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Functional separation in telecommunications:

A comparative analysis of infrastructural areas

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Abstract

During the past 20 to 30 years, public utilities have been subject to market reforms in most parts of the world. Liberalisation has been introduced to improve efficiency in terms of lower costs and more and better services. The subject of this paper is the Danish reforms of its public utilities. The focus is on the utilities where the reforms were first introduced, i.e. telecommunications and electricity. The paper examines the following questions: Which are the main reasons for the different regulatory approaches to the liberalisation of telecommunications and electricity supply? In which direction is the regulation of the two industries developing presently? Furthermore, to what extent have the policies implemented been successful? Finally, is there a relationship between the modes of regulation and the rates of success in the two sectors?

The basic answers in the paper are that the differences in regulation primarily rest on the differences in the techno-economic structures of the two industries, but that some degree of convergence between the modes of regulation has occurred lately. With respect to the rate of success, the achievements are most obvious in telecommunications where consumers benefit from lower prices and more options, while the gains are more debatable in the case of electricity. Regarding the relationship between the modes of regulation and the rates of success, the overall answer is that there is a stronger relationship between the techno-economic structures of the two sectors, on the one hand, and the modes of regulation and rates of success respectively, on the other hand, than between the different modes of regulation and the rates of success.

1. Introduction

During the past 20 to 30 years, public utilities have been subject to market reforms in most parts of the world. The terms used to characterise the reforms have been several, but all point in the same direction: liberalisation, privatisation, and re-regulation followed by de-regulation. The former system of regulated monopolies and many utilities organised as public enterprises was criticised by

politicians, political scientists and economists as being inefficient. The restructuring of public utilities has now been in place since the nineties - in some countries even longer - and the time has come to evaluate its outcome.

An account of the Danish reforms of telecommunications and electricity – the first two public utility industries to liberalise – is presented in this paper. The paper examines the following questions: Which are the main reasons for the different regulatory approaches to the liberalisation of telecommunications and electricity provision? In which direction is the regulation of the two industries developing presently? Furthermore, to what extent have the policies implemented been successful? Finally, is there a relationship between the modes of regulation and the rates of success in the two industries?

In the second section of the paper follows a discussion of the main theoretical arguments for choosing different market structures for the liberalised utilities. In the subsequent section, the more specific regulatory models in the two utility industries are discussed after which follows a summary of the possible reasons for the choice of different models. In the following part, an assessment of the Danish reforms is presented. Finally, before the conclusion, the latest developments in the economic and regulatory structures in the two industries are examined.

2. Vertical separation vs. regulated access

The basic objective of a utility reform is increased economic efficiency. Public utilities are composed of a *network infrastructure*, which is necessary to access customers and provide them with services (here telecommunications and electricity) and the *services* themselves. Before liberalisation, these services were provided by vertically integrated monopolies with exclusive rights. To avoid abuses of their market power, prices and service conditions were regulated.

The argument behind this type of organisation was natural monopoly, i.e. that due to significant economies of scale and scope it is more economic to serve the market in question by just one instead of several suppliers. That argument was criticised as flawed and the critique was supported by a number of concrete analyses of existing public utility markets ([see Baumol et al. 1982; and](#)

Vickers and Yarrow 1988). The integrated monopoly approach to utility organisation was now considered to be inefficient.

The radical solution – a complete liberalisation without any sector-specific regulation – was not considered appropriate for public utilities. The network infrastructures still have elements of natural monopoly characteristics, to different extents. For electricity this is quite obvious, whereas it can be debated for telecommunications. However, without regulation, access to the network infrastructure of the incumbent telecom operator was not realistic and it was – at least in the short run – not economic to bypass it.

Competition theory indicates that horizontal integration will create problems for competition, but that vertical integration only can become a problem in combination with horizontal integration (see Perry 1989). However, as the network infrastructure continues to be operated as a (quasi) monopoly, vertical integration is a problem for public utilities. There is, therefore, an issue to be solved with respect to the relationship between the infrastructure level and the service level.

There are two basic means to deal with this problem and to secure access of competing service providers (Newbury 1999):

- *Vertical separation*: the network and service activities of incumbent utilities are unbundled and separated into independent enterprises.
- *Regulated access*: the incumbent utility continues as a vertically integrated enterprise, but access to its infrastructure is facilitated by public regulation.

With vertical separation, the network operators no longer have any economic interest in particular service providers and can thus be expected to behave as impartial actors. An independent regulator should check that this is actually taking place.

With respect to regulated access, the objective is to ensure that downstream firms can make use of upstream services on equal terms so that they are able to compete with integrated companies. Regulatory remedies supporting this objective include obligation to allow access, non-discrimination, and price control.

In addition to these two basic means, there are different intermediate approaches. Vertical separation can take, at least, three different forms (fig. 1). Ownership unbundling is the EU term for full unbundling and includes a complete separation of upstream and downstream activities. Legal unbundling requires that upstream and downstream activities are separated into different firms, but common ownership is allowed. Accounting separation allows integrated companies to remain, but demands that the costs and revenues related to downstream and upstream activities are made transparent by the use of separate accounts.

Figure: 1 Types of vertical separation

Ownership Unbundling	Represents full unbundling. Upstream and downstream activities are separated in two or more entirely separate firms
Legal unbundling	Upstream and downstream activities are carried out by separate companies, but the upstream firm and one or more downstream firms may be owned by a single entity.
Accounting separation	Is the mildest form of vertical separation. Upstream and downstream activities may take place within the same company, but separate accounts must be prepared for each activity in order to make the conditions for use of upstream services and facilities transparent to the regulator so cross-subsidisation can be avoided.

Source: Inspired by (Cremer, Cremer et al. 2008)

The choice of reform instrument to apply - vertical separation or regulated access or something in-between - differs among utilities and among countries. Nevertheless, there appears to have been a clear tendency to apply unbundling for energy and regulated access for communications. The reason for this difference is the conception of the technical and economic properties of the network infrastructures. The transmission and distribution network in electricity continues to be a true natural monopoly, which is not the case for telecommunications, where the present infrastructure monopoly is contested by competing infrastructures in the future.

An additional argument for choosing regulated access in telecommunications has been the far from clear-cut distinction between network and services and the related cost structure of the network. For this reason, any delineation of a natural monopoly network must be considered provisional and runs

the risk of creating hindrances for the introduction of new services and for new ways of providing existing services.

The techno-economic nature of the dependency of services on the infrastructure is very different in the electricity supply industry. Through a common network the consumers are supplied with electrical energy, which is produced at a number of ‘factories’ (power plants) applying different technologies. It is not important for the consumer to get the electrical energy from the generator company with which s/he has signed a supply contract. Therefore, it is straightforward to separate the physical supply from the contract structure organising the financial flows and to implement vertical separation of generation and sales from the transmission and distribution networks. In telecommunications, on the other hand, each unit of communication must be controlled physically and charged individually.

The different approaches to liberalisation in the two utility industries require different approaches to the principles and design of regulation applied in the new market based context. This regulation addresses the conditions for competing service providers to use the incumbent infrastructure and thus access the final customers. It further includes regulation of the pricing of the services offered by the (temporary or permanent) infrastructure incumbent. Finally, specific regulations such as consumer and environmental protection should be compatible with the new market framework.

3. Regulatory models

In this section, the specific developments in respectively telecommunications and electricity supply are presented with respect to the regulation of the two industries.

3.1 Telecommunications

In telecommunications, regulation of access has been the most important remedy to facilitate competition. In the US, one of the early initiatives promoting competition was the divestiture of AT&T in 1984. In this process, operation of local and long distance communications were separated into different companies. However, infrastructure provision and service provision remained

integrated, and the divestiture has partly been nullified through a number of mergers following the divestiture.

In Europe, the incumbent telecom operators were most often owned by the Government. It was, therefore, a possibility to divest operators into two or more companies before a privatisation. In Denmark, Tele Denmark (later TDC) argued against such a separation and the preference was to establish an integrated entity. An argument at that time was that it was important to ensure a dominant Danish player on the national telecom market. In addition to this, a vertical separation of networks of services would involve substantial technical difficulties. Therefore, Tele Denmark was privatised as one integrated company. The privatization took place in two rounds: In 1994, the Government reduced its ownership share to 51% by an emission of parts of its shares on international stock exchanges. The majority of the shares were bought by international – mainly American – institutional investors. In 1997 and 1998, the company was entirely privatised by the sale of shares to Ameritech.

Most European countries have followed a similar route towards privatisation, and former state owned monopolies are now privatised as fully integrated telecom operators. In 2004, the issue of structural separation was taken up in UK, and in 2005 OFCOM (the UK communications regulatory agency) accepted that the issue was resolved by the creation of a separate BT division called Access Service Division (ASD). In addition, an Equivalent of Access Board is set up to ensure that ASD provides wholesale services on non-discriminatory terms. Similar undertakings are seen in Australia, where Telstra is required to implement an operational separation of its wholesale activities.

The present EU regulatory framework requires national regulators to conduct market studies for 18 different telecom markets (market segments). In the latest European Commission suggestions for a renewed EU communications regulatory framework, the number of markets is significantly reduced. On markets, where real competition is limited by the existence of one or more operators with a significant market power (SMP), it is allowed to impose one or more regulatory remedies. These remedies include (ERG, 2003):

- Transparency

- Non-discrimination
 - Provide equivalent conditions to 3rd party
- Accounting separation
- Access obligation
 - SMP must meet reasonable requests for access to, and use of, specific network elements and associated facilities
- Price control and cost accounting
- Retail obligations - provide good quality services
 - "Regulatory controls on retail services can only be imposed where relevant wholesale or related measures would fail to achieve the objective of ensuring effective competition."

Accounting separation includes an obligation to make transparent the internal transfer prices to the regulated firm's own downstream operation to ensure compliance with a non-discrimination obligation or to 'prevent unfair cross-subsidies'. NRAs (National Regulatory Agencies) have the discretion to specify the format and accounting methodology to be used (ERG, 2003).

In Denmark as well as in a number of other EU countries, accounting separation is used as one out of a number of regulatory remedies imposed on markets, where regulatory intervention is deemed necessary. However, emphasis is on obligation to provide access and price control based on cost accounting. Four different methods are applied:

- 1) Historical costs
- 2) Best practise
- 3) Retail price minus saved retail costs
- 4) Long Run Average Incremental Costs (LRAIC)

As being the theoretically most correct approach, LRAIC is the preferred method. However, construction of models for calculating LRAIC is a time consuming process. Therefore, LRAIC models are available for the most important interconnection products only.

Although competition in most of the retail markets is very limited, competition regulation is restricted to the wholesale markets. The idea is that competition in wholesale will foster competition in retail as well. The markets for wholesale inter-exchange network services are considered to be competitive and regulation has been withdrawn from these markets. Most of the remaining markets are, however, subject to regulatory intervention.

In the wholesale markets for access, termination, unbundled access, broadband access, and terminating segments, TDC is required to grant open access to its competitors at regulated prices and TDC must provide separate accounts for these activities (accounting separation). In the market for access, one of the competitors (Tele2) is obliged to provide open access as well, but not at regulated prices, and accounting separation is not required.

In the mobile market, only mobile termination is regulated. The two dominant operators, TDC and Sonofon (Telenor), were until recently required to provide open access and separate accounts. This intervention has been replaced by a demand to all operators to provide open access at regulated prices.

It follows that Danish telecom regulation focuses on ensuring provision of open access at cost based prices. Accounting separation is required mainly in order to enable the regulator to control that prices are cost based and that no cross-subsidisation takes place.

Structural separation as a remedy to obtain a division between upstream and downstream activities is not currently used. The development on the market for ADSL-services has, however, indicated that the present regulation is incapable of creating real competition in this market. In contrast to switched interconnection, the wholesale services are in this case so complicated that it is very difficult to ensure equal treatment of all operators through regulation. It has, therefore, been proposed to follow the example of UK and enforce some kind of structural separation.

3.2 Electricity

The liberalisation of the electricity supply industry has mainly followed the model of vertical separation. In the first European market directive from 1996 this model was recommended and

made close to mandatory in the second market directive from 2003. The Electricity Act passed by the Danish Parliament in June 1999 followed the recommendation in the first directive (Grohnheit and Olsen, 2002). The liberalisation model was adapted from the earlier reforms in Norway, Sweden, Finland and the UK, which were designed and implemented independently of the European directive. By this choice Denmark was from the beginning placed among the European avant-garde (Amundsen et al., 2006) and fulfilled most of the obligations to be stipulated in the revised market directive from 2003:

- Vertical separation of generation and transmission system operations in independent companies. To begin with, unbundling was legal, preserving common ownership of the operation of generation and transmission systems. Later, transmission systems' operations were taken over by a new state company.
- Vertical separation of retail supply and distribution networks – also preserving legal common ownership.
- Regulated third-party access applying one-stop shopping principles. The opening of the market was gradual - by January 2003 all customers got third-party access.
- Incentive regulation was introduced for the transmission and distribution networks.
- Authorisation procedure for new capacity, allowing all interested parties to have their projects evaluated on equal terms.

With respect to organisation, the electricity wholesale and retail markets were already separated into different enterprises at the time of liberalisation. To achieve the required unbundling, it was only necessary to divest generation from transmission at the wholesale level and sales from the operation of the distribution network at the retail level.

The organisation of retail sales constituted a specific problem. From 2000 to 2003, a (decreasing) number of final customers did not have third party access and, therefore, continued to be supplied on monopoly conditions. In each supply area, a supply license was issued to a special supply obligation company to provide these customers with electricity at regulated prices. When low voltage customers got third party access in 2003 the supply obligation companies continued offering supply at regulated prices to those customers not wanting to be active on the market.

Nearly every low voltage customer has since then chosen this option thus excluding retail competition on this part of the market.

An independent regulatory board, the Danish Energy Regulatory Authority, was established with its members recruited from outside the ministerial system. It regulates access conditions and network tariffs as well as the prices offered by the supply obligation companies. Incentive regulation in the form of revenue cap regulation was introduced for the grid operators (Sørensen, 2006).

After liberalisation, the generation of electricity was no longer regulated by the electricity act but only by the general clauses in the competition act. An exception was the renewable technologies (wind power, biomass and waste incineration) and local gas-fired co-generation that for a period continued to be supported by high feed-in tariffs paid by the consumers as 'public service obligations'. As these technologies increased their market share significantly the competitive market shrunk after liberalisation (from 68 % of total generation in 1999 to 55 % in 2005). They have later had their status changed and now sell their power on the market. To support these 'clean' technologies, they receive a subsidy per kWh produced.

4. Explaining the differences in liberalisation paths

In section 2, the differences in the approach to market structure and regulation between the two utility industries is explained by different technical conditions determining different market conditions. In telecommunications, the infrastructure monopoly of the incumbent telecom was considered temporary and, therefore, not sufficient to justify vertical separation of infrastructure and services. In addition, there appears to be significant economies of integration making it difficult to draw a clear borderline between network and services. A new service will normally require adaptations in different layers of the network that can be blocked by vertical separation. Different owners will sometimes have difficulties agreeing on the best solution and its implementation. That can be costly both in the short term (due to increased transaction costs and to an inferior solution) and in the long term due to a slower speed of the introduction of new services.

This problem is not really relevant in the electricity supply industry as it is easy to separate generation and supply from the transmission and distribution network infrastructure. The network infrastructure is a true natural monopoly that with the present technology is not to be substituted in

a foreseeable future. There are no or only small economies of vertical integration. On the contrary, it can be argued that diseconomies exist (at least in the long term) as continued vertical integration can inhibit access of new technologies as an incumbent integrated company will have a strong incentive to protect its existing power plants and the technologies it has already invested in.

Innovation is taking place as the introduction and diffusion of new generation technologies and of new network technologies and operating philosophies. New generation technologies are often introduced by independent companies and it is more likely that an independent network operator will accept to change and improve the network facilitating the access of these new technologies than an integrated operator.

The different approach to market structure can alternatively be explained by path dependency. This can apparently be the case with respect to Denmark, as telecommunications were (with a few exceptions) vertically integrated before liberalisation took place in the nineties, whereas the electricity supply industry was divided into wholesale (generation and transmission) and retail (distribution and supply of final customers) markets. The two levels were integrated by common ownership and by long-term contracts. But even though the distributors formally were the owners of the two regional generation and transmission companies the latter had through history gained the status as de facto independent entities.

If one broadens the perspective to include other countries, path dependency becomes a less convincing explanation. A number of countries both in Europe and elsewhere (North America) used to have vertically integrated, national or regional electric utilities. And still vertical separation has been the common model applied for the new liberalised market structure in the electricity supply industry.

5. Results of the liberalisation processes

In this section, the actual results in terms of services, prices and competition are presented regarding the two sectors. As it has turned out, it seems as if the liberalisation in telecommunications has been more successful than the liberalisation in the electricity area. A large number of new services have appeared in telecommunications and prices have dropped considerably in many areas to the

advantage of users. Regarding competition, it has been more difficult to create a really competitive market. Incumbents are still dominant. However, competitors gain market shares in an increasing number of market segments.

Electricity is a much more unitary service area than telecommunications. Basically, the service in electricity is electrical power supply. Therefore, the breadth of services is much more limited than in telecommunications though some kinds of service differentiation are possible. Another matter is that prices in the electricity area have not decreased as in telecommunications. This might indicate a competition problem, but may also be the result of for instance increasing fuel prices.

5.1 Telecommunications

The primary objective of the liberalisation reforms has been to create more competition in former monopoly markets, in order to improve market performance. In a report on the Danish telecom strategy published by The Danish Ministry of Research, this objective was formulated as being “best and cheapest by way of real competition” (Ministry of Research, 1995).

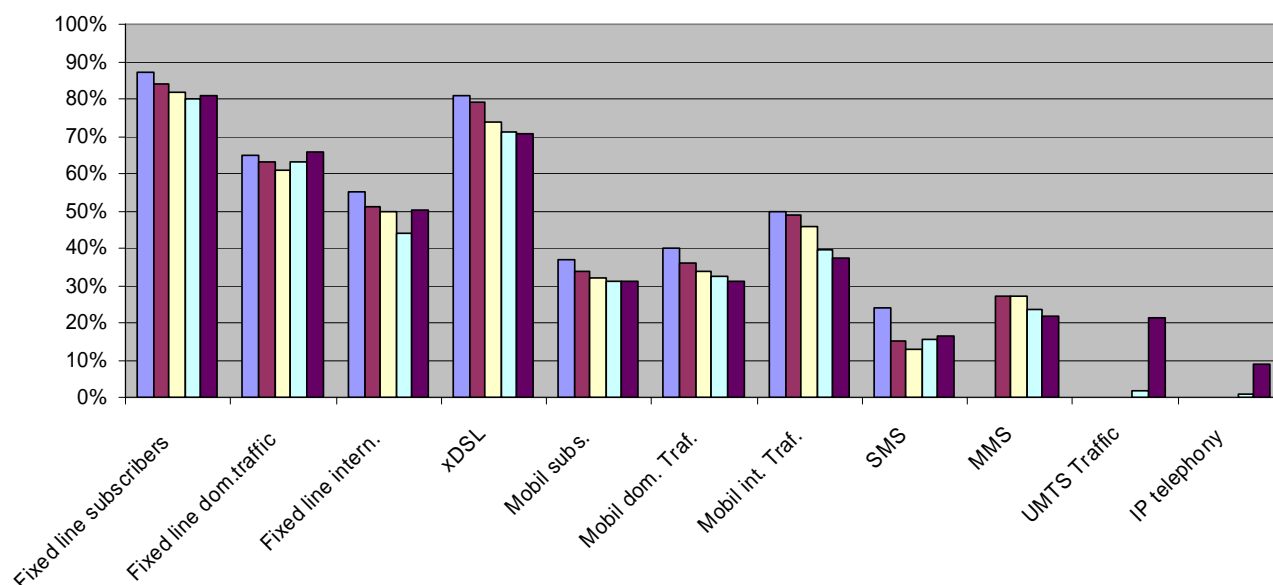
Therefore, the liberalisation reforms are evaluated against three different dimensions:

- The level of competition
- Development in prices (reflecting static efficiency)
- Development in new services (reflecting dynamic efficiency)

The telecommunications sector has undergone a profound development with regard to prices and development of new services. This development cannot be attributed to liberalisation reforms alone. It is, however, difficult to imagine that, for instance, the Internet would have been able to develop with the same speed in a monopolistic market.

Telecom markets have, indeed, become more competitive. However, it follows from figure 2 that the incumbent operator dominates all fixed network services. The figure indicates that in spite of a comparatively tight regulation of open access, it has been very difficult for operators depending solely on the TDC infrastructure to obtain significant market shares.

Figure 2 : TDC's market shares, 2002-2006



Source: (Falch, Henten et al., 2008)

In the mobile market, where four operators have their own infrastructure, competition is much more developed. It should be noted that most fixed services to a certain extent can be substituted by other services. Fixed telephony services can be substituted by mobile telephony and a large number of alternatives to xDSL for broadband access have been developed. Thus TDC's market share on the entire broadband market is 56% (Falch, Henten et al., 2008).

Prices of telecom services are declining. In particular new services such as ADSL have been subject to dramatic reductions: 70-80% in 1998-2007 (ITST, 2007). Charges for mobile services have also declined: 50-70% in the same period. These reductions are caused by reductions in the underlying costs due to technical advances and economies of scale gained by a high growth in the number of subscribers. However, in the mobile market price reductions are clearly related to increased competition as well, as price reductions took place immediately after the number of operators increased from two to four.

Investment activities are often used as an indicator for how a market innovates. From the initiation of the liberalisation in the mid nineties up to 2001, there was substantial growth in telecom investments in Denmark as well as in the rest of OECD. Thereafter, investments declined again to

the level in the mid nineties. Since then investments have recovered. The growth since 2001 is attributed to investments made by the new entrants, and in 2006 the investments in TDC's network only constituted 44% of the total (Falch, Henten et al., 2008).

The development of new services has clearly benefited from liberalisation of the telecom market. Many successful service innovations such as ADSL and cable modem were first introduced by new entrants. TDC has often been reluctant to introduce new services, if they could have a potential negative impact on the revenue earned from their existing services. ADSL harmed the development of ISDN and cable modem is competing with ADSL. The most recent example is VoIP – a service that probably will undermine the revenue of the fixed telephony.

The liberalisation reform has clearly contributed to a more dynamic telecom market. But the attempt to open up the market for downstream activities using the fixed network infrastructure has not been very successful so far. On the other hand, a number of alternative infrastructures – wireless or based on optical fibres - are being developed and create more competition in upstream as well as downstream markets.

5.2 Electricity

The development of the electricity market since liberalisation has been much more restricted than in telecommunications. The supply of electricity provides few opportunities for improving choice and service quality (Joskow, 2000). The main choice parameter is the supply contract and its risk profile. Large consumers can now get an individually designed contract, whereas smaller customers are offered a more restricted set (Johnsen et al., 2006). A future introduction of new meters allowing two-way communication will increase the possibilities for additional services such as monitoring of specific consumption to save energy and to decrease the bill by moving consumption to periods with low prices.

The reform forced the electricity supply industry to vertical separation of generation from transmission and of distribution from the supply of retail customers. However, most of the changes after liberalisation were only restructuring of the former distribution utilities. In contrast to telecommunications, very few new actors have come to the industry from the outside. Only in 2006

did a major change take place as the state-owned oil and gas company DONG took over a large part of generation from central stations (at that time having only one owner) as well as the two largest operators of distribution systems and a smaller one. The remaining part of central generation was taken over by the large Swedish state-owned company Vattenfall.

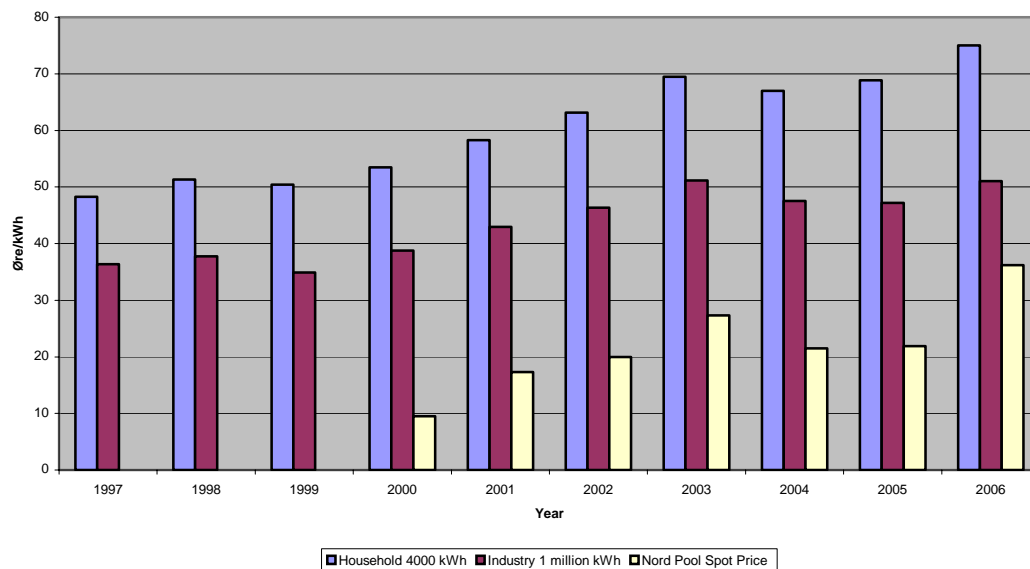
The concentration of generation has been the cause of several cases of abuse of market power on the wholesale market raised by the Danish competition authority against the dominant generator(s) and including most years after liberalisation. The first case (for 2000 and 2001) ended with an agreement obliging the generator to improve its behaviour with respect to the prices offered on the Nordic spot market and, in addition, to be more active as a market maker on the derivative CdF (Contract for Differences) market for hedging against spot price differences between the Nordic countries. The Competition Authority terminated the agreement in the summer 2005 and has later decided that the generator had abused its market power during the period 2003-2006 ([see Danish Competition Authority, 2005 and 2007](#)).

The retail market for larger customers (> 100,000 kWh annual consumption with meters allowing continuously reading) is relatively well developed and these customers will have access to 10-20 different suppliers. Many of them have exploited the opportunity to switch supplier and/or contract (Dansk Energi, 2007). The smaller customers (< 100,000 kWh annual consumption) have traditional meters and are charged according to the load profile of this group in each license area. These customers (households and small business enterprises) are overwhelmingly served by the supply obligation companies (see above) and have not considered switching supplier or contract. The supply obligation companies supply more than 50 per cent of the retail market (Johnsen et al. 2006).

Electricity prices have moved up and down since liberalisation. During the first two to three years, they were relatively low but have increased considerably since then (see figure 3). The higher prices are mainly explained by the wholesale prices on the Nordic market. There are several explanations of wholesale price increases: a more strained supply situation due to low rainfalls in several years in Norway and Sweden; increasing demand; higher fuel prices, and from 2005 the cost of CO₂-emissions permits. In addition, an increasing amount of the Danish power supply comes from prioritised and expensive generation such as renewable energy (wind energy and biomass co-

generation) and local gas-fired co-generation. These additional costs are included in the electricity price.

Figure 3: Consumer price* for households and manufacturing industry (1997-2006) and Nord Pool's spot price (2000-2006)



* Supply and grid prices excluding energy duties and VAT

Source: Own calculations based on the annual statistics of the Association of Danish Energy Companies and the monthly price report from the Danish Energy Regulatory Authority.

The revenue-cap regulation of network tariffs after liberalisation was supposed to increase efficiency but turned out to be a failure and was abolished in 2005. An indicator of the failure is that the distribution system operators didn't take out the full tariffs allowed by regulation. Despite of that, grid prices went up since liberalisation. There are several explanations for this failure: the regulator was inexperienced; the design of the accounting system was too complex and allowed too much negotiating power to the network companies; the initial political support of a tough approach to regulation soon vanished (Sørensen, 2006). During an interim period the operators were not allowed to raise prices in real terms. From 2008, a new system of revenue-cap regulation has been introduced.

6. New market and policy directions

In telecommunications, vertical separation has been discussed since the beginning of the liberalisation process. But it has mostly been turned down with the argument that networks and services are closely tied to one another in telecommunications. Vertical separation would in this situation be an impediment to service development and price reductions. Lately, however, vertical separation has come to the fore. The EU Commission in its latest review of regulations of telecommunications (November 2007) suggested making functional separation a part of the toolbox for regulators. The idea is not that functional separation should be widely required but that ‘the instrument of functional separation should be added to the remedies toolbox of national telecom regulators, to be available for the stubborn cases’, as stated by the European Commissioner Viviane Reding in a speech on October 2007 (Reding, 2007).

Adding to the toolbox of regulators and stubborn cases of national markets with too little competition is, however, not the only reason for the introduction of different kinds of vertical separation in telecommunications. Equally important is the technically based separation of the network layers and service layers. Formerly, telecommunication services would be delivered on dedicated networks – telephony on PSTN, data services on data networks, and television on cable networks. This, however, has changed with digital technology and has reached a new level with Next Generation Networks (NGN). Next Generation Networks are IP-based networks, where different types of services are carried on one and the same network infrastructure.

The implications of this technically based separation between network facilities and services are that different types of organisational separation also will become more prevalent. An example of this is the functional separation of BT in the UK. Another example is the incumbent operator TDC in Denmark, which has outsourced the operation of its fixed network to Ericsson and is on the way to outsource the operation of its mobile network. TDC will thus concentrate on its service provision. This development is not unique for TDC although the specific situation for TDC, which is being divested by private equity funds, may have speeded up the development in the case of TDC.

All in all, we are witnessing a development in direction of more functional separation in the telecommunications area. Furthermore, structural separation is also being considered, for instance

by the Icelandic telecom incumbent, Síminn, which has long planned to divest its infrastructure. Where accounting separation has been a traditional regulatory requirement as well as a management tool for company managements, functional separation will increasingly come to the fore in telecommunications, and even structural separation will be seen.

In the electricity supply industry, structural separation has, as shown in the paper, been the main track in liberalised markets. However, the development towards increased market concentration that is taking place also includes increased vertical integration, where the same companies increasingly will own both generation and distribution of electricity. It, therefore, seems that a certain convergence in the market structures of telecommunication markets and electricity markets is taking place. This does not mean that the basic market and regulatory structures described in the paper in respectively telecommunications and electricity are disappearing entirely. However, it means that neither the technical characteristics nor the regulatory provisions are stable and that a trend towards a convergence of the market and regulatory directions can be seen regarding telecommunications and electricity provision.

7. Conclusion

The aim of this paper is to examine the following questions: Which are the main reasons for the different regulatory approaches to the liberalisation of telecommunications and electricity provision? In which direction is the regulation of the two sectors developing presently? Furthermore, to what extent have the policies implemented been successful? Finally, is there a relationship between the modes of regulation and the rates of success in the two sectors?

The explanation presented in the paper regarding the differences in regulatory approaches is concerned with the different techno-economic characteristics of the two sectors. While it is perfectly possible to entirely separate the generation and distribution of electricity, the infrastructure and the services have been more interrelated in the telecommunications area. A vertical separation of telecommunications would, therefore, risk being a barrier to the development of new services. In the electricity area, on the other hand, vertical integration could limit innovations in generation technologies, as there would be less incentive to develop new generation technologies in a market with integrated companies than in a disintegrated market.

In addition, the distribution infrastructure in electricity is a true natural monopoly, whilst the natural monopoly features of the telecommunications infrastructure are diminishing, as different networks can deliver the same services because of the common digital technology base. Following the argument that vertical integration can only be a problem for competition if there is a monopoly in one of the horizontal layers in the value chain, vertical separation becomes more important in electricity than in telecommunications.

With respect to the present direction of the regulation of the two industries, the most fundamental technological changes are happening in telecommunications. The convergence between IT, telecoms and broadcasting has led to the development of Next Generation Networks, where a variety of different services are carried over a common network. This facilitates a separation between the network layers and the services, which accommodates functional and structural separation in telecommunications – either because companies see an interest in making these forms of division or because the regulatory authorities find it necessary in order to promote competition.

In the electricity supply industry, there are, indeed, innovations in generation technologies as well as in the pricing of services, for instance, but there are no fundamental technological changes affecting the market structure. However, market concentration in the generation market as well as the distribution market has been witnessed and ownership integration between the distribution and generation market has also become more prevalent. There thus seems to be a certain convergence in terms of vertical ownership integration/separation around functional separation – i.e. joint ownership but separation in different company units. This, however, has nothing to do with an ambition to develop a common regulatory platform for the different sectors, but is entirely due to the specific circumstances in the two different sectors analysed. Furthermore, this convergence between the market structures in telecommunications and electricity does not affect the basically different approaches and structures in the two industries.

Regarding the success or failure of the policies implemented, the experiences have been mixed and not always as expected by their advocates. The liberalisation of public utilities was introduced to improve efficiency in terms of lower costs and more and better services. The former system with vertically integrated monopolies and widespread public ownership was criticised as inefficient. In

the European Union, market reforms were introduced from the nineties and onwards. Sometimes it has been hard to open the utility markets for competition and in most cases market dominance by the incumbent operators has continued and is still considerable. In some cases consumers have got lower prices and more choices but not all consumers. The new ideas of independent regulators and incentive regulation have proved quite hard to implement.

The Danish experience of utility liberalisation does not deviate significantly from this general assessment. Compared to other member countries, the Danish authorities were relatively quick to decide and implement utility reforms and, in most cases, they have been ahead of the market opening required in the European market directives. The success is most obvious in telecommunications with many new operators and significantly lower prices and more service options for the consumers. In electricity the achievements are far less impressive. Some cost reductions have occurred and some new services been introduced but most of it on a very modest scale. New models for incentive regulation of the network operators have been tested but far from always met their objectives.

Taking these differences in the success rates into consideration, it would seem paradoxical that telecommunications (with some success in terms of competition, innovation and prices) seems to be developing in direction of functional and even structural separation as in the electricity area (where the success rate is lower). The question could be asked whether this difference in success rates is due to the different models of regulation applied. The answer to this question is no. The differences in the success rates of the two industries have much less to do with the differences in regulatory models than the differences in the basic techno-economic realities of these industries. It is difficult to conclude that one mode of regulation in general will be more successful than the other.

This also leads to a final conclusion: The fact that the liberalisation of telecommunications has been a relative success does not necessarily mean that there will be successes in all other infrastructural areas with policies of liberalisation. This depends on the specific techno-economic realities in the different industries, and the general policies of liberalisation should be adapted to the specific circumstances of the different industries.

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