an autonomous separate company with no interests in generation and retail. In contrary to the Hattori and Tsutsui (2004) study it is not sufficient that the TSO is just legally unbundled. Under legal unbundling we understand that a TSO is organized in a separate company and can further remain in the hands of the previous owner, with interests in retail or generation. On the other hand, in the Steiner (2001) study it was sufficient to unbundle the TSO according to the accounts. All data for the creation of the indicator are collected from the national TSO annual reports.

TPA Indicator (Retail market opening)

The next major goal of the European energy packages is to create an open competitive energy market for electricity. This should be achieved through the third party access introduction the so-called TPA (retail market opening). It was expected that the opening of the electricity retail market would lead to an increased competition which would lead than to lower prices for the electricity end-users .To examine the effect of the market opening here a dummy variable is introduced which takes a value of 1 if all the consumers from a given sector (Industrial or Household) have the possibility to switch to alternative electricity suppliers; otherwise the value is 0. TPA indicator takes the value of 1 just in the case if 100% of the retail market is opened, which means that all consumers have the possibility to switch. Data for the indicator were gathered from different European Commission and ACER (Agency for the Cooperation of Energy Regulators) papers, some data are also collected from the National Energy Regulator annual reports.

Wholesale market for electricity

A good functioning electricity wholesale market requires 3 types of markets, one for long-term contracts (80-85% share), one for short-term (15-20% share) contracts and one balancing market (2-5%share) or virtually instantaneous market which would ensure that the final supply exactly meets the demand, this is crucial for the demand volatility risk management (see Haas and Auer,2006). Under the long-term contracts we understand bilateral electricity sales contracts and under short-term contracts we understand electricity sales on spot market bases. The existence of a spot market should indicate the existence of a competitive market for electricity which should lead to lower electricity prices. That is why dummy variable was introduced which takes the value of 1 if there exists a spot market for electricity and otherwise 0. Under the existence of a spot market we understand the existence of a day ahead market DAM. Data needed for the dummy were collected from the national TSO and National Energy Regulators annual reports.

Wholesale and retail industry ownership structure

The ownership structure of the electricity market players may influence the electricity prices this is also been claimed in the paper of Fiorio and Florio (2013) in which the authors have examined the effect of ownership structure on electricity prices. Under ownership structure we understand if the companies are publicly or privately held companies. To examine the possible impact of the ownership structure a dummy variable is introduced. We make here a difference between the ownership structure of the retail industry and ownership structure of the wholesale industry. In case that there is one dominant wholesale player with a market share higher than 50% and the company is a state owned one which means that the public share is higher than 50%, we assume that the wholesale market is mostly publicly owned and the dummy variable takes the value of 0. The same assumption is made in the case of more public held companies that are dominating the market. The dummy variable takes a value of 1 in case when one dominant player or more dominant players with a market share of 50% are mostly privately owned. The boundary of 50% plus was taken because it is assumed that a company that is mostly privately owned can make independent decisions on democratic bases. Here another approach was used as by Hattori and Steiner which had divided the ownership structure in public owned, mostly public, mostly private and privately held. The decision to use just two dummies was also done because of the structure and quantity of examined countries.

Household and industry user end price regulation

According to ACER (Agency for the Cooperation of Energy Regulators) which is the former ERGEG (European Regulators' Group for Electricity and Gas) a fully opened well competitive markets cannot coexist with regulated energy prices for end-users in a long-term perspective (see ERGEG, 2007). Because of this opinion, a number of papers referring to End-User Price Regulation were released by ERGEG and now also by ACER (for example Report 2008, 2007, 2010). According to these ACER position papers the existence of no end-user price regulation is an important component of market liberalization. These statements made it interesting to examine the effect of end-user price regulation in the end-user price that is why here a dummy variable was introduced which takes a value of 1 in the case that end user prices are regulated or 0 if there is no regulation which would regulate end-user prices. The goal of this variable is to find out if the end-user price regulation has an impact on end-user electricity prices for both sectors once for the households and once for the industry. Data needed for the indicator are collected from ACER, European Commission papers and from the National Energy Regulatory Offices.

Competition

The idea of energy market liberalization reform is to increase/introduce the competition into the market, which should lower the electricity prices in the long run (see Joshkow, 2008). That is why also a competition indicator was introduced which should be used to measure the influence of competition on the end-user prices. The indicator for competition indicates the market concentration which is differentiated into non-concentrated, moderately concentrated and highly concentrated markets. The concentration of the markets in this thesis is measured by HHI index (Herfindahl-Hirschman Index) or in the case when no HHI index was available the concentration was measured by CR1 and CR3 ratios. CR1 and the CR3 ratio indicate the market shares of the biggest and the three biggest companies, which are active on a particular the market. If the $HHI<1000$ then the market is assumed to be non-concentrated, if $1000<HHI<1800$ the market is moderately concentrated and in the case that the $HHI>1800$ the market is highly concentrated. According to several EU documents if $40\%<C3<70\%$ the market is assumed to be moderately concentrated, if $C3>70\%$ the market is highly concentrated. For the $C1>20\%$ means a concerning value for completion $C1>40\%$ suggests market dominance and $C1>50\%$ indicates a market dominance (see Claudia 2013). For the model a dummy variable was created which takes a value of 0 if the market is non-concentrated, 1 if the market is moderately and 2 if the market is highly concentrated. All the HHI and C1 and C3 indicators were gathered from energy regulators annual reports, ACER and European Commission papers in which HHI and C1 and C3 indexes are commonly used as an indication of the market concentration.

4.2.2.2 Variables which are not Directly Connected to the Market Reform

Green energy support scheme

Different papers are comparing the effectiveness of the Renewable Obligation Certificates and Feed-In Tariffs. See for example Scatasta and Mennel (2009) which have found out that Green Certificates make not less likely to innovate in comparison with feed-in tariffs, even if the expectation result was contrary. Another paper of Pizarro et al. (2011) comes to the conclusion that Green Certificates are more efficient, because any improvement in the production would decrease the Green Certificates prices, even in the cases that the energy regulator would be not aware about the efficiency gain. But this is true just in the case of competitive technologies (see Pizarro et.al., 2011). In another paper Ringel (2006) made the conclusion that the both policies can successfully contribute to the increase of renewable energy sources and that both has some pro and cons regarding to ecological effectiveness and economic efficiency. So we can assume that different renewables support schemes have different impacts on the electricity price. This makes it interesting to examine also the effect of the support policies on the end-user electricity price. This is why in the thesis the end-user price effect of the preferred support scheme should be examined. In other words the used policy of a given country may influence the prices, to examine this influence a dummy was created which takes a value of 2 if electricity is supported by Feed-In Tariffs and 3 if by green certificates, otherwise 0. For the creation of the indicator data were collected from different European Union, ACER Papers and from the National Energy Regulators annual reports.

EU Countries Instruments to Support RES-S

- Feed-In Tariff support scheme (FIT): Is based on fixed feed-in tariff, which allows generators of green energy to sell RES-S at a fixed tariff for a predetermined period of time. An alternative of a fixed tariff is based on a premium payment that is added on the top of the market electricity prices. 20 of 27 EU states are currently using the FIT support scheme. In this thesis EE, CZ, SK, SI, LV, LIT and HU is using this support scheme. In particularly EE, CZ and SI are using the FIT Premium scheme (see Maier and Niels.,2003).

- Quota obligation (Tradable Green Certificates TGC): Is a market-based instrument where one party of the electricity supply chain (consumer, supplier or the generator) has the obligation to provide a given minimum share in total electricity consumption from RES-S. Besides the quota target, a market for RES-S is established, where the generators of RES-S have the possibility to sell the so called Green Certificates on the market, for which they receive a financial reward in addition to the electricity sales on the power market. In this thesis Romania and Poland are using this kind of support scheme (see Klein et.al., 2010).

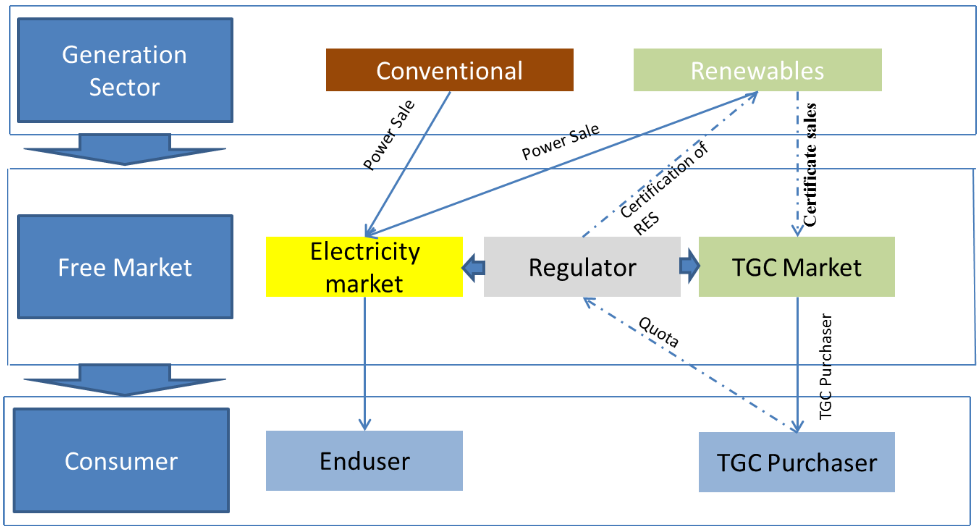


Figure 21 Green Certificate Trading Scheme

There are expectations that using TGC as RES-S support, are more cost-efficient than Feed-In Tariffs. Because Green Certificates ensure a stable development for the set goals and that they drive innovation and cost reduction through the introduction of competition on the electricity market (see Bergek and Jacobsson., 2010). In this thesis, Poland and Romania of the examined countries prefer Green Certificates to Feed-In Tariffs, and it is evident that prices for electricity in both of these countries are relatively lower than in other, that is why the results of model should indicate if support system has influence on the price.

Energy mix

As in the Steiner and Hattori study, also here the price impact of the electricity generating technology mix is examined. As in the table below is shown different energy technologies are connected with different costs. In the table below LCOE Levelized costs of different energy technologies are shown for plant entering service in 2018. LCOE is a tool that was designed for comparison of energy technology cost and performance, the goal of LCOE is not to analyze the influence of financial assumption. In LCOE O&M, performance and fuel costs are considered, but no taxes, incentives and debt/financing structures (see Tidball et.al.,2010).

Plant Type	Capacity factor	LCOE	Fixed O&N cost	Variable O&M costs incl Fuel	Transmission Investment	Total system levelized costs
Conventional Coal	85%	65,7	4,1	29,2	1,2	100,1
Advanced Coal	85%	84,4	6,8	30,7	1,2	123
Advanced Coal CCS	85%	88,4	8,8	37,2	1,2	135
Advanced Nuclear	90%	83,4	11,6	12,3	1,1	108,4
Geothermal	92%	76,2	12	0	1,4	89,6
Biomass	83%	53,2	14,3	42,3	1,2	111
Wind On	34%	70,3	13,1	0	3,2	86,6
Wind Off	37%	193,4	22,4	0	5,7	221,5
PV	25%	130,4	41,4	0	5,9	261,5
Hydro	52%	78,1	4,1	6,1	2,0	90,3

Table 3 LCOE *Source(EIA,2011)*

Because there should be a clear impact of technology on electricity price, also the effect of the energy mix is examined. In this thesis three kinds of electricity sources are examined: the impact of nuclear technologies, hydro technologies and other renewable technologies. Under other renewable technologies we understand here all renewable energy sources as wind, bio, PV, concentrated solar power etc., with the exception of hydroelectricity that is examined separately. It is expected that for example a higher share of other renewables should increase the electricity prices because of the higher costs and support, but on the other hand hydroelectricity is relative cheap and should decrease the price of end-user electricity. For the calculation of the energy mix share, the datasets of ENTSOE (European network of transmission system operators for electricity) and Eurostat were used. The shares are calculated not on the basis of installed capacity but on the basis of the generation share in a given country, which enables a better capture of true costs of the energy mix as in the case when the shares would be calculated on an installed capacity basis. It is also clear those power plants that are already written off can produce electricity for lower costs than new power plants that is especially the case of big hydro energy power plants and old nuclear plants in Europe.

The political impact

There are many papers, which are examining the impact of the government policy orientation on the stock market returns. For example Döpke and Pierdzioch (2006) have found out that there is weak evidence in Germany that stock market returns are higher under right-wing oriented governments than under left wing governments, but on the other hand they have found no hard evidence for political cycles in stock market returns. In another study Leblang and Mukherjee (2005) have examined the impacts of right-wing and left wing governments on the American and UK stock returns between 1930 and 2000. One of the main findings of this paper was that market gains increase under right wing governments, but on the other hand the stability of the market decreases, which suggests a negative welfare effect. These findings are supporting the idea that there might exist also an impact of the government orientation on electricity prices. To observe a possible effect of the government orientation on the electricity prices a dummy variable was created which divides the political orientation into two directions left wing 0 or right wing 1 oriented. The data for the orientation of the governments were gathered in a way that at first results of elections were downloaded from the European Election Database[6] where all parties which get in to the parliament are described according to this description; it was possible to say if the party is rather right or rather left oriented. The next step was to found out which party has nominated the Prime Minister, if the party which

[6] http://www.nsd.uib.no/european_election_database/

has nominated the Prime Minister was a left wing-party, the government was assumed to be left oriented and otherwise.

Import/Export Balance

Between the countries which are examined we can on the one hand find countries which are large exporters of electricity as the CZ but on the other hand also countries which are large net importers of electricity as HU and LIT, LV that is why it is also interesting to find out if there is some influence on the end-user electricity prices in the case that a country imports or exports electricity. To examine this influence a dummy indicator was created which takes a value of 0 if the country is a net importer of electricity and otherwise 1. If a country is importer or exporter it is calculated from the ENTSO-E Data, in the way that from the total imports the total electricity exports were distracted.

Control Variable Gas price

To examine the electricity price it is also crucial to introduce an energy related control price variable, which would indicate how far the price is affected by the increase of costs for electricity generation in general. The best control variable here would be an electricity spot market price but since there is a lack of data about spot market prices another variable has been chosen. As a control variable the gas price for big industrial consumers was used here. The decision for the gas price was done because gas is widely used in European power plants for electricity generation and may therefore reflect the influence of rising costs for electricity generation on the end-user electricity price. The gas price data for big industrial consumers were gathered from the EUROSTAT, in case that a price in a given year and country was missed a gas price average of the other countries in the given year was taken. This was but just the case of early data and since 2005 all prices were available

4.3 Overview of the End-User Price Model Variables

Energy Mix Related Variables	
Nuclear Electricity	Nuclear
Hydro Electricity	Hydro
Electricity from other Renewable Sources	Other Renewables

Table 4 Energy Mix Related Variables

Variables not Directly Connected to the Market Reform	
Electricity Importer/Exporter Indicator	Import/Export
Renewable Energy Support Scheme Indicator	Support Type
Ownership of the Retail Market Active Companies Indicator	Retail Ownership
Ownership of the Wholesale Market Active Companies Indicator	Wholesale Ownership
Right or Left Oriented Government Indicator	Government orientation
Energy Price Related Control Variable Indicator (Gas Price)	Gas Price

Table 5 Variables not Directly Connected to the Market Reform

Variables Directly Connected To The Market Reform	
Household Market Opening Indicator	Open Household Market
Commercial Market Opening Indicator	Open Industrial Market
End-User Price Regulation for Households Indicator	Household Price Regulation
End-User Price Regulation for Industry Indicator	Industry Price Regulation
Existence of a Day Ahead Market for Electricity Indicator	Day Ahead Market
Existence of an Ownership Unbundled TSO Indicator	Unbundled
Competition Indicator for the Wholesale Market	Competition Wholesale Market

Table 6 Variables Directly Connected to the Market reform

4.4 Results of the Electricity End-User Price Model

In this part of the thesis the empirical results of the panel data model will be presented. Firstly the results of the electricity end-user price model for the households, than the results for end-user price model for the industry and in the last part the results of the ratio model are presented. Also some comments and possible reasons for the results are included in this part of the study.

Once again to estimate the impact of various factors on the household and industrial prices, the following panel data regression equation was used:

$$y_{it} = \alpha + X'\beta + Z'\gamma + u_i + v_{it}$$

Where y_{it} was the dependent variable presenting the household price X was the set of independent variables indicating the liberalization reform and Z set of other variables, which may have influence on the end-user price. Under X the effect of the following variables is examined.

1. The Ownership Unbundling of the TSO
2. TPA (Market opening)
3. Existence of a Day Ahead Market
4. Wholesale competition
5. Ownership of Retail
6. Ownership of Wholesale
7. End-user Price Regulation

Between the liberalization market indicators are two indicators, which may differ between the industrial price and household price estimation. The first indicator, which may differ, is the TPA the market opening, because the market opening for the companies was achieved sooner in most of the countries as the market opening for the households. Which may also differ is the end-user price regulation, because in most of the examined countries have the opinion that household consumers should be protected, while industrial consumers not with some exceptions for very small commercial users (for example SK and RO), that is why in many of the examined countries the household prices are still regulated, but on the other hand the prices for commercial users not. All other indicators are the same for the other estimations regarding the liberalization market reform. Indicators and Variables, which are not directly related to the market liberalization, but may have influence on the price.

1. Energy generation Mix
2. Import/Export Balance
3. RES-S Support Scheme
4. Government Orientation (Right or Left Wing)

4.4.1 Results of the Electricity End-User Price Model for the Households

According to Hausman test the results of the fixed effects model were chosen and the results of the random effects model were denied. The table below shows us the estimation results (Variables, Coefficients and the P-Values) calculated in Stata using the model with fixed effects.

Fixed Effects Model Results		
Variable	Coefficients	P-Values
Nuclear	0,1813	0,552
Hydro	-0,1080	0,573
Other Renewables	1,5150	0,009
Import/Export	17,8971	0,009
Support Type	-7,5781	0,003
Unbundling	2,6787	0,442
Open Household Market	12,6392	0,001
Competition Wholesale Market	27,1594	0,281
Day Ahead Market	0,1010	0,978
Retail Ownership	13,4452	0,005
Wholesale Ownership	26,9392	0,001
Government Orientation	4,8951	0,088
Household Price Regulation	2,4612	0,617
Gas Price	0,3174	0,001
Constance	28,9680	0,136
Number of Observation	117	
Number of Groups	9	
R-sq	0,5578	
Corr(u_i, Xb)	-0,51	

Table 7 Results for the Household Electricity End-User Price Model

As the table shows us altogether 117 observations were made in 9 countries (groups) we can also see that there is a correlation of -0, 54 between regressors and errors in the fixed effect model. As the table shows us, nine of the examined indicators are significant in a confidence interval of 90% and six in an interval of 95%.

Variables not directly connected to the market reform

First to the results of the variables, which are not connected directly to the EU Energy Market Reform. According to the results power generated from other renewables sources as for example wind, biogas and PV have a very positive significant effect on the household end-user electricity prices. The indicator for other renewables indicates that the higher the share of other renewable sources in the energy mix is the higher is, the resulted end-user household price. This was an expected result since the other renewables are highly supported by governments, by Feed-In tariffs or Green Certificates and other support schemes. On the other hand there was observed that hydroelectricity tends to decrease the price of electricity and nuclear electricity tends to increase the price of electricity, but both of these results were insignificant according to the results.

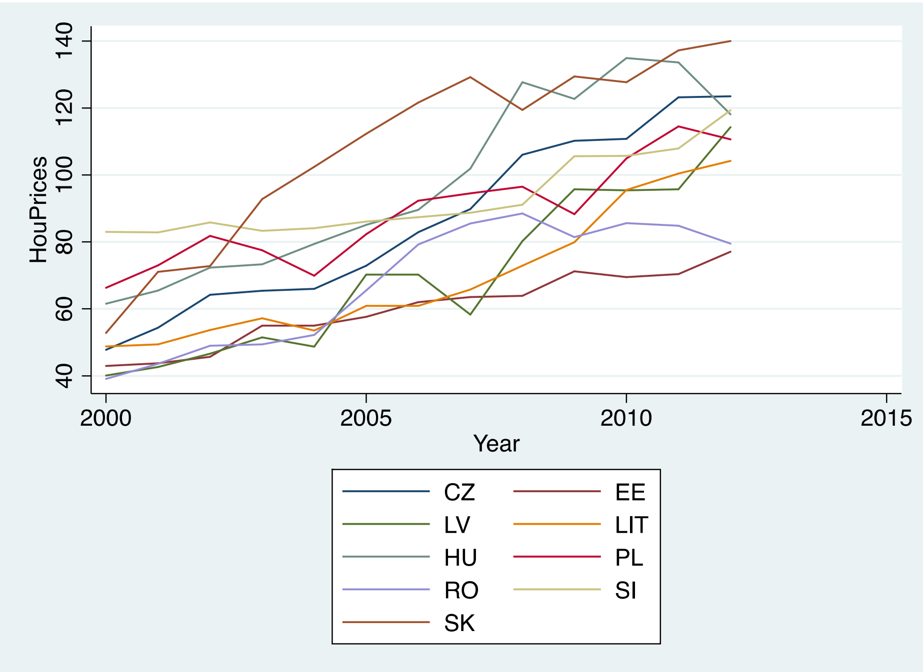


Figure 22 Development of End-User Price for the Households without Taxes

Positive significant is also the dummy variable Import/Export indicating if a country is a net electricity importer or exporter, here the results are a little bit surprising, because they indicate that electricity-exporting countries have higher electricity prices for the household end-users. The dummy variable, which indicates the government orientation, has also a positive significant effect on the end-user electricity price for the households. According to the results in countries with right oriented governments the end-user electricity price for the households tends to be higher. Another political influenced variable examined here was the kind of the used green energy support scheme through the support type variable. The support type dummy variable indicates what kind of the energy support scheme is used in a given country, and according to the results there is a highly significant influence of the support scheme used on the end-user household electricity prices.

Results directly connected to the market reform

One of the main intentions of the energy reform was to open the markets and to introduce competition in retail market, which should lead to lower end-user prices, but the results from the model are indicating that the opposite happened. The prices for the household end-users increased in the examined countries, which indicates also the variable Open Household Market which is highly positive significant which means that the market opening has led to higher household prices. On the other hand, the variable day ahead market, is highly insignificant but negative, while the variable indicating existence of the ownership unbundled transmission system operator is positive but also not significant. According to the results none of this two indicators significantly influences the end-user electricity price. The existence of a regulated end-user price is positive and not significant and indicates no influence on the household end-user price. The ownership structure of the wholesale as also of the retail electricity industry has also a positive highly significant influence on the household end-user electricity prices, more exactly in countries where the electricity industry is in majority in private companies hands the price for end-users tends to be higher. The conclusion for the household end-user market according to the presented model results is that the energy market reform in the examined countries has led to higher end-user electricity prices and not vice versa as it was expected.

Influence of the directly energy price related variable gas price is also highly significant and positive as expected and does influence the electricity end-user price of households.

4.4.2 Results of the Electricity End-User Price Model for the Industry

In the case of end-user industrial prices according to the Hausman test, the model with the random effects was chosen, which is contrary to the model, which was preferred, by the estimation of the effects on household prices. As mentioned before, the rationale behind the random effect model is that the variation between entities is assumed to be random and uncorrelated with the independent or predictor variable.

Random Effects Model Results		
Variable	Coefficients	P-Values
Nuclear	0,1221	0,032
Hydro	0,0757	0,479
Other Renewables	1,0959	0,055
Import/Export	2,9141	0,627
Support Type	0,1930	0,936
Unbundling	6,6468	0,048
Open Industrial Market	7,4928	0,009
Competition Wholesale Market	2,0254	0,622
Day Ahead Market	0,6981	0,809
Retail Ownership	10,2942	0,002
Wholesale Ownership	8,3653	0,158
Government Orientation	1,0200	0,648
Industrial Price Regulation	-12,5435	0,001
Gas Price	0,4737	0,000
Constance	31,8241	0,000
Number of Observation	117	
Number of Groups	9	
R-sq	0,8350	

Table 8 Results for the Industrial End-User Price Model

As the table shows, altogether 117 observations have been made in 9 countries (groups). We can also see that there is no strong correlation between regressors and errors in the fixed effect model. As table shows us seven of the examined indicators are significant in a confidence interval of 90% and 6 in a confidence interval of 0,95.

Variables not directly related to the energy market reform

The influence of the energy mix on the industrial end-user prices is according to the results present. Especially the variable nuclear, which is used to examine the influence of the nuclear energy share on the industrial end price, is highly significant, which leads to the conclusion that higher nuclear energy share increases the prices of electricity for industrial end users. The variable representing the other renewables sources is also positive significant, as in the case of households and indicates that the higher is the share of other renewables sources which are mostly supported the higher is the resulting industrial end-user price for electricity. The variable indicating the negative/positive electricity balance import/export is highly insignificant; the same conclusion can be done for the variables Support Type (indicating kind of RES scheme) and government (indicating the orientation of a Government).

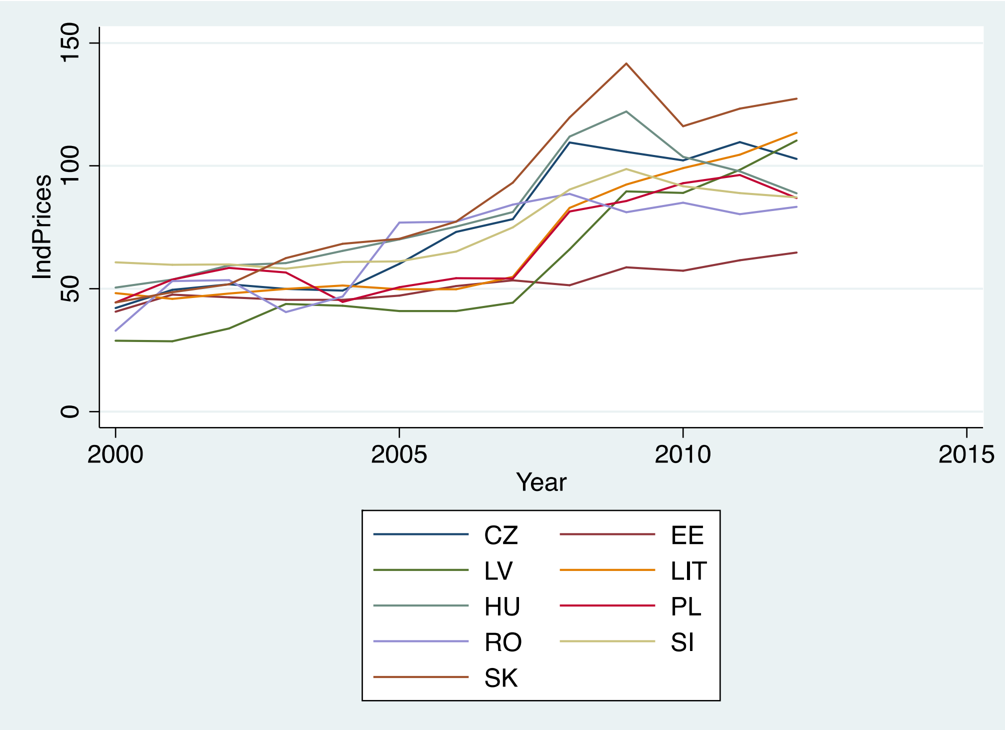


Figure 23 Industrial End-User Price Developments without Taxes

Variable directly related to the energy market reform

As often noted the most important part of the energy market reform is the market opening or the so-called third party market access, which should lead to lower end-user prices of electricity. But this is here not the case among the examined countries, because the variable indicating the market opening is positive and significant which means that the market opening has led to higher electricity prices in case of the industrial electricity end-user prices. In case of the end-user industrial prices, the ownership unbundling indicator unbundled has a positive significant result which undermines the observation of the market opening and strengths, the observation that the energy market reform leads the higher industry end-user electricity prices. On the other hand the variable industrial price regulation is negative and highly significant, which means that price regulation in the industrial sector has a negative, lowering influence on the industrial end-user electricity price. On the other hand the indicator of the electricity day ahead market existence is positive insignificant and is not influencing the end-user prices. The same applies to the variable indicating the competition in the wholesale market which is also insignificant and positive. The indicator of the ownership structure of the retail industry is positive significant and may have positive influence on the end-user prices of electricity on the other hand the ownership of the wholesale sector is also positive but not significant. The conclusion here is that there is a strong evidence of the fact that the energy market reform in the examined countries has a positive effect on the industrial end-user prices in terms of higher prices for the industrial consumers.

Influence of the directly energy price related variable gas price is also highly significant and positive as expected and does influence the electricity end-user price for industrial consumers.

4.4.3 Results of the Ratio Model

The goal of the ratio estimation model is to observe if there is an opposite price development among the end-user industrial and household price, in the same way as Steiner did. To examine the effect of the ratio on the end-user prices is crucial because it should show if the market liberalization effect has the same development effect on both prices or not. Before presenting the results it is supposed that the prices are drifting from each other as shown in the Figure below, and that the gap between the end prices is bigger than before market liberalization in the examined countries.

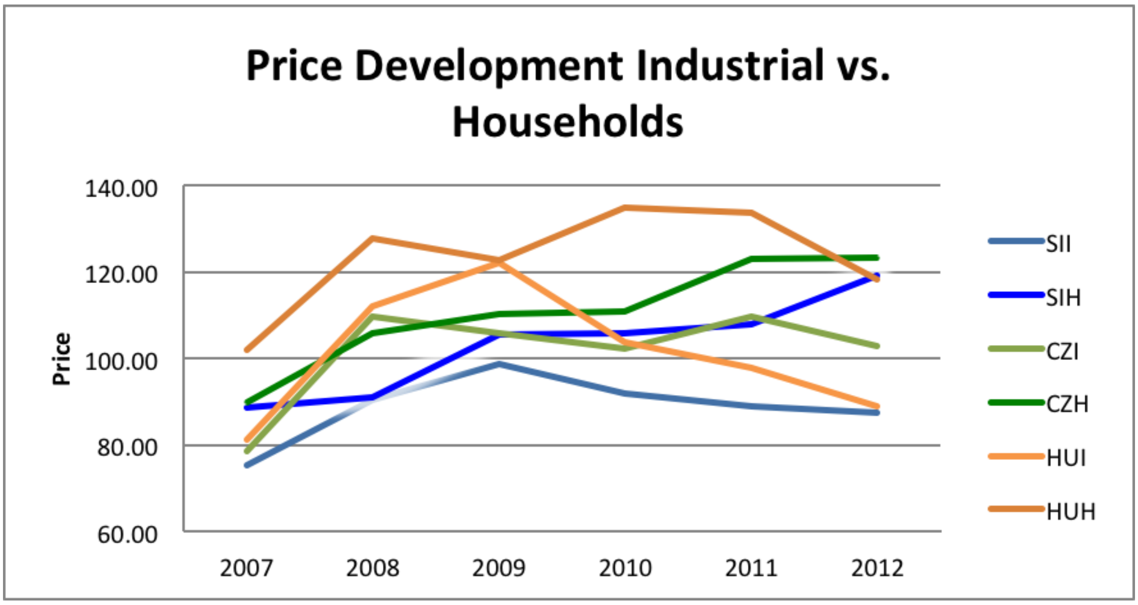


Figure 24 Comparison of the Industrial and Household Price Development

The results were again estimated for both models, the random effect and fixed effect model, following again a Hausman test to prefer one of the model. According the Hausman test, the model with the random effect should be preferred in the case of the ratio panel data estimation model. In the model the impact of the following variables was examined.

1. Ownership Structure
2. Energy Mix
3. Market Opening
4. Existence of the DAM
5. TSO Unbundling
6. Competition on the Wholesale Market
7. Government Influence

Variable	Coefficients	P-Values
Nuclear	0,0004	0,504
Hydro	-0,0005	0,464
Other Renewables	0,0078	0,081
Unbundling	0,0569	0,035
Open Household Market	0,1140	0,006
Competition Wholesale Market	0,0269	0,377
Day Ahead Market	-0,1186	0,000
Retail Ownership	0,1062	0,003
Wholesale Ownership	-0,1672	0,000
Government Orientation	-0,0520	0,044
Gas Price	-0,0002	0,849
Constance	0,8555	0,000
Number of Observation	117	
Number of Groups	9	
R-sq	0,3470	

Table 9 Results of the Price Ratio Model

The figure above is showing the estimation output for the ratio, using the model with the random effects as mentioned before. The results here are presented according to the same model as before, at first the influence of the variables, which are not directly connected to the energy market reform, will be presented and then the directly related. The results are indicating 7 significant results on a 90% confidence interval and 6 significant results on a 95% confidence interval.

Variables not directly related to the energy market reform

In the case of the ratio the share of nuclear energy has a positive but not significant effect on the price difference between the industrial and household electricity energy price. The share of hydroelectricity has a negative not significant effect on the price difference. On the other hand, the share of other renewable energy sources has a positive and significant effect on a 90 % confidence interval on the price ratio. But this significance can be the result that the share of other renewables sources on the energy mix has increased simultaneously with market opening and liberalization in all examined countries. Other significant results are, regarding to the ownership structure of the retail and, wholesale electricity market players. More particular the indicator retail ownership is highly significant and positive and the variable wholesale ownership is strong negative and also significant which mean that in case of privately owned generation companies the gap between the industrial and household end-user electricity price tends to be bigger, on the other hand it is very interesting that both ownership indicators have the exact opposite effect on the ratio, since one increases the ratio the other one declines it. According to the variable used to examine the influence of the government orientation, the orientation has also a highly significant influence on the ratio, which means that in countries with right oriented governments the gap between the industrial and household prices tends to be higher than in governments with left political orientation.

Variables directly connected to the energy market reform

The variables used to examine the influence of particular parts of the market reform, are showing some unexpected results. The ratio was used to examine the idea that energy market opening is increasing the gap between the industrial and household prices, and that the industrial players are now in a better position to negotiate better prices than before, and that they can now play out their market strength.

The most interesting and much unexpected result is that the indicator Open Household Market is highly positive and significant. This means that the market opening has a declining influence on the price ratio, and not an increasing impact as expected. The variable Open Household Market was preferred to the Open Industrial Market because in this observation the effect of the whole market opening should be examined and not just of a partly market opening. Also the variable indicating the ownership unbundling of the transmission system operator is highly positive significant and has declining influence on the difference between industrial and household end-user electricity prices. The same effect has also the competition indicator on the ratio. The indicator which indicates the existence of a Day Ahead Market in a given country, is on the other hand highly significant and negative which means that the existence of Day Ahead Markets lower the prices for the industrial players but increases the for the household end-users .

4.5 Overview of the Results of the Random and Fixed Effect Model

Variable	Fixed Household		Random Household		Fixed Industry		Random Industry	
	Coef.	p>(t)	Coef.	p>(t)	Coef.	p>(t)	Coef.	p>(t)
Nuclear	0.181	0.552	0.072	0.232	-0.044	0.890	0.122	0.032
Hydro	-0.108	0.573	0.071	0.507	-0.099	0.650	0.075	0.479
Other Renewables	1.515	0.009	0.637	0.230	0.689	0.277	1.095	0.055
Import/Export	17.897	0.009	9.100	0.149	-0.502	0.949	2.914	0.627
Support Type	-7.581	0.003	-0.848	0.754	-0.644	0.823	0.193	0.936
Unbundling	2.6787	0.442	5.158	0.122	0.356	0.931	6.646	0.048
Open Market	12.639	0.001	15.569	0.000	7.243	0.018	7.492	0.009
Competition	27.159	0.281	-1.491	0.715	16.443	0.563	2.025	0.622
Day Ahead Market	0.101	0.978	12.193	0.000	-4.573	0.290	0.698	0.809
Retail Ownership	13.445	0.005	-7.498	0.058	20.288	0.000	10.294	0.002
Wholesale Ownership	26.939	0.001	40.372	0.000	10.899	0.198	8.365	0.158
Government Orientation	4.895	0.088	4.661	0.097	1.460	0.649	1.200	0.648
Price Regulation	2.461	0.617	-6.451	0.245	-9.000	0.027	-12.543	0.001
Gas Price	0.317	0.001	0.293	0.011	0.563	0.000	0.473	0.000
Cons	28.968	0.136	40.668	0.000	33.033	0.110	31.824	0.000

Table 10 Overview of the Fixed and Random Effects Model Results

Variable	Ran	Ran	Fix	Fix
	Coef.	p>(t)	Coef.	p>(t)
Nuclear	0.000	0.504	-0.006	0.039
Hydro	-0.001	0.464	0.001	0.659
Other Renewables	0.007	0.081	-0.002	0.763
Unbundling	0.056	0.035	0.028	0.419
Open Market	0.114	0.006	0.125	0.001
Competition	0.026	0.344	-0.477	0.069
Day Ahead Market	-0.118	0.000	-0.036	0.334
Retail Ownership	0.106	0.003	0.026	0.563
Wholesale Ownership	-0.167	0.000	-0.006	0.929
Government Orientation	-0.052	0.044	-0.025	0.319
Gas Price	-0.000	0.849	0.001	0.544
Cons	0.855	0.000	1.114	0.000

Table 11 Overview of the Fixed and Random Model Results for the Ratio

Results for the households and industrial prices

In summary the results are showing some very interesting findings for the new European Union member countries. Especially the fact that the market opening in both markets; in the industrial as in the household market has led to higher electricity prices, which does not match the expectations of the European Union Energy Market Reform. These finding here are supported by the results of both models as by the fixed also by the random ones as we can see in the results overview tables, where all results are presented not just the one preferred by the Hausman test. On the one hand this result is in contrary with the Hattori study, where the open market indicator TPA has been found to be negative and significant for both models the fixed and also for the random one, but on the other hand Hattori has examined different 19 OECD member Countries for a different time interval as it was done here. The unbundling indicator is according this study results positive and insignificant with the exception of the random model for the industry, where the unbundling indicator is positive significant, in the Hattori study unbundling has been found to be positive significant for all fixed and random estimation models. The last comparable variable with the Hattori study is the indicator which indicates an existence of a Day Ahead Market or in the case of the Hattori study an existence of a spot market for electricity. The Results for this indicator were positive and insignificant for the fixed effect models and positive significant for the random effect model for the households and positive insignificant for the industrial price in this study on the other hand in the Hattori study the indicator indicating an existing spot market for electricity has been found to be significant and positive. But here is again crucial to mention that Hattori has examined other countries for a time period of 1987-1999 an here new European Union member countries for a period from 2000 to 2012 were examined.

Results for the household industrial price ratio

The results for the ratio model are unexpected especially for the market opening as mentioned before. The market opening is in case of both models positive and significant which is in contrary with the Hattori results which has estimated negative significant results for the market opening. Hattori has also estimated that unbundling is also negative and significant, which is not the case of this estimation, but here the indicators are differently defined for this study and the Hattori study. The results regarding to the existence of a day ahead market are also different, in Hattories study the existence of an electricity spot market is positive significant, in this study the existence of a day ahead market indicator is negative for both models and in the case of the random model also significant.

As mentioned before the results of this study and Hattori study, are different in many cases, the reason for this differences are especially differently defined indicators, variables, different time interval and examined countries. Also the purpose of this study was not to compare the results with a Hattori, but to examine the effect of the European Energy Market reform on the end-user prices in the new European Union member countries using a similar model as Hattori did, that is also why here the detailed results of Hattories study are not presented. The comparison of the results was just done for presenting some results of the Hattori study which are often in contrary with the results of this study and are supporting to view that the energy market reform has a declining end-user electricity prices effect, but also in his estimation some variables/indicators have an increasing price effect on the end-user prices especially the indicators unbundling and the existence of a spot markets do not necessarily lower the end-user electricity prices (see Hattori,2004) .

5. The Network Tariff Model

As mentioned in the introduction in this part of the thesis, a network tariff model based on the regression end-user price panel data model will be presented.

$$y_{it} = \alpha + X^{'} + u_i + v_{it}$$

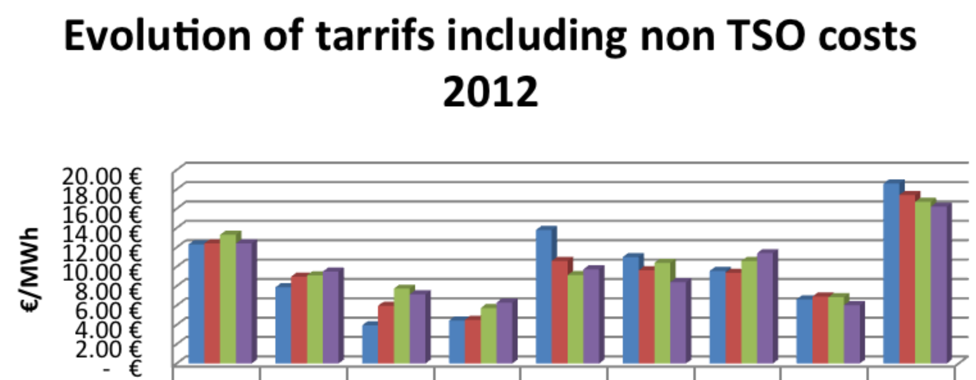
There is again a dependent variable y_{it} representing the level of the TSO tariff and independent variables $X^{'}$, which are used to explain the dependent variable. Once again the fixed affect model and then the random effect model are used. On the end a Hausman test is done to make a decision of which model results should be preferred. The goal of this micro panel data model is to find out, whether there is some relationship between the tariff levels and companies profitability and if the tariffs are used to make profits in the first place in some cases. The most of the countries are also examined in the macro study; the additional countries were taken to obtain sufficient large data sample for the model, since in this case the data from 2006-2012 are examined instead of 2000-2012, as it was the case of the macro model. The decision for the period 2006-2012 was made because there were not enough public data available for the earlier periods on the one hand and on the other many of the TSO companies were vertically integrated before 2006, and were not publishing financial data of the TSO companies separately, as it is the case today. In the study the economic results of transmission operators of the countries CZ, HU, SI, PL, RO, SK, EE, I, F, IRE, A, ESP and

DK for time period of 2006-2012 are examined using a panel data regression model as in the macro study.

Country	Company	Country	Company
CZ	CEPS	SI	ELES
HU	MAVIR	PL	PSE
RO	TRANSELECTRICA	SK	SEPSAS
EE	ELERING	I	TERNA
F	RTE	IRE	EIRGRID
DK	ENERGINET	A	APG
ESP	REE		

Table 12 Overview of Examined Companies

The motivation for this micro study was also the huge differences between the tariffs among countries see, Figures 1, 2, 3 where the evolution (2009, 2012) and structure (2012 tariffs) of the TSO tariffs of some countries are shown.



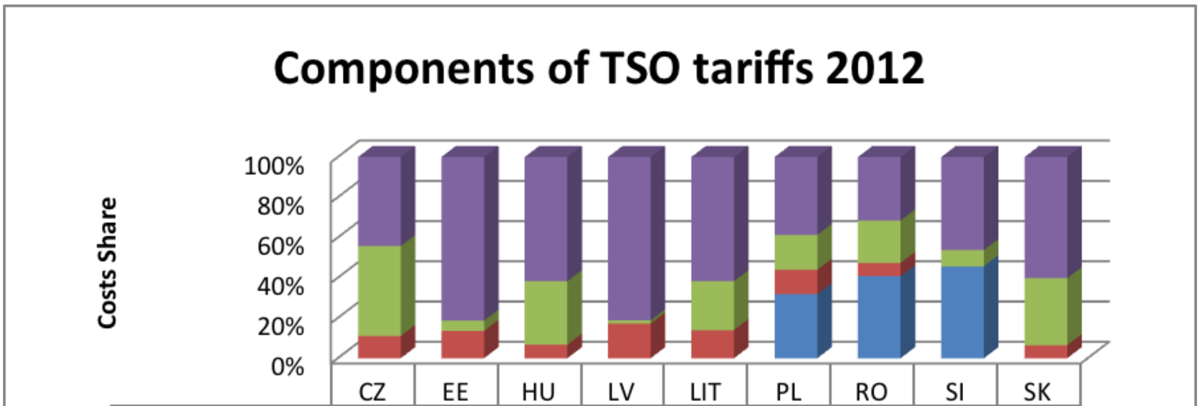
	CZ	EE	HU	LV	LIT	PL	RO	SI	SK
2009	12.30 €	7.87 €	3.95 €	4.45 €	13.80 €	11.00 €	9.57 €	6.63 €	18.60 €
2010	12.40 €	8.98 €	5.96 €	4.51 €	10.60 €	9.63 €	9.38 €	6.91 €	17.40 €
2011	13.30 €	9.11 €	7.73 €	5.73 €	9.13 €	10.40 €	10.60 €	6.85 €	16.70 €
2012	12.40 €	9.50 €	7.14 €	6.29 €	9.74 €	8.40 €	11.40 €	6.02 €	16.20 €

Figure 25 Evolution of Transmission Tariffs in Chosen Countries *Source.:ENTSOE*

The tariff for the TSO is one of the basic components of the electricity price, which is regulated by independent energy regulatory offices. The other regulated parts of the electricity prices are the so called DSO tariffs, in other words the tariffs for the distribution of electricity from the TSO network to the end consumer and the third regulated part in some countries is the contribution for the support of renewable energies. As mentioned before, here only the influence of the TSO tariffs will be examined and the question is if the tariffs in some countries are not set in favors of the TSO companies especially in countries where TSO companies are owned by particular countries, and are than used as some kind of milk cows to collecting money and filling the state treasury, in other words if the tariffs are not used as hidden electricity taxes. This suspicion is strengthen, by a simple comparison of the tariffs, as for example the tariff in Slovakia in 2012 was 16,20 €/MWh and in Slovenia 6,02 €/MWh and so on.

Tariff Components

According to ENTSOE 2012 overview of transmission tarifs [7] we can divide the TSO tariffs components among the examined countries into a part which is responsible for covering the transmission losses, a part which is used to service and to develop the transmission networks, and a part which should cover the system services and other charges which are charged. Other charges are levied just in PL, RO and SI.



	CZ	EE	HU	LV	LIT	PL	RO	SI	SK
Infrastructures	5.53 €	7.80 €	4.41 €	5.03 €	6.01 €	3.25 €	3.60 €	2.78 €	9.79 €
System Services	5.58 €	0.50 €	2.26 €	0.10 €	2.37 €	1.46 €	2.42 €	0.49 €	5.43 €
Losses	1.38 €	1.30 €	0.48 €	1.07 €	1.36 €	1.02 €	0.75 €	- €	1.05 €
Other Charges	- €	- €	- €	- €	- €	2.67 €	4.66 €	2.75 €	- €

Figure 26 Tariff Components in Chosen Countries *Source.:ENTSOE*

5.1 Network Tariff Model Set-Up

After deep recherche I found no paper which would examine the impact of various factors on the price of TSO tariffs using a panel data model. On the other hand there are many other

[7] (ENTSO-E, 2013)

papers, which are dealing with transmission tariffs especially in the European Union market. Especially the paper from Montero et. al is very interesting, where Montera (2001 et. al) had used correlation analysis to benchmark electricity TSO tariffs in the countries of the European Union. In their work they have also used data from ENTSO-E and the national TSO operators. (see Montera, 2001) The goal of the model is to examine the TSO tariffs and to find out if the levels of the tariffs are justified in terms of higher operational costs or not. The justification of the tariff level is important because the TSO tariffs should first of all be used to cover the costs of the infrastructure, system services and the costs of electricity transmission losses. To justify the price level of the tariffs; the data about the TSO operator's profitability were gathered from the TSO Annual reports. In case that the profitability of national TSO operators is higher in countries where the tariff price level is higher, it is assumable that the higher profitability is the result of higher tariffs if this would be the case, we could claim that the higher TSO tariffs are not justified on the basis of higher operating costs. To examine the TSO tariffs various indicators (independent variables) will be used and presented. The independent variable in this case will be again the price which is in this case the price that is paid in average to transport 1MWh of electricity in a given country and in a given year. As mentioned already before some data are gathered from the national grid operator companies, which is especially a problem in the course of collecting the financial data as revenues, profits etc. in foreign currencies. In case that the data were in foreign currencies, they were changed in EUR values using exchange rates from end of the given year. All the exchange rates were collected from the EUROSTAT database.

5.1.1 Variables

The indicators (independent variables)

To examine the effects of the profitability of the national TSO Companies on the TSO tariffs several profit indicators will be presented here. The most of these profitability indicators were also used in the Montera paper. The biggest challenge by the indicators is to make them comparable among countries, even if in each country exists just one TSO company, but all companies are variously large which is the result of the different size of markets they operate in the reasons for differences are mostly size of the country, number of inhabitants, electricity consumption and electricity mix of each country.

5.1.2 Profitability Indicators

All indicators presented here are ratios. The most crucial indicator used here to examine the influence of profitability on the tariffs is the ratio of the operating profit of a given company divided by the total network transmission length of a particular TSO operator. Under the electricity transmission lines we understand here all 110kV, 220kV, 400kV and higher kV transmission lines. The decision to use the operating profit instead of net profit was done because of the fact that here are included just the profits of the operating activities of ta TSO company and no special one-time effects. To measure the profitability of the TSO makes sense just in the case that the whole profit source of the TSO company was from TSO operations; we assume here that this is also the case if in the profit also the profit from market operations are included which. Another indicator, which is used to examine the TSO tariffs, is the ratio of revenue and km of transmission lines installed. Despite the fact that revenue is not a profitability indicator, it can show us how much revenue has the TSO operator gathered for one km of transmission lines installed.

Financial profitability indicator

One of the most used profitability indicator, which is used to compare the performance of companies active in similar industries is return of assets ROA=Net Incomes/Assets. As mentioned before, ROA is highly dependent on the industry, and since the industry of the TSO operators is examined, ROA is used here as an explanatory variable that should help to examine the impact of the company’s profitability on TSO tariff levels.

5.1.3 Not Financial Indicator

Network Development, Investments and Network Loss

One of the major roles of the TSO is also to put investments into the network, in the structure, to reinforce physical and commercial transmission connections among countries, to create bigger cross-national market (see Riechmann, 2009) To examine the effect of investments on the TSO tariffs, two indicators were created which should indicate if in countries where big investments in the network were undertaken, the TSO tariff is higher or not. This indicator should show us if the level of tariff might be justified partly by the investments into the network. To make the investments comparable, once a ratio was created which is calculated as the fraction of undertaken investments and revenues. The other investment related ratio indicator which could justify the TSO tariff levels are investments expressed by investments in 1 km of the existing network lines calculated as investments divided by network km. The last variable used in this study is the Total Network Loss of the TSO divided by the Total Network Length, this variable should show, if there is an influence of network losses on the tariffs, because bigger electricity losses per 1 km network are raising the costs for the network operator that are covered through the tariffs. All data needed for the indicator are gathered from the national TSO companies' annual reports and ENTSOE.

Variables of the network tariff model	
OpProf/km	Profit on 1km of Network Lines
Revenue/km	Revenue on 1km of Network Lines
Inv/km	Are Investments on 1km of Network Lines
Network Loss/km	Network Loss Divided by the Total Network Length
ROA	Return on Assets
Inv/Revenue	Investments Divided by Revenue

Table 13 Variables of the Network Tariff Model

5.2 Results of the Network Tariff Model

In this part of the thesis, the results of the micro model will be presented. As mentioned before the data of 16 TSO companies were used in the examination, the particular company names were presented in a comprehensive table in the part where the model was described. The goal was to figure out if higher TSO tariffs are leading to higher profits and otherwise. It is also important to mention that all data used here, with the exception of tariff levels are collected from the annual reports of the companies and it is possible that each company defines or calculates the collected data in another way and may not be comparable one to one, but for this analyses which uses a statistical regression panel data model are this little differences negligible. Just for example some companies are presenting their total network lengths rounded on 100 km some on 10 km, but this is not significant for the model since the real total length of the networks is several 1000 km in a particular country. Also the revenues and profits of some of the companies includes parts which are not directly related to the operations of the networks, but also in this cases its negligible since this is the case of some companies on the one hand and on the other hand the share of other operations on revenues and profits are lower than 10%, so on the end the big picture is not wrong and leads to valid conclusions.

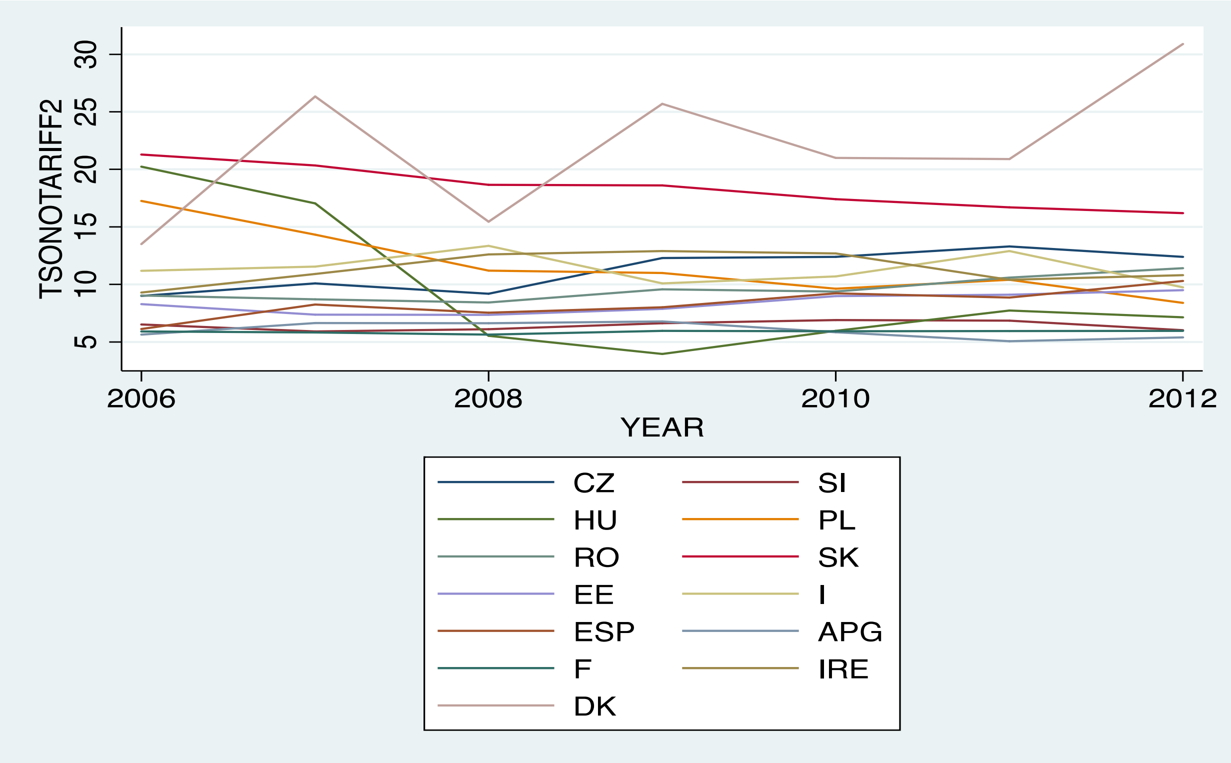


Figure 27 TSO Tariff Development

Results

As in the previous models also here a Hausman test for the model was done to make the decision which result should be preferred, either the fixed or random effect model. The Hausman test indicates here that the model with random effects should be preferred and not the fixed one. In the figure below a comprehensive table with all results is presented. The results are considered to be significant on a 0.9 confidence interval.

	Fixed		Random	
Variable	Coefficients	P-Values	Coefficients	P-Values
Inv/km	0,9707	0.002	0,0981	0.001
Revenue/km	-0,0099	0.731	0,0083	0.695
ROA	0,0747	0.49	0,0426	0.30
OpProfit/km	0,1893	0.031	0,1689	0.030
Inv/Revenue	-3,0632	0.400	-3,4759	0.310
Networ Loss/km	-3,4264	0.488	-2,2916	0.495
Cons	10,3252	0.003	8,6582	0.001
Number of Observation	91		91	
Number of Groups	13		13	
R-sq	0,1360		0,2455	

Table 14 Results for the Network Tariff Model

Investment and operation related variables

In the model two investments related indicators were used, the Investment/Total Network Length ratio and the Investment/Revenue ratio. To examine the effect of investments on the tariffs was crucial because as mentioned in the model description, a part of the tariffs is used to cover investments into the networks and if this indicator is significant then it is possible to argue that higher investments into the networks would lead to higher TSO tariffs. According to the results the Investment/km ratio is positively significant, but on the other hand the Investment/Revenue ratio is not significant but positive. Positive means that higher company investments are reflected in higher tariffs; the result here especially, the significant one, is underlying the claim that the investment level, at least partly, explains the level of tariffs. The only one operation related variable examined in the study was, the ratio of Network Lost/km, this ratio was examined with the goal to find out if there is some relationship between the tariff levels and network lost, because a part of the TSO tariffs is used to cover exactly these network loses. In the results the indicator was highly insignificant, which means that this indicator does not help to explain the level of tariffs.

Revenue and profit related indicators

The Revenue/Network km variable is according to the model results not significant, negative and do not help explain the levels of tariffs. It is interesting especially for the case of the Revenue/Network km ratio, where one would expect that higher tariffs should lead to higher revenues and vice versa. The reason for this result may be the fact that in the ratio the sum of transported electricity was not taken into account, since the tariffs are paid by 1MWh- of transferred electricity. The electricity flow was not considered because there was a lack of data availability about the electricity flows.

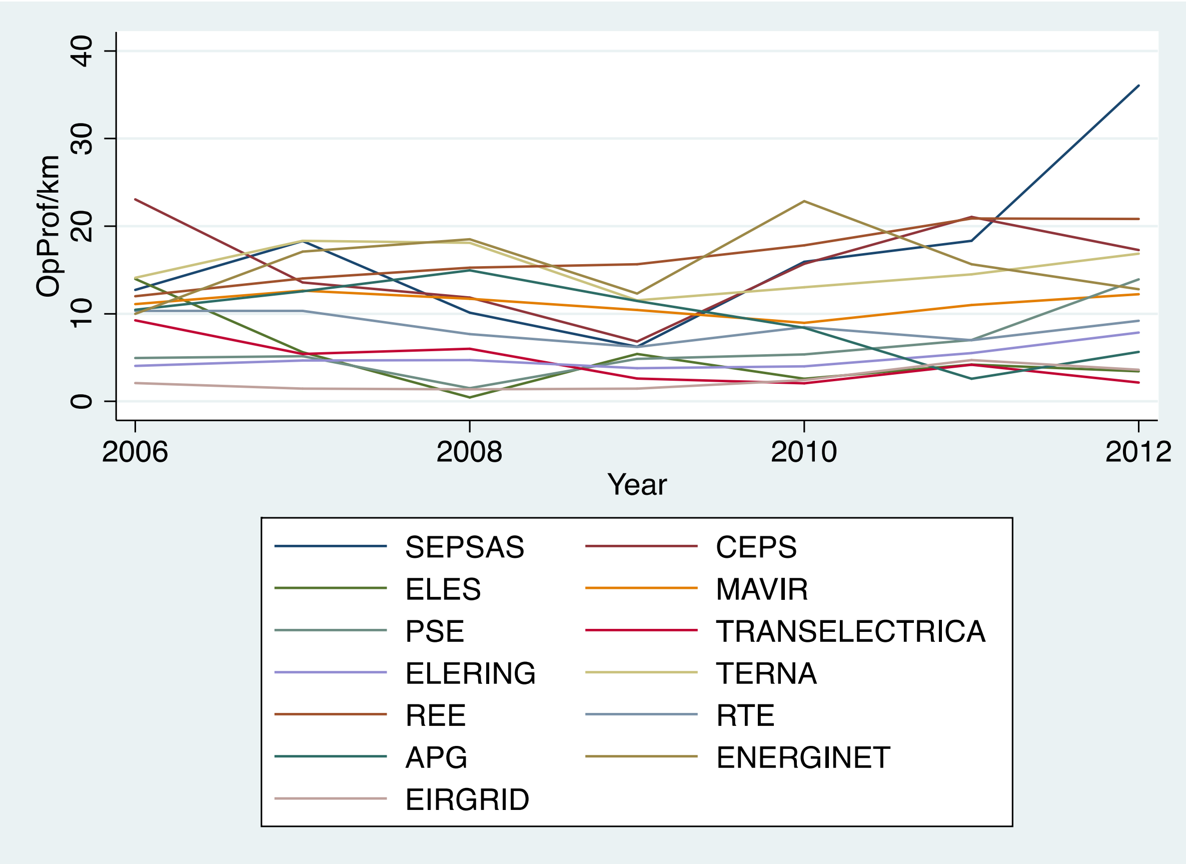


Figure 28 Overview Profits/Km

The influence of the operating profit was examined using an Operating Profit/Networks km ratio. The ratio was found to be positive and significant, this positive significance tells us that the resulting operating profits of the companies are helping to explain the level of tariffs, in other words higher profits are leading to higher tariffs and vice versa. The support of the results is showed also on the Figure above which is showing us the development of the Operating profits ratio of all examined companies. As we can see the operating profits of the companies as CEPS and SEPSAS, which are operating in countries with high tariff levels, are higher than in companies which are operating in low tariff countries. The next financial indicator used in this study was ROA that is a basic commonly used financial performance number. This indicator was found to be not significant and positive. The insignificance of this indicator can be the result of different accounting habits of the examined companies because each company values the assets of their own according to the existing accounting legislative in a given country, which means that the same asset in Poland can be valued differently as in Slovakia for example.

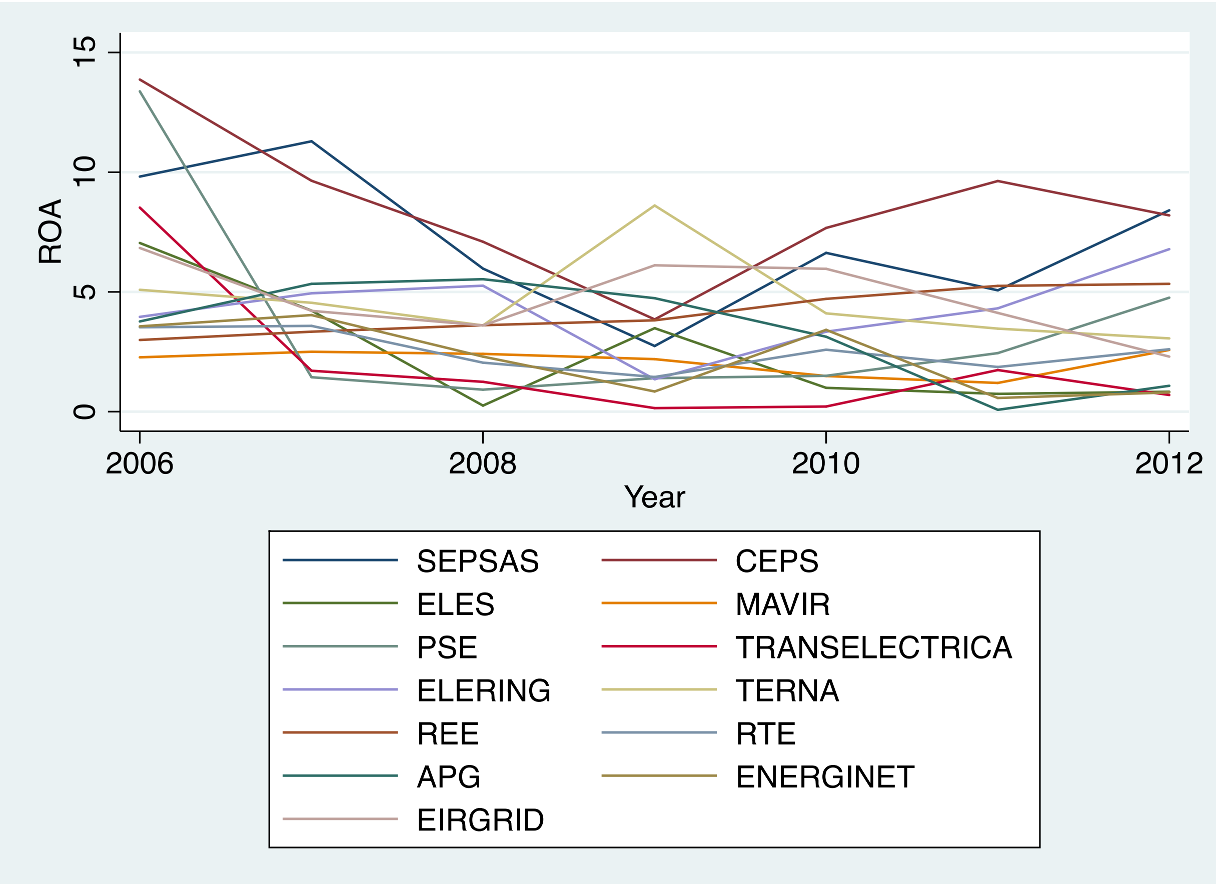


Figure 29 Overview ROA Development

In the table above, the ROA indicator development for each examined companies are showed. Even if the ROA was not found to be significant, again the reality makes it suspicious how it is possible that in countries as Slovakia SEPSAS and Czech Republic CEPS, the ROA are in average higher than in the most other countries and that again the ROAs of the examined companies are higher in countries with higher TSO tariff levels. All these results let us make the assumption that some countries may use high tariff levels to achieve high profits margins, the other issue is to find out why regulators do set so high tariffs. It is also crucial to mention again the case of Slovakia and Czech Republic and to compare it with the case of Romania for example.

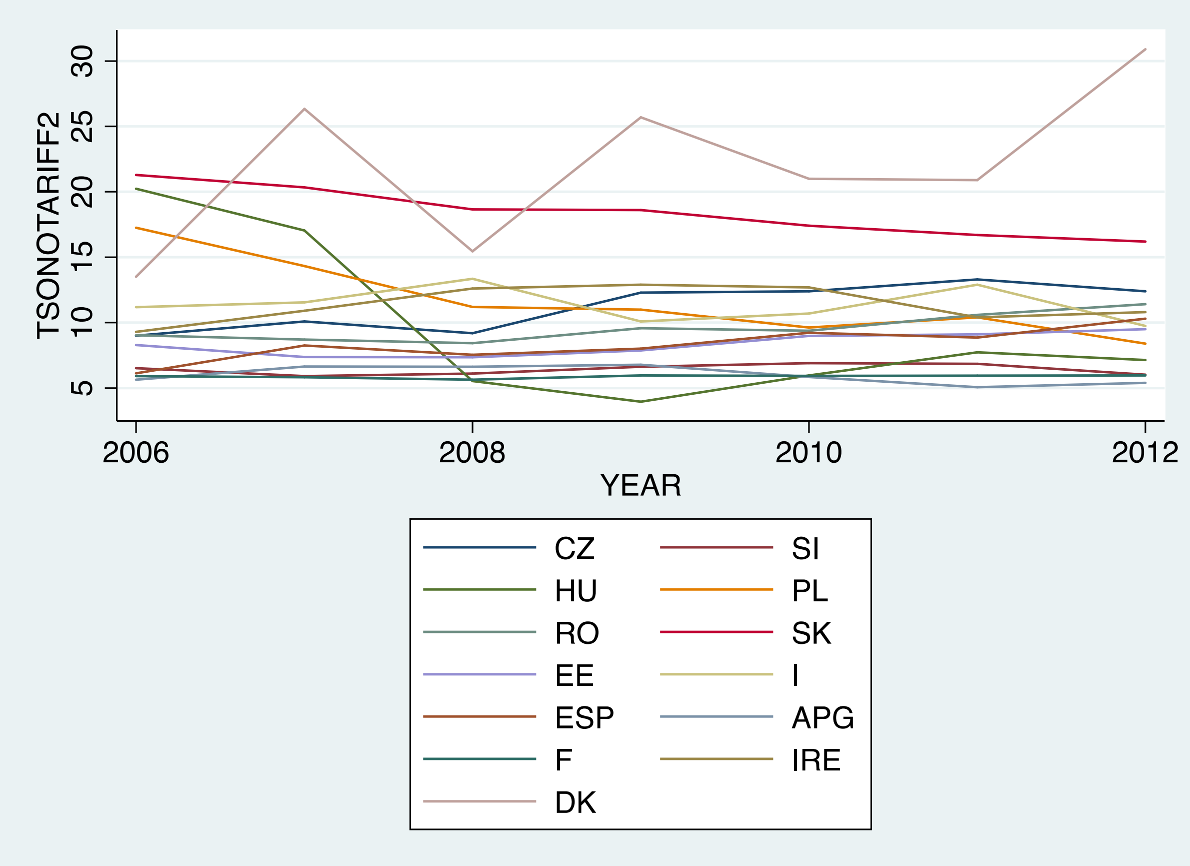


Figure 30 TSO Full Tariff Development

5.3 Summary of the Network Tariff Model Results

As we can see on the figure above, the tariff level differences between the examined levels are huge. Some differences can be surely simply explained and are related to the given specifications of the networks. Surely, high volatility of renewables makes it hard to manage the networks work properly. For example: the case of Denmark and wind energy electricity integration in the networks. As it is commonly known Denmark produces large amounts of wind electricity, which must be integrated into the networks, this brings up some additional system induced costs which can be divided according Gross into: balancing costs, reliability, congestions, network and reinforcement costs (see Gross et.al,2006)[8]. These additional costs,

[8] (Gross, Heptonstall, Anderson, Green, Leach, & Skea, 2006)

which are the product of high volatile wind energy, may be also the reason for so high network tariff costs in Denmark and in some other countries. On the other hand, it seems to be evident, according to the gathered data that in some countries the height tariffs are used to make higher profits, which are then collected by governments which are in many cases the owners of the TSO companies, as the results of the micro study are indicating. These results make it evident that there is strong need, for a common regulation of tariffs in the EU which would be adapted on the givens of the particular country as energy mix, electricity flows, volatility, density and so on. On the other hand it is also important to examine the TSO tariffs and the network regulation schemes of the examined countries, even more particularly, to understand the level of tariffs much more. There is also a need to define the Total TSO tariffs as one term, which would be used in each country, because today in some countries under TSO tariffs and the TOTAL TSO tariffs are the same, but in some countries they differ, and TOTAL TSO tariffs are covering for more or additional costs as TSO tariffs[9]. This is important to make the tariffs even more comparable.

Country	Company	Ownership	Country	Company	Ownership
CZ	CEPS	Public	SI	ELES	Public
HU	MAVIR	Public	PL	PSE	Public
RO	TRANSELECTRICA	Mixed	SK	SEPSAS	Public
EE	ELERING	Public	I	TERNA	Mixed
F	RTE	Mixed	IRE	EIRGRID	Public
DK	ENERGINET	Public	A	APG	Mixed
ESP	REE	Mixed			

Table 15 TSO Ownership Structure of the Examined Countries

6. Conclusion

This thesis was split into two parts, the first part was about the end-user electricity prices and the main goal was to examine the economic influence of the European Energy Market reform on the end-user prices in the Industry and Household market in the Czech Republic, Slovakia,

[9] (ENTSO-E, 2013)

Hungary, Poland, Estonia, Lithuania, Latvia, Eastland, Slovenia and Romania. The second part was about the TSO tariffs, and the goal here was to find out if there is some reason to suspect some countries of misusing TSO tariffs to achieve high profits, especially in countries where the TSO are state owned and not publicly listed companies.

End-user electricity prices

The main findings of the thesis were that the influence of the market opening in both sectors was significant positive, which means that prices for the industry as for the households became higher as before the market reform and market opening in the examined countries and this is in contrary to the expectations of the European Union policy makers. The market opening has led also to an even higher gap between the industrial and household prices, but this effect was expected. On the other hand it is also important to wait a few other years and then again reexamine the effects of the reform, after the market will began work as it should and all countries of the EU will be well interconnected through their electricity networks and the end-user price regulations stop to work. The results also indicates, as expected, that a big share of supported green electricity increase the prices for both markets, that is why in the EU should be worked more also on this issue to make green electricity be payable for the customers and also here a common most effective policy for green energy support should be chosen; what policy it should be, was not the goal of this thesis.

TSO-Tariffs

The results here are strongly indicating that the setting of tariffs by the independent regulators, are differently working among the examined countries. The TSO tariffs should be set in the way that all costs are covered and some fair profits are enabled. But the operating profits of the examined companies are showing that in some countries the profits are much higher than in another one, this is especially the case where the TSO operators collect higher tariffs. Here a question arises, if in some countries the TSO tariffs are indeed not hidden energy taxes as for example in Slovakia. That is why the tariffs in the EU should be examined even more particular in the future especially in countries where tariffs are in average higher than in other comparable countries. A possible solution for this problem would be to introduce common rules for all national TSO operators on which bases the tariffs would be calculated because if we are speaking about one common EU market for energy also the rules for the companies should not differ among member countries.

Data Samples

There is also a strong need for a more comprehensive and detailed database, for some energy indicators in the EU, to make such studies more accurate, because today more sources must be used and then adapted. For this study, it was especially the case of the historical end-user prices, where for some countries the prices just from the year 2004 were available. Spot prices for electricity, and so on are missed completely in the database. Also the indicators above the ownership structure, competition and switch rates are not available in the EUROSTAT database. Especially comprehensive data about the switch rates in particular countries would extremely help to indicate a possible well running competitive market. So there is a strong need for more particular energy related indicators in EUROSTAT database to make possible to do such studies more accurate.

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Internet Links:

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- The European Network of Transmission System Operators for Electricity

www.epp.eurostat.ec.europa.eu

- The Statistical Institution of the European Union

www.nsd.uib.no

- Norwegian Social Science Data Services

www.iea.org

- International Energy Agency

http://www.ceer.eu/

- Council of European Energy Regulators

http://www.eia.gov/

- U.S. Energy Information Service

http://www.urso.gov.sk/

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http://www.eru.cz/

- Czech Energy Regulatory Office

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- Hungarian Energy and Public Utility Regulatory Authority

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- Energy Regulatory Office of Poland

http://www.agen-rs.si/

- Slovenian Energy Agency

http://www.regula.lt/

- National Commission for Energy Control and Prices of Lithuania

http://www.sprk.gov.lv/

- Public Utilities Commission of Latvia

http://www.konkurentsiamet.ee/

- Estonian Competition Authority

http://www.anre.ro/

- Romanian Regulatory Authority for Energy

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