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Structural separation and access in telecommunications markets

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STRUCTURAL SEPARATION AND ACCESS IN TELECOMMUNICATIONS MARKETS

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Abstract

This paper presents a basic framework to assess whether structural (vertical) separation is desirable. It is discussed within the setting of fixed telecommunications markets. From an economist's perspective, the key question that underlies the case for structural separation is: is there a persistent bottleneck? The obvious candidate is the 'local loop', or local access network. If yes then it makes sense to compare the costs and benefits of structural separation. The framework provides a set of options that the regulator can use strategically, by using the threat of a break-up to influence an incumbent's competitive stance in the wholesale market.

JEL Code: L96, L12, L4, L51.

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1. Introduction

Telecommunications markets have known great turmoil during the last decade.¹ A major promise of the European liberalization process in the 1990s was the rollout of local access networks.² In fact, underlying the liberalization of telecommunications markets was the belief that technological progress would end the natural-monopoly nature of the industry. Given the high expectations, however, the rollout of local networks has been disappointing or at best narrowly targeted, and at present throughout the European Union (EU), there is still relatively limited competition in the ‘local loop’. While operators found it worthwhile to connect offices in business districts and metropolitan areas, residential customers have been much less exposed to entrants with their own networks. Residential callers did, however, benefit from entry by firms without their own networks, purchasing capacity from incumbent operators and reselling it to end-users in order to offer voice telephony services (known as ‘Carrier Select’ services). Also, entry based on ‘local loop unbundling’ (LLU) did initially not demonstrate the growth that was expected.³ ⁴ Nevertheless, it turned out to be an effective means for entrants to offer broadband Internet access based on DSL technology.⁵

To make LLU a success, regulatory frameworks have been set up in the EU to ensure that entrants can get access to key inputs from incumbents. However, incumbents do not have strong incentives to act in a cooperative manner, as it would result in more

¹ See e.g. “Beyond the bubble: A survey of telecoms”, *The Economist*, 11 October 2003.

² Local access networks, also known as customer access networks, connect end-users’ devices to local switches. The transmission medium typically consists of wire (e.g. copper wire or optical fiber) or radio spectrum.

³ Unbundling of the incumbent’s local access network allows entrants to lease the incumbent’s local lines in order to get access to end-users.

⁴ It is important to note that if the success of certain entry modes has been limited, this is largely in comparison to policy makers’ initial expectations. In general, there exists no objective benchmark to assess the timeliness and speed of adoption of new technologies. Instead of regulatory ineffectiveness, the slow pick-up of LLU might just as well be due to well-informed business decisions.

⁵ See De Bijl and Peitz (2005) for an overview of LLU developments in Europe.

intense competition. For instance, in the UK, LLU-based entrants offering broadband Internet access have accused incumbent BT of deliberately making the unbundling process costly and difficult. In the light of these types of incentive problems, questions have been raised about the effectiveness of regulation aiming at the development of LLU-based entry.⁶

It is widely accepted that behavioral regulation, such as regulating wholesale access prices, has its limitations.⁷ For instance, regulators are not perfectly informed about incumbents' cost levels, information which is needed to select optimal regulated prices. Also, designing regulation is a complex matter, requiring substantial time and effort without guaranteeing that regulatory interventions are optimal. Therefore, it has been suggested in policy discussions that it may be better to directly change incumbents' incentives, rather than trying to control their behavior (see OECD, 2002; Ofcom, 2004). One way to do this is to vertically separate the regulated firm into monopoly part and a competitive part ('structural separation'). Accordingly, given the limitations of behavioral regulation, a central question is whether the effectiveness of LLU can be increased in a more drastic way, compared to adapting and fine-tuning existing regulation. As a case in point, in 2004 the UK communications regulator Ofcom assessed whether structural separation of BT's infrastructure from its retail activities could perhaps deal with the alleged advantages for BT Retail when purchasing services from BT Wholesale. In order to pre-empt a possible break-up, BT offered to reduce wholesale prices for access to its local network.⁸

This paper presents a basic framework that can be used to assess whether (mandatory) structural separation is desirable in a given market. This framework is illustrated in the European context of the market for fixed telecommunications (voice and Internet access), but it can, in principle, also be applied to other industries, such as electricity, post, railways, and financial markets. The underlying approach is that before deciding on the introduction of structural separation, a crucial question needs to be addressed:

⁶ See e.g. OECD (2000).

⁷ See e.g. Laffont and Tirole (2000).

⁸ See "BT ducks break-up with price cuts", BBC News, 23 June 2005, <http://news.bbc.co.uk/1/hi/business/4122060.stm>.

is there a persistent bottleneck? Within the context of this paper: is local access a persistent bottleneck?⁹ To address this question, the following definition of a bottleneck will be used: an input to a production process, such as a certain part of a network, is a (monopolistic) bottleneck – or equivalently, an essential facility – if it is essential to provide services to end-users, and it cannot be economically reproduced, typically because of substantial sunk costs.¹⁰

To offer a different interpretation of the decision framework, I will discuss the example of Ofcom's considerations to split BT unless it gives rivals in the retail market (without local networks) 'fair and equal' access to its network. This example nicely illustrates that this type of framework provides a set of options that the regulator can use strategically, by using the threat of a forced break-up as a means to adjust an incumbent's competitive stance in the wholesale market. It also illustrates the link (or stretch) between a regulator's way of enforcing certain behavior in the market and its economic underpinnings.

Some related papers are the following. In a paper that discusses various network industries and argues that different restructuring options are appropriate in different sectors, Pittman (2003b) proposes to motivate decisions about restructuring of industries by addressing the benefits from competition after entry in the product stage, the extent of scope economies between the production and the network stage, the difficulty of detecting and preventing discrimination by network operators, and the harm from discrimination to competition and welfare. The framework suggested in my paper is compatible with Pittman's guiding questions. Cave (2003) discusses structural separation in the context of postal markets and presents a similar decision tree that assesses the case for structural separation. Crandall and Sidak (2002) discuss several cases of structural separation in the US. They argue that (mandatory) structural separation leads to substantial costs in terms of forgone coordination

⁹ It should be noted that there is a second main strand of structural separation in telecommunications, namely between local and long distance services. This type of separation has been very relevant in the US. See e.g. Faulhaber (2003) for an overview. This paper also abstracts from call termination as a bottleneck.

¹⁰ See Knieps (2002).

benefits and economies of scope, and that the observed failures of entrants flow from defects in their own strategies, rather than from anticompetitive behavior.

The structure of this paper is as follows. Section 2 provides the conceptual starting points of the paper. First, it presents a simple definition of vertical separation and briefly discusses the costs and benefits of structural separation (subsection 2.1). Second, on a stylized level it presents different modes of entry and competition, and discusses their welfare implications both in the short and the long run (subsection 2.2). Section 3 then provides a rudimentary framework to assess whether structural separation may lead to a higher welfare level (section 3.1). Next, it discusses an strategic application of this framework (section 3.2). Section 4 concludes the paper.

2. Background

2.1 The rationale behind the notion of vertical separation

There are many definitions of structural or vertical separation, ranging from setting up ‘Chinese walls’ between monopoly parts and competitive parts (leading to accounting separation), to ‘physically’ breaking up a company into parts without ties between them (leading to full ownership separation). An extensive overview of different modes of separation is provided in OECD (2003). For the purposes of this paper, a generic notion of separation will be used: structural separation means that an integrated firm, that is, a firm that operates a network and provides services over it, is split into:

- (i) a company owning the local access network, providing wholesale access (the network operator); and
- (ii) the rest of the company, providing retail services, and possibly operating those parts of the network that do create problems of anticompetitive behavior, such as long-distance networks (the service provider).

The central idea of this stylized definition is that the incumbent’s retail operations are put in a position similar to that of entrants who do not have a local access network.

Accordingly, the newly created service provider has to lease local lines from the network operator, just like LLU-based entrants.

Structural separation has several potential or claimed benefits and costs.¹¹ Arguably, the main benefit of separation is non-discriminatory access for all operators without local networks. Separation eliminates the incumbent's retail operation's ability and incentives to discriminate in the downstream market. In particular, it eliminates the incumbent's incentives and possibilities, whether legal, economic or technical, to raise the costs of its rival firms by reducing quality or increasing the cost of access, which would lead to 'double marginalization' and hence an inefficiency. On a more general level, the scope for anticompetitive practices and leverage of market power into related markets, such as Voice over Internet Protocol (VoIP), may be reduced. In particular, structural separation may make the prevention of cross-subsidization more effective and make reliable cost information about the incumbent's non-competitive activities more readily available. Furthermore, the idea is that regulation in the non-bottleneck parts of the value chain becomes simpler, more effective, and less costly. Not only are firms that are not vertically integrated easier to monitor, anticompetitive behavior is much less likely to occur. Another argument in favor of separation is that it allows for the coordination of investments between all service providers and the network operator, rather than only between the incumbent's network and retail activities.

There are also several potential and claimed costs to structural separation. Splitting an integrated operator is likely to be a difficult process. For instance, where should one draw the line? It may not be straightforward to determine at which level in the network hierarchy, and where exactly in a switch, the separation should be made. Also, in itself separation is a very drastic, disruptive and costly intervention, while there is no guarantee that it will lead to the desired outcome. In particular, it is

¹¹ See e.g. Ofcom (2004). Crandall and Sidak (2002) and OECD (2003) contain more extensive discussions on this topic. In a different context, Mulder et al. (2005) analyze the costs and benefits of separation implied by the proposal by the Dutch Minister of Economic Affairs to replace legal unbundling in the energy distribution industry by ownership unbundling.

uncertain if regulation will really become more effective and simple. Next, separating a vertically integrated operator eliminates the coordination benefits, as well as the economies of scale and scope, that accrue from vertical integration. As a consequence, it may lead to delays in investments. For example, coordinating investments in the network between the new (separated) parties may become problematic, given that innovations in services may require investments in competitive as well as non-competitive activities. This type of coordination plays, for instance, a large role in the railways sector.¹² Furthermore, separation may lead to a crystallization of market power in the access market, which may distort the rollout of alternative networks. Also, given that separation is a costly and time-consuming affair, it may raise the cost level of the incumbent operator. In particular, the incumbent faces costs to reorganize, although it is hard to say in general whether these costs are substantial. Another example of a cost increase is that an integrated firm may have a lower cost of capital, that is, a lower cost of attracting funds. Thus, although structural separation eliminates all possibilities to raise rivals' costs, it introduces new possibilities to do so, by increasing the incumbent's rather than entrants' costs.

The necessary cost-benefit analysis in a given situation will neither be easy nor lead to a simple, unambiguous result. Ofcom (2004) argues that the arguments in favor of and against structural separation are "finely balanced", while practical considerations suggest that it may be wise to avoid the cost and disruption of a break-up. As noted in OECD (2003), there exists little evidence that the benefits of vertical separation of the local access network loop are sufficiently larger than its costs; moreover, the outcome of separation is uncertain while the costs may turn out to be large. However, should policy makers simply weigh the costs and benefits of structural separation, and based on the outcome, decide whether to go ahead with it, or is there more to it? Given the potential costs and uncertainties mentioned above, one should at least think twice. One also has to keep in mind the fact that structural separation will keep the bottleneck status – if any – of local access intact. Overall, before initiating a cost-benefit analysis, one should assess exactly under which conditions structural

¹² Pittman (2003a).

separation makes sense in the first place. A central point is that these conditions are closely linked to the nature of competition.

2.2 The nature of competition

Although the issue of vertical separation became prominent with the introduction of competition in markets for fixed voice telephony, we adopt a somewhat broader view and consider markets for fixed telephony and Internet access. A central question that underlies privatization, liberalization, and more specific structural policy interventions such as separation, is whether competition, and what type of competition, is feasible at all in the market for fixed telecommunications. Do we just have to wait some more years before we can observe fullfledged competition between operators with their own networks? Or will some parts of the market always remain monopolistic, despite attempts by regulators to introduce competition? The answers to these questions are still not evident. Recently, for instance, Ofcom (2004) judged that competition in fixed telecommunications is still fragile, despite a long history of regulation aiming at the creation of effective competition.

To discuss the possibilities for competition, it makes sense to distinguish different modes of entry and competition. Typically, three stylized entry modes are distinguished in the market for fixed telecommunications: (1) facilities-based entry: entrants roll out their own networks, including local access networks; (2) LLU-based entry: entrants, who may roll out their own long-distance networks, lease local connections from the incumbent; and (3) Carrier Select-based entry: entrants, who may roll out their own long-distance networks, purchase originating access from the incumbent to allow their customers to originate calls. Whereas facilities-based entry implies complete network rollout, ‘pure’ cases of LLU-based entry and Carrier Select-based entry would involve partial or no infrastructure investment with regard to local access networks.¹³ Hence, the latter two entry modes can be grouped together under the label ‘access-based’ entry, although this does not do justice to the possibility that

¹³ LLU-based entry typically involves more investments than Carrier Select, because of the necessary technical adaptations at the level of local switches.

such entrants may actually invest substantially in their networks, for instance at the long-distance level, or selectively (targeting particular users) at the local level. One should therefore be aware that the distinction above does not explicitly recognize the wide variety in entry opportunities that can be observed in the real world. Applied entry strategies include, for instance, combinations of network rollout in metropolitan areas aimed at business customers and LLU-based access to residential end-users.

In a recent speech, former European Commissioner Mr Monti warned against phrasing the discussion in terms of facilities-based versus access-based competition:

“The debate, it seems, is between those who advocate a facilities-based model of competition on one side, and those who advocate a model of competition based on access on the other side. [...] I believe that there is not necessarily a contradiction between access-based and facilities-based competition. Competition would never be able to develop, in the short term, if entrants were not able to gain access to the incumbent operator’s network to start offering services.” (Monti, 2003; emphasis in the original.)

Although using a black-and-white distinction can be misleading, distinguishing different entry modes can be very useful, and is probably necessary, to structure the discussion in terms of fine-tuning regulation that takes into account entrants’ incentives to invest.¹⁴ The usefulness for policy purposes of making such a distinction is implicitly confirmed in the following remark:

“However, it must also be that, in the longer term, the regulatory framework should privilege operators which base their competitive advantage on building their own infrastructure, simply because they are those who are likely to best improve the competitive conditions of the market.” (Monti, 2003.)

To allow for this type of intervention, one has to make a distinction between different types of entrants. In this example, to design a regulatory framework that over time

¹⁴ See, for instance, De Bijl and Peitz (2002) and Valletti (2003), for analyses and discussions of access and retail regulation in different entry modes.

increases entrants' incentives for network rollout, one should not ignore that entrants may lean stronger towards access-based operations or towards a strategy aiming at building their own infrastructure. In particular, which type of strategy an entrant follows will heavily depend on the regulatory regime in the first place.

As a helpful thought experiment, let me discuss the welfare implications of different entry modes.¹⁵ Note first that facilities-based entry results, by definition, in 'infrastructure competition' (or 'network competition'), whereas access-based entry leads to 'services competition'.¹⁶ The former type of competition implies that competitors have their own (local) infrastructure. The latter one implies that entrants offer services to end-users but do not have their own networks, or at least not the bottleneck parts of networks.

Important consequences of infrastructure competition are that it results in a level playing field between incumbent and entrants, that it allows for more innovation by entrants, and that it does not erode incumbents' incentives to upgrade and maintain their own networks, as there is no 'free riding' by entrants. As a consequence, infrastructure competition typically leads to a higher welfare level in the longer run: dynamic efficiency is increased. A possible inefficiency of infrastructure competition, however, is the waste involved in duplicative sunk investments. Services competition, on the other hand, results relatively quickly in intensified competition and hence lower prices for consumers. It also avoids duplicative investments in networks. These factors are good for static efficiency in the short run. Drawbacks are, first, that relatively little effort and commitment – both in terms of innovation and investment – are required from entrants, and second, that entrants depend heavily on regulation. Resale or access-based business models may also limit the scope for innovation by entrants, since the incumbent's existing infrastructure is restrictive (in terms of technological possibilities and efficiency levels) compared to a network that is

¹⁵ Throughout the paper, welfare is defined as the sum of producers surplus and consumers surplus.

¹⁶ See also Cave and Vogelsang (2003) for a discussion on infrastructure and services competition.

designed from scratch.¹⁷ It can also be argued that services competition deters or delays infrastructure competition.¹⁸ In particular, this may be due to the fact that economies of scope between the upstream and downstream sector may deteriorate, so that the network operator no longer receives correct incentives for maintaining and upgrading its network if it is not active in the production stage.¹⁹ Services competition may therefore lead to lower dynamic efficiency. Finally, services competition not only requires that a heavy apparatus of fine-tuned, asymmetric access regulation remains in place, but also tends to lead to a form of competition that relies heavily on regulation. For instance, withdrawing a regulatory regime of open access can easily force entrants that focus on reselling and marketing telephony services to leave the market.

Overall, services competition tends to lead to higher static efficiency in the short run, but it strongly depends on the regulatory framework, while infrastructure competition tends to lead to more innovation and higher dynamic efficiency in the longer run, with less need of regulatory intervention. Dynamic efficiency seems to be the most important factor that determines welfare gains, due to the fact that it leads to more drastic and long-term increases of welfare.²⁰ Accordingly, it seems safe to say that infrastructure competition will lead to higher welfare in the longer run (although one should be somewhat careful, given that network duplication can be wasteful).

It is important to note that network rollout takes time, so that typically the benefits for consumers do not materialize immediately. Hence services competition can be a

¹⁷ Crandall and Sidak (2002) argue, based on empirical observations in the US, that entrants that build their own networks are more likely to generate revenues and survive than entrants that rely on access.

¹⁸ See Bourreau and Doğan (2004).

¹⁹ This is important in railways (see Pittman, 2003a, b).

²⁰ See e.g. Bourreau and Doğan (2001). See Hausman (1997) for a case study on the long-run welfare effects of innovation. De Bijl et al. (2003) discuss network and services competition in postal markets.

necessary stepping stone during the transition towards infrastructure competition.²¹ The emergence of successful operators may take several years, while the Schumpeterian process of ‘creative destruction’ can lead to bankruptcy of entrants along the way. Thus, patience and determination from politicians, policy makers and regulators are required. Regulators, in addition, must actively make themselves redundant over time, for example by committing to ‘sunset clauses’ that trigger the withdrawal of certain types of regulation at pre-defined events. From a political economy viewpoint, this may not happen automatically, as regulators may be not be eager to reduce their workload.

To conclude, the bottom line of the discussion above is that infrastructure competition, if it is feasible, tends to be superior to services competition. Although it may lead to inefficient duplication of networks, it does give rise to greater potentials for competition and innovation, which will have their payoffs for dynamic efficiency in the longer run. In this respect, the main question that underlies the desirability of structural separation is whether infrastructure competition is feasible. This is the topic of the next section.

3. Policy framework

3.1 A framework for assessing the desirability of structural separation

The stylized comparison between network competition and services competition (see the previous section) naturally raises the question whether market characteristics are such that network competition is feasible. By definition this is the case if the cost characteristics of network elements and the market characteristics related to demand and the nature of competition, make it possible that two or more firms, each one with its own facilities, can co-exist in a competitive market.

²¹ For an extensive analysis of the types of access regulation that are best to safeguard LLU-based entry and at the same time give entrants incentives to roll out their own networks, see De Bijl and Peitz (2002).

From an economist's perspective, the desirability of structural separation is subject to the welfare implications of the types of competition that can emerge in a certain market. In particular, mandating vertical separation makes sense if it increases welfare. Accordingly, based on the reasoning in the previous section, there is no need for structural separation if the market allows for network competition. Put differently, structural separation makes sense only if local access is a bottleneck or an essential facility, that is, if it is essential to provide services to end-users, and it cannot be economically reproduced because of substantial sunk costs. Since technological change may eliminate the bottleneck nature of certain network elements, one should add the condition that bottlenecks will remain persistent, or at least are expected to do so with a large likelihood. The latter condition is especially relevant in telecommunications, a market which is characterized by rapid technological change.

Note that bottlenecks must be distinguished from 'natural' entry barriers, such as those resulting from economies of scale and scope. The latter type of barriers make entry more difficult or costly, but need not preclude it, while bottlenecks pose, by definition, insurmountable barriers for entrants. Many, if not most, markets have natural-monopoly characteristics (i.e., costs are sub-additive, or there are economies of scale), but this does not mean that there are bottlenecks or that competition is not viable. For example, postal markets exhibit strong economies of scale, but without substantial sunk costs that result in bottlenecks.²² Experience in several countries demonstrates that facilities-based competition is a realistic option in the postal sector. As far as is allowed by legislation, various postal markets have seen entry by firms taking care of sorting and delivering themselves, sometimes even on a nation-wide scale. This is quite different in the markets for electricity and gas, where economies of scale and sunk costs of the distribution network do not allow for more than one firm being active in distribution.

The presence of a persistent bottleneck is not sufficient to make a case for structural separation, since one should also assess why the existing regulatory regime is not

²² The value chain in the postal sector consists of mail collection, transport, sorting, and delivery. See De Bijl et al. (2003). Postal boxes may be an exception, though, as they may constitute a bottleneck.

effective. Since separation is a costly and risky intervention, improvement of current regulation should always be considered before taking drastic measures. Here, it is important to note that an assessment of the quality of the regulatory regime should not ignore the goals set by the regulator. For instance, is the regulator trying to maximize welfare, or perhaps just aiming at the creation of competition in the short run? In the latter case, it is likely that there is substantial scope for improvement, as competition as a goal in itself is likely to conflict with the maximization of welfare. Note also that a practical problem of assessing the quality of the regulatory framework is that there may not be a good benchmark. How can one assess whether the effectiveness of regulation can be improved? Perhaps experience in other countries provides help, but still, for the best-in-class country there is no comparison available.

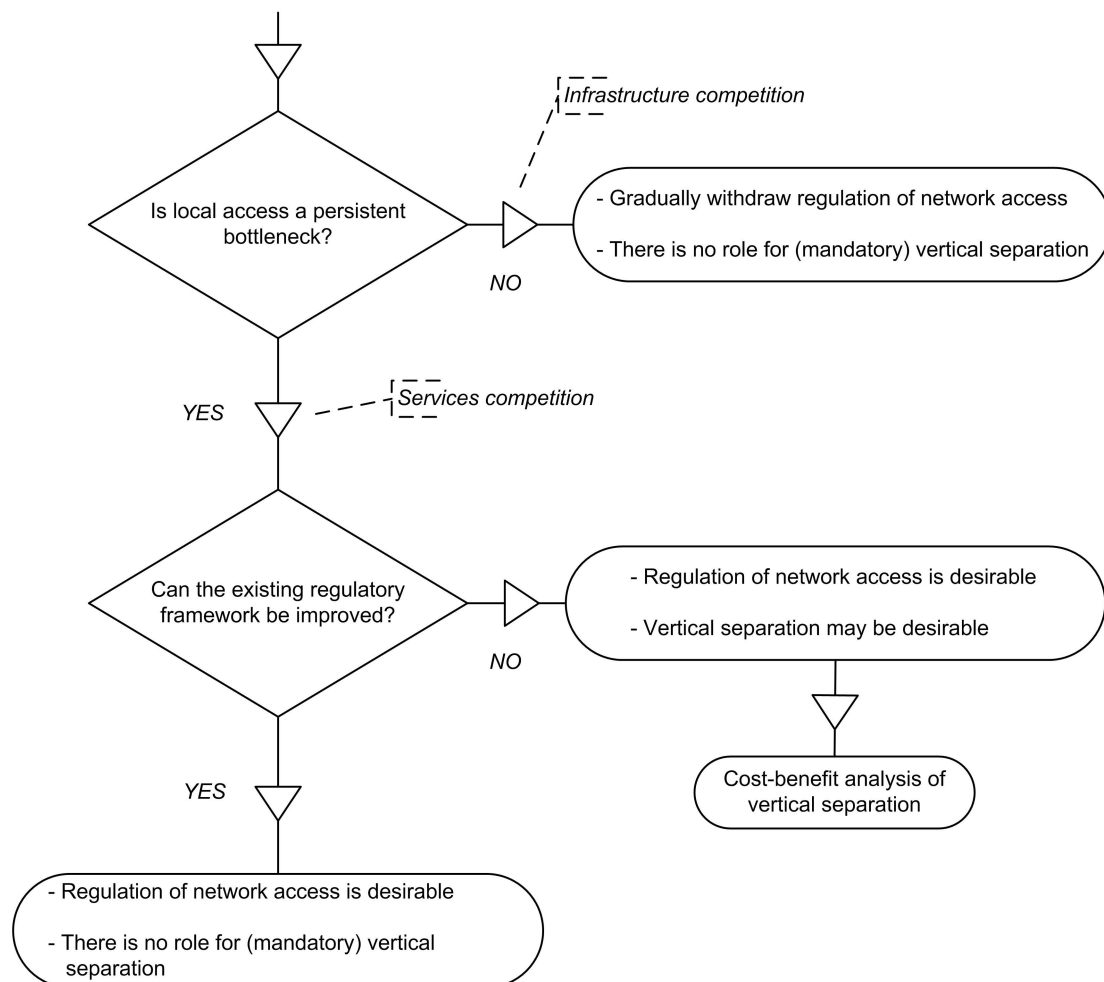


Figure 1: Guiding principles for structural separation.

If local access is a persistent bottleneck and assuming that the existing regulatory regime already is as effective as it can be, then structural separation can be an option. Having arrived at that point, a cost-benefit analysis is called for. Figure 3.1 summarizes the policy maker's decision problem as we have discussed it so far.²³

Figure 3.1 illustrates that the key issue is the assessment of the bottleneck-nature of local access. Such an assessment may not be easy, unfortunately, as it depends on a range of different parameters related to cost, demand, technological and institutional characteristics. The cost structure of local access is perhaps the most important factor that is involved. If the investment for network rollout are substantial and involve a large sunk cost, then it is more likely that there is a bottleneck. Cost characteristics do not exist in a vacuum, though. They depend to a large extent on the population density and geographical characteristics. For instance, rolling out a local access network typically involves less costs (per end-user) in a metropolitan area, where consumers are located closely to one another, than in a rural area. Furthermore, local access based on existing technologies may happen to be a bottleneck now, but technological change may drastically change the cost characteristics of local access networks. In fact, such technologies already exist, think for instance of wireless networks.

Demand characteristics also play an important role. The willingness to pay and nature of demand for telecommunications services determines the future revenues from the investment. Since business customers usually require more services and demand higher 'quantities' than residential customers, investing in a network will not be equally attractive for different segments of the market. Indeed, since the liberalization of telecoms markets, network rollout has been narrowly targeted: operators found it most worthwhile to connect offices in business districts and metropolitan areas, while residential customers have been much less exposed to entrants with their own networks.

Finally, the institutional environment can have an important impact on the feasibility of network competition. In particular, the goals, views and beliefs of policy makers and regulators, and how they translate into current and (expected) future access

²³ See Cave (2003) and Ministry of Economic Affairs (2000) for related frameworks.

regimes, are crucial for the investment climate. For instance, Hennis and Zelner (2001) find, in an empirical study, that a low level of infrastructure deployment in a country may not mean that the market potential has remained untapped, but rather indicates a substantial risk of expropriation by the government. Within the context of this paper, the regulatory regime may discourage or even prevent firms from investing in network rollout.²⁴ Suppose, for example, that facilities-based entry is, in principle, profitable for a certain number of entrants. If the regulator enforces a mandatory access regime combined with artificially low access prices, then those entrants lose their incentives to roll out networks themselves. Thus, if the regulator believes that network competition is not feasible, and for that reason imposes network access at low access prices, then the belief of the regulator becomes a self-fulfilling prophecy. In addition, a regulator may want to stimulate services competition independent of the existence of bottlenecks, in order to show that regulation is effective in the short run. More generally, whether a regulator wants to promote competition, secure low prices for consumers, or encourage the rapid deployment of infrastructure will indirectly be an important determinant for operators' incentives to invest.

Although it is outside the scope of this paper to present a complete framework for the identification of bottlenecks, the discussion above provides some guidelines. First, unsegmented structural separation is unlikely to be fully effective, as it ignores fundamental differences that may exist across segments. In particular, one should distinguish segments according to population density, geographical characteristics, and different customers types (e.g. corporate and residential customers). Any assessment of bottlenecks will depend on the characteristics of the segments. The importance of geography suggests that structural separation may be an option in some areas but not in others, resulting in regional network operators. The extent to which regionally limited structural separation is technically feasible is another question, one that needs to be addressed in this type of situation. Second, since the bottleneck-

²⁴ Crandall and Sidak (2002) argue that in the US, investments by entrants in residential areas have occurred at a slower rate than in business areas because of regulatory distortions. In particular, mandatory unbundling at artificially low prices encourage entrants to rely on incumbents' facilities, and to 'wait and see' before investing. These empirical observations confirm that mandatory access may distort firms' investment decisions.

nature is intertwined with policy and regulatory choices, one has to neutralize feedback effects by conceptualizing a hypothetical regime without mandatory access. This thought experiment, in which entry based on resale is ruled out by definition, provides a useful starting point for the analysis. It allows one to filter out policy-makers' and regulators' beliefs about the feasibility of network competition, as well as their goals (e.g. to stimulate services competition in the short run).

3.2 Strategic use of the framework by regulators and policy makers

In a recent consultation, Ofcom (2004) proposed three options in order to deal with the fragile nature of competition in fixed telecoms in the UK: (1) remove sector-specific regulation and rely on competition law; (2) make a referral to the Competition Commission in order to trigger a legal investigation on the desirability of imposing structural remedies, in particular structural separation of BT; and (3) improve regulation dealing with bottlenecks so that “real equality of access”, that is, competitors getting the same quality and price of access as BT's retail arm, will result. Although Ofcom stated that it would like to step back and let the competitive process do the work, it argued that there remain enduring bottlenecks that call for access regulation. Ofcom argues that, as the arguments in favor of and against structural separation are balanced, it is most practical and wise to avoid separation, and instead aim at more effective regulation of access. Accordingly, Ofcom suggests a decision process along the lines of figure 3.1, but interestingly, with a twist.

Before eliminating the option of separation, Ofcom expresses the desire to see “[...] real evidence of progress towards a regime which guarantees real equality of access” (Ofcom, 2004; p. 63). Effectively, the three options set out by Ofcom boiled down to a choice between a change by BT in its behavior towards competitors or facing structural separation of its wholesale and retail businesses. Thus Ofcom uses the threat of a forced break-up as a means to adjust BT's competitive stance in the wholesale market. This example suggests an alternative interpretation of figure 3.1. When assessing whether the existing regulatory framework can be improved, the threat of separation can actually be a way of making the incumbent ‘behave’. In this sense, the framework in the previous subsection creates a set of options that the

regulator can use strategically, in order to influence BT's decisions. Although it may be too early to judge the effectiveness of the latter approach, it is interesting to note that BT responded to Ofcom's proposal by offering to reduce wholesale broadband prices and open its network to competitors.²⁵

Figure 3.2 depicts a simplification of the game played by Ofcom and BT, starting at the moment after Ofcom announced that it was seriously considering structural separation.²⁶ It is depicted in the 'extensive-form' representation known from game theory, the standard toolbox to analyze strategic behavior.²⁷ First, at the node in the top of the game tree, the incumbent faces a choice between discriminating in the wholesale access market, and providing access on equal terms to all. Next, if the incumbent chooses to hinder entrants, the regulator chooses between structural separation of the incumbent and leaving it intact. If the incumbent chooses not to discriminate, then the game is over, as separation is no longer an issue.

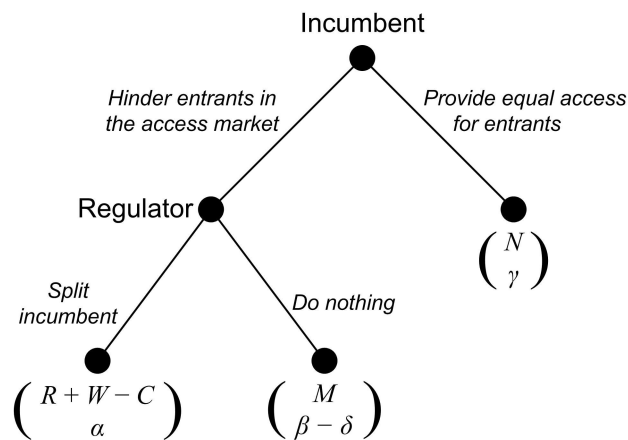


Figure 3.2: The regulatory game.

²⁵ See "BT offers equal access to rivals", BBC News, 3 February 2005, <http://news.bbc.co.uk/1/hi/business/4233121.stm>.

²⁶ By 'seriously', I mean that it was likely that Ofcom would follow up this option if necessary. Hence, I assume that Ofcom made a credible commitment.

²⁷ An 'extensive-form game' in game theory specifies the players, their moves, the timing of their moves, and their payoffs resulting from each possible combination of actions by the players.

Also in the figure, the payoffs of the two players are given between brackets: at each end-node of the game, the incumbent's payoff is on top, and the regulator's payoff (in greek symbols) at the bottom. For the sake of illustration, the former are measured in terms of profits, and the latter in terms of social welfare effects and the reputation of being an effective regulator. The explanation of the notation is as follows: R denotes the incumbent's profits in the retail market after vertical separation, W its profits in the wholesale market after vertical separation, and C the cost of separation incurred by the firm. Hence its total profits after a break-up are equal to $R + W - C$. Its profits in case it can hinder entrants without punishment are denoted by M , while N denotes the profits of an integrated incumbent that does not discriminate. Parameter α is the regulator's subjective valuation of the welfare level in case vertical separation is implemented in order to deal with discriminatory behavior by the incumbent, while parameter β denotes the regulator's valuation of welfare in case the regulator does not punish such behavior. In the latter case, the regulator incurs a reputational loss of δ .²⁸ Finally, the welfare level in the case of equal access provided by an integrated incumbent is denoted by γ . Note that the regulator's reputation remains unharmed if it breaks up an obstructing incumbent and if obstruction does not take place. Only if the incumbent gets away with anticompetitive behavior, the regulator's reputation for being an effective authority deteriorates. Natural conditions for the parameters are that $M > N$, that is, without punishment, the incumbent has an incentive to obstruct entrants, and $\gamma > \beta$, that is, discrimination of entrants is assessed by the regulator as being bad for welfare.

Let us consider how the game may be played. The way to 'solve' a game of this type is to start at the bottom,²⁹ which is the regulator's decision node. Breaking up the incumbent is a credible threat if the reputation damage in the case of a market that

²⁸ Additional notation is avoided by assuming that the regulator's valuation of welfare levels and reputational losses are measured in the same units and can be added up without weight adjustments.

²⁹ The underlying idea, known in game theory as 'subgame perfection', is that in *each* possible stage of the game, a player will make a decision that is best for him or her.

doesn't work well, is sufficiently large, or if the welfare loss of unpunished bad behavior is sufficiently large. Stated in terms of the parameters, $\alpha \geq \beta - \delta$. Let us suppose that this is indeed the case, so that structural separation is indeed optimal after obstruction by the incumbent has taken place. Now we move up one step in the game tree, to the operator's decision node. The incumbent expects that if it hinders entrants, it will be split and receive profits $R + W - C$. Hence, in order to prevent the operator from obstructing access, it must be that $N \geq R + W - C$, that is, facilitating equal access and remaining an integrated operator is most profitable. The bottom line of this example is that the threat of separation is effective as a deterrent of access discrimination if the parameters are such that $\alpha \geq \beta - \delta$ and $N \geq R + W - C$. If this is the case, then the pair of strategies ("*Provide equal access for entrants*", "*Split incumbent*") forms a Nash equilibrium based on a credible threat.³⁰ Note that the action "*Split incumbent*" will not occur in the outcome of this equilibrium, but the regulator would not hesitate to go ahead with in case of obstruction by the incumbent. In the outcome of this equilibrium, the incumbent will provide equal access, so that the regulator no longer has to consider structural separation.

Interpreting the regulatory game in the light of figure 3.1, one can observe that Ofcom's use of the threat of separation ignores the fact that even though local access may currently inhibit network competition, it is very unlikely to be a persistent bottleneck. Ofcom seems to be unwilling to wait for the longer term, in which the problem may take care of itself as new technologies can be expected to erode BT's monopoly in local access networks. Also, Ofcom apparently believes that there is no scope for regulatory improvement consisting of the development of more effective remedies against discrimination by BT – except, of course, if BT makes a first move towards organizational changes that can help to prevent discrimination. Arguably, the game has been played in line with the outcome of the Nash equilibrium described above. Recently, BT proposed (among others) to create a new access division, which

³⁰ In a Nash equilibrium, no player can do better by choosing a different strategy, given the strategy chosen by the other. By starting at the bottom and going backward, actually we have constructed a 'subgame perfect' Nash equilibrium, which implies a Nash equilibrium in every 'subgame'.

should lead to fair access for competitors. Ofcom is inclined towards accepting BT's proposals.³¹

The example of Ofcom and BT provides a clear illustration of the strategic interaction between a regulator and an incumbent operator in a situation where structural separation is considered as a realistic intervention. Of course, reality is more complex, with entrants participating in the game as well, and including BT's plans for its '21st Century Network'. Nevertheless, the game discussed here contains the crucial elements needed to assess Ofcom's threat to influence BT's behavior towards entrants in the wholesale market.

4. Conclusion

Since network rollout takes considerable time and entrants initially lack a track record for quality, open access regimes and asymmetric access regulation can be useful in infant markets. However, superimposing a market structure for the longer run may be counterproductive. In particular, prolonged facilitation of resale-based entry may limit the options for entry and hence enforce existing monopolies. The potential damage of such an intervention can be quite large in industries with fast technological change where the nature of future winning technologies is unknown. Hence, regulatory intervention that directly interferes with market structure must be applied with a great amount of care. Furthermore, investing in telecommunications assets is relatively risky. Think, for instance, of the unpredictability of demand (both in quantity and in nature), and about the high speed of technological change in ICT industries. Should policy makers try to reduce the risks faced by firms and investors? It will be obvious that it is socially optimal to reduce regulatory uncertainty to the minimum by creating a transparent and predictable regulatory environment. Nevertheless, interfering with

³¹ See "BT dodges break-up bullet", ZDNet UK, 23 June 2005, <http://news.zdnet.co.uk/communications/0,39020336,39205238,00.htm>; and Ofcom (2005), stating that it "[...] considers that the package of undertakings offered by BT is appropriate to address the difficulties which it has identified [...]".

the intrinsic risks of new technologies is likely to distort firms' incentives to invest and enter new markets. This can be detrimental to social welfare.

Structural separation raises similar concerns of interfering with market structure and the risk of distorting firms' investment decisions. This paper underscores the key issue that underlies the case for structural or vertical separation, which is whether there is a persistent bottleneck with respect to local access. Since the answer depends on cost and demand characteristics of different market segments, a simple and single answer may not exist. Moreover, the answer is interdependent with policy and regulatory views, beliefs and choices. For segments with persistent bottlenecks, structural separation may be an option, so that a cost-benefit analysis will be a natural step to follow, under the condition that the effectiveness of the current regulatory regime cannot be improved.

The straightforward framework presented here that summarizes the main decisions to be made with regard to structural separation, applies, in principle, to any industry. Other network industries, such as electricity, railways and post immediately come to mind. In electricity markets, *a priori* it makes sense to completely separate transport and distribution from generation and retail activities. In the Netherlands, the Minister of Economic Affairs has proposed to do this, but without having done a cost-benefit analysis to verify if it leads to a substantial welfare increase that outweighs the cost of the intervention. The major postal activities (collection, transport, sorting and delivery) are not characterized by bottlenecks, so post does not lend itself to access regulation or structural separation. Another example is provided by the markets for national and international clearing and settlement of securities transactions (see European Commission, 2002), in which the 'book entry' function of securities depositories has characteristics of a bottleneck.³² Hence it may be socially optimal to separate this function from the competitive parts involved in clearing and settlement, and create a central European securities depository that performs the book entry function at a regulated price. The international central securities depositories that currently provide this function as part of a bundle of clearing and settlement services,

³² See Milne (2002).

would then only be active in the markets for competitive services related to securities trade.

Recall that this paper focused on the market for fixed voice telephony and Internet access. The relevance of this market delineation is that the local loop has been a bottleneck in the market for fixed voice telephony, but is unlikely to be persistent in the broader relevant market that includes broadband Internet, and which feeds back into the voice market through VoIP. To see this, note first that it is beyond controversy that local access is becoming more important for economic activity on a broad scale, as is illustrated by applications and services that run over the Internet, e-commerce, and also by the prospects of flexible homeworking to combat traffic jams. At present, there already exist various alternative technologies to the traditional copper lines of incumbents. Examples include cable, the third generation of mobile telephony, WiFi (in particular if hotspots are connected to create a local network), and wireless local loop. In many cases, cable and mobile telephony already provide substitutes for end-users in the market for fixed telephony. More generally, while not all of the examples mentioned above have already been introduced or adopted, there is no reason to expect that none of them will become a serious alternative, especially since broadband applications start making compelling cases for more ‘pipes’. Apparently, plain voice telephony just didn’t trigger cable operators (and others) to invest or upgrade their networks and make them available for two-way communication. However, with the emergence of ‘triple play’ offerings, that is, bundles consisting of voice, television and Internet over a single connection, they will probably not want to miss the boat. Also, if firms do not invest themselves, end-users may take initiative themselves, such as the development of a community-based network of connected WiFi hotspots.³³ Accordingly, it seems to be a stretch to continue to view the local loop as a persistent bottleneck in the broader market for fixed telecommunications services. The implication is that mandatory access regimes should gradually be withdrawn, so that entrants’ incentives to invest in local access networks are not distorted. Moreover, the emergence of competing networks implies that structural separation is losing its relevance in fixed telecommunications.

³³ For an example, see <http://www.wirelessleiden.nl/english/>.

References

Bourreau, M. and P. Doğan (2001), “Regulation and innovation in the telecommunications industry”, *Telecommunications Policy* 25, 167-184.

Bourreau, M., and P. Doğan (2004), “Service-based vs. facility-based competition in local access networks”, *Information Economics and Policy* 16, 287–306.

Cave, M. and I. Vogelsang (2003), “How Access Pricing and Entry Interact”, *Telecommunications Policy* 27, 717-727.

Cave, M. (2003), “Separation and Access Prices in Postal Services”, paper prepared for conference “Structural Separation and Access Pricing: A New Synthesis”, 21 November, Amsterdam.

Crandall, R.W. and J.G. Sidak (2002), “Is Structural Separation of Incumbent Exchange Carriers Necessary for Competition?”, *Yale Journal on Regulation* Vol. 19, p. 335-411.

De Bijl, P.W.J. and M. Peitz (2002), *Regulation and Entry into Telecommunications Markets*, Cambridge University Press.

De Bijl, P.W.J., and M. Peitz (2005), “Local Loop Unbundling in Europe: Experience, Prospects and Policy Challenges”, *Communications & Strategies* 1/57, 33-57.

De Bijl, P.W.J., E.E.C. van Damme and P. Larouche (2003), “Towards a liberalized postal market”, report by TILEC, Tilburg University.

European Commission (2002), “Clearing and Settlement in the European Union: Main Policy Issues and Future Challenges”, Consultative Communication, COM(2002)257.

Faulhaber G.R. (2003), “Policy-induced Competition: The Telecommunications Experiments”, *Information Economics and Policy* 15, 73-97.

Hausman, J. (1997), "Valuing the Effect of Regulation on New Services in Telecommunications, *Brookings Papers: Microeconomics*, 1-38.

Henisz, W.J. and B.A. Zelner (2001), "The Institutional Environment for Telecommunications Investment", *Journal of Economics & Management Strategy* Vol. 10, p. 123-147.

Knieps, G. (2002), "Does the system of letter conveyance constitute a bottleneck resource?", mimeo, Universität Freiburg, presented at the Königswinter Seminar, Contestability and Barriers to Entry in Postal Markets, 17-19 November.

Laffont, J.-J. and J. Tirole (2000), *Competition in Telecommunications*, MIT Press.

Milne, A. (2002), "Competition and the Rationalisation of European Securities Clearing and Settlement", mimeo, City University Business School, London.

Ministry of Economic Affairs (2000), "Publieke belangen en marktordening: Liberalisering en privatisering in netwerksectoren", The Hague.

Monti, M. (2003), "Competition and Regulation in the Telecom Industry – The way forward", Speech/03/604, ECTA Conference, Brussels, 10 December.

Mulder, M., V. Shestalova and M. Lijesen (2005), "Vertical separation of the energy-distribution industry: An assessment of several options for unbundling", CPB Document No 84, CPB Netherlands Bureau for Economic Policy Analysis, The Hague.

OECD (2000), "Structural Separation in Regulated Industries", Background note by Secretariat, Working Party No. 2 on Competition and Regulation, DAF/CLP/WP2(2000)8.

OECD (2002), "Restructuring Public Utilities for Competition", *Policy Brief*, February.

OECD (2003), “The Benefits and Costs of Structural Separation of the Local Loop”, Working Party on Telecommunication and Information Services Policies, DSTI/ICCP/TISP(2002)13/FINAL, 3 November.

Ofcom (2004), “Strategic Review of Telecommunications”, Phase 2 consultation document, 18 November.

Ofcom (2005), “Notice under Section 155(1) of the Enterprise Act 2002 Consultation on undertakings offered by British Telecommunications plc in lieu of a reference under Part 4 of the Enterprise Act 2002”, 30 June.
<http://www.ofcom.org.uk/consult/condocs/sec155/sec155.pdf>.

Pittman (2003a), “Railroads are different”, presentation prepared for conference “Structural Separation and Access Pricing: A New Synthesis”, 21 November, Amsterdam.

Pittman, R. (2003b), “Vertical Restructuring (or Not) of the Infrastructure Sectors of Transition Economies”, *Journal of Industry, Competition and Trade* 3, 5-26.

Valletti, T. (2003), “The Theory of Access Pricing and its Linkage with Investment Incentives”, *Telecommunications Policy* 27, 659-675.

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