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THE ELECTRICITY INDUSTRY REFORM PARADIGM IN THE EUROPEAN UNION: TESTING THE IMPACT ON CONSUMERS

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The Electricity Industry Reform Paradigm in the European Union: Testing the Impact on Consumers

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Abstract

The standard electricity industry reform paradigm in several EU countries since the 1990s includes privatization, unbundling, liberalization. While the implementation and design of reforms widely differs across the EU, the European Commission insists on a rather unified approach, aiming at the full opening of the internal market. Privatization neither is a necessary pre-requisite of liberalization, nor it is mentioned in the EU electricity market directives. Many economists, however, believe that public ownership can be an impediment to other reforms, and that it leads to production inefficiency. To test the latter question and the reform paradigm in general, as captured by the OECD regulatory reform database, we consider electricity prices and survey data on consumer satisfaction in the EU-15. Our empirical findings reject the prediction that privatization leads to lower prices, or to increased consumer satisfaction. Moreover, country specific features tend to have a high explanatory power, and the progress toward the reform paradigm is not systematically associated with lower prices and higher consumers satisfaction. We discuss possible interpretations of our findings, suggest possible explanations, and some policy implications.

Keywords: Electricity industry, privatization, liberalization, unbundling
JEL code: L94, L33, L43
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1 Introduction

The electricity industry can be described as including four different activities: generation, transmission (the high voltage network), distribution (the middle and low voltage network), retail (supply to final consumers). These four activities or industry segments have different technological and economic characteristics. Generation is often considered as potentially competitive, because economies of scale in most types of production process are said to be not large. Transmission and distribution are natural monopolies, at the national and regional level, because of the high network fixed sunk costs. Eventually, retail supply is often seen as potentially competitive, because trading and marketing activities do not imply high fixed costs.

Traditionally, all or some of these activities were vertically integrated in many European countries, with state or municipally owned enterprises playing an important role. The market was highly regulated, with very limited opportunities for users to switch to alternative suppliers. There was no third party access to the transmission grid. This integrated pattern was the deliberate result of policy reforms that consolidated the mostly private and fragmented European electricity industry in its earlier stages, under the governments' view that for economic, political and social reasons the previous pattern, mainly based on regional private monopolies or collusive oligopoly, was either inefficient or undesirable (see Millward, 2006 for a detailed history of nationalization and consolidation in Europe). Despite some policy convergence in the interwar years, and further reforms in the 1950s, in the following half century there were however persistent and significant variations in industry patterns across countries in Europe, in terms of technologies, ownership, governance, per capita-consumption, spatial and vertical integration, market structure, and prices.

Following privatization and liberalization in the UK in the 1990s, and the EU directives in the last ten years, a new paradigm has emerged, or 'a measure of consensus over some generic measures for achieving a well functioning market-oriented industry' (Jamasb and Pollitt, 2005, p.2). For the first time in the history of the electricity industry in Europe a unique cross-country policy reform pattern has been advocated by

international organizations, notably the European Commission, the OECD, and the World Bank in the transition economies.

The new paradigm is usually simplified as suggesting three parallel reforms: privatization (sale of existing publicly owned firms and licensing of private entrants), unbundling (associated with incentive regulation of the networks, third-party-access, establishing and independent regulator), and liberalization (i.e. allowing entry and competition in generation and retail).

The World Bank (2007) suggests a quite longer list of reform items:

a) De-monopolization and regulation: unbundling vertically integrated monopolies to foster competition in generation and supply; privatize and shifting the role of the state from owner to regulator; promoting entry by foreign investors; establishing transparent energy markets; building regulatory capacity
b) Prices and fiscal policy: promore fully cost-reflective prices; elimination of production subsidies; taxation based on externality correction; enforce metering and collection of bills; closing uneconomic plants
c) Foreign trade: opening markets to imports; eliminating taxes on fuels and electricity; strengthening regional trading arrangements; expanding transboundary energy connections
d) Investment policy: rely on energy companies to sustain investment, not on the public sector budget; support energy efficiency; increase flows of foreign capital with appropriate measures
e) Social protection: safety nets for the redundant staff; social service functions to be transferred to local governments, not to companies; support to the poor through lifeline tariffs or means-tested subsidies (abolish cross-subsidies)
f) Environmental protection: supporting environmental assessment; introducing emission norms; mainstreaming new environmentally friendly technologies.

Looking at this comprehensive package of policy reforms, it seems that many items are not strongly correlated, can be implemented under a variety of industry structures and government interventions, thus the degrees of freedom in the reform design are higher than sometimes is suggested. For example, opening market to imports may be consistent with different ownership regimes: in principle, there is nothing that prevents the import of electricity from abroad when the generation or the transmission

network is publicly owned. Vested interests against international traded can be strong either under public or private ownership. Unbundling can be legal, accounting, or ownership separation, with quite different implications. Promoting entry of foreign investors is compatible with weak promotion of transboundary physical networks, in fact it would amount to offer rents because of distorted domestic prices to a coalition of investors lager than the national one. Vertical integration can be combined with liberalization under effective third party access. Liberalization of generation can be combined with constraints to retail competition. It is thus difficult to see the logical necessity of linking together all the items of the reform package. The case for implementing the comprehensive paradigm rests on a mixture of beliefs and evidence, with only limited cross-country empirical research based on standard econometric approaches.

Without empirical testing, however, some of the tenets of the reform paradigm are questionable, or at least depend upon a large number of pre-conditions. For example, while sometimes the new paradigm has been justified by dramatic technological changes that were assumed to reshape the industry, e.g. new generation process using gas as fuel and the loss of economies of scale., this argument seems to be simplistic. The mix of energy sources in Europe is too diverse to confirm this explanation. Nothing of importance has changed in most generation processes, from nuclear to hydro, in the last twenty years in most countries, to justify an overwhelming technological explanation of the paradigm shift.

It seems more reasonable to look at the new paradigm as a set of policy reforms based on increased confidence in market forces and private ownership, against the decline in confidence in planning and public ownership, for a number of reasons that we do not discuss in this paper. Moreover, the ambition by the EC to create an ‘internal’ (in fact a transboundary market for services), may contribute to the explanation to the policy reversal, more than any compelling technological shift.

In this perspective, the driving idea behind privatization of electricity companies is that public ownership is intrinsically less efficient than private ownership, because of an incentive argument. In turn, the rationale for unbundling is to separate the potentially competitive stages from those with natural monopoly characteristics, that may need some public regulation. Eventually, liberalization would bring market forces in the

industry, and competition would deliver production and allocative efficiency, hence lower prices, or lower mark-up over costs, for users.

As mentioned, while -according to somebody- the consensus on the new paradigm is high in the EU, the empirical evidence that supports it is more limited. After ten years of experience with its implementation, it seems appropriate to move from speculation on its merits to testing its impact on empirical grounds. Particularly, it would be interesting to check the differential impact of privatization against other reforms, because admittedly their association is far from granted, see Jamasb and Pollitt, 2005. In fact, while the EU directives are mute on this point, OECD economist tend to link together ownership and market reforms (see Conway and Nicoletti, 2006; or Lampietti et al., 2007).

Empirical research on the impact of electricity reform at national level is available in some EU countries, but a major problem in this area is often the lack of appropriate analysis of counterfactuals, i.e. comparing scenarios with and without reforms, or with a different mix of reforms (Newbery and Pollitt, 1997). The data needed to perform this analysis are often not easily available. The large variations in progress in the implementation of the new paradigm across the EU countries, while a matter of disappointment for the EC, offers however a proxy for such counterfactuals. By observing different industry characteristics in different countries we can try to infer the differential impact of reforms.

Thus, our empirical approach is to take advantage of the diversity in European electricity reform patterns and to control for a number of potential explanatory variables to predict two simple performance indicators: prices of electricity to consumers, and satisfaction of consumers with prices they pay and quality of service provided. As for prices, we use standard statistical databases, such as those provided by Eurostat and the International Energy Agency (IEA). For consumer satisfaction, we use three waves of the Eurobarometer survey (2000-2002-2004), a well known social attitudes study performed on behalf of the European Commission. To describe the national reform patterns and trends we use REGREF, a database developed by the OECD.

This combination of objective and subjective evidence allows us to double check our findings. Panel analysis of price trends, using regulatory and technological variables, plus country macroeconomic and other structural features, offers objective

evidence on the observed impact of reforms at an aggregate level. Our findings can be compared with the results of the main study commissioned by the EC, DG Internal Market, see Copenhagen Economics (2005). Micro-data on consumers perceptions capture additional information, not covered by aggregate data, and not considered in detailed in the Copenhagen Economics Study.

The reason to cross-check objective and subjective evidence is also that, as revealed by Lampietti et al (2007) in the context of the transition economies, aggregate data in same cases may conceal important issues, such as tariff rebalance, social affordability, quality of services (e.g. interruption or irregularity of voltage), non-payment, shifts to other sources. While we cannot go as in depth as they do in their country studies, our analysis by using a large survey dataset (Eurobarometer) is, as far as we know, the first attempt to see how consumers in the EU-15 perceive the price they pay and the quality of service, conditional to the reform variables and a number of individual and country features.

Our main findings are the following: first, panel estimation of prices tend to reject the prediction that privatization per se leads to lower electricity prices, after controlling for other reforms, and other industry and country-specific variables; second, customer satisfaction for prices is correlated to observed prices, confirming that perceptions by consumers are consistent with the objective evidence; third, customer satisfaction about prices and quality of services is higher with public ownership than under private ownership.

Moreover, in general, country specific fixed effects tend to dominate the explanations as compared with the regulatory variables. We conclude that the evidence, at least at this stage of reforms, does not (yet?) support the view that a unique paradigm of privatization-unbundling-liberalization is clearly more beneficial to electricity consumers in Europe than others.

The structure of the paper is the following. The next section reviews some features of the electricity industry and its reform in selected EU countries. Then we offer an empirical analysis of country panel data on prices. The subsequent sections considers survey data evidence on consumer satisfaction with prices and quality and propose simple empirical models. The paper is concluded by a discussion of our findings against the arguments for the electricity reform paradigm, and some policy

implications

2 European industry reforms in the EU 15

2.1 The Eu directives

The aim of the first EU electricity directive of 1996[1] was to gradually introduce competition in order to create an European market for electricity. Some principles were established: the unbundling of different production stages, the introduction of transparent rules for licensing new generation plants, the gradual extension to final customers of the right to buy electricity directly from the producers and the right of access to the network by new entrants. From July 2004 a new directive repeals that of 1996[2]. Aim of this new directive is to speed up the integration process and the development of competition and therefore it is more detailed than the old one on several issues, the most relevant of which are clearer rules about the unbundling of production stages (especially the separation of the grid from the supply); the compulsory creation of a national energy regulator; the immediate opening of the market to all customers. In particular, the directive requires market opening to all non-household customers by 1 July 2004 and to all customers by 1 July 2007.

This new Electricity Directive was due to be transposed in national legislation by member states by July 2004. These requirements aim to yield a strongly market-led system. However, many member state have been slow in implementing these measures. At the end of 2005, Greece, Luxembourg, Portugal and Spain did still not fully notify the Commission the legal measures taken for the purposes of transposition. In November of 2006 the European Commission published the report on the functioning of the internal market in electricity and gas. This report confirmed that cross border competition was not yet sufficiently developed to provide customers with a real alternative from the nationally-established suppliers. Key indicators in this respect were the absence of price convergence across the EU and the low level of cross-border trade. This situation was a direct consequence of the failure of member states to implement the

[1] First European Electricity Directive n. 92, 1996
[2] Second European Electricity Directive n. 54, 2003

second electricity directives on time or with sufficient determination. Furthermore, inadequate use of existing infrastructure and insufficient interconnection between many member states prevents real competition from developing, despite the political commitment of the European Council made in 2002 to achieve an import capacity of at least 10% of internal consumption. Out of the 15 members states before the 2004 and 2007 enlargement of the EU, 11 of them have companies that have strong or dominant market position. In some cases, far from reducing their market power, these companies now appear to have more market power than they did before the first directive was passed. To illustrate the diversity of the industry in the EU we briefly sum-up here some features of the industry in selected countries. This is not intended to be a comprehensive account, but just a way to underline the persistence of structural diversity in industry patterns across EU countries.

2.2 Electricity supply sources

A shortcut way to describe the electricity generation side of the electricity industry in any country is to look at the sources of energy. Geography and national strategies have shaped in the EU a very uneven landscape. In this subsection, and in the following ones in this section of the paper, we focus on five major countries in the EU 15: UK, France, Germany, Italy and Spain, and in three Nordic smaller countries: Sweden, Denmark, Finland.

The productive mix in the UK, around 2002-2004 comprises roughly 80% fossil fuels (gas and coal in equal shares, very modest role of oil) and the remaining part is almost entirely provided by nuclear power (hydro, wind, other renewables play a marginal role). This pattern can be compared with France : in 2004 here almost 78% of the electricity produced was generated by nuclear plants, only 10% from fossil fuels, and 11.5 from hydroelectric and renewable sources. This situation leads to much lower direct (short run) production costs than in the other EU 15 countries.

The Spanish productive mix is more balanced. There is a prevalence of fossil fuels (59%, more than half of it being coal) followed by nuclear (22%), hydroelectric (12%) and other renewables (6%). Very different the pattern in Italy, where the current productive mix is the result of a political choice (following a referendum) to dismantle nuclear power stations. In 2004, 80% of the electricity is derived from fossil fuels, with

oil and gas each around 30%), and 16.5% is of hydroelectric origin, while only 2.6% is from other renewable sources. Germany has a productive mix more similar to Spain, which includes 63% fossil fuels (but mainly coal), 27% nuclear and the remaining 10% produced by hydroelectric and other renewable sources.

Turning to the Nordic countries, differences in their energy sources for electricity are also impressive. In 2004 the energy in Sweden is produced mainly by nuclear (50%) and hydro (39%) with only 10% coming from fossil fuels. In Finland, the largest source of electricity is the fossil fuels (55%) but a relevant part is derived also from nuclear (26%), with the remaining from hydro and other renewable sources. As regard Denmark, the productive mix is dominated by fossil fuels (83%, mainly coal) with the remaining electricity entirely derived from renewable sources different from hydroelectric.

2.3 External trade

International trade of energy is marginal in most countries, but not in all of them. The UK is marginally a net importer of electricity. In 2004 its imports satisfied around 2% of demand. Spain is a marginal net electricity exporter in 2004 (+1%). France, in contrast, is the most important European net exporter of electricity. Roughly 15% of the electricity produced in the country is sold to Italy, Germany, UK, Spain and Belgium. Germany is also a net exporter of electricity, while Italy is a substantial net importer of electricity: roughly 13% of demand is satisfied by imports from Switzerland, France, Slovenia and Austria.

Looking at the Nordic countries, Sweden imports only a small fraction of its internal demand of electricity (1.4% in 2004), but Finland imports almost 5% of its demand in 2004, and Denmark exports a substantial fraction of its production (almost 8% in 2004).

It is interesting to record here that other EU countries with substantial international trade of electricity exist: Luxembourg, Netherlands, Belgium import more than 20% of their consumption. Austria, and, outside the EU, Switzerland have established themselves as active electricity traders.

2.4 Reform trends

The UK was the first European country to implement a comprehensive reform of the electricity sector at the end of the 80s. The liberalization process started in 1989 with the Electricity Act. It was completed in 1999. The reform contemplated the liberalization and simultaneous privatization of the two state companies (National Power and Power Gen), and of a network of RECs (regional electricity companies). The privatization process ended in 1995, in England and Wales, but Scotland and Northern Ireland followed a different path. As regard the market opening at the beginning the right to choose the electricity supplier was granted only for the major users, but the threshold level was progressively reduced, reaching a complete liberalization in 1998. The Electricity Act established also the introduction of a wholesale market and the complete separation of the transmission activity from generation. In the network services (transmission and distribution) the price was regulated by the price cap, under the control of OFFER, a regulation agency, now called GEM.

Again in contrast to the UK, France was one of the latecomer in implementing the EU directives. The experience of liberalization begun only in 2000 when the government approved the law n. 108 which modified the pre-existing structure created by the Law of 1946. The reform predicted a regime of regulated third party access, the introduction of a wholesale market and a progressive opening of the sector with the possibility for the consumer to choose the retailer. The threshold level was established in 100 GWh in 2003 and was gradually reduced in the subsequent years. The elimination of any threshold is foreseen in 2007.

The reform of the energy sector begun in Spain with the privatization of two public electric utilities. From 1988 to 1999 the privatization of *Red Electrica* and *Endesa* was completed. In 1994 the Law 40/1994 known by the acronym LOSEN was enacted with the aim of liberalize the sector. This law mandated the legal unbundling of the transmission network and created an independent joint public-private TSO[3] called *Red Electrica Espanola* (REE). REE offers regulated TPA[4] to both the transmission network and the distribution network. In so far as generation LOSEN was quite permissive in terms of the maximum market share that any given Spanish generating

[3] Transmission System Operator
[4] Third party access

company could control. Therefore the subsequent years were characterized by an acceleration of the trend toward consolidation: from over 35 independent regional generation companies in 1990 only five were left by 2002. The LOSEN was surpassed by Law 54/1997 which accelerated the process of liberalization by imposing the right to choose the electric supplier to 100% of electric energy consumer and the introduction of a wholesale market.

In Italy, the transposition of the first EU directive was realized by the implementation of a decree in 1999. The main changes realized were the introduction of competition in generation and supply to final consumers; the vertical separation of the production stages; the creation of a wholesale market. The reform of 1999 did not provide for an immediate total openness: since 2000 those with a consumption of over 20 GWh have been able to join the free market. The threshold has been progressively reduced to in the end arrive to a total liberalization in 2007. The Bersani decree imposed also the vertical disintegration of ENEL spa and the constitution of the public company GRTN (*Gestore della Rete di Trasmissione Nazionale*) to manage the national transmission. The GRTN guarantees open access to the network, according to the conditions and tariffs determined by the regulator.

Germany begun to implement the EU directives in 1998 with the Energy Act and completed the reform in 2005 with the Energy Industry Act. The reform introduced total openness: each consumer had the right to choose his own supplier without any limitations or volume threshold. The supplier could also be a producer, a regional distribution company or a municipalized company. An electricity exchange was also set up, but only in the august of 2005 a regulatory body, the Federal Net Agency, was installed with the mandate to control the prices of the industry.

In 1996 there was a radical reform in Sweden following the experience of Norway[5]. After the enacting of the Law for Electricity Supply a total production liberalization and a regime of authorization were implemented. The transmission system remained in public hands, in a monopoly regime managed by a non-profit state company, and distribution was delegated to 280 municipalized firms. The retail market was fully opened and since 1996 the consumer can choose their own supplier without

any threshold level. The separation between transmission and distribution operators was effective since 1992, but only in compliance with the second EU electricity directive the overall degree of vertical integration of the industry became completely unbundled.

Finland choose to reform the sector in 1995 with the Electricity Market Act. From then on the market was progressively liberalized and since 1997 the consumer can freely choose their own supplier. The reform also establishes the division between the transmission and generation firms although the distribution companies are not yet fully unbundled.

The reforming experience in Denmark is very similar to that of the other Nordic countries and begun in 1996 with the Danish Supply Act but was completed in 2001 when the law established the complete rights for any type of consumer to choose the supplier. The electricity sector is characterized by the presence of public local companies and despite some privatization the overall ownership structure still remains public. The separation between generation and transmission activities was established in 1996, but the total unbundling of the industry, regarding also distribution, was completed in 2001. Table 1 shows some of the acts implementing the EU directives.

[5] Norway was the first Nordic country to liberalise its electricity market in 1991, following the British model in most respects, but without privatization. The state now still plays a leading role through local distributors and in some cases also public producers.

Country	Law
Austria	Law of electricity supply 1998 - Energy Regulator Act 2000
Belgium	Law for the organization of the electricity market 1999 - Federal law of 1 June 2005
Denmark	Danish supply Act 1996 - Act No. 375 of 1999 - Act No. 138 of 2004
Finland	Electricity market Act 1995 - Amendment to the Electricity Market Act 2004
France	Law n. 108 of 2000
Germany	Act on the supply of Electricity and Gas 1998 – Energy Industry Act 2005
Greece	Electricity Law 1999
Ireland	Electricity Regulation Act 1999 - Utilities Act 2000
Italy	Bersani decree 1999 – Marzano Law 2004
Luxembourg	Law on the organization of electricity market 2000
Netherland	Electricity Act 1998
Portugal	Decree Laws 182-85 of 1995
Spain	Law 407-1994 Electricity Act (LOSEN) - Law 54/1997 (Electricity Power Act
Sweden	Law for Electricity supply 1995
UK	Electricity Act 1989

Source: European Commission - Study on Unbundling of Electricity and Gas Transmission and Distribution System 2005 and A. Al-Sunaidy, R. Green, "Electricity deregulation in OECD countries", Energy, vol. 31, pp. 769-787, 2006

Table 1: The EU 15 electricity liberalization laws

2.5 Market structure

There is no evidence that market structures are converging to a unique pattern in the EU, even if there are some common trends diven by the policy initiative of the European Commission.

After the process of liberalization the number of companies producing electricity in the UK increased considerably passing from 6 to 47 in two years. More recently there have been however processes of re-integration and expansion that have increased the concentration of the market. Generation consists of approximately 20 private entities, with only 7 having a market share above 5%. In particular the market is dominated by Innogy (21%), British Energy (18%) and PowerGen (17%). The retail market is characterized by the presence of 7 big suppliers with a market share above 5%, while the number of distributors is higher (15 distribution companies in 2004). The ownership of the transmission grid is divided between four different private companies.

In France the structure of the industry is very different with respect to the UK. The French national government has a strong traditional relationship with its energy industry. The primary electric utility *Electricitè de France* (EDF), is a vertical integrated public company formed through a process of nationalization of the electric energy industry by the law of 1946. As regard unbundling the government decided to introduce only a form of accounting separation between transmission and generation, essentially maintaining the vertical integration of the electric sector. Another

characteristic of the process was the absolute reluctance to privatize EDF: this orientation hampers the development of a transparent and non discriminatory electricity market. Although new private generators have been given access to the market, EDF still owns and controls the majority of generation as well as the transmission and distribution networks. EDF is responsible for approximately 89% of the generation capacity in 2005, while the *Compagnie nationale du Rhone* (CNR), also a public owned company, controls almost entirely the remaining share. In 2001, CNR created *Energie du Rhone*, as a joint venture with Electrabel, the former Belgian national utility, to distribute and retail the electricity CNR produces in France.

In Spain, the most relevant outcome of the electricity policy so far has been the emergence of some big firms that consolidated their generation assets. The number of firm with a market share above 5% in this stage is particularly low: the market is overwhelmingly controlled by the three largest companies Endesa, Iberdrola and Union Fenosa, which together account for 83% of the generation installed capacity. The competition in the retail market is in contrast wide, with almost 300 firms operating, and only 3 have a market share above 5% in 2004.

After a long history of private oligopoly, Italy changed to a vertically integrated public monopoly in 1963. ENEL, the public sector company, became a public limited company in 1992. After the privatization process started at the end of the 90s, the government now controls 21% of the company. In generation the decree allowed ENEL to retain a maximum market share of 50% after 2003. As a consequence, three of its generation companies were sold on the market: the sale of Elettrogen, Eurogen, and Interpower were completed by the end of 2003. In terms of electricity generated five operators have a market share over 5% in 2004: ENEL Produzione (39%), Edison group (11%), ENI Group (9%), Endesa Italia (8.2%) and Edipower (8%). In addiction to ENEL the major final suppliers who operate in Italy include: AEM Milano, AEM Torino, Dalmine Energy, Edison, Enipower, Verbund, EDF. The distribution network is again virtually controlled by ENEL, with the exception of few cities where the local municipalities own the distribution companies.

In Germany, prior to the recent reform, the law of 1935 had led to the existence of a *de facto* regime of private regional monopoly with nine vertically integrated supra-regional companies which, in 2000, still controlled 80% of production, 40% of

distribution and all transmission. Below this oligopolistic level that has been static for decades, a regional level operates that is formed of about 80 firms whose principal activity consists of acquiring energy from the large distributors and reselling it at a local level. About 800 entities operate at a local level, most of them publicly owned. As regard generation 90% of the total electricity in Germany is produced by only four large groups: ENBW, Vattenfall Europe, RWE, EON. In terms of electricity supply, each of the four large companies holds a market share of much more than 5% and the market share of another 6 companies range from 0.9% to 2.1%. Together, these ten companies supply more than 60% of total German electricity consumption, while the remaining is mainly made up by private generators and municipal utilities. As for the separation between the transmission and the generation process despite the two stages are officially divided since 2002 the European Commission[6] argues that there is still an insufficient unbundling because the interest structures of the Transmission system operator seems to be influenced by supply interest of incumbent companies. The transmission assets are split between 4 companies while the number of distributors is particularly high. The ownership structure of the industry continue to be mixed with the contemporaneous presence of public and private operators.

The three Nordic countries, despite being well integrated in one regional market do not show structural similarities. In Sweden, at corporate level, the former monopolist Vattenfall still has a dominant position with a market share in generation of 47% in 2004. This company is 100% government owned. In Finland the ex monopolist IVO was partly privatized but the national government still owns the majority of the shares. The rest of the industry is characterized by a large number of local companies, often publicly owned. The overall degree of competition in the country after the reform process is satisfactory: there are 5 companies with a market share above 5% in the generation stage, while the structure of the retail market is much more concentrated with 3 firms having a market share above 5%. For generation the western part of Denmark is dominated by Elsam while the eastern by Elkraft. The market share of the largest generator in the country is 33% in 2004 while the number of firms having a share above

[6] General Directorate for Energy and Transport, "*Prospect for internal and electricity market 2007: implementation report*", January 2007.

5% in generation are 2. In the retail segment of the industry there is a great number of suppliers (more than 100 in 2003) with 5 having a market share greater than 5%.

All the Nordic Countries are part of a joint wholesale electricity market. The Nord Pool market was created in 1996 by Norway and Sweden and afterwards was completed with the entry of Finland (1998) and Denmark (1999). So the profile of the electricity industry of all these countries has to be considered jointly. If we look at the entire Nord Pool we can discern a competitive context: the generating companies with a market share over 5% are 10, while the aggregate share of the three largest generators is under 40% in 2004, and this seems to be compatible with mainly public ownership of generation and of the networks.

In general in the EU concentration in the industry remains high, with the largest three generation firms or the three largest retailers, controlling more than 60% of the market in the large majority of countries, whatever the extent of privatization, with two polar exceptions: the UK and the Nordic countries, the former with no public ownership left, the latter with mostly public sector firms.

This brief overview of the electricity industry in five major EU countries, and in three smaller Nordic countries, shows a striking variety of patterns. As mentioned, some common trends can be discerned, but it is not self-evident that a unique European pattern is emerging. This, in a sense, is good news for empirical analysis, because it allows to test whether structural diversity is associated with different performances. We try in the next sections to use available comparative data to test the reform paradigm in the EU-15. We consider this as an exploratory research, because we are fully aware of the difficulty of capturing the many structural and legal diversities that we have mentioned, in a summary way, in this section. There are however very few attempts in the literature to evaluate the electricity reforms across the EU, and it seems useful to contribute to the policy reform debate on empirical grounds.

3 Data

The main source of data for this paper is the IEA 2006 Electricity Information data set, which collects data about electricity variables of OECD countries (IEA, 2006). The time series starts in 1960 however the data set contains many missing observations before the end of the 1970s. In particular, the time series of (net of taxes) electricity prices for households, which will be extensively used in this paper, starts in 1978 and for most of the EU15 countries it ends in year 2005. Figures 1 and 2 plot the log prices of electricity for households since 1978 for the EU15 countries, measured in national currencies per Kwatt/hour. They show that log prices have increased throughout the period showing some convergence for all countries in the Euro area, including the UK.

The data set we used comprises 408 observations on household net prices across the EU-15. As Table 2 shows, the dataset presents several missing observations, especially in the cost variables. This means that, although most likely very relevant to explain the dynamics of electricity prices, cost variables have to be introduced in the analysis with caution, as they will cause a sharp reduction of the sample size.

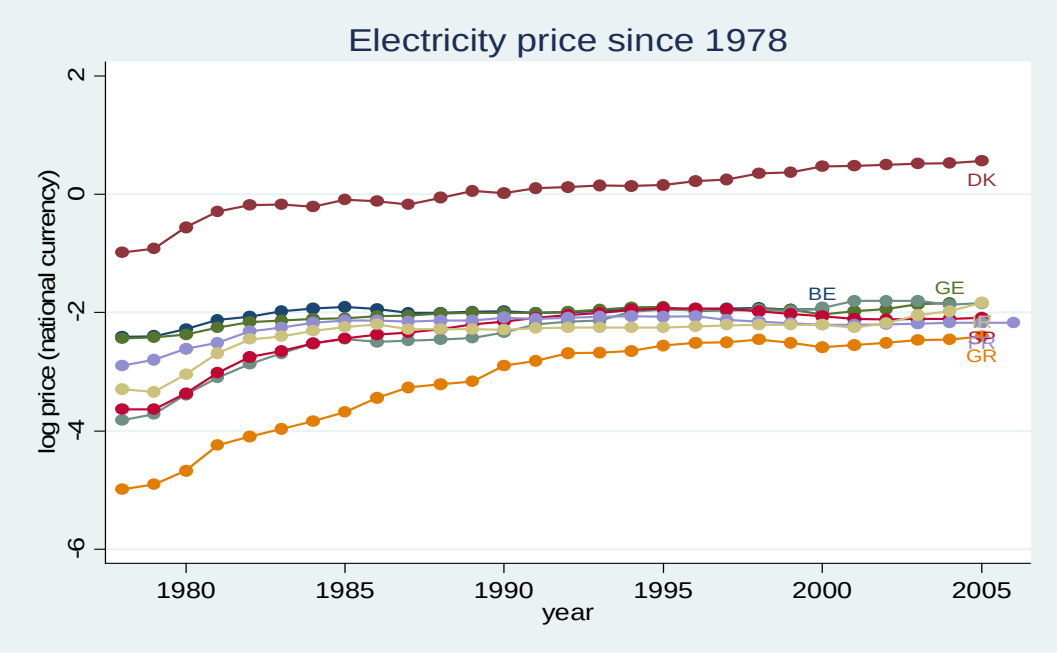

Figure 1: Electricity (log) price dynamics for households, in national currency per KW/hour.
Note: BE=Belgium, DK=Denmark, GE=Germany, GR=Greece, IT=Italy, SP=Spain, FR=France, IR=Ireland.

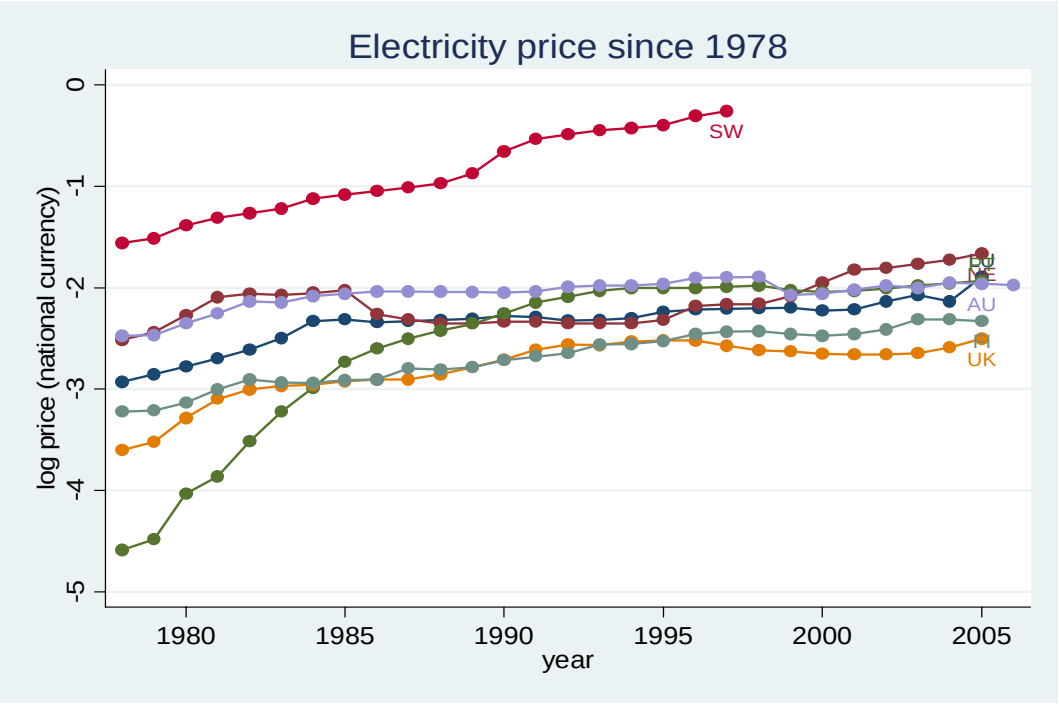

Figure 2: Electricity (log) price dynamics for households, in national currency per KW/hour.
Note: LU=Luxembourg, NE=Neatherlands, PT=Portugal, UK=United Kingdom, FI=Finland, SW=Sweden, AU=Austria.

Variables	Obs	Mean	Std. Dev.	Min	Max
Household price (Kw/h in national currency)	408	0.24	0.33	0.07	1.60
Energy sources					
Source Hydro. (GWh/Tj)	394	18274.31	21007.10	0.00	73668.00
Source Comb. Fuel (GWh/Tj)	394	69179.42	88650.60	29.00	349166.00
Imports (GWh/Tj)	394	9479.15	10940.37	0.00	51519.00
Energy Distribution Loss (GWh)	394	9255.65	9624.75	24.00	34185.00
Macro-economic variables					
Population (M.)	406	24.95	25.52	0.36	82.52
GDP (nat. curr. Billions)	406	478.29	493.49	5.09	2148.89
Residential Consumption (GWh)	394	36373.66	40740.92	394.00	146744.00
Cost variables					
Cost Comb. Oil (Nat.Curr./TOE)	287	154.39	46.99	67.09	400.57
Cost Coal (Nat.Curr./TOE)	266	96.71	37.30	47.41	258.82
Cost Gas (Nat.Curr./TOE)	196	155.70	42.64	71.87	324.26

Source: IEA (2006)
Table 2: summary statistics of some relevant variables.

We also extensively use REGREF, an OECD regulatory database (Conway and Nicoletti, 2006) which collects some indicators of privatization, disintegration, liberalization of several services of general interest across some OECD countries. Focussing on the electricity market, we use in particular the variable "public ownership", which measures the public ownership of each SGI and is coded from 0 (private ownership) to 6 (public ownership), the variable "vertical integration", which is an indicator of vertical separation in different industries and is coded from 0 (ownership separation) to 6 (integration), and the variable "entry regulation", which is a weighted average of legal conditions of entry in a market and is coded from 0 (free entry) to 6 (franchised to one firm). Although in some cases these variables only take discrete values, they are allowed to take any value in the 0-6 range (Table 3) and at present the time series starts in 1975 and ends in 2003. The average trend across the EU15 countries since 1985 has been towards a marked reduction of public ownership, a less integrated industry structure and a less regulated access to the market (Figure 3).

	Vertical Integration	Public Ownership	Entry Regulation
Belgium	5.38	1.50	4.63
Denmark	5.43	4.24	4.79
Germany	4.09	3.00	4.83
Greece	5.53	6.00	5.62
Italy	5.33	5.59	5.28
Spain	4.14	2.64	4.77
France	5.79	6.00	5.29
Ireland	5.12	6.00	5.49
Luxembourg	4.50	0.00	2.30
Netherlands	3.98	5.17	5.02
Portugal	4.76	4.97	5.43
Great Britain	3.10	3.36	3.28
Finland	3.67	4.24	4.26
Sweden	4.03	3.00	4.17
Austria	5.38	4.50	5.31

Source: our calculations on REGREF (Conway and Nicoletti, 2006)

Table 3: Some regulatory indices about the electricity industry.

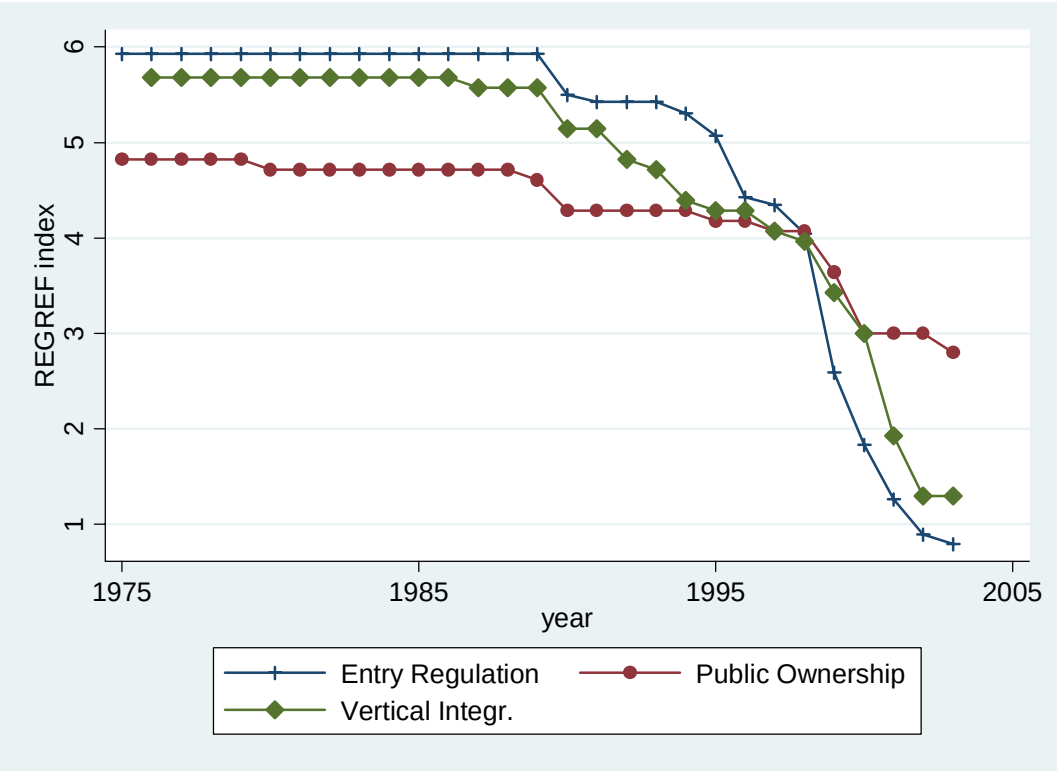

Figure 3: Trends of mean of regulatory indices across EU15.

4 Explaining electricity price dynamics

In this section we estimate a model where log prices are expressed as a function of regulatory variables, such as vertical integration, public ownership and entry regulation. Let p_{it} be the log of household electricity prices for country *i* at time *t*, R_{it} the vector of regulatory variables for country *i* at time *t*, which includes vertical integration, public ownership and entry regulation, and t the deterministic trend.We estimate the model:

$$p_{it} = c + R_{it}'\beta + \alpha_i + t\gamma + \varepsilon_{it} \qquad (1)$$

where c, α, β, γ are parameters to be estimated and ε is the error term. As available data are a panel from 1978 of 15 European countries, parameters c, β, γ of model (1) are estimated using panel fixed effects. Fixed effects are preferred to random effects as p_{it} is conditional on α_i, where α_i can be estimated and can reasonably be

interpreted as ‘one of a kind’ and cannot be viewed as a random draw from some population, since it represents countries. Results are reported in the first column of Table 4, showing that vertical integration and entry regulation are significantly different from zero at the 1% level, while public ownership is relatively insignificant in explaining total variability. It is however worth noticing that only the sign of entry regulation is positive. In other words, if the entry to the market was made freer by one point using the REGREF indicator (i.e. reducing by one point the market entry indicator variable, which goes from a minimum of 0 to a maximum of 6) causes the price to reduce by about 11%. However, if the indicator of vertical integration was also reduced by one out of six point, it would have a counterbalancing effect on electricity prices, increasing them by over 6%.

The model (1) has been tested also against some alternatives. In columns (B)-(D) a set of other controls were introduced, including some energy source variables, such as hydroelectric and combustible fuel, an energy import variable, an efficiency variable measured in terms of energy distribution loss, some macro-economic variables including national GDP, population and residential consumption, and finally some cost variables, such as the price of combustible oil, of natural gas and of coal for energy production.

Results show that electricity price is consistently higher the larger is the dependency on combustible fuel rather than on hydroelectric energy generation; that energy distribution inefficiencies are not a key determinants of electricity prices while an increase of 1% of energy imports in GWh/Tj cause the price of electricity to increase by about 2-3%, depending on the model specification chosen. While residential consumption is not statistically very significant, the size of national population and of the national product are statistically significant and their signs are consistent with economic theory. In particular, an increase of national product, as measured by the GDP shifts the demand schedule upwards increasing the market price and a larger population increases the economies of scale, reducing average costs and the household market price of energy. Finally, the introduction of cost variables, such as prices of combustible oil and coal show that these are very important variables to explain the variability of household electricity prices, but also that they do not greatly change the interpretation of the other variables in the model. Unfortunately, the main drawback of the introduction

of the cost variables in model (1) is that these variables present many missing observations, causing the sample dimension to decrease dramatically, with important effects on the significance of some coefficient estimates, such as, for instance, the vertical integration variable. However, the main message that comes out of the estimation of model (1) is that regulatory variables are relevant determinants for electricity prices and that, with likely surprise to some readers, the disintegration of the structure of the energy industry might cause a negative effect on electricity prices, while the reduction of the public ownership share in the electricity market is not a key determinant for reducing the electricity price for households.

Model (1) presents a couple of main limitations. First, it overlooks the possible presence of common trends among dependent and independent variables. Second, it is not a dynamic model. The first problem relates to the fact that since 1978, which is the starting date of our time series, electricity (log) prices in national currency presented some increasing dynamic, although different across countries. Analogously, other variables, such as regulatory indices and cost variables, also showed trends across the time period considered. A Dickey-Fuller test for the presence of unit roots shows that all variables considered are integrated of order one, with the only exception of the population variable, which presents a deterministic trend.[7] Hence, we estimated the model

$$D.p_{it} = c + \beta(D.R_{it}) + \alpha_i + \delta_{it} \qquad (2)$$

where the symbol *D.* before a variable shows that it has been differenced. Estimation of model (2) is presented in Table 5, column (A). Analogously to model (1), model (2) was also augmented to include other variables, such as energy sources, cost and macro-economic variables. Table 5 shows that the overall R-square largely decreases in model (2), confirming that the large values of the R-square coefficient of model (1) was mostly due to the presence of common trends. Secondly, it shows that the impact of regulation (as measured by the REGREF indicators) on the change of log electricity prices is rather small and not statistically significant. Although someone may

[7] The Dickey-Fuller test is not presented here but could be obtained from the authors upon request.

argue that the length of the time series is small and that the analysis might be affected by measurement error, which could be the main reason of statistically insignificant results on regulatory indices, they should still reckon that there is no empirical evidence showing that increasing vertical disintegration and reducing the public ownership in electricity markets have a decreasing effect on energy prices for households. The barriers to entry coefficient consistently has a beneficial effect on prices, although not statistically significant.

When model (2) is augmented for including other stationary variables, results show that the more significant variables are energy imports, population and GDP. Also input cost variables are very relevant to explain the change of log prices, however their introduction in the analysis causes the sample dimension, as well as the significance of the other variables considered, to drop dramatically.

In Table 6, we report the Arellano-Bond estimation of model, which uses the GMM estimation method. Besides showing the strong autocorrelation of first differences in log prices, the main messages of these estimations are again that a more import-dependent country tends to have higher prices than others; that increased input costs have a cost-increasing effect on electricity prices and that regulation variables have an insignificant effect on electricity prices.

Dependent variable is log net price of electricity (net of tax) for households

	Panel regression, fixed effects				
	(A)	(B)	(C)	(D)	(E)
Vertical Integr.	-0.065***	-0.027*	-0.028*	-0.051*	-0.061
	[0.019]	[0.011]	[0.011]	[0.021]	[0.033]
Public Ownership	-0.017	-0.007	-0.007	0.015	0.030
	[0.019]	[0.013]	[0.013]	[0.019]	[0.024]
Entry Regulation	0.110***	0.090***	0.091***	0.075***	0.065**
	[0.016]	[0.010]	[0.010]	[0.016]	[0.020]
year	0.044***	0.021***	0.023***	0.041***	0.041***
	[0.003]	[0.003]	[0.004]	[0.005]	[0.005]
Source Hydro. (log GWh/Tj)		-0.073**	-0.074**	-0.162**	-0.151*
		[0.023]	[0.023]	[0.059]	[0.065]
Source Comb. Fuel (log GWh/Tj)		0.098***	0.102***	0.142***	0.054
		[0.029]	[0.030]	[0.037]	[0.056]
Imports (log GWh/Tj)		0.038**	0.037**	0.020	0.025*
		[0.012]	[0.012]	[0.012]	[0.012]
Energy Distribution Loss (log GWh)		0.091	0.110	0.264*	-0.097
		[0.090]	[0.097]	[0.112]	[0.110]
GDP (log Nat.Curr. B.)		0.719***	0.724***	0.382***	0.292***
		[0.041]	[0.042]	[0.071]	[0.078]
Population (log M.)		-1.637	-1.596	-3.927***	-4.150***
		[0.841]	[0.846]	[1.138]	[1.101]
Residential Consumption (log GWh)			-0.052	-0.223*	0.007
			[0.104]	[0.106]	[0.117]
Cost Comb. Oil (log Nat.Curr./TOE)				-0.027	-0.055
				[0.040]	[0.059]
Cost Coal (log Nat.Curr./TOE)				0.391***	0.189***
				[0.045]	[0.046]
Cost Gas (log Nat.Curr./TOE)					0.153*
					[0.060]
Constant	-89.801***	-46.194***	-48.232***	-76.473***	-73.468***
	[5.873]	[5.083]	[6.515]	[7.991]	[7.576]
R-squared	0.511	0.848	0.848	0.888	0.855
Obs.	353	324	324	198	141

Standard error in brackets

* p<0.05, ** p<0.01, *** p<0.001

Table 4: Fixed-effect panel estimation

Dependent variable is log net price of electricity (net of tax) for households

	Panel regression with stationary variables, fixed effects		
	(A)	(B)	(C)
D.Vertical Integr.	0.008	0.001	-0.015
	[0.008]	[0.007]	[0.013]
D.Public Ownership	-0.005	-0.004	-0.004
	[0.010]	[0.009]	[0.016]
D.Entry Regulation	0.011	0.007	0.021
	[0.007]	[0.006]	[0.012]
D.Source Hydro. (log GWh/Tj)		-0.010	-0.016
		[0.017]	[0.030]
D.Source Comb. Fuel (log GWh/Tj)		0.017	0.004
		[0.025]	[0.030]
D.Imports (log GWh/Tj)		0.017	0.023*
		[0.010]	[0.011]
D.Energy Distribution Loss (log GWh)		0.042	0.048
		[0.048]	[0.059]
D.GDP (log Nat.Curr. B.)		0.177***	0.016
		[0.038]	[0.051]
Population (log M.)		-0.938***	-0.489
		[0.185]	[0.275]
D.Residential Consumption (log GWh)		-0.142	-0.020
		[0.127]	[0.139]
D.Cost Comb. Oil (log Nat.Curr./TOE)			0.081***
			[0.024]
D.Cost Coal (log Nat.Curr./TOE)			0.143***
			[0.034]
Constant	0.047***	2.698***	1.406
	[0.005]	[0.524]	[0.767]
R-squared	0.019	0.185	0.349
Obs.	339	309	183

Standard error in brackets

* p<0.05, ** p<0.01, *** p<0.001

Note: D. stands for first difference. The variable *Population* is trend stationary.

Table 5: Fixed-effect panel estimation

Dependent variable is log net price of electricity (net of tax) for households

	Arellando and Bond estimation			
	(A)	(B)	(C)	(D)
D.log net price (-1)	0.858***	0.874***	0.889***	0.753***
	[0.015]	[0.023]	[0.024]	[0.036]
D.Vertical Integr.	0.003	0.007	0.005	-0.008
	[0.004]	[0.004]	[0.004]	[0.014]
D.Public Ownership	-0.003	-0.004	-0.004	0.007
	[0.004]	[0.005]	[0.005]	[0.013]
D.Entry Regulation	-0.003	0.000	0.003	0.011
	[0.004]	[0.004]	[0.004]	[0.008]
D.Source Hydro. (log GWh/Tj)		0.002	0.001	-0.009
		[0.010]	[0.010]	[0.026]
D.Source Comb. Fuel (log GWh/Tj)		0.027	0.039*	0.044*
		[0.017]	[0.017]	[0.021]
D.Imports (log GWh/Tj)		0.026**	0.028**	0.037***
		[0.009]	[0.009]	[0.008]
D.Energy Distribution Loss (log GWh)		-0.037	0.010	-0.029
		[0.036]	[0.038]	[0.040]
D.GDP (log Nat.Curr. B.)		0.004	0.010	-0.161***
		[0.023]	[0.023]	[0.036]
D.Residential Consumption (log GWh)			-0.178***	0.003
			[0.047]	[0.048]
D.Cost Comb. Oil (log Nat.Curr./TOE)				0.049*
				[0.023]
D.Cost Coal (log Nat.Curr./TOE)				0.056**
				[0.018]
D.Population (log M.)		0.716	0.734	-0.295
		[0.376]	[0.378]	[0.474]
D.Cost Gas (log Nat.Curr./TOE)				0.107***
				[0.024]
Constant	-0.001	-0.003	0.001	0.009***
	[0.001]	[0.002]	[0.002]	[0.002]
Obs.	325	297	297	123

Standard error in brackets

* p<0.05, ** p<0.01, *** p<0.001

Note: D. stands for first difference.

Table 6: Arellano and Bond estimation.

5 Consumers' satisfaction with electricity prices

In the previous section we analyzed whether an objective measure of an important element of consumers' welfare, such as the market price consumers pay for electricity, is strongly influenced by the industry structure, the market entry regulation and the public ownership share in the industry. In this section we push forward the analysis undertaken in Fiorio and Florio (2007), where subjective satisfaction with prices and quality of three important public utilities, including electricity supply, was analyzed. Consumers' subjective satisfaction is measured in the Eurobarometer data set, which collects information about approximately 1,000 people in each European countries in 2000, 2002 and 2004 (for a thorough analysis of the Eurobarometer datasets concerning satisfaction with some services of general interests, see Fiorio et. al., 2007).

As satisfaction to different SGI is coded with ordinal variables, analogously to Eurobarometer (2004), we dichotomize consumers' satisfaction, i.e. answers to questions about prices and quality of SGI are classified into "satisfied" and "not satisfied". In particular, the consumer price satisfaction variable is recorded equal to 1 if the respondent states that the price he pays for fixed telephone (or gas or electricity) services is fair, and is recorded equal to 0 otherwise. The consumer quality satisfaction variable is recorded equal to 1 if the respondent states that the quality of the fixed telephone (or gas or electricity) services used is very good, and is equal to 0 if the answer is fairly good, fairly bad or very bad.[8]

Table 7 shows that satisfaction with electricity supply is very large across the EU. As many as 60% of European consumers are satisfied with prices and over 40% are very satisfied with quality.

[8] Some readers might be puzzled by the fact that we include among the non-satisfied those who declared that quality of SGI is fairly good, however this is due simply to increase variability. In fact, only about 5% of consumers across services rate quality of SGI as fairly or very bad.

Satisfied with price of electricity supply

	Descriptive statistics					Countries		
year	Obs	Mean	Std. Dev.	Min	Max	Min	Median	Max
2000	15	0.61	0.14	0.38	0.82	Portugal	Germany	Luxembourg
2002	15	0.60	0.13	0.37	0.79	Italy	Sweden	Luxembourg
2004	15	0.65	0.17	0.32	0.89	Greece	Germany	United Kingdom
all	45	0.62	0.15	0.32	0.89	Greece	Belgium	United Kingdom

Very satisfied with quality of electricity supply

	Descriptive statistics					Countries		
year	Obs	Mean	Std. Dev.	Min	Max	Min	Median	Max
2000	15	0.46	0.19	0.13	0.72	Portugal	Finland	Ireland
2002	15	0.43	0.19	0.08	0.69	Portugal	Finland	Ireland
2004	15	0.42	0.19	0.10	0.71	Portugal	United Kingdom	Denmark
all	45	0.44	0.19	0.08	0.72	Portugal	United Kingdom	Ireland

Source: our estimates on Eurobarometer data.

Table 7: Descriptive statistics for different SGI by year and pooled sample.

As we do not know the exact level of individual satisfaction, S^*, for each service, we assume that satisfaction is generated by a latent variable model:

$$S^* = \mathbf{x}\boldsymbol{\beta} + e \qquad (3)$$

where $\mathbf{x}\boldsymbol{\beta} = \beta_1 + \beta_2 x_2 + ... + \beta_k x_k$ includes individual characteristics (i.e. sex, occupation) accounting for individual observed heterogeneity, time-varying country macroeconomic variables (i.e. GDP level and rate of growth) accounting for time-varying heterogeneity, a time fixed-effects to capture any time trend and some time-invariant country-fixed effects to capture any country-specific effects. Finally, e accounts for unobserved heterogeneity. As S^* is latent, one can only observe

$$S = 1[S^* > 0]$$

where e is a continuously distributed variable independent of $\mathbf{x}$, the distribution of e is symmetric about zero and $1[\bullet]$ is equal to 1 if the argument is true and equal to zero otherwise. Assuming that e is distributed as a standard normal we obtain the probit model:

$$\Pr(S = 1 \mid \mathbf{x}) = \Pr(S^* > 0 \mid \mathbf{x}) = \Pr(e > -\mathbf{x}\boldsymbol{\beta} \mid \mathbf{x}) = 1 - \Phi(-\mathbf{x}\boldsymbol{\beta}) = \Phi(\mathbf{x}\boldsymbol{\beta}) \equiv p(\mathbf{x}) \qquad (4)$$

where Φ is the standard normal cumulative density function.

The partial effect of x_j on $p(\mathbf{x})$ depends on $\mathbf{x}$ through the standard normal density function, $\phi(\mathbf{x\beta})$, as $\partial p(\mathbf{x})/\partial x_j = \phi(\mathbf{x\beta})\beta_j$. The average partial effect (APE) for a continuous variable x_j is:

$$APE_j = \beta_j \frac{1}{n}\sum_{i=1}^{n}\phi(\mathbf{x}^i\boldsymbol{\beta}) \qquad (5)$$

where n denotes the number of observations, and $\mathbf{x}^i\boldsymbol{\beta}$ the value of the linear combination of parameters and variables for the *i*-th observation. The APE for a dummy variable is:

$$APE_j = \frac{1}{n}\sum_{i=1}^{n}[\Phi(\mathbf{x}^i\boldsymbol{\beta} \mid \mathbf{x}_j^i = 1) - \Phi(\mathbf{x}^i\boldsymbol{\beta} \mid \mathbf{x}_j^i = 0)]$$

which avoids the problem of setting the dummy variables to their means.

All estimates to follow present results in terms of APE. As controls, $\mathbf{x}$, we used a set of individual characteristics (including sex, age, marital status, age when finished education, occupation, political views, respondent's cooperation as assessed by interviewer), of country fixed-effects, year dummies, some country-level macroeconomic variables (population density, GDP per capita, GDP growth rate, employment growth rate, Gini index) and some regulatory indicators of entry regulation, public ownership, market structure and vertical integration.[9]

Differently from Fiorio and Florio (2007), we include also electricity market prices for households among the independent variables of model (3) to verify whether subjective satisfaction depends on actual prices and whether the relationship between subjective satisfaction and regulatory variables is at all driven by the relationship between regulatory variables and market prices of electricity. In Table 8 marginal effects for price satisfaction are reported. In column (A) no market price is included and it is shown that regulation variables are important variables to explain the variability of

the probability of being satisfied with electricity prices. If the public ownership in the electricity industry was larger by one point (as measured in the REGREF data set), the probability of consumer's satisfaction increases by an average of 2.8%. If vertical integration increases and entry is more regulated, each by one point, probability of satisfaction increases by about 1.5%. Table 8 also shows that country fixed-effects are the most relevant factors determining the consumers' satisfaction. In column (B) we also introduce the level of price for electricity in national currency per kilowatt/ hour in log relative terms (at the 2000 base year). The idea is to see whether consumers' satisfaction is somehow related to prices, as one would expect and verify whether this alters the conclusion obtained from model (A). The estimated coefficient for the price level is significantly different from zero and with a negative sign, showing that a percentage increase of prices would have a very strong impact on consumers' satisfaction reducing their satisfaction by nearly 60%. It is also worth noting that coefficients on regulatory variables remain positive and significant, although the impact of a larger public ownership on higher satisfaction decreases in magnitude while that of a larger entry regulation on higher satisfaction increases. The price level variable has a stronger effect on capturing the differential country effects as now most of the country fixed effects variables are not significantly different from the reference country and those which are have a positive sign. As the reference country is the UK, this can interpreted as evidence that *ceteris paribus* consumers living in the country where electricity services have been liberalized the most and where privatization of the electricity services is now complete are not more likely to be satisfied than in others countries, and they are even less satisfied than citizens of Austria, Germany and Denmark.

Finally, model (B) shows that across the three years considered, the trend is towards a significant increase of consumers' satisfaction. Column (C) includes the first difference of log prices, to analyze whether the change of prices rather than their levels are effective to explain consumers' perception. However, it can be seen that its marginal effect is about zero and not statistically significant. Once again, the coefficients of regulatory variables remain significantly positive. Results show that subjective

[9] It would be meaningful to include a variable of household income but it is not available for the whole period considered. However, some of the variables included, such as education, occupation and age of the

satisfaction with prices is strongly and significantly correlated with market prices and presents the expected sign. In other words, consumers' satisfaction increases if price levels are lower.

Table 9 shows the results of the estimation of similar models where the dependent variable is now the consumers' satisfaction with electricity supply quality. Results show that the quality satisfaction is much more variable and fewer variables are significant. In particular, the prices coefficients are positive, showing that higher prices are correlated with perception of higher quality, but this correlation is not statistically significant. The trend is improving across years, although it is again not statistically significant. Among regulatory variables, only public ownership is significant at the 5% level if price levels are introduced, but is not statistically significant if the first difference is included. Coefficients of entry regulation are significant at the 10% level regardless of the specification used. However, the estimated coefficients in the regression are always positive showing that higher public ownership, more integrated industry and entry regulation are have a positive effect on consumers' satisfaction with electricity service quality.

respondent are likely to be highly correlated with income.

Price Satisfaction

	Electricity: Price (A)	Electricity: Price (B)	Electricity: Price (C)
Regulation variables			
Public Ownership: Ele	0.028***	0.013**	0.031***
Vertical Intergration: Ele	0.015***	0.015***	0.018***
Entry Regulation: Ele	0.013**	0.043***	0.022***
Price variables			
Price (nat.curr. per Wh. log)		-0.588***	
Price first difference (nat.curr. per Wh. log)			0.000
Year dummies			
year 2002	-0.063***	0.078***	0.011
year 2004	0.076***	0.161***	0.136***
Individual characteristics	Yes	Yes	Yes
Macroeconomic controls	Yes	Yes	Yes
Country fixed-effects			
Belgium	-0.609***		
Denmark	0.391***	0.392***	0.387***
Germany	-0.318***	0.231***	-0.322***
Greece	0.377***	-0.375	0.360**
Italy	0,023	0.114	-0.199
Spain	0.394***	0.309	0.395***
France	0.412***	0.245	0.404***
Ireland	0.387***	0.344	0.388***
Netherlands	-0.595***	0.068	-0.593***
Portugal	0.381***	-0.010	0.350*
Finland	0.385***	0.338	0.386**
Sweden	0.387***		
Austria	0.390***	0.363**	0.390***
Observations	40597	36007	36007
Pseudo-R2	0,07	0.074	0.073
Log-Likelihood	-25127766	-22219	-22239

Robust p values in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Omitted country variable is the UK

Table 8: Average partial effects of consumers' satisfaction with electricity prices.

Quality satisfaction

	Electricity: Quality (A)	Electricity: Quality (B)	Electricity: Quality (C)
Regulation variables			
Public Ownership: Ele	0.019***	0.025**	0.011
Vertical Intergration: Ele	0.008	0.007	0.000
Entry Regulation: Ele	0.021*	0.013*	0.022*
Price variables			
Price (nat.curr. per Wh. log)		0.125	
Price first difference (nat.curr. per Wh. log)			0.002
Year dummies			
year 2002	0.026	0.009	0.018
year 2004	0.036	0.029	0.020
Individual characteristics	Yes	Yes	Yes
Macroeconomic controls	Yes	Yes	Yes
Country fixed-effects			
Belgium	-0.176		
Denmark	0.343	-0.219	0.500*
Germany	-0.217**	-0.354***	-0.208**
Greece	-0.334	-0.084	-0.232
Italy	-0.348**	-0.396***	-0.293
Spain	-0.217	0.060	-0.017
France	-0.115	0.131	0.167
Ireland	0.347	0.604**	0.582*
Netherlands	-0.202	-0.351***	-0.337***
Portugal	-0.367***	-0.311	-0.328*
Finland	0.189	0.590	0.502
Sweden	0.365		
Austria	0.273	0.457	0.484
Observations	41554	36844	36844
Pseudo-R2	0.076	0.074	0.074
Log-Likelihood	-25131	-22158	-22162

Robust p values in brackets

Note: Omitted country variable is the UK

Table 9: Average partial effects of consumers' satisfaction with electricity quality.

6 Discussion and concluding remarks

Our empirical findings do not support the view that a unique dominant reform paradigm is dominant in terms of welfare changes across the EU –15 members states, at least when we focus on the most obvious performance indicator for consumers' welfare: prices. Both if we consider aggregate country data on prices, or micro-data on consumers' satisfaction, public ownership tend to decrease prices (or to be not significant in some models); vertical disintegration tend to increase prices (or to be not significant); entry barriers, as can be expected, do lower prices (but do not increase consumers' satisfaction). Cost data, country specific features, and other country controls, have in general higher explanatory power than regulatory variables. Results on quality are less easy to interpret, but again do not provide a clear support to the reform paradigm.

How can we interpret these findings? If you have very strong prior beliefs that the paradigm must work, you may conjecture either that the data do not capture adequately the benefits of reforms, or that the indexes supplied by the OECD regulatory reform database do not capture all the subtle dynamics involved. One can also think that in some countries it is too early to draw conclusions.

While we cannot entirely dismiss these three set of possible objections, one should consider that: first, our estimations are based on databases produced by the same international organizations that are most supportive of reforms; second, the econometric tests we perform are quite easily replicable; third, the time span of observation is reasonably long as compared with many other industry reforms. Moreover, we are not going to conclude that the paradigm is under any circumstance not keeping its promises. We would rather suggest that probably some of its assumptions are perhaps too strong or too simplified, and empirical analysis shows that more flexibility and realism is needed.

As an indication for further research, we discuss in turn the three cornerstones of the paradigm: privatization, unbundling, liberalization, and why in some cases empirical analysis may lead to counterintuitive results.

a) Privatization is certainly in the weakest logical connection with the other two set of reforms. The Nordic countries show that highly competitive national markets, and a regionally integrated transboundary market is well supported by an industry structure where public ownership plays a remarkable role. The fact that generators are often owned by municipalities can be seen as an intrinsic constraint to anti-competitive mergers and acquisition, that are often motivated not by economies of scale in production, but by the desire to influence prices. The same reasoning may apply to a public sector owned firm exposed to competition. In contrast, UK, Belgium, and Spain industries are fully under private ownership, but their performance are so different, from the very good to the very bad, that is difficult to attribute a clear role to privatization per se in these countries, after having controlled for other factors. The same applies for the entirely public owned industries in Ireland, France, and Greece. In fact best and worst performers are in either groups.

The main case for privatization, as mentioned in the opening section, is an efficiency argument. There are some factual problems in the electricity industry with this argument, however, that can explain our rather counterintuitive findings. First, in terms of productive efficiency, the electricity industry is based on rather well-established technologies, that are more or less common knowledge. Long run marginal costs per Kwh produced or distributed, or per units of existing capacity, according to different sources of energy and of types/scale of plants are easily available to engineers, managers, government officials, and financial investors. Moreover, the quantity/price combinations available to generators are largely dictated by priority/cost merit rules and other rationing mechanisms, that greatly reduce managerial discretion. Thus, the extent of asymmetric information between stakeholders is probably reduced in the electricity industry as compared with other industries. Any electrical engineer can quite easy discover whether a plant is well managed or not. Hence, for a well motivated public sector management, and a benevolent government, the possibility for the former to earn rents based on a principal-agent mechanism should not be exaggerated.

Second, public sector managers can collude with policy makers and trade unions to allow for labour hoarding, golden plating of plants, and distributing rents. The extent of such behaviours is however rather easy to be detected, and a government that is under hard budget constraint, or that is exposed to scrutiny over corruption because of the

democratic system of check and balances, will refrain from allowing too much rent-seeking in a highly technical industry. An example are the US, where a substantial fraction of power generation is controlled by the local public sector, and where, under strong regulation, the differences in productivity are minimal, even if there may be some political influence in appointing directors.

On the other side, one should not exaggerate the efficiency case for private ownership. Major players are often, after all, large firms managed by boards of directors who respond to coalitions of shareholders. The latter, in turn, are often quite at arm's-length distance from them, as it happens when they are financial investors. Those investors may well have objectives that cannot be described as outright profit maximization, for example because they are pension funds looking more for stable returns than for taking the risks usually associated with innovation. A close scrutiny of who actually are the 'private' owners of the privatized electricity industry may show that in many cases they do not need to be described as aggressive profit maximizers. Thus, the interplay between top executives and shareholders in the privatized electrical utilities should be seen with a dose of sober realism, not with first-year textbook microeconomics.

Moreover, when we focus on price performance, the role of ownership in the electricity industry is even less clear cut than the new paradigm would imply. Basically, consumers pay a price that can be broken down to a number of components: indirect taxes, retailing margins, costs for transmission and distribution, costs for generation. Clearly, indirect taxes have nothing to do with the other components, because they are decided by governments. If generators optimize over the energy mix, generation costs are largely dominated by the prices of inputs and the technical efficiency of plants. The picture here is much messy than one would expect, because indeed the mix of energy sources available is the result of a number of policy decisions, most of them external to the owner of the generating plant. Examples are Italy, that rejected after a referendum to build nuclear power plants, or the existence of subsidies to some kind of energy sources in Germany, or the complex licensing of imports of gas from Russia, or the nuclear national strategy in France, etc).

Eventually, the overall mark-up over costs under private ownership is not necessarily lower than under public ownership. The overall mark-up over costs depends

probably more upon the interplay of regulation and competition, than upon ownership per se. Standard public economics theory would say that the mark-up over costs should be rather lower under public than under private ownership, if regulation or competition do not perfectly substitute for long-run marginal cost pricing rules in the public sector (if these rules where more or less applied before reform) again after controlling for technological constraints.

Actually, our empirical finding seem consistent with the latter interpretation, because they show that, at least for the countries and the years we have considered, both objective data on prices and consumers perceptions converge in predicting lower prices under public ownership, or neutrality of ownership on prices.

Thus, is there something going wrong with the reforms? This is difficult to say without a detailed analysis, but we suggest two examples that may question the universal validity of the new paradigm.

There is some evidence that the general case for unbundling was too strong. First, when regulators allowed to do so, electric utilities quickly tried to re-integrate vertically, and the resulting combinations in some countries were more cost-effective and more resilient to shocks that their competitors. These reinforced the view in the business that the cost of vertical disintegration should be assessed along with its benefit, and there seem now to be a shift of opinions against ownership separation of networks from generation. According to Glachant and Leveque,2005 (p.10):

“ The industrial reference model for electricity reforms completely changed between 1995 and 2001. It has shifted from a preference for structures that are vertically disintegrated between generation, trading, and sale to final consumers toward a preference for vertical reintegration. Bankers and financiers have finally joined companies with stockholders and managers and concluded that vertical integration is the best protection against volatility and the cyclical nature of markets. Nowadays, most national and European energy markets involve firms that are vertically integrated.”

If this view prevails, and at the same time horizontal mergers and acquisitions processes go ahead as we can observe since several years in the EU, clearly the foundations of the reform paradigm is even more questioned. Competition by and large should happen only by regulating third party access to infrastructures owned by some of the players. It it is not self evident that it is more difficult to achieve this if the owner is

a private firm, than with a public one. Under a TPA regime a private unbundled or re-bundled company should constrain its generation capacity to allow for a competitor to use its infrastructure. One may think that it would be much easier to do with a public owned, vertically integrated, *but non monopolistic,* public sector firm, operating under strict incentive regulation, and with clear public service obligations.

This bring us to the last issue, some policy implications of our findings. If the overarching goal of the European Commission is to stimulate the creation of an internal market, that is a wider trade of electricity across the EU, the focus should probably shift from a dubious unique reform paradigm, to be implemented by each country, to a more substantive EU-wide energy policy initiative. The true concern should not be whether EDF is publicly owned, or if it is full unbundled, but whether the French consumers (and firms) can buy electricity from competitors, including from those generating electricity abroad, if the latter are ready to supply it at tariffs lower than to EDF.

The constraints that prevent this fundamental consumer protection mechanism from electricity monopoly power in the EU, are related with lack of physical investment in trans-European energy networks (the TEN-E), and in establishing the rules of the game and the institutional arrangements for allowing international trade of electricity, at least at regional level as in the Nordic example. After all, the true success story of the European project since the 1960s, lies in opening borders to trade, not in dictating detailed market structures deemed to be the most efficient and competitive. Let us open the border to electricity trade, and we shall then see which are the best industry patterns (not necessarily the same in Greece and Sweden, however). The fact that in our empirical models imports do not concur to lowering prices is probably additional evidence that currently interconnection and trade are often a residual mechanism for most countries, capturing only marginal demand with higher willingness-to-pay.

Ironically, for the time being, a strong policy option in favour of international trade of electricity may imply that in an integrated European market, some state-owned, perhaps vertically integrated, companies will be more competitive than some national privately-owned ones, currently de facto protected by the lack of physical interconnections, incomplete institutional arrangements for trade or by other forms of sheltering regulations. It is sufficient to look to the dispersion of electricity tariffs in the EU to understand that, after all, the key policy step forward should be to the opening of

national systems, whatever they are, to the challenge of competition from abroad. There is no point in reshuffling ownership structures and other aspects of the industry in a mainly domestic perspective, seeking for structural uniformity. If the overarching goal is to offer the consumers the best quality and price of service in an integrated Europe, international market opening seems to be by far more important than imposing privatization, unbundling and domestic liberalization, when those reforms do not deliver the most socially efficient outcomes given the country specific features.

The neutrality of the founding fathers of the European project as regard public ownership was wise, because the ownership structure of essential services in any society is probably more about the desired balance of economic and political powers than about efficiency and competition. Economists sometimes tend to misunderstand what ownership actually is, because are inclined to apply a very simplified model of the incentives it provides, and to disregard political, social and subtle legal aspects of property rights. The balance of public and private property rights should be left to governments and citizens to consider and to decide, when the relative merits in terms of productive efficiency or of market behaviour are uncertain, or limited. If municipalities wants to produce their power in Nordic countries, or France to centrally manage its nuclear industry, this is something that should not be questioned by the EC or by other international organizations. Moreover, unbundling network industries under certain circumstances can work, in other cases it may be too costly. Liberalization on a national basis may be less useful than expected if the domestic producers, whatever their ownership, are sheltered by international competition. However, a European consumer, or a representative body acting on his behalf, should be given the right and the opportunity to buy electricity from whoever offers it to the lowest prices, for a given quality, and under secure long term supply arrangements, in a sustainable environment. Thus an integrated EU energy strategy, with its incentives and disincentive mechanisms, should replace the obsession with dictating a uniform industry reform paradigm.

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Appendix A: data sources and definitions

Regulatory variables	REGREF, OECD dataset. Conway and Nicoletti (2006)
Eurobaromter data	Eurobarometer (2006)
U.S. dollar exchange rate	Source: Exchange rates to the U.S. dollar (USEXRMEI) were taken from the OECD Main Economic Indicators, with the following exceptions. IEA(2006)
Consumer Price Index	Base period: 2000=100 Source: The consumer price index (CPI) data were taken from the OECD Main Economic Indicators. IEA(2006)
Household Electricity Price (US$/unit)	Taxes, in national currency per physical unit, submitted to the IEA Secretariat by Administrations have been expressed in US$/unit using the Exchange rates to the U.S. dollar from the OECD Main Economic Indicators. IEA(2006)
Household Electricity Tax (US$/unit)	Taxes, in national currency per physical unit, submitted to the IEA Secretariat by Administrations have been expressed in US$/unit using the Exchange rates to the U.S. dollar from the OECD Main Economic Indicators. IEA(2006)
Distribution Losses	All losses due to transport and distribution of electrical energy and heat. For electricity, losses in transformers which are not considered as integral parts of the power plants are also included. IEA(2006)
Electricity imports	Amounts of electricity are considered imported or exported when they have crossed the national territorial boundaries of the country. If electricity is “wheeled” or transited through a country, the amount is shown as both an import and an export. The countries of origin for imports and destination for exports are neighbouring countries from which the electricity has been received (imports) and to which it has been sent (exports). Physical quantities are usually given. IEA(2006)
Residential consumption	Consumption by all households. Households with employed persons, a small part of the total Residential Sector, are included. This sector covers ISIC Division 95. (NACE Division 95). IEA(2006)
Source Hydroelectric (GWh/Tj)	Potential and kinetic energy of water converted into electricity in hydroelectric plants. Pumped storage is included. IEA(2006)
Source Combustible fuel (GWh/Tj)	Refers to fuels that are capable of igniting or burning, i.e. reacting with oxygen to produce a significant rise in temperature. They are combusted directly for the production of electricity and/or heat. IEA(2006)
Cost Gas (US$/TOE)	Gross calorific value basis for data in US dollars/10^7 kcal. Net calorific value basis for data in US dollars/toe. IEA(2006)
Cost Coal and cost combustible oil(US$/TOE)	Heavy (high sulphur) fuel oil and steam coal prices for electricity generation in US dollars/t, natural gas prices for electricity generation in US dollars/10^7 kcal. IEA(2006)

Appendix B: extended tables of Section 5

This appendix shows the tables 6 and 7, where coefficients for individual characteristics and macro-economic variables are also reported. In addition to what has been discussed in Section 5, Table B1 shows that satisfaction with price is less likely the older is the respondent and for unemployed people. More educated people and house persons, managers and students are more likely to be satisfied with prices than self-employed. There is no difference in price satisfaction between married an single respondents, while people with political views closer to the centre tend to be less dissatisfied than people voting for the extremes.

Table B2 shows instead that individual characteristics are able to explain a very limited amount of probability of satisfaction with electricity service quality.

Price Satisfaction	Electricity: Price	Electricity: Price	Electricity: Price
Regulation variables	(A)	(B)	(C)
Public Ownership: Ele	0.028***	0.013**	0.031***
Vertical Intergration: Ele	0.015***	0.015***	0.018***
Entry Regulation: Ele	0.013**	0.043***	0.022***
Price variables			
Price (nat.curr. per Wh. log)		-0.588***	
Price first difference (nat.curr. per Wh. log)			0.000
Year dummies			
year 2002	-0.063***	0.078***	0.011
year 2004	0.076***	0.161***	0.136***
Individual characteristics			
female	-0.014*	-0.012	-0.012
age	-0.005***	-0.005***	-0.005***
age squared	0.000***	0.000***	0.000***
single	0,005	0.004	0.004
separated/divorced/widowed	-0,012	-0.013	-0.012
age when finished education	0.010***	0.010***	0.010***
(age when finished education) squared	-0.000***	-0.000***	-0.000***
manager	0.043***	0.041***	0.042***
other white collar	0,015	0.012	0.012
manual worker	0,009	0.009	0.009
house person	0.036**	0.034**	0.035**
unemployed	-0.032*	-0.034*	-0.034*
retired	0,02	0.020	0.020
Student	0.181***	0.187***	0.185***
political views: center	0.019**	0.019**	0.019**
political views: right	-0,004	-0.004	-0.003
political views: d/k or n.a.	-0,007	-0.007	-0.006
respondent's cooperation: average/bad	-0.048***	-0.049***	-0.049***
Macroeconomic controls			
Population Density	0.015***	0.002	0.010***
GDP growth rate	-0.030***	0.002	-0.015*
GDP, per capita	-0.003**	-0.004**	-0.004*
employment growth rate (-1)	0,006	-0.021***	0.001
Gini	-0,008	0.017***	-0.002
Country fixed-effects			
Belgium	-0.609***		
Denmark	0.391***	0.392***	0.387***
Germany	-0.318***	0.231***	-0.322***
Greece	0.377***	-0.375	0.360**
Italy	0,023	0.114	-0.199
Spain	0.394***	0.309	0.395***
France	0.412***	0.245	0.404***
Ireland	0.387***	0.344	0.388***
Netherlands	-0.595***	0.068	-0.593***
Portugal	0.381***	-0.010	0.350*
Finland	0.385***	0.338	0.386**

Sweden	0.387***		
Austria	0.390***	0.363**	0.390***
Observations	40597	36007	36007
Pseudo-R2	0,07	0.074	0.073
Log-Likelihood	-25127766	-22219	-22239

Robust p values in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%

Note: Omitted variables are: male, couple/married, self-employed, political views left, country UK

Table B1: Average partial effects of probability of consumers' satisfaction with electricity price.

Quality satisfaction	Electricity: Quality	Electricity: Quality	Electricity: Quality
Regulation variables	(A)	(B)	(C)
Public Ownership: Ele	0.019***	0.025**	0.011
Vertical Intergration: Ele	0.008	0.007	0.000
Entry Regulation: Ele	0.021*	0.013*	0.022*
Price variables			
Price (nat.curr. per Wh. log)		0.125	
Price first difference (nat.curr. per Wh. log)			0.002
Year dummies			
year 2002	0.026	0.009	0.018
year 2004	0.036	0.029	0.020
Individual characteristics			
female	-0.003	-0.002	-0.002
age	-0.001	-0.001	-0.001
age squared	0.000	0.000	0.000
single	-0.015	-0.016	-0.016
separated/divorced/widowed	-0.009	-0.009	-0.009
age when finished education	0.001	0.001	0.001
(age when finished education) squared	0.000	0.000	0.000
manager	0.011	0.010	0.010
other white collar	-0.021	-0.024	-0.024
manual worker	-0.018	-0.018	-0.018
house person	0.000	-0.001	-0.001
unemployed	-0.032	-0.032	-0.032
retired	0.005	0.006	0.006
student	0.027	0.024	0.026
political views: center	0.009	0.009	0.009
political views: right	0.025	0.027	0.027*
political views: d/k or n.a.			
PoliticsLR==4	-0.019	-0.018	-0.018
respondent's cooperation: average/bad	-0.016	-0.015	-0.015
Macroeconomic controls			
Population Density	0.001	0.005*	0.003
GDP growth rate	0.006	0.004	0.011
GDP, per capita	-0.008*	-0.009*	-0.011*
employment growth rate (-1)	-0.001	0.009	0.001
Gini	0.002	-0.008	-0.003
Country fixed-effects			
Belgium	-0.176		
Denmark	0.343	-0.219	0.500*
Germany	-0.217**	-0.354***	-0.208**
Greece	-0.334	-0.084	-0.232
Italy	-0.348**	-0.396***	-0.293
Spain	-0.217	0.060	-0.017
France	-0.115	0.131	0.167
Ireland	0.347	0.604**	0.582*
Netherlands	-0.202	-0.351***	-0.337***
Portugal	-0.367***	-0.311	-0.328*

Finland	0.189	0.590	0.502
Sweden	0.365		
Austria	0.273	0.457	0.484
Observations	41554	36844	36844
Pseudo-R2	0.076	0.074	0.074
Log-Likelihood	-25131	-22158	-22162

Robust p values in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%

Note: Omitted variables are: male, couple/married, self-employed, political views left, country UK

Table B2: Average partial effects of probability of consumers' satisfaction with electricity service quality.

Appendix C: Some tables about the extent of regulation around EU-15

Country	Ownership*		Third party access to the transmission grid		Degree of vertical integration	
	1975	2004	1975	2004	1975	2004
Austria	Mostly public	Mixed	No TPA	Regulated TPA	Integrated	Mixed
Belgium	Mostly private	Mostly private	No TPA	Regulated TPA	Integrated	Unbundled
Denmark	Mostly public	Mixed	No TPA	Regulated TPA	Integrated	Unbundled
Finland	Mostly public	Mixed	No TPA	Regulated TPA	Mixed	Mixed
France	Public	Public	No TPA	Regulated TPA	Integrated	Mixed
Germany	Mostly public	Mixed	No TPA	Negotiated TPA	Mixed	Mixed
Greece	Public	Public	No TPA	Regulated TPA	Integrated	Mixed
Ireland	Public	Public	No TPA	Regulated TPA	Integrated	Mixed
Italy	Public	Mixed	No TPA	Regulated TPA	Integrated	Unbundled
Luxembourg	Private	Private	No TPA	Regulated TPA	Integrated	Integrated
Netherland	Mostly Public	Mixed	No TPA	Regulated TPA	Mixed	Mixed
Portugal	Public	Mixed	No TPA	Regulated TPA	Integrated	Mixed
Spain	Mixed	Mostly private	No TPA	Regulated TPA	Integrated	Unbundled
Sweden	Mostly public	Mixed	No TPA	Regulated TPA	Integrated	Unbundled
UK	Public	Private	No TPA	Regulated TPA	Integrated	Unbundled

Note:

*: Ownership classification is based on the estimate of the public share in the revenue of the industry. The categories are the following: Public (more than 85%); Mostly Public (70-85%); Mixed (30-70%); Mostly Private (15-30%9; Private (less than 15%).

Sources:

D. Levi Faur, "The politics of liberalization: privatization and regulation for competition in Europe's and Latin America's telecoms and electricity industries", European Journal of Political Research, Vol. 42, pp. 705-740, 2003; R. J. Serralles, "Electric restructuring in the European Union: integration, subsidiarity and the challenge of harmonization", Energy Policy, vol. 34, 2452-2551, 2006; Conway, P. and G. Nicoletti, "Product Market Regulation in non-manufacturing sectors in OECD countries: measurement and highlights", OECD Economics Department Working Paper, 2006.

Table C1: The EU 15 electricity sector: organization of the industry before and after liberalization

Country	Internal Production (GWh)	Total Consumption (GWh)	External Balance (%)	Source Mix (% over internal production)			
				Combustible Fuels	Nuclear	Hydro	Others
Austria	64142	67223	-4.5	94.2	3.8	0.09	1.85
Belgium	85441	93218	-8.3	42.6	55.4	1.9	0.1
Denmark	40463	37591	7.6	83.6	-	0.06	16.2
Finland	85817	90687	-5.3	55.8	26.4	17.5	0.13
France	572241	510201	12.1	10.1	78.3	11.4	0.2
Germany	606636	604015	0.4	63.7	27.5	4.5	4.3
Greece	59344	62164	-4.5	89.3	-	8.7	2
Ireland	25569	27143	-5.7	93.5	-	3.8	2.7
Italy	303322	348957	-13	81.1	-	16.4	2.5
Luxembourg	4136	7510	-44.9	78.2	-	20.7	0.1
Netherland	100736	116953	-13.8	94.2	3.7	0.1	2
Portugal	45105	51586	-12.5	75.5	-	22.4	2.1
Spain	279953	276925	1	59	22	12	6
Sweden	151727	149263	1.4	8.7	51	39.6	0.7
UK	395305	402795	-1.8	77.3	20.2	1.9	0.6

Notes: External balance = [(Internal Production – Total consumption)] / Total Consumption. Others include: geothermal, solar, wind and other renewables

Source: Eurostat, 2006

Table C2: The EU 15 electricity sector: production, consumption, balance and source mix 2004

Country	1999	2000	2001	2002	2003	2004	2005
Austria	21.4	32.6	34.4	-	-	-	-
Belgium	92.3	91.1	92.6	93.4	92.0	87.7	85.0
Denmark	40.0	36.0	36.0	32.0	41.0	36.0	33.0
Finland	26.0	23.3	23.0	24.0	27.0	26.0	23.0
France	93.8	90.2	90.0	90.0	89.5	90.2	89.1
Germany	28.1	34.0	29.0	28.0	32.0	-	-
Greece	98.0	97.0	98.0	100.0	100.0	97.0	97.0
Ireland	97.0	97.0	96.6	88.0	85.0	83.0	71.0
Italy	71.1	46.7	45.0	45.0	46.3	43.4	38.6
Luxembourg	-	-	-	-	80.9	80.9	-
Netherland	-	-	-	-	-	-	-
Portugal	57.8	58.5	61.5	61.5	61.5	55.8	53.9
Spain	51.8	42.4	43.8	41.2	39.1	36.0	35.0
Sweden	52.8	49.5	48.5	49.0	46.0	47.0	47.0
UK	21.0	20.6	22.9	21.0	21.6	20.1	20.5

Source: Eurostat, 2006

Table C3: The EU 15 electricity sector: market share of the largest electricity generator 1999-2005

		Wholesale Market		*Retail Market*		*Transmission*	Distribution
Country	Year	Number of companies representing at least 95% of the net electricity generation	Number of companies with at least 5 % share of national generation	Total number of suppliers	Number of suppliers with market share over 5%	Number of transmission companies	Number of distribution companies
Austria	1999	55	6	175	6	3	-
	2000	54	5	170	7	3	150
	2001	46	5	153	7	3	155
	2002	-	-	-	-	3	155
	2003	34	7	160	-	3	139
	2004	39	5	125	5	3	133
Belgium	1999	2	1	-	-	-	-
	2000	2	2	34	3	1	50-70
	2001	2	2	36	4	1	33
	2002	-	-	-	-	1	33
	2003	2	2	45	2	1	28
	2004	3	2	48	3	1	26
Denmark	1999	559	2	95	3	-	-
	2000	826	3	83	3	2	80
	2001	117	2	67	1	2	77
	2002	-	-	-	-	2	77
	2003	16	2	113	5	2	130
	2004	42	2	76	-	2	120
Finland	1999	38	4	-	-	-	-
	2000	38	4	>100	3	1	107
	2001	39	4	>100	3	1	100
	2002	-	-	-	-	1	100
	2003	25	4	>100	3	1	95
	2004	29	5	>100	3	1	91
France	1999	2	1	178	1	-	-
	2000	3	1	174	1	1	171
	2001	3	1	174	1	1	172
	2002	-	-	-	-	1	172
	2003	4	1	166	1	1	166
	2004	4	1	166	1	1	161
Germany	1999	70	4	1200	3	-	-
	2000	70	4	1200	3	4	900
	2001	70	4	1100	3	4	880
	2002	-	-	-	-	4	880
	2003	60	4	940	4	4	930
	2004	-	5	940	4	4	950
Greece	1999	1	1	1	1	-	-
	2000	1	1	1	1	1	1
	2001	1	1	1	1	1	1
	2002	-	-	-	-	1	1
	2003	1	1	5	1	1	1
	2004	1	1	4	1	1	1
Ireland	1999	1	1	-	1	-	-
	2000	1	1	6	1	1	1
	2001	1	1	8	2	1	1
	2002	-	-	-	-	1	1
	2003	5	3	6	4	1	1

	2004	3	2	8	4	1	1
Italy	1999	9	2	-	-	-	-
	2000	62	4	194	2	1	171
	2001	1260	4	193	2	1	219
	2002	-	-	-	-	1	219
	2003	79	4	390	3	1	178
	2004	83	5	400	6	1	173
Luxembourg	1999	-	-	2	2	-	-
	2000	-	-	2	2	-	-
	2001	-	-	12	2	2	15
	2002	-	-	-	-	2	15
	2003	9	1	11	3	2	11
	2004	9	1	11	3	2	10
Netherland	1999	83	4	-	7	-	-
	2000	11	6	33	7	1	18
	2001	75	4	29	3	1	18
	2002	-	-	-	-	1	18
	2003	87	4	42	3	1	20
	2004	53	4	34	3	1	12
Portugal	1999	3	3	-	-	-	-
	2000	3	3	13	1	1	1
	2001	3	3	13	1	1	3
	2002	-	-	-	-	1	3
	2003	36	3	5	1	1	1
	2004	46	3	9	1	1	1
Spain	1999	4	4	-	3	-	-
	2000	4	4	150	3	1	About 400
	2001	4	4	488	4	1	297
	2002	-	-	-	-	1	297
	2003	5	4	375	6	1	299
	2004	5	4	315	3	1	313
Sweden	1999	38	3	165	3	-	-
	2000	7	3	165	3	1	204
	2001	7	3	127	3	1	248
	2002	-	-	-	-	1	248
	2003	7	3	127	3	1	180
	2004	14	3	130	3	1	184
UK	1999	18	6	29	9	-	-
	2000	32	8	22	8	4	15
	2001	34	6	19	8	4	15
	2002	-	-	-	-	4	15
	2003	22	6	24	7	4	15
	2004	20	7	32	7	4	15

Source: Eurostat, 2006

Table C4: The EU 15 electricity sector: market structure 1999-2004