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Unbundling in the Telecommunications and the Electricity Sectors: How Far should it Go?

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Abstract:

In this paper we discuss the European regulation policy regarding vertical separation in communications and electricity industries. In the electricity sector the discussion concerns ownership unbundling while in communications the recent regulatory debate is about functional separation. We conclude that for electricity, ownership unbundling seems to be the best option to achieve competition in wholesale markets although there is still some risks concerning investment. Instead, for the communication sector the regulatory options are deeply dependent on the intensity of network competition between operators that combine different technological platforms. Technology also seems to be a key driver for diverse regulatory approaches concerning the unbundling requirement.

Key Words: *Unbundling, Communications, Electricity, Next Generation Networks*

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1. Introduction

During the last 25 years, both on developed and developing countries, there has been a sound experience of restructuring, deregulation and privatization of sectors that were previously regulated monopolies and most of the times also state-owned. Reasons behind this trend were manifold: technology changes, poor performance of regulated firms and a general ideological shift towards markets are among the most important.

A central feature in debate for network sectors concerns unbundling. The most common argument in favor of integration was basically twofold: it would be a solution to overcome, at least partially, double marginalization and it would give incentives to upstream investments (Höffler and Kranz, 2008). Since the 90's and for most European network industries, the main political question - Should vertical integration be allowed? – has been replaced by two others:

- How far that separation should go?
- Should the same policy principles apply to all network industries, namely public utilities?

In the communications sector most of the European countries already implemented accounting separation and the present debate is about functional separation. UK introduced it in 2006. Sweden and Italy followed this policy aiming to encourage retail competition. However, in other European countries (Netherlands, for instance) regulators decided to maintain vertical integration, mainly arguing that the incumbent firms face competition from alternative networks.

Based upon the evidence of unbalanced cost allocation by electricity firms between regulated and non-regulated operations, the European Commission introduced the 96/92 EC Directive which required the accounting unbundling of both generation and retail stages of the electricity value chain from the network business (transmission and distribution). Later on, the 2003/54/CE Directive went further requiring legal unbundling as there were serious grid access problems by non-integrated firms. Through their transmission business, integrated companies acted as barriers to market competition either favouring their own generators or through under investments on the transmission grid. Finally, in 2007, the Third Energy Package was proposed by EC in order to solve, among others, this problem which EU Energy Sector Enquiries proved to be major barriers to liberalisation. As it will be explained in section 4, the final outcome of this recent EC regulatory initiative was a compromise that still can give place to under investment on the grids.

Therefore, at the moment, communications and electricity face the same question: how far should the unbundling process go?

The main goal of this paper is to analyse the arguments under discussion, namely:

1. Which were the main reasons for different regulatory approaches in the past?

2. Presently is it possible to draw some lessons from one sector to the other concerning the effects of different regulatory approaches on competition and investment?

Overall, we conclude that ownership separation is fairly influenced by the economic nature of each utility infrastructure. Vickers (1995) recognizes that the most significant contribution of ownership unbundling to competition in network industries is that it reduces the incentive to discrimination by a network operator which belongs to the same holding group of other generators and/or retail firms. There is empirical evidence on the increasing congestion of transmission networks with the development of wholesale markets and its negative impact on competition (Joskow, 2005a, 2005b and 2006). Also, Hirst (2004) refers that the dynamics of investment in transmission capacity is far from that of trading patterns. Ownership unbundling achieves competition in electricity wholesale markets, although it may eventually lead to a concentration increase of generation through mergers. As presented by Balmert and Brunekreeft (2009) the EC final political compromise on the unbundling issue of the transmission business may raise some complicated, unexpected problems on investments, one of the chief arguments which the 3rd Package proposal aimed to solve.[3] The EC final political compromise on the unbundling issue allows for three models: Full Ownership Unbundling, Deep Independent System Operator or the "Third Way" (Effective and Efficient Unbundling – EEU). In the so-called Deep-Independent System Operator model4 the System Operator has the investment decision power, thus the network owner can make the investments but, doing so, it introduces a full separation between the decision-maker and the risk-taker which is, as Pielow *et al*. (2009) recognize, a problem both economically and legally. In the communication industry regulators initially favour access to the incumbent's network (mandatory unbundling sharing) as a policy to promote competition. Recently, some European countries implemented functional separation aiming to reduce the incentives to discriminate the independent operators. This is the same argument as in electricity. However, the implementation of functional separation depends on the intensity of network competition between operators that combine different technological platforms.

The structure of the paper is the following: in section 2 we present a theoretical framework for the comparison of the unbundling problem in both sectors. In section 3 we discuss the vertical separation in the communication sector, focusing in the recent European experiences and on the challenges from the developments of next generation networks. In section 4 we discuss the recent regulatory developments in the electricity sector highlighting the arguments in favour and against ownership unbundling and in section 5 we present our main conclusions.

[3] Balmert and Brunekreeft (2009) call the investment argument used by the European Commission the "*strategic investment withholding".*

2. A Theoretical Framework

The unbundling issue, namely its most radical version - ownership unbundling – has been covered by the economic theory either by the neoclassical approach or by organisational economics. While the first focus on vertical integration as a firm reaction to (pre-existing) market power problems or as a firm action to get (or enlarge) market power on upstream (backward integration) or downstream markets (forward integration), the later points out to other features that may be rather helpful to understand the dynamics of network industries. With regard to those features, the organisational economics sustain that firms face a variety of potential transaction costs, contractual and organisational contingencies that are specifically connected to their business (see, for instance, Joskow (2006) and Growitsch and Stronzik (2008)). As Finger and Künneke (2006) refer in line with other authors who sustain the idea of co-evolution between institutions and technology[5], there is an interrelation between the technical and institutional coordination of infrastructures. They argue that in the network industries, there are four major functions – interconnection, interoperability, capacity management and system management – that are related to the network operation that enable the complementarily along infrastructures. Thus, there is need to have a comparable institutional and technological coordination to achieve a good functioning throughout the infrastructure. Furthermore, they argue that the infrastructure performance is closely related to the coherence of those coordination mechanisms.

Network industries (telecom, electricity, gas, railways, aviation, postal services, etc) have unique characteristics: significant economies of scale or scope (extending to natural monopolies); far-reaching externalities in production or consumption; and large vertical and horizontal integration. According to Joskow and Schmalensee (1983) and Baumol and Sidak (1994), these features explain why the introduction of competitive mechanisms and the creation of open markets had equal impacts on both innovations and disruptions.

Like other utility industries, telecommunications and electricity have separate activities which produce intermediate goods or services that are complements in the production of a final good or service. This means that there are strong vertical relationships. Furthermore, these industries often present significant economies of scale which, due to efficiency arguments, have justified being regulated and fully integrated.

Another common feature between electricity and telecommunications, which is a crucial argument in the vertical integration decisions, is the need to ensure adequate incentives to invest in the networks upgrades through the expected returns on investments.

[5] See, for example, Dosi (1982), North (1990), Perez (2002), Saviotti (1996), Soete (1985) and van Tunzelmann (2003).

Additionally, vertical integration requires strong regulation in order to avoid the anti-competitive behaviour, which might negatively affected the incentive to invest, both from incumbents and new operators.[6] When incumbent firms anticipate the regulatory obligation to share the network with rivals at regulated prices that do not allow the expected return of the investment, their incentive to invest is threat. Also, the investment from new firms might be negatively affected as the firms expect to use the incumbent network and so have a little incentive to build their own infrastructure.

However, many arguments in favor of some degree of vertical separation have been advanced in the two industries under analysis. The standard arguments rely on the anticompetitive practices implemented by the vertically integrated firms, in particular when there are blocked segments, that is, when the independent operators have no alternatives to the vertical integrate network access in order to develop their activities. Other important argument is related with the reduction of regulatory intervention allowed by the development of competition. Vertical integration also has strong limitations concerning the transparency on the allocation of common costs, which can be use for anticompetitive purposes. Network externalities were also common arguments used to justify that network industries could not sustain competition with vertical separation.

Therefore, the discussion on unbundling requires a careful analysis of the different levels of vertical separation.[7]

Ownership separation requires the separation of network infrastructure from the services that use the infrastructure, by the creation of legal separate firms with a different ownership. The ownership separation might be incomplete, when there is partial ownership. Ownership separation is the higher degree of vertical separation that also implies the highest costs from loosing vertical integration.

Legal separation is comparable to ownership separation, in the sense that it requires the existence of legal separate entities, but these entities have common ownership.[8]

Functional separation requires the creation of an independent division that is responsible for the parts of the networks not easily replicate. This division provides access in an equal basis to the retail operators, including the incumbent retail operator. It is required that this business unit has an independent management from the rest of the firm. Functional separation is an intermediate form of vertical separation as the separate business units have common ownership. Implementing

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[6] Grajek and Röller (2009) find empirical evidence of a negative effect of access regulation on investment. Also, Pindyck (2007) argues that access regulation in US discourages investment by both incumbents and entrants if the access prices are too low.

[7] For a more detailed description of different degrees of vertical separation see Cave (2006) and for discussion applied to next generation access networks see Cave (2010). For deeper developments of function separation see, for instance, Tropina *et al*. (2010).

[8] For a detail comparison of legal and ownership separation see, for instance, Crémer *et al*. (2006) and Höeffler and Kranz (2008).

functional separation requires the existence of separate information systems and the training of employees in order to respect the "Chinese walls" built between the business units, so that non-discrimination of independent firms is achieved.

Accounting separation is the weaker form of vertical separation as the upstream and downstream activities take place in the same firm. Only the accounts of each activity are separate. Accounting separation allows transparency about internal transfer prices in order to avoid price discrimination. However, this level of separation does not ensure non-price discrimination, such as delays or different product quality. Although crucial for the reform process, the separation of potentially competitive activities from network activities is just one dimension of the building of competitive markets. According to Glachant and Perez (2007) the other two dimensions are also very important: modularity and sequencing.

Baldwin and Clark (2000) define the former as "(…) *a particular design structure, in which parameters and tasks are interdependent within modules and independent across them*" but they clearly state that "*but in a complex design, there are often many levels of visible and hidden information*", which means that perfect modularity is far from being the most common case.

The third dimension is the implementation of those modules into the chain to carry the competitive transactions in the new framework. As some authors emphasize, the decisions sequence in the construction of competitive modular chains is critical and nearly as important as the actual structure of those chains. According to Newbery (2002), this sequence structures the behavior of the stakeholders as it creates new interests and new rights over both the modules and the transactions between them. To Aoki (2001), each institution can generate incentives and manages information autonomously. This may be a handicap as it can be difficult to economic agents to understand and to use a complex institution. But this author also calls the attention for the impact that the overlap of existing institutions can have on the evolution and the combination of their activities.

In short, *unbundling* is one aspect of the complex competitive reform of network industries, although it may be actually the most important in the present stage of the European liberalization process. Although national state regulatory and institutional arrangements remain significant and influential (Hudson, 2003), it seems clear that it is a pivotal question both to competition and investment of network industries as electricity and communications. Notwithstanding, under a strict technological perspective, these industries have different characteristics that may pose particular regulatory challenges and may explain different corporate strategic moves.

In the following sections we discuss the regulatory options concerning the various degrees of vertical separation recently applied in the telecommunications and electricity industries.

3. The Communications Sector

3.1. Vertical Separation: the European Experience

The liberalization process in the telecommunications sector started in the mids 1980s (although with significant differences among the European countries). The introduction of competition reshaped the sector' structure, as the incumbent firms have to share many segments of the market with the new comers. Additionally, many new market segments emerged due to the high level of technological innovation. One of the most important transformations in the sector was the development of competition between different technologies used to deliver communications services (infrastructure-based competition). Today technologies based on copper and optical compete with cable television networks and with wireless networks.

In parallel with the liberalization there was a strong development of the regulatory policy, both at European and national level. Following the 2002 package of rules which govern the telecommunications sector in Europe, new rules were approved by the European Member States in November 2009.[9] These new rules should be transposed into the national laws by May 2011. An important decision is the creation of the BEREC (Body of European Regulators of Electronic Communications), with main purpose of achieving a better coordination between the national regulations.

Regarding the unbundling issue, the new rules introduced a general framework to evaluate and implement functional separation. This possibility may be used by national regulators as a remedy when other instruments "have failed to achieve effective competition and there are important and persisting competition problems and/or market failures" (article 13a, from EC Directive 2009/140) by the national regulators. Also, the unbundling option can be implemented voluntarily by the vertically integrated firms (article 13b. from EC Directive 2009/140), and different levels of unbundling (functional, legal, ownership) might be implemented. The introduction of these new rules is a clear position in favour of functional separation when other instruments to developed competition are no longer efficient, which approximates the evolution in the telecommunications sector to what is happening in the electricity sector.

Traditionally network access in telecommunications (also called mandatory unbundling sharing) was the main instrument used by European regulators to promote efficient entry and competition. Vertical separation, although in discussion, had limited practical implementation. The reasons for this trend can be found in several features of the communications sector when compared with other network sectors, like electricity, natural gas or railways, which continue to be natural monopolies. Essentially due to technological developments, in communications there are many market segments where the entry of new firms is feasible as long as

[9] Directive 2009/140/EC of the European Parliament and of the Council of 25 November 2009.

the infrastructure access is ensure. Also important to understand this evolution is the fact that network access involves lighter modifications in the market structure than any other degree of vertical separation.

Additionally, there are important cost complementarities and economies of scope between network and services that enhance the vertical integration advantages. The introduction of new products or the upgrade of the existing ones frequently requires adjustments in the network, and these might be costly under vertical separation (Olsen *et al*., 2008). These arguments contribute to explain why the European incumbent firms', were privatized a single integrated firm.

However, it is crucial to point out that vertical integration has negative effects on competition, essentially because firms have incentives to discriminate against competitors.[10] The discrimination can be based on prices or on other strategies, including raising the rivals' costs, reducing the quality of the input delivered to downstream competitors or reducing rivals' demand.[11]

Vertical separation may also allow a reduction on the regulatory intervention, as anticompetitive behavior is much less likely to occur[12] and this effect is more intense as deeper is the vertical separation.

Recently the European debate about vertical separation was intensified and accompanied by some practical implementation. Certainly, this trend is not independent on the observation that, in several markets, the access regulation was not able to develop real competition in the downstream segments (Bijl, 2005). For instance, Olsen *et al.* (2008) referred that, in the Danish market for ADSL-services, it is even difficult to ensure equal treatment of all operators through regulation. Also, in Italy, there was a slow implementation of Local Loop Unbundling until 2006 (Baake, 2006). For the UK, Whalley and Curwen (2008) argue that "Service based competition had been possible since the late 1990s but had enjoyed limited success because, it was alleged, BT had abused its dominant position".

In order to analyze the development of retail competition in European countries we present information about the fixed broadband access market in 2005 and 2009 (Tables 1 and 2). In spite of the significant heterogeneity between countries, the data supports the conclusion that network access allowed the development of competition in the retail markets. The date distinguished four different types of network access: (i) Resale - the entrant resells the services provided by the incumbent, without introducing specific features; (ii) Bitstream access - the incumbent installs a high speed access to the final consumer and the

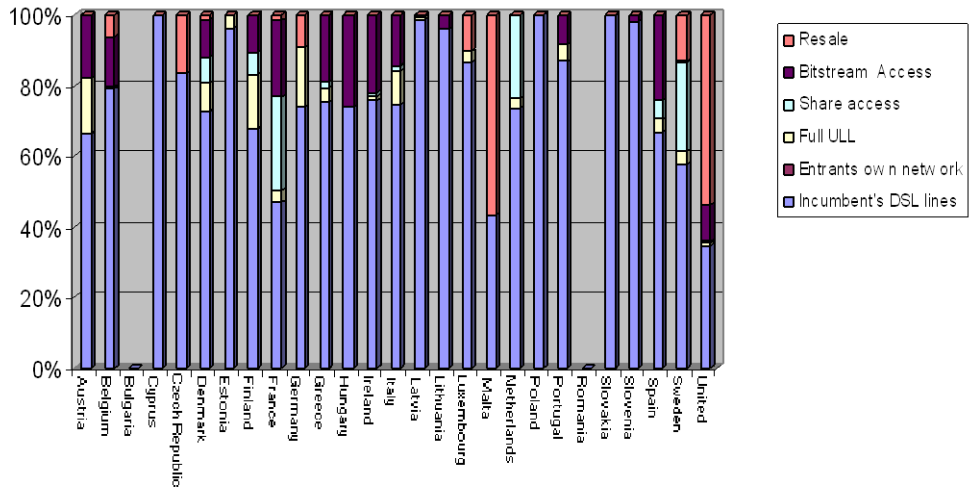
[10] To a deeper discussion of this argument see Cave and Doyle (2007), Doyle (2008) and the references therein.

[11] These strategies are often called sabotage. For details see Mandy and Sappington (2007).

[12] For a detailed description of the merits and disadvantages of functional and structural separation see Bijl (2005), OECD (2003, 2007) and Cave and Doyle (2007). For an analytical approach see Sappington (2006), Doyle (2008), Kirsh and Hirschhausen (2008) and Gomez-Ibanez (2003).

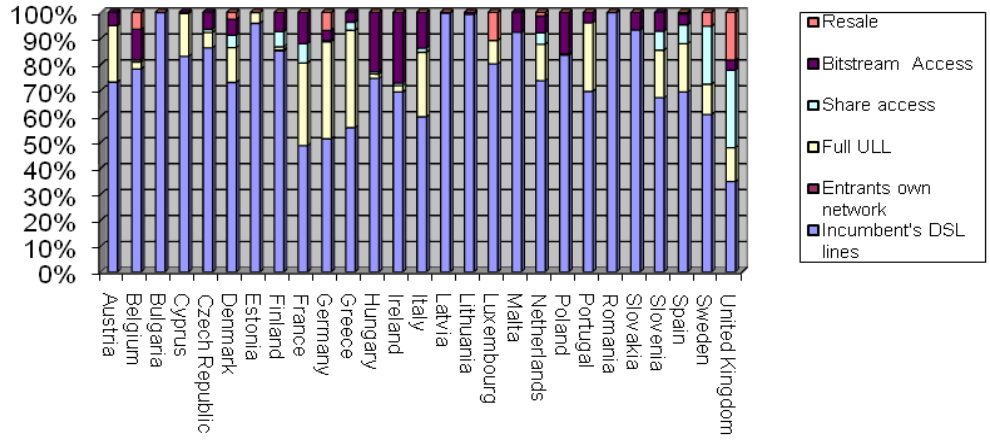
entrant uses this access, having some freedom in the definition of its services; (iii) Share access – both incumbent and entrant use the same line, in which the incumbent continues to deliver telephone service and the entrant provides high speed data services; (iv) Full local loop unbundling - the incumbent rents a line that is exclusively used by the entrant. This type of access allows more freedom in the specification of its services. Therefore, resale corresponds to the simplest type of entry and the one that requires less investment from the entrants. Additionally, it is the type of entry that weakly contributes for the development of a competitive retail market. On the other extreme, full local looping unbundling is the type of unbundling that strongly contributes for the development of competition, as it allows the entrants to offer competing services.

Table 1 - DSL lines, July 2005



Source: EC (2008a)

Table 2 - DSL lines, July 2009



Source: EC (2008a)

In the period 2005-2009, and for most of the countries, new entrants had globally gained market share. In Slovenia, Germany and Greece the new entrants' DSL lines increased 31.1, 22.5 and 19.7 percentage points. The significant exception is Malta with decrease of 49.2 percentage points.

There was also a reduction in resale and a pronounced increased in the types of access that allow the development of differentiate strategies for the entrants (in particular Full LLU). Malta and UK are two cases of a strong reduction in the proportion of resale (56.8 and 35.6 percentage points, respectively). Greece, France and Portugal are the countries with higher increases of Full LLU (33.4; 28.6 and 21.6 percentage points, respectively). In particular due to the reduction in resale the incumbent's direct control over end-users has reduced below 50% of the European broadband market in 2009 (EC, 2009b)

Overall, this information suggests that in the period 2005-2009 there was an increase in the competitive level of the retail broadband markets. However, it also clearly displays the heterogeneity in the entry process in the broadband access market among the European countries.

From these data we can also understand why network access was no more able to allow further development of competition and that stronger decisions were necessary in some European countries. The debate on vertical separation came to the front of discussion with the implementation of functional separation of British Telecom (BT) in 2006. In 2005, Ofcom studied the vertical separation of BT in two companies, one of which would supply retail services while the other would supply the wholesale services to all suppliers of retail services. However, in 2006, and with the agreement of BT, Ofcom decided for functional separation, which does not involve the creation of a legal independent firm. Functional separation implies the

separation of the parts of the network that are difficult to replicate but that are necessary to provide final services (ERG, 2007). This decision leaded to the creation of Openreach, a division operationally independent from BT. Openreach is in charge of the management of the incumbent's network and also of the provision of access to the network, not only to the retail departments of BT but to independent operators as well. Accordingly to Ofcom this arrangement is more effective in securing non discriminatory practices and in encouraging investment in network than the access price regulation.[13] The evaluation made by Ofcom of the functional separation is globally positive.[14] This is supported by the significant increase in the unbundled lines in UK: the sum of Full LLU with Share access lines increased from 73 140 in 2005 to 4.76 millions in 2008 (EC, 2008a). Notwithstanding, Ofcom systematically mentions several features that need to be improved. One is the separation of the information systems between Openreach and the rest of BT. Without this separation that requires the effectiveness of the "Chinese walls", is quite difficult to avoid the non-discriminatory behaviour of BT.

Several other European regulators and incumbent firms are studying functional separation. In 2008, Telecom Italia announced the creation of Open Access, a division inspired in the UK Openreach (Whalley and Curwen, 2008).[15] In Denmark there are also some proposals to follow the UK example (Olsen *et al*., 2008). In 2007, the Netherlands regulator decided not to implement vertical separation. The main arguments relay on the existence of an alternative infrastructure (cable), and on the potential negative effects on investment in NGN (Whalley and Curven, 2008). On the contrary, in 2008, TeliaSonera agree with the Swedish regulator the implementation of functional separation.

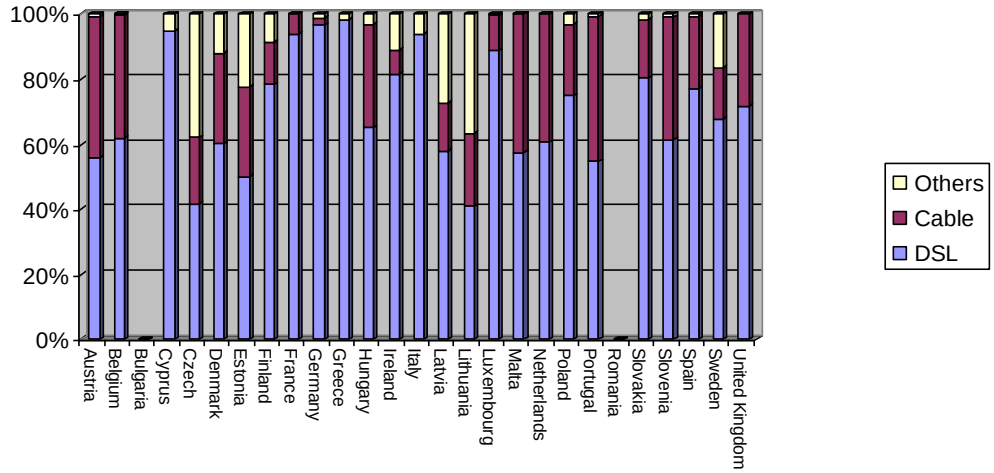
Overall, we conclude that in recent years there is a great diversity of strategies among the European countries concerning vertical integration. As one important argument is based on the development of alternative infrastructures, we present in detail information (Tables 3 and 4) about the weight of each infrastructure.

[13] This is also the opinion of Reding (2007).

[14] For a detailed analysis and reference of the Ofcom evaluation reports see Whalley and Curwen (2008).

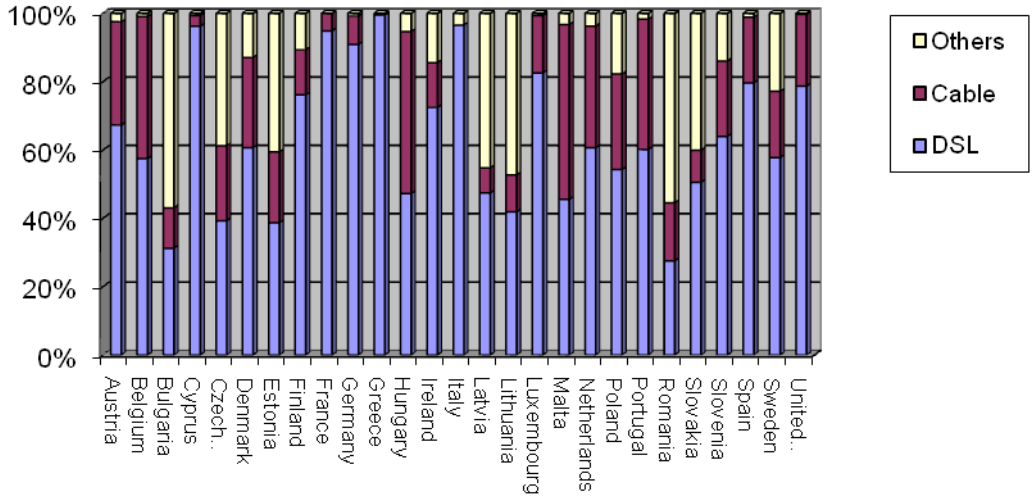
[15] According to Amendola *et al*. (2007), operational separation was introduced in Italy in 2002, and its positive effects in terms of increasing of LLU lines and decline in wholesale prices were already visible in 2005. The operational separation is a lighter form of vertical separation than functional separation. For a detail comparison between the Italian and the British models see Amendola *et al*. (2007).

Table 3 - Broadband access July 2005



Source: EC (2008a)

Table 4 - Broadband access July 2009



Source: EC (2008a)

It stands out that DSL continues to be the dominant infrastructure in the broadband access in many countries. In France, Germany, Greece, Italy and Cyprus, the DSL has a market share above 90%. Then, for these countries it is difficult to

consider that the competitive pressure of the alternative platforms is a strong argument in favor of the vertical integration. Different evolution is observed, in Netherlands, Belgium and Sweden, where DSL' market share are below 62%.[16]

Also, it is worth mention that countries where DSL is the dominant platform are among those that have more broadband lines: Germany has 20.2% of all broadband fixed lines of the 27 European countries, France and UK have 15.7% and 14.9%, followed by Italy, Spain and Netherlands (EC, 2008).[17]

Most of the European regulators still devote great effort to the protection of competition between different operators which provide services over the incumbent infrastructure (intra-platform competition). Differently, the US emphasizes competition between networks, DSL, cable, wireless, etc (inter-platform competition). In this line, the US regulator ended the mandatory unbundling sharing by telephone companies, as cable network were never subject to unbundling sharing, neither in US or in Europe (Wallsten and Hausladen, 2009).

3.2. The Effects of Vertical Separation on Investment

In spite of the positive effects on competition, vertical separation might also have significant negative effects. Besides the structural effects on industries organization not easily reverted, it is important to evaluate the impact of vertical separation at two different levels: coordination costs and incentives to invest. The first level concerns the possible increase of the coordination costs and the sacrifice economies of scope resulting from vertical separation. The introduction of new services frequently requires adjustments in the network and this might be costly to implement under vertical separation (Olsen *et al*., 2008). One example of this problem is found in the complaints of UK independent operators about the interaction with BT after the creation of Openreach. Furthermore, Amendola *et al*. (2007) argue that for deeper vertical separation (as is the case of functional separation relative to operational separation) the negative effects are more pronounced due to an increase in transaction cost and to the lower incentives to invest and innovate.

The second level is related with the potential negative effects of vertical separation on the incentives to invest and innovate caused by many factors as:

i) the easier access to the incumbent's network discourages the investment by independent operators in their own networks, and then the "ladder of investment"[18] is interrupted. Therefore, the regulatory goal of developed

[16] Notice that in some countries (Bulgaria, Czech Republic or Romania, to name a few) the DLS' market share is low but the absolute values for broadband lines are also very small (see Table I in Appendix).

[17] See Table I in Appendix.

[18] The "ladder of investment" theory (Cave and Vogelsang, 2003; Cave, 2006) foresees that initially the entrant firms use the incumbent firm's network to deliver their products and this allows retail competition. After the initial period, new entrants will invest in their own infrastructure competing with the incumbent firm also at the upstream segments of the market.

infrastructure competition might be weakened. The empirical observations of Crandall and Sidack (2002) for the USA markets support this argument. Furthermore, the vertical separation might intensify the dependence of the alternative operators from the incumbent's network.

ii) it may cause a delay in the decisions to invest, in particular when the coordination between network investments and services specifications is crucial. Amendola *et al*. (2007) relate the delay in UK investments in NGN with the functional separation of BT, arguing that the countries where functional separation was not adopted are also the countries with more investment in NGN.

iii) it may reinforce the market power at the wholesale level with negative consequences for the development of infrastructure network competition and, thus, with negative effects on investment and innovation at this level.

3.3. Next Generation Networks (NGN)

With the development of NGN, the same network can deliver to final consumers different services (voice, data, video, high definition television, etc). Then, there is room for significant economies of scale and scope (Doyle, 2008; ERG, 2007). This perspective supports the argument of the incumbent firms that wish to maintain and develop vertically integrated networks. In this context, old concerns about the exercise of market power the network rise out again. "Leveraging market power in telecommunications is a live and real issue and is becoming more pertinent in the context of NGN and NGA investments" (Doyle, 2008).

The communications sector is at this moment in a crucial period. Huge investments in fibre optical network are vital for the development of the NGN and the incumbent firms are large investors. Functional separation, designed to solve more efficiently the problem of discrimination may have negative effects on the incentives to invest. As was mentioned above, OPTA decided not to implement functional separation because of the potential negative effects on the incentive to invest in NGN.

Additionally, the technical changes introduced by NGNs might have consequences on the decision of vertical separation. Until recently "telecommunication services were delivered on dedicated networks: telephony on PSTN, data services on data networks, television on cable networks." (Olsen *et al*., 2008), and access price regulation intended to incentive downstream competition. However, this is rapidly changing with the development of NGN and it is foreseeable the development of competitive networks. A re-evaluation of the arguments in favor and against vertical separation in communication sector is necessary in this new framework. Kirsch and Hirschhausen (2008) argue that, from a technological point of view, as NGN allow the provision of several services thought the combination of different physical network infrastructure, there will be a separation of infrastructure and services and, consequently, a reduction in the

economies of scope between infrastructure and services. Then, the authors claim that "structural separation becomes less costly as technical synergy losses from the separation of access networks are mitigated" (Kirsch and Hirschhausen, 2008. p.71). This is also in line with Cave and Hatta (2009), who conclude that the costs of separation can be lower under the NGN framework. However, these authors also call the attention for the possible increase in transaction costs.

In this respect it is worth to mention the empirical results obtained by Wallsten and Hausladen (2009) using data from the broadband access in European countries. The authors conclude that the more a country relies on access network, the less incumbent and entrants invest in next generation networks. Also, they found that entrants that provide services over their infrastructure and firms that face strong competition from cable networks are the ones that invest more in fiber. These conclusions support the idea that competition between networks stimulates investment and innovation.

Overall, we observe that in telecommunications markets firms can offer to final consumers bundles of services (triple play, for instance) that are provided through the combination of different technological platforms. Also, competition between networks is already a reality. Therefore, competition between vertically integrated firms that in the past had a single dominant technology may be reinforced, decreasing the concerns about market power effects.

4. The Electric Power Sector

The physical characteristics of the electricity supply industry are the main determinants of its optimal regulatory design. The industry has large sunk costs, its value chain is composed by four vertical stages with different optimal scales (generation, transmission, distribution and retailing) and it is a single product industry of a non-storable good delivered through a network, requiring instantaneous supply and demand physical balance.

4.1. The Energy Directives: from Full Integration to Vertical Separation

Balancing generation and consumption is one of the most complex technical problems to be solved. It arises from the electricity market specific features: the need for continuous electrical equilibrium, unexpected demand and supply fluctuations, a limited capacity to establish and send price signals to market participants on a continuous basis and also a small short-run elasticity of demand (Fehr *et al*., 2005).

A real-time balance between generation and electricity consumption (both by end users and the grid itself) is crucial for safeguarding transmission system security. As electricity is not storable[19], disturbances of equilibrium between generation and load make the system frequency to deviate from its set value which,

[19] Only hydro systems with dominance of large water reservoirs allow for some degree of storage.

according to the extent of that deviation, can affect the behavior of electrical equipment or lead to the (protective) disconnection of generation plants. Large deviations may even cause system black-outs.

Different types of transmission institutional arrangements may cover either partially or completely the European power system. Almost all continental systems (managed by different transmission organizations under different regulations) are interconnected and synchronized (every system has the same frequency all the time). These interconnected systems create strong externalities between zones (e.g. loop flows[20]). This is not the case for the UK power system. It is an "isolated" system, thus it is not synchronized with the continental system (it is interconnected by DC lines[21]). In this case, externalities are much smaller than in continental Europe as there are no loop flows. Thus, the coordination of the whole European power system is not an easy task but it is an absolute condition, as to increase cross-border competition as well as the internalization of cross-border externalities (Thomas, 2007).

The importance of transmission, a natural monopoly that has to be regulated, is not proportional to its share on the total cost of supplied electricity: about 5% according to some authors always under 10% according to others[22]. Retailers and generating firms (particularly those with large power plants) have the greatest interest on transmission network.[23] Both for generation and retailing, competitive markets suppose access to the network on equal, non-discriminatory conditions. This is the main reason why unbundling is necessary. However, how far this should go remains controversial.

There is sound empirical evidence of the benefits and cost savings from vertical integration (see, for example, Kaserman and Mayo, 1991; Fraquelli *et al*., 2005). Advantages are manifold. We can distinguish, among others: the reduction of transportation costs if common ownership results in closer geographic proximity as well as the reduction of coordination costs; control over inputs – (in generation) is increased, which allows for differentiation in favor of related businesses; entry barriers are increased and

[20] Loop flow: The movement of electric power from generator to load by dividing along multiple parallel paths; it especially refers to power flow along an unintended path that loops away from the most direct geographic path or contract path (EIA 2008).

[21] Direct current (DC) is the unidirectional flow of electric charge. Direct current is produced by such sources as batteries, thermocouples, solar cells, and commutator - type electric machines of the dynamo type. Direct current may flow in a conductor such as a wire, but can also be through semiconductors, insulators, or even through a vacuum as in electron or ion beams. In direct current, the electric charges flow in a constant direction (AC).

[22] See, for example, Thomas (2007) and Marques (2003).

[23] Households and industrial customers (except a very small part of the largest consumers that are supplied directly by the transmission network) are connected to the (low voltage) distribution network. Small generators and most renewable and combined heat and power (CHP) generators feed directly into the distribution network.

may be used by integrated incumbents against potential competitors; finally, the integrated utility is able to capture profit margins either upstream and downstream.

The reform of the European electricity industry started in Great Britain in 1989 through a massive privatization and restructuring program. The basic assumption for the reform was that competition would force power firms to become more efficient, engaging lower prices and better services.

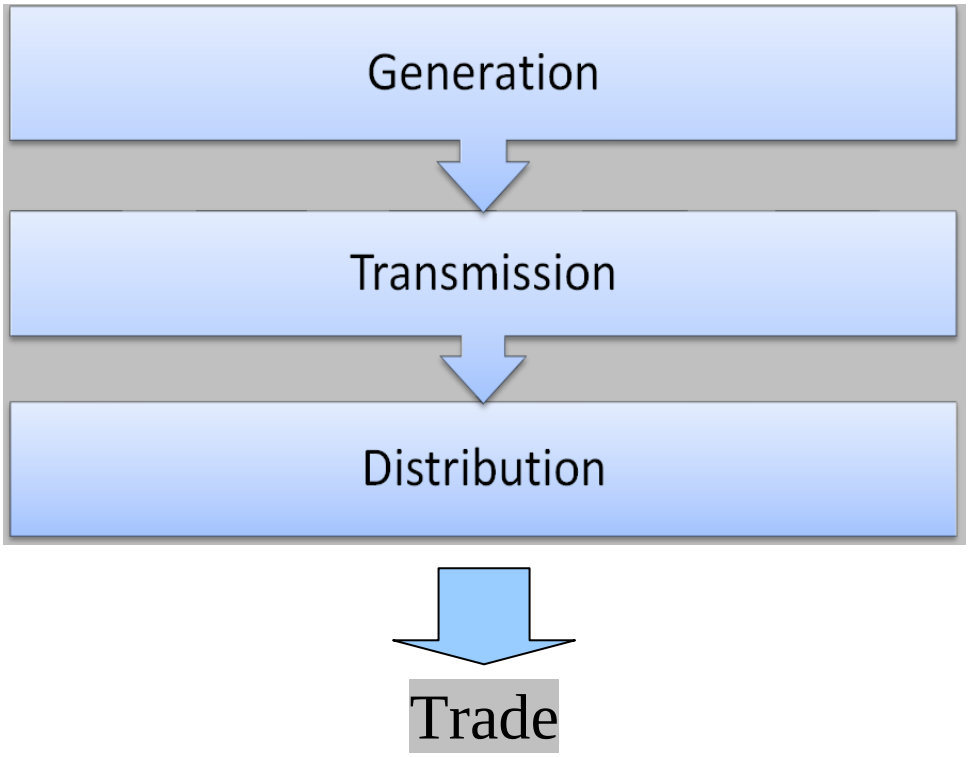
Electricity competitive reforms comprehend four inter-related steps: privatization of state-owned assets; opening the market to competition; the unbundling of transmission and distribution from generation and retailing; the introduction of an independent regulator. However, the EU liberalization process only concerned directly the three last steps. The EU Directives have never mentioned privatization as a necessary condition to accomplish the competitive reforms. Nevertheless, the empirical evidence made it clear that liberalization could not be pursued without privatization of former state owned monopolies (Pollitt, 2009).

All EU countries have been required to unbundle and liberalise their wholesale and retail markets since 1998. However, the consequences on competition and on prices are still far from what was expected from the implementation of EC Directives. According to Hall *et al*. (2009) ownership concentration remains a core feature of the European electricity market despite the competitive reform.

Electricity systems were highly integrated worldwide, most of the times fully integrated, until the 90's. This meant that the different stages of the electricity value chain remained in the same firm, most of the times state-owned. The electric power industrial organization presented a similar organization worldwide: highly controlled monopolies in exclusive (franchise) areas.

The traditional model presented four main characteristics: vertical integration, state ownership, monopoly and a whole, final tariff that consumers must pay without any chance to choose their supplier.

Figure 1. The Electric Power Industry: traditional model



The electricity value chain has four stages: generation from a variety of sources; transmission which is the transport of high voltage electricity over long distances; distribution as the local transportation at lower voltage to final customers; and at last, the retailing activities which comprehend the selling and billing to final consumers.

A high vertical integration between the four stages of the value chain was quite frequent, although other cases concerned only the integration between generation and transmission or between distribution and retail. Another important feature of electricity companies was – still is in several cases – their large size and importance within national frontiers. The economic arguments for the traditional model are the significant vertical economies which could be obtained. Those economies are particularly evident between generation and transmission. Meanwhile, there are also significant economies of density in distribution, especially to smaller customers. But there are three kinds of economic incentives for vertical integration that are generally presented: the reduction of transactions costs but also distortions arising from market power of upstream activities or/and downstream activities and information improvement (OECD, 2001). The argument used for

market power distortions remains particularly interesting due to its assumptions. Starting from the fact that, whenever a price differs from marginal cost, there is a loss in overall welfare, the argument in favor of vertical integration was that it would ensure that the firm would sell to its downstream partner at a price equal to marginal cost.

Since the 19(90)'s the EU energy policy has introduced deep and extensive changes on electricity and natural gas markets that have completely modify the old energy paradigm. Three Electricity Directives have been set: 1996, 2003 and 2009. As Pollitt (2009) refers, these Directives also had a significant impact on the energy policy of two European non-EU countries: Norway and Switzerland.

The Directives general model for electricity considered the four separate activities mentioned above where electricity generation is known as wholesale activity. The rationale behind the Directives was clear: wholesale and retail activities could be made competitive, thus the prices would be set by markets as the core assumption was that sectors which are run on competitive rules are more efficient than those run as monopolies. The final result should be lower prices to the final consumers. Transmission and distribution were natural monopolies and prices would be set by an independent Regulator.

The liberalization process has been a dynamic, huge task, since it has involved various problems: the enlargement of national to regional markets, the reduction of entry barriers to new competitors on generation and retail, the reforming of transmission and distribution regulation emphasizing investment incentives and considering scattered, intermittent renewable generation. Independent regulation also proved to be critical for the achievement of the reforms. The three Electricity Directives can be seen not just as the legislative background of the liberalization process but also as a process of learning by doing and learning by other experiences around the world. Notwithstanding the broader scope of the EU Directives, the unbundling issue stands as the core of the controversy about the best strategy to break down persistent barriers to cross-border trade, investment and competition (Buchan, 2007).

The unbundling process dates from the 96/92/CE Directive which introduced the independence of Transmission Operators (TSO) and Distribution Operators (DSO) from generation and trade. For TSOs this separation should be, at least on management, and for DSOs the independence should be on accountability.

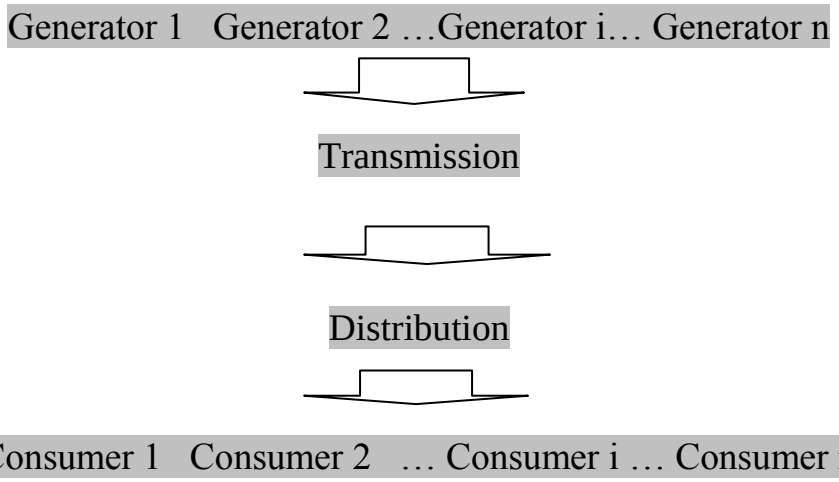
According to Thomas (2007) the distinction between the network ownership and the network operation was already implicit. In fact, the Directive imposed that the access to the networks should be available to all wholesalers and retailers on equal terms. Moreover, an independent regulatory board was supposed to ensure that this access should be impartial and in the competitive stages of the value chain (wholesale and retail businesses) that competition should be fair. Thus, the crucial question should be who controls the network – respectively, the TSO and the DSO – not the network owners. However, the empirical evidence proved that the 1st Directive was unable to attain its main goals.

However, under accounting unbundling, integrated utilities could still allocate costs to the advantage of the firm. As there were common costs shared by generation and transmission, the opportunity to have a substantial share of those costs inappropriately allocated to the network business was real. The final outcome was the unjustified increase of scale economies.

The 2003/54/CE Directive went further. Transmission and Distribution should be, at least, legally unbundled. Thus, for both segments of the value chain, management should be legally independent from generation and supply. Once again, the rationale behind the 2nd Directive was the concern about non-discriminatory access to electricity (and gas) networks but also a reasonable doubt on whether current arrangements were delivering efficient and timely investments in transmission capacity.

Legal unbundling is a better form of unbundling, as it requires that the grid should be owned and operated by a firm whose exclusive activity is the network business. Although the cost allocation issue might be solved, other problems may arise due to the fact that the network can be owned by a firm which may belong to the same holding group. The 2nd Directive confirmed the new electricity organization model (Figure 2) where: generation and trading businesses are competitive, there is full incompatibility between monopolist and competitive activities and there is vertical and horizontal separation.

Figure 2. The New Electricity Model



Notwithstanding, the enquiries carried out by the European Commission in 2005 and 2006[24] concluded for the existence of severe problems concerning the effective liberalization of the European energy market, namely: insufficient market

[24] See EC (2005, 2006, 2007a and 2007b).

integration, lack of transparency, lack of confidence on price determination, market concentration and small downstream market competition.[25]

4.2. The 3rd Energy Package: Unbundling and Competition

Market integration is a fundamental tool to improve competition in national markets. Although great improvements had been made - real capacity margin have improved from less than 5% in 2005 to 7.6% in 2006 - there was still a large work to be done to get a fully integrated market. Most of the European countries presented an interconnection capacity (in relation to installed generation capacity) between 10% and 30%. Both the lack of transparency and the lack of confidence on prices determination may be translated, among others, by the diversity of prices and the consumer perception on change of electricity prices.[26]

While there were prices that could be easily explained, there was also evidence of large discrepancies which were less understandable. Different kinds of fuels used in generation can be responsible for both high prices and high price volatility. Weather conditions are another cause of high prices, for they can explain more pressure on demand and, in the case of small rain, the reliance of electricity generation on thermal plants. However, the diversity of tax share on final prices was also remarkably wide. Moreover, as EC studies on impact assessment recognized (EC, 2007d) from 1998 to 2006, in countries with ownership unbundling, household electricity prices rose by 5.9%, while the increase in countries without ownership unbundling attained 29.5%.[27]

Despite the bias introduced by the existence of regulated industrial tariffs in some countries, there was an evident dispersion of prices for the same type of customer. Tax share on final prices also presented (still presents) significant differences among member states. In ownership unbundled markets[28] the electricity price for industrial consumers decreased by 3.0% along the same period of time, while in markets without ownership unbundling this price increased by 6.0% (EC, 2007d).

Concentration plays a very important role on the final impact of the competitive reform. The competitive stages of the electric power industry show high concentration levels (EC, 2009a) Tables II and III (see Appendix) show the concentration level of the European electricity markets for 2006 and 2007 respectively for the wholesale and the retail markets.

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[25] For a detailed analysis see EC (2002, 2003, 2004, 2005, 2006, 2007b, 2007c, 2008b).

[26] See Tables 1A, 1B and 2 in Appendix.

[27] The application of regulated tariffs for household consumers can explain why prices were not as sensitive as it would be expected to changes in market conditions.

[28] See, for instance, EC(2007a) and Thomas (2007).

Out of 25 countries, 12 presented a Herfindhal-Hirschman Index[29] in the generation stage above 5 000 for the electricity generation segment (very high concentration), 5 were highly concentrated (HHI between 1 800 and 5 000) and only 8 of them had a moderately concentrated generation structure (HHI between750 and 1800).

Concentration was also remarkable on retailing (Table 2). Out of the 27 EU member states and Norway, 6 had a single company dominating over 5% of the retail market and in 22 countries the 3 largest companies had an aggregated market share over 40% (EC, 2009a).30

The 3rd Energy Package proposed in 2007 by the European Commission – coming into force on the 3rd March 2011 - represented a strong attempt to reinforce the unbundling and its effects on competition, and to solve electricity and gas problem of network under-investment. This new legislative package comprehended the formation of a European Network of Transmission System Operators (ENTSO)8 for electricity and gas for the implementation of common standards in order to facilitate cross-border energy supplies, the establishment of an agency as a new body to coordinate the actions of the national regulatory authorities (ACER) and more stringent unbundling rules designed to ensure effective independence of the network business from the rest of the vertically integrated energy utilities.

The main argument used by the EC to propose the unbundling regulation to the electricity and gas sectors was the disappointing development of competition in the European energy markets. Furthermore, it also argued that network capacity scarcity were serious threats to the security of supply but also acted as national market barriers in favour of incumbents. Under this perspective, the new legislation was assumed to be a crucial (although controversial) tool to implement the European Energy Market.

Although the impact assessment presented by the EC to support ownership unbundling, covered a wide range of variables, there was considerable criticism on the examples presented. Most of these impacts were analysed on past empirical evidence. According to those studies, full ownership unbundling revealed a general positive impact on the energy market, in particular by stimulating investment, reducing market concentration and contributing to the reduction of energy prices. On the other hand, there was no empirical evidence of eventual negative effects on credit ratings, share prices, R&D and the relationship with external suppliers (EC, 2007d). According to the Commission, due to the EU dependence on fuel imports, namely on Russian gas, ownership unbundling presented another advantage: it would ensure that "energy networks could not be owned either by EU suppliers or by non-EU supply companies" (EC, 2007d, p.45).

[29] The Herfindahl-Hirschman Index (HHI) is a commonly accepted measure of market concentration. It is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers.

The 2007 EC initial proposal was concentrated on the debate upon two particular institutional arrangements of the electricity transmission – the Independent Transmission System Operator (ITSO)[31] and the Legally Unbundled Transmission System Operator (LTSO)[32] – other 5 models of transmission ownership can be identified worldwide: the Independent System Operator (ISO), the Hybrid Independent System Operator/Independent Transmission Owner (ISO/ITO) and the traditional model of Vertical Integration (VI).

The National Grid in England and Wales is an example of ITSO. It is fully unbundled from the rest of the system and the firm owns and operates transmission assets. According to Lévêque *et al*. (2008), this may be the first-best arrangement under a national (isolated) perspective framework, where the transmission organization and the regulator cover the entire system. These cases have no cross-border externalities and cross-border competition in generation is small.

An example of LTSO is the French RTE since 2005. The transmission owner and the operator are independent but they are 100%-owned by the vertically integrated utility. According to Pollitt (2008), this is an increasingly common model.

The ISO model exists in several electricity markets, including the USA and in Europe. In the USA, it is the case for PJM interconnection,[33]and in Europe for the Scottish Electricity. The system operator does not own the transmission assets but it is ownership-unbundled from the rest of the system.

In the ISO/ITO hybrid model, both of the organizations are ownership unbundled from the rest of the system and the Independent Transmission Owner (ITO) has no operation function. This is the case for Nord Pool, but also for Argentina and Chile. Nord Pool is a particularly interesting case, namely due to the ISOs regional coordination and to the significant public ownership of assets.[34]

Finally, there is still the vertically integrated utility (VI). While the Directives have introduced regulation that removed this model from the possible institutional arrangements, it is still *de facto* in place in some European power markets.

The Third Energy Package[35] was finally adopted on 13 July 2009 after a long struggle against different national interests and perspectives. This new Gas & Electricity Directive will come into force on 03/03/2011. In its final version, it

[31] Corresponding to Full Ownership Unbundling.

[32] Corresponding to Deep-ISO.

[33] PJM is a regional transmission organization that manages the high voltage electric grid and the wholesale electricity that serves 13 states and the District of Columbia.

[34] See Bergman, (2002, 2003).

[35] This package consist of five new legal acts: Directive 2009/72/EC concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC; Directive 2009/73/EC concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC; Regulation (EC) No 713/2009 establishing an Agency for the Cooperation of Energy Regulators; Regulation (EC) No 714/2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003; Regulation (EC) No 715/2009 on conditions for access to the gas transmission networks and repealing Regulation (EC) No 1775/2005.

allows for three alternative institutional arrangements: (Full) Ownership Unbundling (OU), (Deep) Independent System Operator (ISO) and the Effective and Efficient Unbundling (EEU) or "the third way".[36]

In the ownership unbundling option of electricity and gas TSOs, the EC preferred option, the ownership of transmission assets have to be transferred to completely independent third parties that will have to operate the networks. In those Member States where TSOs are public, they can remain as such.

In the ISO model, the member-state appoints an external entity (independent from the vertically integrated firm) to assume the Transmission System Operator functions. However, the integrated firm is allowed to retain its transmission assets in its balance sheet.

In the Effective and Efficient Unbundling (EEU) model, basically supported by France and Germany, the Transmission System Operator stays inside the vertically integrated firm and the transmission assets stay in the firm balance sheet. However, the regulation burden is reinforced in order to guarantee the ITO independence towards the vertically integrated holding. In this model, transmission assets remain in the balance sheet of the vertically integrated firm only as financial assets. According to Säcker (2008) and Balmert and Brunekreeft (2009), the "third way" is a continuation of the Vertically Integrated model but under stronger legal unbundling rules and given more capacity to the Regulator to intervene in what concerns network investments.

In a report of March 2010 (EC, 2010), the European Commission recognized it had applied a high number of procedures (against 25 Member States for electricity and against 21 Member States for gas) for serious violations concerning 2003 Directives. Those procedures concerned several violations of the current legal framework namely: lack of transparency, lack or insufficient coordination among transmission operators to allow for the maximum interconnection capacity available, small regional cooperation (or even no cooperation at all), insufficient effective intervention by national regulators.

In fact, most of the problems identified by the Commission in 2005 and 2006 still hold. This is confirmed by recent data collected on market concentration (Tables IV and V in Appendix) and unbundling of network operators, respectively Transmission System Operators (Table 5) and Distribution System Operators (Table 6).

In the last two years, the electricity wholesale market presented a slight decrease of concentration (in terms of generation capacity) which was reflected in a lower Herfindhal - Hirschman Index for 10 Member States. However, concentration remains high in most regions. This is particularly important as the European Electricity Market is, for the moment, mostly the assemblage of regional markets.

[36] A third option was proposed by a group of eight Member States led by France and Germany at the end of January 2008, as the negotiations on the European Council and the European parliament continued.

For the whole retail market, concentration remains very high with few exceptions. The market share of the three largest firms is still above 80% in 14 Member States (EC, 2010).[37]

Since 2006/2007, there was no evolution in what concerns TSO unbundling (Table 5). The only exception happened in 2009 with the first case of an electricity cross-border TSO[38].

Table 5. Electricity TSOs Unbundling

Electricity	Number of TSOs	Number of TSOs Ownership Unbundled	Public Ownership	Private Ownership	TSO network assets	
					with	without
Austria	3	0	75,5	24,5	1	2
Belgium	1	0	NA	64,45	1	0
Bulgaria	1	0	100	0	0	1
Cyprus	1	0	100	0	0	1
Czech Republic	1	1	100	0	1	0
Denmark	1	1	100	0	1	0
Estonia	1	0	100	0	1	0
Finland	1	1	12	88	1	0
France	1	0	84,66	15,34	1	0
Germany	4	0	0	100	4	0
Great Britain	1	1	0	100	1	0
Greece	1	0	51	49	0	1
Hungary	1	0	0,01	99,99	1	0
Ireland	1	1	100	0	0	1
Italy	8	1	30	70	8	0
Latvia	1	0	100	0	0	1
Lithuania	1	0	61,7	38,3	1	0
Luxembourg	1	0	32,8	67,2	0	1
Malta						
Northern Ireland	1	1	0	100	0	1
Norway	1	1	100	0	1	0
Poland	1	1	100	0	1	0
Portugal	3	1	51	49	1	0
Romania	1	1	76,5	23,5	1	0
Slovak Republic	1	1	100	0	1	0
Slovenia	1	1	100	0	1	0
Spain	1	1	20	80	1	0
Sweden	1	1	100	0	1	0
The Netherlands	1	1	100	0	1	0

Source: EC (2009)

4.3. Unbundling Options and Network Investment

The need for the improvement of transmission investment is closely related to liberalization and competition. Congestion of the transmission networks has greatly increased with the development of wholesale markets (Joskow, 2005a, 2005b). This is also referred by Hirst (2004) who also argues that investment in transmission capacity has not followed the pace of changes in trading patterns. Joskow (2006) explains how transmission congestion (and related reliability constraints) creates load pockets, thus reducing competition among generators, and how this leads policymakers to impose mitigation rules which create other kind of market distortions.

[37] The new European regulation concerns both electricity and gas but only high voltage/long distance transmission networks. The distribution networks are subject to the 2nd Energy Directives (2003).

[38] E.ON sold its high-voltage transmission network to the Dutch state-owned TSO (TenneT).

Part of the lack of investment in interconnections can be explained by conflicts of interest within vertically integrated utilities. Strategic response by agents with market power may oppose investment objectives. This was one of the most important assumptions of the 3rd Energy Package, namely the EC initial proposal on ownership unbundling and also on the powers attributed to the Agency for the Cooperation of Energy Regulators (ACER) created by the Regulation (EC) No. 713/2009 of the European Parliament and of the Council of 13 July 2009. It will be ACER which will ensure the regulatory oversight of cross-border issues.

There were two basic assumptions of the 3rd Energy Package: (i) vertically integrated firms do not want to expand their own networks into markets where they are not currently competitive players or where their expectations to become competitors are small; (ii) the second assumption is a corollary of the former: a network expansion would mean new rivals in their own national market.

As we have already mentioned, the EC used some empirical evidence to support the argument that ownership unbundling would increase network investment and thus improve competition in national markets: 13 Member States had already implemented ownership unbundling in electricity. Having transmission as their only business, those companies acted accordingly to their business profile: of companies using auctions to ration congested capacity, those which were unbundled reinvested 33% of congestion auction revenue into new capacity investments. Instead, bundled companies only reinvested 17%. Meanwhile, it was also admitted that there was empirical evidence on the decline of network investment along transition periods due to the ownership unbundling regime (Buchan, 2007).

In the absence of sound empirical evidence, it is worth asking if ownership unbundling really matters in which concerns network expansion. It seems clear that the most important driver of real investments is the expected rate of return. At the same time, major risks of network investments are undoubtedly connected to regulation and political instability. In Europe, we would say that regulatory risk may be is assumed the most serious risk.

Forecasting future investment needs (and costs) for electricity network business is highly problematic, as asymmetric information between the regulator and the firm is the core question. This has always been one of the most complicated challenges to regulation, as asymmetric information is also associated to adverse selection problems (Joskow, 2008). Regulatory changes are expected to be implemented on transmission but also on distribution. Incentive regulation and incentive regulatory mechanisms are complex variables to be taken into account by network investors.

The effective capacity of ACER to intervene at cross-border level will be crucial to create a stable regulatory framework for cross-border investments, and to decrease or minimize the regulatory risk. Regulatory stability is crucial to facilitate investments and these are a main driver of market integration and competition improvement. ACER will become fully operational in March 2011 and it is expected that it will provide a framework at EU level for national regulators to cooperate.

However, as the final compromise on ACER covered mainly cross-border issues – although redressing the regulatory gap on cross-border issues and providing regulatory oversight of the cooperation between transmission system operators – its effective capacity to fulfill the unbundling legislation ambitious goals remain dubious.

From a dynamic perspective, corporate investment decisions under any model can have an impact on end-user prices. Over - investments unnecessarily charge capital costs, which drive up network charges. Network under-investments into the grid are directly linked to network congestion which increases congestion management costs but also reduces market competition. Notwithstanding, out of the three unbundling options, it is the (Deep) ISO model which may bring about some specific problems concerning investment. Some authors[39] call such problems "*strategic investment withholding*". Basically, the starting point is the double goal of the unbundling regulation: to strengthen cross-border interconnector capacity (allowing more trade) and to increase market competition. The "*strategic investment withholding*" is but the EC argument that vertically integrated utilities would not have adequate incentives to invest on cross-border connections as this could decrease their market power as incumbents. How can this apply to the (deep) ISO model?

In the Independent System Operator option, although the ownership of transmission and generation assets can be integrated, there is a full separation between system operations and transmission facility ownership, investment and maintenance, and the ownership of both generation and marketing businesses as well. This means that the ISO does not own (nor maintain) transmission assets, but it has the responsibility for scheduling and dispatching generation and load. In performing such tasks, the ISO is the entity which manages the allocation of the (scarce) transmission capacity. Moreover, when an ISO have the authority to define and to decide on new network investments ("*deep*" ISO) it can apply the "*investment obligation*" to the Transmission Operator. Then, this model transfers the capacity and authority concerning network investments from the Transmission Operator to the ISO which will engage a rather uncommon situation where the decision-maker and the risk-taker – the investor - will become different entities. A possible solution to this problem would be to tender the investment projects. In this case, there would be also the participation of a third party in the tender and the Transmission Operator would not be forced to invest. Anyway, this could not completely solve the problem: although tendered transmission investments can be very convenient for most of new, large projects, yet non-separable investments (network upgrading, for example) could not be easy to handle.

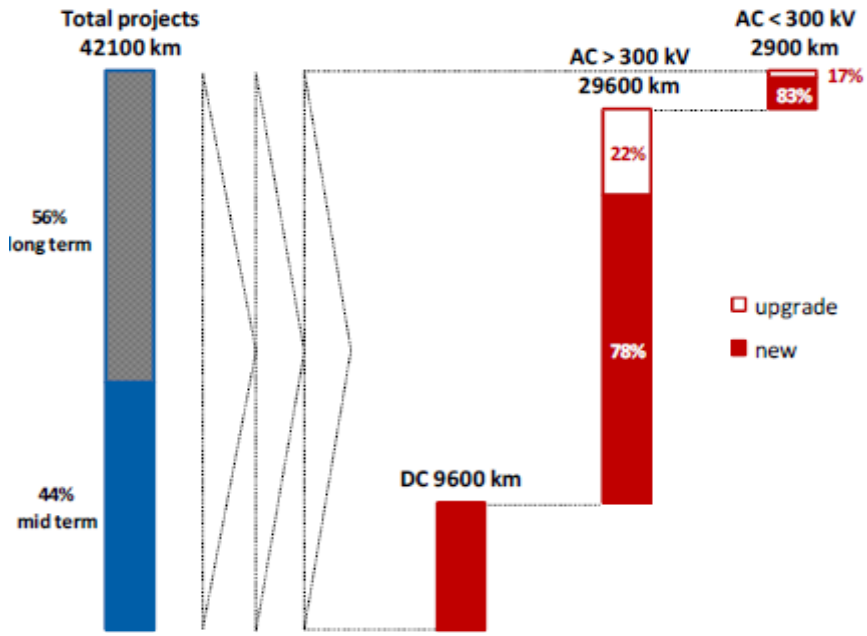
However, even under a theoretical perspective, the "*strategic investment withholding*" argument may be not straightforward. When a vertically integrated utility has a short generation capacity compared to retail, then it may be eventually

[39] For example, Özdemir *et al.* (2009), Pielow *et al.* (2008) and Balmert and Brunekreeft (2009).

interested in increased cross-border capacity in order to purchase power. The same applies when the incumbent integrated utilities have excess capacity and low variable costs (Balmert and Brunekreeft, 2009).

It seems clear that the increasing complexity of the European Energy Market, namely its transmission system will probably require a strengthening of the monitoring and intervention capacity of European agencies in the next years. The system deals with 42 TSOs from 34 countries and the power system serves 525 million citizens, generates 828 GW and involves 305,000 km of transmission lines managed by the TSOs. The demand is about 3,4000 TWh/year and exchanges attain 400 TWh/year which means less than 12% of demand. Total infrastructure investment needs to attain the EU goals for 2020 amount to 35,000 km of new transmission lines and upgrades of 7,000 km of existing lines across 34 European countries. It is widely recognized that the EU network systems require significant upgrade, replacement and addition of infrastructure to ensure a reliable electricity delivery and supply, in particular to integrate the increasingly deployed renewable energy sources.

Figure 3. EU Network investment needs (2010-2020)



Source: Dobbeni (2010)

New transmission investment projects must answer the three main drivers of the EU energy policy: security of supply (SoS), integration of renewable energy sources (RES) and the completion of the Internal Energy Market (IEM).

Most probably, electricity generation from renewable sources will have to be higher than the 20% share planned for 2020, as transport and heating are not

expected to attain EU energy and climate targets by then. Some studies indicate a share of 30 to 35% of electricity generation from RES that must be reached in 2020 which represents a huge challenge for the European network because it will have to balance large amounts of variable renewable power from a lot of distributed generator plants.

Current electricity transmission and distribution systems were designed over 40 years ago to serve large, centralized conventional power plants. The new power system is planned to be built on micro-grids and smart grids that use advanced communication and control technologies to connect and distribute small renewable energy generators. As a consequence, those intelligent grids will have to be linked up into a super grid by building new interconnections. This will guarantee the security of supply at all times by transporting large energy leads across regions (EREC and Greenpeace International, 2010). However, to attain such targets, a massive investment on R&D, namely on Information Technology (IT), involving all stakeholders and an active EC participation and funding must be accomplished.

5. Conclusions

The two networks under analysis have quite different features which naturally impose diverse regulatory options. Electricity is a single product industry while in communications there is a proliferation of services, with an increasing degree of complementarily. Additionally, the rate of technological innovation is quite different among these sectors. In communication sector there is an increasing high rate of new services, new networks functionalities and, more recently, the convergence of networks. This rapidly changing environment reshapes competition features and demands specific regulatory approach. Meanwhile, in the last decade, the electricity sector has been experiencing an innovation dynamic on generation that is now leading to a deep revolution on the grids.

Regarding the unbundling issue, we conclude that the regulatory policy in communications is much less mandatory than in electricity. In order to promote competition the European regulators follow a policy of mandatory network access. Only recently we observe functional separation of some incumbent firms to enhance competition and until now there is no recent case of ownership or structural separation in the major telecommunications firms (Cave and Hatta, 2009).

The electricity industry innovation rate has also been much lower than for the communications. This feature certainly contributes for the deeper implementation of the unbundling process. Meanwhile, the sector technical characteristics maintain, at least until the IEM is accomplished, the need for a strict unbundling regulation, reinforced by the innovation effort at the network level. Therefore, the regulatory experience in this sector, in particular the identification of the problems with functional and legal unbundling, brings important lessons for the communications' regulatory policy, namely:

(i) The evaluation of costs associated to the formation of a new ITSO firm. Beyond initial costs, there are also additional costs for (high quality data) information systems. Social and cultural costs may also be remarkable as the negotiation with stakeholders may be rather complicated. The costs from the loss of scale economies for those firms that were previously integrated will be very high.

(ii) Between 2000 and 2009, the electricity sector has been an important player in the merger business. As refereed by Pollitt (2009) at the beginning of this year, vertical integration has increased, either within the electricity sector or by convergent mergers (through the acquisition of gas assets). This trend has created a new scenario opposite to the EC unbundling measures. A similar corporate move may be plausible in the telecommunications sector.

(iii) The empowerment of the European Agency for the Cooperation of Energy Regulators (ACER) is pivotal for successful market integration and for competition. Therefore, the final compromise on ACER almost as an advisory role - to TSOs, national regulatory boards, the European Commission, the European Council and the EU Parliament - may become a strategic error. The same reasoning applies to the BEREC.

(iv) Under-investment is linked to network congestion and to adverse selection. Some unbundling models may involve an increased regulatory burden on companies and their investment strategies that can compromise their expectations.

The solutions to these problems certainly will be important insights to the communications sector, in particular the answers to promote the investment. Until now, most of the European countries implemented accounting separation. Some also implemented functional separation (UK, and more recently, Sweden and Italy). This path approximates communications to the electricity sector. However, with the recent changes introduced by NGN the old questions of vertical separation emerged once again, especially the ones related to market power and the incentives to invest. Some claim that, with competing networks, vertical separation might no longer be defendable. Others still strengthen the advantages of vertical separation, arguing that the alternative technologies had not yet created real competition in the market. We conclude that the analysis of the competition level between operators that combine different technologies is a crucial step to discuss the regulatory options on unbundling in the communications sector. Overall, it is worth to stress that communication regulators can extract important knowledge from the experience with ownership separation in the electricity markets.

Appendix

Table I. Broadband lines by countries, July 2009

Countries	Total	
	lines	%
Austria	1818547	1,52
Belgium	3041315	2,55
Bulgaria	905340	0,76
Cyprus	166681	0,14
Czech Republic	1867535	1,56
Denmark	2049975	1,72
Estonia	352739	0,30
Finland	1626700	1,36
France	18763211	15,72
Germany	24100288	20,19
Greece	1753434	1,47
Hungary	1728021	1,45
Ireland	948814	0,79
Italy	11888074	9,96
Latvia	394973	0,33
Lithuania	609408	0,51
Luxembourg	153995	0,13
Malta	108554	0,09
Netherlands	6221800	5,21
Poland	4898277	4,10
Portugal	1868453	1,57
Romania	2649371	2,22
Slovakia	772024	0,65
Slovenia	449024	0,38
Spain	9477901	7,94
Sweden	3009978	2,52
United Kingdom	17756507	14,87
Total	119380939	100,00

Source: EC (2009b)

Table II. Concentration in the wholesale electricity markets in Europe (2006/2007)

	Number of companies with more than 5 % share of generation capacity (%)			Share of 3 biggest companies (%)			HHI		
	2006	2007	Δ	2006	2007	Δ	2006	2007	Δ
Austria	5	5	0	52,2	52	-0,2	1575	NA	
Belgium	2	2	0	93	99,9	6,9	6500	8390	1890
Bulgaria	6	6	0	56,4	56,4	0	NA	NA	
Cyprus	1	1	0	100	100	0			0
Czech Republic	1	1	0	73,54	76,85	3,31	NA	NA	
Denmark	2	2	0	75	75	0	NA	NA	
Estonia	1	1	0	99	99	0	NAP		
Finland	4	4	0	67	68	1	NA	NA	
France	1	1	0	93	93	0	7589	6960	-629
Germany	5	4	-1	68,52	85,4	16,88	NA	NA	
Greece	1	1	0	99	NA		NA	1000	
Hungary	6	5	-1	67	67	0	1825	2119	294
Ireland	4			72			4773		
Italy	5	5	0	66,3	61,2	-5,1	2265	2126	-139
Latvia	1	1	0	95	93	-2	8110	8110	0
Lithuania	3	3	0	84	84	0	3285	3160	-125
Luxembourg	3	3	0	74,8	80	5,2	4020	5843	1823
Malta									
Norway	5	6	1	43,7	40	-3,7	1997	NA	
Poland	6	5	-1	62,8	50,9	-11,9	1789	1312,7	-476,3
Portugal	3	2	-1	75	72,5	-2,5	4612	4472	-140
Romania	5	5	0	65,1	63,7	-1,4	1890	1813	-77
Slovak Republic	1	1	0	84,8	85,2	0,4	7207	NA	
Slovenia	3	3	0	89,8	92,7	2,9	5224	7208	1984
Spain	4	5	1	60,3	76	15,7	1843	2269	426
Sweden	3	3	0	79	78	-1	880	NA	
The Netherlands	4	6	2	62	61	-1	1604	1592	-12
United Kingdom	6	8	2	37,5	41	3,5	938	986	48

Source: EC(2009)

Table III. Concentration in the retail electricity markets in Europe (2006/2007)

	Number of independent suppliers (%)			Companies with market share over 5% (%)			Market share of three largest companies in whole retail market (%)		
	2006	2007	Δ	2006	2007	Δ	2006	2007	Δ
Austria	3	3	0	7	7	0	80	80	0
Belgium	18	18	0	3	4	1	NA	NA	
Bulgaria	4	4	0	3	3	0	97,5	97,5	0
Cyprus	0	0	0	1	1	0	100	100	0
Czech Republic	285	282	-3	3	3	0	NA	99	
Denmark	5	9	4	8	7	-1	NA	NA	
Estonia	3	3	0	1	1	0	99	99	0
Finland	5	5	0	4	4	0	40	40	0
France	17	18	1	1	1	0	NA	94	
Germany	NA	NA		3	3	0	45,7	46,1	0,4
Greece	24	25	1	1	1	0	100	100	0
Hungary	11	12	1	4	4	0	85,57	87,18	1,61
Ireland	7	7	0	4	4	0	85	85	0
Italy	213	NA		4	3	-1	26,9	60	33,1
Latvia	8	8	0	1	1	0	100	97	-3
Lithuania	17	18	1	1	1	0	100	100	0
Luxembourg	2	3	1	4	3	-1	NA	93	
Malta									
Norway	5	5	0	5	5	0	35,7	31,2	-4,5
Poland	21	27	6	6	6	0	NA	44,9	
Portugal	3	3	0	3	2	-1	98,5	99,6	1,1
Romania	140	117	-23	5	5	0	43	44	1
Slovak Republic	140	151	11	3	3	0	NA	35	
Slovenia	8	14	6	6	7	1	71	68	-3
Spain	12	24	12	5	4	-1	67,5	83,9	16,4
Sweden	10	10	0	3	3	0	49,8	NA	
The Netherlands	20	22	2	4	4	0	NA	NA	
United Kingdom	16	21	5	6	6	0	NA	NA	

Source: EC(2009)

Table IV. Concentration (in terms of capacity) in the wholesale electricity markets in Europe (2007/2008)

ELECTRICITY	Number of companies with more than 5 % share of generation capacity (%)			Share of 3 biggest companies (by capacity) (%)			HHI (by capacity)		
	2007	2008	Δ	2007	2008	Δ	2007	2008	Δ
Austria	5	6	1	51,2	50	-1,2	NAP	NAP	
Belgium	2	2	0	99,9	97,5	-2,4	8390	7206	-1184
Bulgaria	6	6	0	56,4	56,4	0	NA	NA	
Cyprus	1	1	0	100	100	0	1	1	0
Czech Republic	1	1	0	76,85	75,31	-1,54	NA	NA	
Denmark	2	2	0	75	75	0	NA	NA	
Estonia	1	1	0	99	99	0	NAP	NAP	
Finland	4	4	0	68	68	0	NA	NA	
France	1	1	0	93	93	0	6960	NA	
Germany	4	4	0	85,4	84,7	-0,7	NA	2008	
Great Britain	8	8	0	41	42	1	986	901	-85
Greece	1	1	0	NA	NA		10000	10000	0
Hungary	5	5	0	67	67,9	0,9	2119	1911	-208
Ireland	5	4	-1	71	86	15	NA	NA	
Italy	5	5	0	61,2	57,6	-3,6	2126	1351	-775
Latvia	1	1	0	93	94	1	8110	8110	0
Lithuania	3	3	0	84	85	1	3160	3095	-65
Luxembourg	3	3	0	80	79	-1	5843	5682	-161
Malta						0			
Northern Ireland	NAP	4		NAP	86		NAP	4096	
Norway	6	6	0	40	43	3	NA	1826	
Poland	5	5	0	50,9	52,5	1,6	1312,7	1363,3	50,6
Portugal	2	2	0	72,5	72,2	-0,3	4472	4521	49
Romania	5	5	0	63,7	70,98	7,28	1813	2116	303
Slovak Republic	1	1	0	85,2	83,9	-1,3	6930	5019,922	-1910,08
Slovenia	3	3	0	92,7	92,5	-0,2	7208	4369	-2839
Spain	5	5	0	76	72,9	-3,1	1827	1716	-111
Sweden	3	3	0	78	74,7	-3,3	NA	NA	
The Netherlands	6	4	-2	61	69,9	8,9	1592	1551	-41

Source: EC (2009)

Table V. Concentration in the retail electricity markets in Europe (2007/2008)

ELECTRICITY	Number of nationwide suppliers	Companies with market share over 5% in the whole retail market (%)			Market share of three largest companies in whole retail market (%)		
	2008	2007	2008	Δ	2007	2008	Δ
Austria	10	7	6	-1	64	62	-2
Belgium	12	4	NA	1	NA	NA	NA
Bulgaria	1	3	3	0	97,5	97,5	0
Cyprus	1	1	1	0	100	100	0
Czech Republic	310	3	3	0	99	99	0
Denmark	16	7	7	0	NA	NA	
Estonia	3	1	1	0	99	99	0
Finland	25	4	4	0	40	40	0
France	17	1	1	0	94	97	3
Germany	17	3	3	0	46,1	52	5,9
Great Britain	17	NA	NA		NA	NA	
Greece	37	1	1	0	100	100	0
Hungary	78	4	4	0	87,18	80,73	-6,45
Ireland	9	4	4	0	85	84	-1
Italy	23	3	3	0	60	59	-1
Latvia	2	1	1	0	100	100	0
Lithuania	2	1	1	0	100	100	0
Luxembourg	7	3	4	1	93	94	1
Malta							
Northern Ireland	18	NAP	4		NAP	90	
Norway	26	5	5	0	31,2	36	4,8
Poland	19	6	6	0	44,9	44,3	-0,6
Portugal	4	2	2	0	99,6	99,6	0
Romania	138	5	5	0	44	48	4
Slovak Republic	176	3	3	0	35	60	25
Slovenia	13	7	7	0	68	58	-10
Spain	75	4	4	0	83,9	84,8	0,9
Sweden	104	3	3	0	NA	NA	
The Netherlands	21	4	4	0	NA	NA	

Source: EC (2009)

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