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Regulation of telecommunication and deployment of broadband[1]

Abstract

This memorandum explores the question whether regulation in telecommunications encourages or hampers the development of new technologies. Contrary to other network industries, the telecommunications industry is more and more characterized by several, competing networks, such as cable, copper, and wireless. Regulation is, however, still needed as in several components of telecommunications sources of market power remain. The key issue in the regulation of access to a network is dealing with the possible trade-off between static efficiency and dynamic efficiency. Favourable conditions for access to the network contribute to allocative efficiency and productive efficiency, but can negatively affect incentives for investments in upgrading of existing infrastructures and developing new ones.

In the Netherlands, regulation of the telecommunication industry is designed to enhance competition between alternative infrastructures without affecting the technology choice of both incumbents and entrants. In the market for unbundled access to the local loop and the market for high quality wholesale access, a trade-off exists between static efficiency and dynamic efficiency. Regulated access tariffs, which are based on average costs, seem to be a good compromise between static and dynamic efficiency. Tariffs for access to the local loop reflect actual costs of the existing copper infrastructure, giving entrants incentives to make efficient make-or-buy decisions. In addition, the threat of infrastructure competition in the local loop, as well as the service-based competition between providers using different infrastructures, i.e. copper and cable, provide incentives for the incumbent to increase efficiency. Our overall conclusion is that Dutch regulation of the telecommunication industry gives efficient incentives for technological developments such as the deployment of broadband.

[1] This memorandum is written as a part of a project on broadband policies (see CPB, 2005). The authors of this memorandum benefited from discussions with the other members of the project team, i.e. Bert Minne and Henry van der Wiel (both CPB) and Joost Poort (SEO). In addition, they thank Jonas Rozenstok and his colleagues at the OPTA for their comments on draft versions of this memorandum. Of course, the usual disclaimer applies.

1 Introduction

This memorandum explores the relationship between regulation of the telecommunications industry and the deployment of broadband. According to the International Telecommunication Union (ITU), regulation is a key factor for broadband competition (ITU, 2003). Effective regulation encourages competition on existing infrastructures and reduces barriers to rolling out new infrastructures. A study by The Allen Consulting group, modelling the economic impact of broadband infrastructure for specific regions in Australia, concludes that the regional economic effects of an open network are almost 20% higher compared to a vertically integrated service provider (ACG, 2003).

Our exploration of the relationship between regulation and the deployment of broadband focuses on the impact of regulation on investments in technological improvements. Moreover, the focus of the analysis is on the Netherlands, although attention will be given to experiences in other countries. Although the market for broadband includes both broadband infrastructure and content and application services, we will only zoom in on infrastructure. As we will show, market failures, and hence regulation dealing with them, are clearly present in communications infrastructures, whereas they are virtually absent in content and application services.[2] The key question of this memorandum is therefore: to which extent does regulation of the telecommunication industry affect investments in new communications infrastructures in the Netherlands?

This memorandum starts with a concise description of the main characteristics of telecommunications as a network industry, potential market failures following from it and the relationship between market power on the one hand and static and dynamic efficiency on the other (section 2). These characteristics, market failures and relationships influence policy options which governments have in order to improve performance of the telecommunication industry. Section 3 describes the main issues of regulation and competition policy regarding this industry. Section 4 offers an overview of access regulations in different countries around the globe, such as South Korea, Canada and Sweden, whereas section 5 focuses on regulation in the Netherlands. Section 6 addresses the key issue of this memorandum: the relationship between regulation and broadband in the Netherlands. Section 7 summarises the conclusions.

[2] See CPB (2005) for an elaboration on these services.

2 The need for regulation in telecommunications

2.1 Telecommunications as a network industry

The telecommunications industry is traditionally viewed as a network industry, like energy and railways. Network industries have three fundamental, mutually-related characteristics which make them different from other sectors (CPB, 2004). These characteristics are

- the presence of network infrastructures
- which form essential links in the related chain of activities, and
- which coincide with substantial economies of scale.

In the next sections, we will focus on the telecommunications industry and concisely elaborate on each of the above characteristics.

2.1.1 Presence of network infrastructure

Telecommunication infrastructure sometimes gives rise to network externalities. From the perspective of consumers, network externalities occur if “one person’s utility for a good depends on the *number* of other people who consume this good” (Varian, 2003). This holds in particular for the telecommunications industry, where each newly connected consumer raises the value of the system to consumers already present. Due to the positive effect on total value, this network externality is viewed to be positive. Besides network externalities, consumption externalities may arise too. Negative consumption externalities arise, for instance, in the electricity industry if aggregated demand, resulting from many individual decisions made by consumers, raises the load of the system so much that supply is unable to follow and, hence, brown-outs or even black-outs result. In telecommunication negative externalities arise as an excessively high consumption level of one user negatively affects the speed or quality of the telecommunication services available to the others. All these externalities follow directly from individual behaviour.

Another typical characteristic of a network infrastructure are increasing returns to scale and scope in network size: “a greater number of complementary products can be supplied - and at a lower price - when the network grows.” (Tirole, 1988). This also applies to the development of the network: the more developed a network is, the cheaper extending the network generally is. In a well-developed railway system for instance, or an electricity grid or natural-gas network, extending the system to more locations within the same area incurs relatively low costs due to the small distances which have to be covered.

2.1.2 Essential facility

The network infrastructure forms an essential facility in the industry meaning that the infrastructure is a necessary input for activities of sectors using the infrastructure and the infrastructure cannot (economically or technically) be duplicated by competitors (Worldbank, 2000). Train operators absolutely need tracks to offer their transport services, just as electricity producers need wires to transport power, and suppliers of telecommunication services need an infrastructure such as local loops, support structures as poles and conduits, telephone numbers or frequency spectrum.

The essential character of a facility depends, however, on the perspective from which a sector is viewed. In the gas industry, for instance, gas producers could develop alternative ways, notably liquefying, to transport gas if pipelines have not been developed. A rail operator could use other means of transport, such as busses, if tracks are not available on certain distances. In the telecommunication industry, technological developments have brought forward several alternative techniques for telecommunication, making one specific technique less essential. Due to the digitalization of information, existing cable and (mobile) telephone networks are more and more able to perform the same functions. This implies that none of the existing networks can be deemed essential, although some parts of existing networks are still essential, such as the local loop of copper lines in many countries. It depends on the sustainability of the current market structure (i.e. can several networks continue to coexist?) as well as the future demand for telecommunication services (i.e. will the current networks become technologically obsolete?) to which extent a telecommunication network remains an essential facility in a specific market and region.

Strongly related to the essential-facility character of networks is the high level of interdependence between users of infrastructure, i.e., in the case of telecommunications, the producers and consumers of content and the service providers. Consequently, use of the infrastructure requires much coordination in order to prevent accidents on the tracks, black outs in the supply of power or disturbances in telecommunication services. Moreover, the closely links between infrastructure activities and operational activities could cause economies of scope, i.e. integrating these activities in one firm could be more efficient than conducting these activities in separate firms.

2.1.3 Economies of scale

Network industries coincide with significant economies of scale due to the high level of fixed costs and (very) low marginal costs. If investments in a network infrastructure have been made, these costs are mainly sunk, i.e. these costs can not be recovered. The huge fixed costs and the scale effects related to it make it uneconomical to double networks in most countries. As a consequence, networks are often natural monopolies.

Whether or not a telecommunication network is a natural monopoly ultimately depends on the level of fixed costs relative to demand. Interestingly, both fixed costs and demand have been subject to substantial change over the last ten to fifteen years in such a way that a monopoly has become less ‘natural’. Consider, for instance, the market for telephony. This market used to be a clear example of a natural monopoly. The fixed costs of setting up a telephone network were so high that only one network could be economically exploited. However, the introduction of the GSM standard gave rise to an alternative technology with much lower fixed costs. There are still economies of scale, but generally the market for telephony is no longer regarded as a natural monopoly nowadays.

Lower fixed costs thus decrease the tendency to natural monopolies. But the same applies to a higher demand. As mentioned, due to digitalization of content the existing cable and telephone networks can nowadays perform similar communication services. Together with the increased demand for telecommunication in general, this implies that the economic value of these networks has increased. Hence, the ratio of fixed cost relative to demand for a given network has considerably improved. It is unclear how many competing networks could co-exist, but to have only one supplier of a fixed telecommunication network has become less ‘natural’.

2.2 Market failures in telecommunications

The characteristics of network industries give rise to several potential market failures. The most important one of these market failures is the existence of market power. Other potential market failures are the existence of externalities, the hold-up of investments and information asymmetry. In this memorandum, we focus on market power as this market failure forms the background behind regulation of the telecommunication industry.[3]

The presence of network externalities and economies of scale in the provision of essential facilities gives advantages to the (incumbent) firms. These advantages, which were enhanced by legal arrangements giving incumbent firms dominant positions in the industry, include the following (Worldbank, 2000):

- Control of essential facilities;

[3] CPB (2005) gives an analysis of the significance of all potential market failures in the telecommunications industry, in particular in relationship to the deployment of broadband.

- Economies of established national networks which cannot be matched by new entrants for many years;
- Vertical economies, i.e. economies of vertically integrated production facilities, such as local access networks, national long-distance networks, and international networks;
- Control over network standards and development;
- Cross-subsidies, e.g. of local access services by international services as occurred in many countries;
- Customer inertia resulting in switching costs, including both specific expenses, such as purchases of new telephones, modems or decoders, and inconveniences caused by, for instance, dialling extra digits and dealing with two telephone bills.

The dominant position following from these advantages gives the unregulated incumbent several options for strategic behaviour in order to raise its own profits. According to the Telecommunications Regulation Handbook (Worldbank, 2000), a dominant telecommunications operator can increase its profits by:

- Refusing or delaying essential facilities to competitors;
- Providing services or facilities to competitors on discriminatory terms or at excessive prices leading to allocative inefficiencies as these prices exceed marginal costs and, hence reduce the level of consumption;
- Predatory pricing or cross-subsidization of competitive services with revenues from network services;
- Bundling of services on competitive markets with services related to essential facilities;
- Increasing switching costs by actions to "lock-in" customers.

2.3 Market power and efficiency

2.3.1 Static and dynamic efficiency

The objective of policies directed at market power is to increase efficiency. Economic efficiency can be viewed at from two perspectives: static and dynamic. Static efficiency is maximized under two conditions. First the sum of consumer and producer surplus should be maximized. This condition is called allocative efficiency, and it is achieved when goods are priced according to their marginal costs.[4] The second condition, labelled productive efficiency, states that production should take place at the lowest possible costs (given all available technologies). If the second condition does not hold, so called x-inefficiencies exist.

[4] Perfect price discrimination, where every consumer pays according to his maximum willingness to pay, also maximizes the sum of consumer and producer surplus.

Dynamic efficiency refers to the present value of the future stream of static total welfare. The development of product innovations that increase consumer surplus, or process innovations that lead to smaller production costs, enhance dynamic efficiency. However, maximizing dynamic efficiency is not the same as maximizing static efficiency in every period, because under some circumstances dynamic efficiency requires conditions that adversely affect static efficiency. If innovation requires large investments, high post-innovation profits are needed to recover the costs of innovation.

2.3.2 Trade-off between static and dynamic efficiency in telecommunications

Strategic behaviour by firms resulting from their market power generally reduces social welfare due to price distortions. But besides this adverse impact of market power on static efficiency, dynamic efficiency might also be affected by market power. Theoretically, this relationship is, however, not clear. Too little competition could reduce the incentives to innovate, because the 'reward' for an innovating monopolist is generally smaller than the reward for a competitive firm. Loosely speaking: the monopolist is already enjoying monopoly profits[5], whereas a competitive firm has the opportunity to escape from competition by innovating, resulting in monopoly profits. However, if the innovation is easily imitated, these monopoly profits will merely be temporary. Other firms will simply copy the innovation, making the innovator lose its competitive advantage. When the innovator knows this in advance, it will have much smaller incentives to invest in innovative activities. Therefore, the presence of too many competitors that can easily imitate an innovation reduces the incentives to innovate.

In conclusion, in theory market power may enhance dynamic efficiency, but it may also reduce it. Or, put differently: there could be a trade-off between static and dynamic efficiency, but they can also go hand in hand. Empirical research, however, appears to be less ambiguous. An overview by Canton (2002) suggests that in most industries competition is found to be conducive to dynamic efficiency. The synthesis of theory and empirics presented in this paper mentions a number of conditions in an industry that result in a trade-off between static and dynamic efficiency. These conditions are:

- High research and development expenditures: as these costs are largely sunk, post-innovation profits (i.e., low static efficiency) are needed to recover the costs.
- Low marginal costs: if marginal cost are low (relative to fixed costs), average costs are declining over a large range of output. Scale economies result, implying a large market share and high price-cost margins for a firm. These (statically inefficient) prospects are conducive to innovation, as earning back the cost of innovation is relatively easy.

[5] Arrow (1962) has labeled this the replacement effect: the monopolist replaces himself at a slightly higher profit level.

- High technological and commercial uncertainty: again, high post-innovation profits are needed to overcome these uncertainties.
- Network effects: if these are present, being the first to innovate will be highly profitable. The propensity to innovate is therefore high, but after the innovation the winner will obtain a large and stable market share.
- Highly fluctuating market shares: this condition states that it is actually possible to take over the market due to a successful innovation.

Summarizing, Canton (2002) states that static inefficiencies due to market power can coincide with dynamic efficiency if the industry is characterized by high costs of research and development, substantial economies of scale and high technological or commercial uncertainty. Put differently: if the sunk costs of innovating are high, excess profits are required in order to undertake the innovative activities. Excess profits, in turn, require market power, which can be found in markets where scale economies and network effects prevail.

How does this apply to the telecommunications industry? As telecommunications is not a typical knowledge-intensive industry (such as pharmaceutics), spending on research and development is not very high. Telecommunication is predominantly capital-intensive, and technological advances in capital are typically developed outside the telecom industry (by manufacturers of telecommunication and network equipment). Still, the costs of *introducing* an innovation, particularly if it concerns the roll out of a new network, are high and largely sunk.

Will a telecom firm be able to recoup the costs of innovation? This depends on the appropriability of profits associated with the innovation: can a firm that introduces some new innovation or increase in infrastructure quality appropriate sufficient gain before its competitors are able to imitate and reduce the benefit to unprofitable levels (Bennett et al., 2001)? The costs associated with switching from one infrastructure provider to another are certainly helpful in this respect. These switching costs actually grant some monopoly power to the innovator. If switching costs are smaller than the benefit from switching from the existing infrastructure to the new infrastructure, but larger than the gain from switching from one new infrastructure to another, an innovator will be able to recover the cost related to the innovation or upgrade of its infrastructure.

This reasoning supports the evidence for a trade-off: switching costs, whilst bad for static efficiency, are conducive to investments in more advanced infrastructure that are characterised by high fixed costs.[6] Furthermore, marginal costs are low (i.e., scale economies are substantial), network effects are clearly present and, in particular commercial uncertainty appears to be high as well.[7] Only highly fluctuating market shares are not observed in telecommunications, partly due to switching costs, but also due to the relatively short period of market liberalization. Nevertheless, scale economies, network effects and switching costs give telecom firms some degree of market power. If a telco is successful, it will, at least for some time, be rewarded by monopoly-like profits. Given the high costs of introducing innovations in infrastructure, these profits are highly conducive to undertake innovative activities in telecommunications. Static and dynamic efficiency hence do not seem to go hand in hand in the telecommunication industry.

Further evidence for the existence of the trade-off between static and dynamic efficiency may come from indicators that reflect the present level of static and dynamic efficiency of the telecom industry. Although static and dynamic efficiency are hard to measure, the following variables can be used for this. For static efficiency, one could e.g. look at demand side substitutability (to what extent is it possible for customers to substitute other services for those in question) and supply side substitutability (to what extent can suppliers switch, or increase, production to supply the relevant products or services), the number of suppliers and the level of switching costs. Dynamic efficiency can be approximated by the number of product and process innovations, a larger set of choices for consumers and improvements in quality and services. If one finds that telecom is statically inefficient but dynamically efficient, or vice versa, this would further support the evidence for a trade-off.

Naturally, the size and significance of the trade-off, as well as the present location on this trade-off, matters a lot for policy. We will come back to this issue in chapter 6, where we discuss the effects of Dutch regulation on the deployment of broadband. But first we will describe the main general issues regarding regulation and competition policy in telecommunications.

3 Policies for the telecommunication industry

3.1 Regulation and competition policy

In order to solve the above (potential) market failures in the market for telecommunication, governments have several policy options to intervene in the industry. In the past, state

[6] Hausman (1997) shows that neglecting the irreversibility of these investments has led the Federal Communication Commission in the US to focus too much on static cost efficiency. As such, the FCC "...has failed to account for the demonstrated large gains in dynamic economic efficiency that arise from new investment." Hausman (1997, p. 36).
[7] Most telecom firms have fully depreciated the huge amounts they have paid for UMTS-licenses in only a few years. Apparently they have all greatly overestimated the value of these licenses.

ownership was a common choice to influence, i.e. to determine, the behaviour of network firms. This solution enabled public-owned firms, among others, to set prices at marginal-cost level as public authorities gave lump-sum subsidies to cover fixed costs. Although this option theoretically solves the issue of allocative efficiency, it generally scores less on the issue of productive and dynamic efficiency because of the lack of incentives for management to improve productivity and to increase innovation.

Because of the unsatisfactory performance of the public-owned monopolists in the telecommunication industry, governments started a process of liberalization and privatization in the European countries in the 1990s. Simultaneously, economic regulation and competition policy were introduced in order to establish competitive markets and solve competition problems. Economic regulation is directed at designing competitive markets, e.g. by proscribing conditions for network access, while competition policies focuses at preventing and curbing abuses of market power (Worldbank, 2000). Regulation and competition policies are strongly mutually related.[8]

3.1.1 Regulation

Regulation (in the broad sense) has to ensure that network operators do not abuse market power resulting from the natural monopoly of the network. Regulatory measures include both structural measures and behavioural measures. The former affects the legal and ownership structure as well as the vertical and horizontal organization of the industry, while the latter focuses at changing the incentives of players in the industry. Behavioural measures include access regulation, notably negotiated or regulated third-party access, price regulation (e.g. caps on the prices the dominant firm may demand) and quality regulation.

Consistency in regulation is an important issue. A private firm that plans to invest in a new broadband telecommunication network will take into account that, in case its network becomes an essential facility, it will be subject to policy measures (notably access and price regulation). Too much uncertainty about future regulation will adversely affect welfare if it makes firms refrain from otherwise welfare enhancing investments. Under adaptive expectations, this implies that current regulation should not give rise to uncertainty.

3.1.2 Competition policy

Competition policy is directed at conditions, other than access tariffs, affecting entrance of new players to the local loop, and, more generally, competition within this industry. The need for

[8] The need for sector-specific regulation of the telecommunications industry is declining due to the growing competition within this industry. According to several authors, the industry eventually will only be subject to general competition policy (see e.g. De Ru, 2004). The question is, however, in which pace this development is emerging.

this policy follows from the options the owner of the network has to hinder competitors, which can be summarized under the heading 3D: deny, delay and detail. An unregulated owner of the local loop could, for instance, impede access to the local loop by referring to shortage of space for co-location at the main distribution frames. Other examples of anti-competitive behaviour are discriminatory use or withholding of information, strategic designs of products, bundling, predatory pricing and tacit collusion.[9] In the remaining of this memorandum we focus on regulation issues.

3.2 Regulation of access

3.2.1 Key issues

Introduction of competition in a network industry, such as telecommunications, requires adequate regulation of access to network components which cannot easily be duplicated. In the case of a vertically-integrated firm, both parts of this firm, i.e. the network part and the service provision, usually are closely interwoven. As a result, a vertically-integrated firm has strong incentives to hinder downstream competitors (see above under the heading “market power”). Consequently, key issues in the regulation of networks are the accessibility to the network of upstream or downstream commercial firms, the tariffs network firms may demand for the use of the network and the investments by network owners in maintaining and extending the network.

3.2.2 Unbundling

In order to reduce the options for a firm to hinder competition and to increase the power of the regulator to effectively intervene in the market, unbundling is a regulatory measure generally applied in network industries. After all, proper third-party access to network can only be realized if network activities are conducted independently from competitive activities. However, separation can incur significant costs due to economies of scope between network management and service provision. The choice of the degree of unbundling, such as accounting unbundling, legal unbundling or ownership unbundling, is not the same across industries and may also depend on characteristics of the country. “As experience mounts with weaker forms of separation, a movement can be discerned, especially in certain sectors, towards stronger and more effective forms of separation.” (OECD, 2001.)

In telecommunication, separation of the local loop from competitive services appears to be problematic. Separation undermines incentives for efficient investment in the local loop, as it is

[9] See ERG (2004) for a systematic overview of competition problems and remedies. The past has shown several examples of this kind of practices in the Netherlands resulting in actions by the regulator (see website of the regulator for an overview of disputes: www.opta.nl). In the more recent past, less of such events have happened suggesting that the regulator together with the competition authority (NMA) is improving its effectiveness in dealing with competition restricting behaviour in the telecommunication industry.

difficult to contractually arrange that the owner of local loop appropriates returns on his investment. Because of the alleged high economies of scope between network management and retail, local loop unbundling is usually carried out in a form of access regulation, such that the incumbent retains ownership and responsibility for maintenance of the lines which are then leased to the rival operator. The OECD (2003) strongly doubts whether ownership unbundling in telecommunication would strengthen competition and, hence, reduce prices, while it views the costs of full separation significantly high, in particular due to increased problems with coordination of investments between network firm and retail firms.[10] Given the growing competition among alternative techniques for telecommunication, i.e. copper lines, cable and wireless techniques, the networks in this industry cease to be bottlenecks, reducing the need for unbundling (De Bijl, 2004).

3.2.3 Access conditions

In determining the access condition, the regulator has to deal with the issue of hold-up, i.e. the risk the investor in network infrastructure faces regarding future access conditions. Therefore, network firms very much need contracts which give them certainty about future access conditions in order to deal with the risk of ex post opportunism of users of the infrastructure.

The determination of access tariffs belongs to the key issues of regulating network industries, as it is related to allocative efficiency as well as dynamic efficiency (Mason et al. 2001, Canoy et al. 2003)[11]. Proper regulation of access fees for the infrastructure is needed to give the network firm adequate investment incentives without distorting the market for services. However, the relationship between access tariffs and (infrastructure) competition is not unambiguous because of the existence of two separate dynamics: the impact of access tariffs on entry and the mechanism described by the idea of a ladder of investments (Brunel University, 2001). The former dynamic requires low access prices in order to encourage entry and, hence, competition by entrants. However, if access prices are below average costs, the network firm does not have an incentive to invest in the (new) infrastructure (such as glass fibre).

The second dynamic states that access prices should rise in order to stimulate investments by entrants when they are climbing on the ladder of investments. Eventually, access tariffs will reach a level at which the (potential) entrant will be indifferent between paying the access tariffs for using the local loop of the incumbent and rolling-out its own infrastructure to the end-

[10] In a cost-benefit analysis of structural separation in telecommunication, OECD (2003) concludes that structural separation in this industry is “risky with benefits that seem limited, uncertain, indeed, conjectural, with on the other hand, potentially significant costs including potentially adverse effects on network development. Certainly, there is insufficient evidence that benefits would be convincingly in excess of costs”.

[11] “Any access price affects operator’s (potential) profits, and hence also their incentives to enter the market, to invest in new technologies, to roll out networks, to maintain and upgrade existing networks and so on.” (Canoy, et al., 2003)

user. Consequently, the incentive for the incumbent to improve efficiency (and performance) of the local loop follows from the threat that entrants will roll-out alternative infrastructures.

If a network firm is integrated with a downstream firm, i.e. a service provider, regulation is needed to guarantee access of other downstream firms to the infrastructure in order to realize competition in the market for service provision. If other service providers have own networks, regulation has to force interconnection of the several networks because of the existence of network externalities (see above). Interconnection in telecommunication means that, for instance, "a phone call originated in a local loop is carried over the network of other carriers both nationally and internationally" (Shy, 2001). Without interconnection, only the largest firm would eventually remain (Aalbers, et al., 2002).

4 Regulation of telecommunication in international perspective

4.1 Introduction

As was argued above, communication networks generally experience substantial economies of scale and network externalities, leading to significant market power or even monopolies. Without government intervention, i.e. regulation, this will generally lead to a loss of welfare due to high prices. This section gives a concise overview of regulation in the telecommunications industry in different countries around the globe, in particular South Korea, Canada, and Sweden. These countries have relatively strongly developed broadband markets (Wu, 2004). According to OECD (2005) data, the number of broadband subscribers per 100 inhabitants in these countries in 2004 ranged from 25 (South Korea) to 15 (Sweden). We will distinguish three major components of regulation: (state) ownership, structural measures (unbundling) and regulation of access conditions. In section 5, we will analyze these matters more extensively for the Netherlands.

4.2 Ownership

In South-Korea, the former incumbent telecommunication firm, Korea Telecom, is gradually privatized in the 1990s which process was finalized in 2002. In spite of the privatization of the industry, government still affects its development by means of licensing procedures, imposing standards and proscribing the choice of equipment and technologies. Moreover, foreign ownership of telecommunication firms is restricted by law to 49% which limits the options for foreign firms to invest in South Korea. Contrary to other regions in the world, many countries in

Asia, e.g. India, Indonesia, Philippines and Malaysia, have imposed restrictions on foreign ownership (Fink et al., 2001).

Canada also shows significant restrictions on foreign ownership in the telecommunications industry (Wu, 2004) as a result of the political ambitions to “to promote the ownership and control of Canadian carriers by Canadians” (article 7 of the Telecommunications Act of 1993, OECD, 2002). Most telecommunication firms in this country are privately owned (OECD, 2002). After the introduction of competition, the number of firms increased rapidly making the market fairly competitive which benefited the development of technologies, such as broadband (OECD, 2002).

In Sweden, the government (still) owns almost 50% of the TeliaSonera which is the result of the merger (in 2002) of the Swedish incumbent telecommunications operator (Telia) and the Finnish firm Sonera. Also local authorities have shares in telecommunication firms. For instance, the municipality of Stockholm owns the network firm Stokab which has invested in a (dark) fibre network in the Stockholm region, consisting of more than 30 towns.[12] The local authorities in this region set up Stokab primarily to improve the coordination of digging activities and to encourage broadband access for low-income families. Stokab is a wholesaler of bandwidth to over 70 service providers, including public authorities and telecommunication companies.

4.3 Unbundling and access tariffs

All countries mentioned above have imposed legal unbundling of the local loop (Wu, 2004). South Korea and Sweden introduced ULL only recently (2002 and 2001, respectively), implying that this measure is not a necessary condition for a rapid deployment of broadband as that process started before the introduction of ULL in these countries.

In the United States, investments in fibre-to-the-home (Ftth) networks are not subject to unbundling if they are additional to existing (copper) local loops (OPTA, 2005b). If the Ftth-network replaces a local loop (i.e. a brownfield investment) the owner of that network has to give access to third parties only for enabling transmission of voice (i.e. 64 Kbps) while the remaining capacity of the fibre (above 64 Kbps) is not unbundled. Third-party-access obligations are not imposed when an Ftth-network is realized in a region without any existing local loop (i.e. a greenfield investment).

[12] Source “Stokab, city-owned dark-fiber provider, http://www.point-topic.com/content/operatorSource/ profiles/ Sweden/ Stokab_brief_050719.htm, 19 July 2005.

In Canada, the charges for access to the local loop were initially based on "incremental costs plus a 25% mark-up for the recovery of fixed and common costs" (OECD, 2002). As the resulting level of the access tariffs appeared to hinder entrants, charges were significantly reduced.

5 Regulation of telecommunication in the Netherlands

5.1 Introduction

In the Netherlands, regulation of the telecommunication industry is mainly directed at the local copper infrastructure.[13] In the past, this was due to EU legislation which only focused on this infrastructure. According to the current EU framework for telecommunication, other infrastructures are also subject to regulation if they have dominant positions on markets. As the Dutch cable infrastructure has a modest share in the national market for internet access (approximately 15%), the regulator decided not to regulate access to this infrastructure (OPTA, 2005b).[14] The same argument holds for other infrastructures, such as fibre. Due to the relatively small market shares, access to these infrastructures is not (yet) regulated. This section, therefore, focuses on regulation of the copper infrastructure.

5.2 Ownership

The owner of the local loop is KPN, the former state-owned vertically-integrated monopolist. For about a decade, KPN has been quoted on the stock exchange. Under influence of the European Commission aiming for less government influence in the telecom industry, the State has reduced its share in this company. Currently, the Dutch State possesses about 15% of KPN.[15] Besides this share in KPN, the State possesses a golden (symbolic) share giving it veto rights in strategic decisions regarding KPN, such as mergers and acquisitions. Whether a golden share *de facto* gives the State more influence in the firm is subject to debate. Moreover, according to the European Commission this special treatment of the State cannot be maintained. Therefore, we conclude that the owner of the Dutch local loop can be viewed as a private party pursuing private interests. Regulation of access of essential facilities owned by this party is, therefore, required to achieve competitive markets.

[13] Currently, broadband is offered through the copper infrastructure by ADSL.
[14] Furthermore, unbundling is practically not feasible in cable networks, where connections are never truly individual.
[15] See press release of ANP-AFX, 19 January 2005.

5.3 Unbundling

Important components of the economic regulation of the telecommunication industry are unbundling of the local loop and access regulation. As clarified before, unbundling is needed in order to achieve competition on the market for service provision. In the Netherlands and in other countries of the European Union, the local loop has been unbundled for several years now after it has been made compulsory by the European Union (EU, 2000). Unbundling of the local loop (ULL) means that other firms have access to the main distribution frames (MDF) and to local exchanges within the local loop. Unbundling enables entrants to offer broadband access (in case of partial unbundling by line sharing) or broadband access as well as telephone services (in case of full unbundling) without rolling-out a complete infrastructure immediately.

Contrary to several other European countries, owners of backbones (i.e. the long-distance infrastructure) are not obliged to give access to this infrastructure (what is called bitstream access).[16] Although the regulator initially intended to proscribe bitstream access in order to foster competition, several legal procedures between OPTA and a firm demanding bitstream access (Tiscali) against KPN resulted in the judicial decision that the then prevailing Telecommunication law did not provide a legal base for bitstream unbundling (Steenbruggen, 2004). Consequently, potential competitors in the Netherlands needed to invest in own backbones in order to reach end-users. According to its latest annual report, the regulator (OPTA) views the different treatment of local loop and bitstream as beneficial for the development of facility-based competition (OPTA, 2005).

5.4 Access tariffs

The wholesale-access tariffs (for using the ULL of KPN) are regulated. In the early stages of ULL, the regulator (OPTA) based these tariffs on historical costs including a return on capital. The regulator planned to start with relatively low tariff levels and to raise the levels after a number of years (see e.g. Van Eijk, 1999). The initially low levels should attract new players to the new market while raising the tariffs should give sufficient incentives to both the network owner to invest in its network and to competitors to develop alternative infrastructures.

Under influence of several legal disputes, the method of cost allocation gradually changed. Currently, wholesale-access tariffs are based on actual costs (also called embedded direct costs). OPTA motivates the choice for this method by the mechanism described earlier, where the (potential) entrant faces a ‘make-or-buy’ decision, which, in turn, motivates the incumbent to improve efficiency (and performance) of the local loop.

[16] As we will explain later, this does not apply to the market for high quality wholesale access.

As a matter of fact, access tariffs have declined since the start of access regulation. For instance, according to a memorandum of the regulator, KPN has proposed to reduce (one-off as well as periodic) 2004/2005 tariffs for access to the main distribution frames and for line sharing by 3 to 15% (OPTAa, 2004). As the access tariffs are cost based, this decrease is due to efficiency improvements in the management of the local loop. It is not unlikely that, given the growing competition within the industry, the access tariffs will be less strongly regulated in the future, giving the owner of the local loop more freedom to determine tariffs (see e.g. De Ru, 2004).

6 Dutch regulation and the deployment of broadband

6.1 Relevant markets in broadband and efficiency

This section discusses how the Dutch regulator of the telecom industry (OPTA) has dealt with the possible trade-off between static and dynamic efficiency. In particular, this sections analyses to which extent the regulation of the telecom industry has affected deployment of broadband in the past and explores the impact of current regulation on future deployment of broadband in the Netherlands.

Since the impact of regulation on dynamic efficiency depends on both the strength and nature of the trade-off between static and dynamic efficiency, as well as on the (starting) position on the trade-off, we first have to evaluate the current situation in the Netherlands. In order to do such an analysis, we need to clearly define the relevant markets we are examining. In line with OPTA, we will distinguish three different markets. These markets will be described below.

Based on European directives, OPTA distinguishes three relevant markets within the provision of broadband through the copper infrastructure. The first relevant market is the market for unbundled access. More precisely, it refers to the market for unbundled access (including shared access) at the wholesale level to metal networks in order to provide broadband services (OPTA 2005b). The supply side of this market consists of metal network owners (usually KPN), whereas so-called DSL-platform holders, such as BBned, Versatel and Tiscali, but also KPN, constitute the demand side. These platform holders are, in turn, suppliers in the second relevant market in broadband. On these markets, wholesale broadband access is traded. Wholesale broadband access is the product that a network owner delivers to a service provider. Besides the DSL-platform holders mentioned above, other (cable) companies such as UPC, Essent and Casema offer wholesale broadband access as well. By means of wholesale broadband access, internet service providers, such as Zonnet, Wanadoo or XS4ALL offer broadband access to the end-users. This constitutes the third relevant market.

OPTA analyzed these markets and concluded that KPN has a dominant position in the market for unbundled access as well as in the market for high quality wholesale broadband access. In these markets, demand substitutability, supply substitutability as well as the level of potential competition are considered to be too low to leave these markets unregulated. Therefore, KPN is obliged to give access to its network to competing platform holders against regulated prices.

Having defined the relevant markets in broadband, we now return to the question whether a trade-off exists between static and dynamic efficiency. We assess the current level of static and dynamic efficiency in the relevant broadband markets and determine the impact of regulation. Table 6.1, summarizing the main findings of this chapter, shows that in two markets, i.e. the market for unbundled access to the local loop and the market for high quality wholesale access, a trade-off exists between static efficiency and dynamic efficiency. In the market for low quality wholesale access a modest trade-off between static efficiency and dynamic efficiency can be found. This is due to the fixed costs associated with investments in infrastructure on the on the one hand and uncertainty about future revenues caused by the fierce competition on the other. In the last market, i.e. the retail market, a positive relationship exists between the level of competition (static efficiency) and innovation (dynamic efficiency). The next sections explain these results for each market.

Table 6.1 Efficiency states relevant markets

Relevant market in broadband	Regulated	Static Efficiency	Dynamic Efficiency	Trade-off
Unbundled access to the local loop	Yes	Medium	Medium	Yes
High quality wholesale access	Yes	Medium	Medium	Yes
Low quality wholesale access	No	High	Medium	Modest
Retail access	No	High	High	No

6.2 The market for unbundled access

Without regulation, this market is bound to be statically inefficient. With no substitutability on both the demand side and the supply side, allocative efficiency will be low due to high access prices and anti-competitive practices (such as delaying collocation and unbundling requests). Furthermore, x-inefficiencies may well exist. Although in theory a monopolist would gain from reducing x-inefficiencies, in practice the lack of competition usually reduces the incentives to maximize productive efficiency.

Dynamic efficiency, however, is expected to be high. As this market is a typical natural monopoly, an innovator will be able to fully reap the benefits of a successful innovation. A radical innovation in this market would be the replacement of the local loop by another local loop[17] (increasing the capacity of the existing local loop is an innovation in another market, namely the market for broadband access). Provided that the new local loop is indeed economically profitable (in the sense that the private revenues will outweigh the private costs), either an entrant or the incumbent will roll out the new network of local loops. Due to the high fixed and sunk costs associated with this, duplication by other suppliers will not arise. Therefore, the first supplier to roll out a new local loop infrastructure will be able to appropriate all rents. Other possible innovations in this market are generally far less radical. Here, one can think of organizational and operational improvements related to the physical unbundling process, network maintenance, as well as billing and account management. But the same principle applies: the (unregulated) innovator can fully reap the benefits of these innovations. Although an incumbent will have weaker incentives to do so, the threat of entry can be sufficient to make an incumbent innovative.

In short, without regulation, the market for unbundled access will be statically inefficient, but dynamically efficient. However, for a number of years the local (copper) loop has been subject to access regulation by OPTA. The key question now is whether the way the local loop is regulated affects the development of alternative infrastructures and other innovations. As mentioned, lower access tariffs, albeit good for static efficiency, generally reduces the appropriability of profits due to innovation.

Initially, a scheme with rising access prices was pursued by OPTA. At first, access prices were based on historical costs. Then, access prices would gradually rise to the level of actual costs. The initially low access prices encouraged firms to enter the market for wholesale broadband access by rolling out their own backbone networks and connecting these networks to local loops rented from KPN. However, these low access prices did not encourage the rolling-out of alternative local loops by other firms, because access tariffs were presumably below the actual average cost. The gradual rise of access prices up to the level of actual costs was meant to overcome this. If a potential entrant would expect that his costs will be lower than the actual costs of KPN, this would encourage him to roll out his own network of local loops. This, in turn, would discipline KPN to lower its actual costs to the lowest possible level.

This latter effect clearly emerged in the market for unbundled access. Access prices have in fact declined, indicating that actual costs have fallen below the level of historical cost.[18] The prevailing method of access pricing, based on actual costs, seems nevertheless dynamically efficient, as it gives both the incumbents and entrants incentives to invest in the local loop.

[17] However, if this new loop is not made of metal, but, e.g. fiber, the new infrastructure will not fall under the current definition of the market for unbundled access.

[18] Note that this decline in average costs can be due to incremental innovations, but also to a reduction of x-inefficiencies and increasing economies of scale.

Entrants will only invest in an alternative infrastructure if that is more efficient than using the network of the incumbent. Otherwise, this 'make-or-buy' decision which (potential) entrants face stimulates the incumbent to improve efficiency and performance of its own local loop. Although post-innovation profits will be lower due to regulation, the innovator will at least be able to recover its costs. Consequently, the current regulation of the local loop does not bias the investment decisions of both incumbents and (potential) entrants.[19] Formally, it does have a negative impact on static efficiency, because the access price is above the level of marginal costs. However, given the high level of fixed costs, marginal cost pricing would probably imply that the incumbent will not be able to recover its fixed costs. Therefore, prices based on average costs seem to be a good compromise between static and dynamic efficiency.

In the future, additional incentives for improving efficiency of the existing local loop may come from competition from other infrastructures, in particular cable but also wireless.[20] As such a development would alter the relevant market of unbundled access, regulation might be less needed to balance and/or stimulate static and dynamic efficiency. But under present market conditions, access tariffs based on actual costs increase static efficiency, but still give entrants as well as the incumbent sufficient incentives to improve the network of local loops.

6.3 The market for wholesale broadband access

Without unbundled access to the local loop, each platform holder would need to have its own local loop network in order to offer broadband access. Given that a local loop network is a typical natural monopoly, static efficiency would be low in the wholesale market as well. Similarly, without unbundled access dynamic efficiency would be high, given the favourable appropriability conditions. However, unbundled access regulation exists nowadays. How does this affect static and dynamic efficiency in the market for wholesale internet access?

As mentioned, the unbundling of the local loop combined with the relatively low access tariffs and no unbundling of the higher parts (bitstream) of the network have contributed to investments in alternative backbone infrastructures (OPTA, 2005). The first measure (ULL and low access tariffs) provided potential competitors with a guaranteed option to use the existing local loop against relatively favourable conditions while the latter measure forced those firms to invest in own backbone networks. Consequently, infrastructure competition in higher parts of the network has emerged in the Netherlands. Currently, DSL Platform holders own approximately five different backbone infrastructures.

[19] From this respect, the regulation of OPTA can be called technology neutral (see OPTA, 2005b).

[20] At present, however, these incentives are not very strong, because both cable and wireless are no feasible substitutes in the market for unbundled access (OPTA, 2005b).

The analysis of this market by OPTA shows that the market for wholesale broadband access in practice consists of two separate relevant markets. The distinguishing feature between these two markets is the contention ratio (in Dutch: overboekingsfactor), i.e., the ratio of guaranteed and maximal band width. The level of contention determines which services can be offered at the retail level. In particular data communication services, mainly used by firms to connect their different offices by means of a closed network, require high levels of overbooking. OPTA concludes that the relevant market for wholesale broadband access with a contention ratio of 1:20 or higher (high quality) is different than the market with contention lower than 1:20 (low quality).

Low quality access

Over the last ten to fifteen years, several firms have invested rather heavily in new network capacity.[21] As the costs of these investments are, within reasonable boundaries, hardly influenced by the size of the cables, firms chose to roll out backbones with very large (spare) capacities.[22] As a large amount of capacity is not yet utilised, supply is determined by short run marginal costs. As a consequence, static efficiency is high at this moment.[23]

The capacity of existing networks is constantly being enhanced by technological developments in communication equipment. For instance, by using different colours of light in stead of only one, many more light signals can be transported over the existing glass fibre networks. For the near future, investments in new wholesale capacity will hence not be hindered by large sunk costs. Therefore, as long as the existing (spare) capacity and developments in transportation equipment are sufficient to meet demand, dynamic efficiency will also be high.

This leads us to conclude that now and in the near future, both static and dynamic efficiency are high in the market for low quality wholesale access. Only in the long run, when e.g. a completely new technology will require significant investments, the trade-off between static and dynamic efficiency may alter.

High quality access

Providing data communication services, the most important retail market for high quality broadband access, requires a national network. As KPN is the only firm with such a network,

[21] And continue to do so (see OPTA 2005c).

[22] Overoptimistic expectations regarding future demand may also explain this.

[23] One may wonder whether the current situation is sustainable. Some suppliers have made substantial losses. If this continues to be the case, firms may even exit this market. It is, however, unlikely that this will eventually lead to substantial market power for the remaining firms (and hence low static efficiency). After all, given the level of fixed costs relative to demand, this market is not a typical natural monopoly.

and duplication of this network is not economically feasible, KPN has a dominant position in the market for high quality wholesale access. For this reason, KPN has to grant access to its network against reasonable conditions. As this situation closely resembles current market conditions in the market for unbundled access, we derive the same conclusions here regarding static and dynamic efficiency. Due to current regulation, static efficiency is increased, but sufficient incentives remain for entrants and incumbents to improve the network.

6.4 The market for retail broadband access

Retail broadband access basically consists of two different services: transmission and internet-connectivity. Often these two services are provided by one and the same supplier. Both the cable network and the copper local loops are apt for offering retail broadband access.

In absence of regulation, in particular the unbundling of the local loop, the retail market for broadband access would be statically inefficient. The retail market for high quality would, in that case, even be monopolized, as KPN is the only wholesale supplier. KPN would set its wholesale access prices so high that potential entrants to the retail market would not be able to compete with KPN’s (or a subsidiary) retail business. KPN would then also be the only supplier of high quality retail broadband access, leading to a statically inefficient market.

In the low quality segment of the retail market, cable companies also offer retail broadband access. If upstream regulation was absent, we would hence have two independent suppliers of retail broadband access in most regions. This, however, does not mean that static efficiency would be high. In particular KPN would still have substantial market power. The reason for this is that end users perceive the quality of internet access through cable inferior to internet through DSL networks (see OPTA 2005a). Although this does not give KPN monopoly power, still we can expect that prices would be substantially higher than marginal costs. Hence, static efficiency would be low in a retail market without regulation in the upstream market.

But, as explained above, due to regulation the market for low quality wholesale broadband access has become quite competitive.[24] This, combined with the low entry barriers in retail broadband access, has led to high levels of static efficiency in the retail market. Dozens of independent providers are active now, offering many different types of competing subscriptions.

[24] This process was obviously stimulated by the fact that cable networks have become apt for communication services rather than just for the transmission of radio and television.

Does this negatively affect dynamic efficiency? The answer is no, because the costs of introducing new retail services is rather low (compared to demand). It mainly involves new services related to internet-connectivity. Both these activities do not require monopoly profits.

In conclusion, predominantly due to regulation in the upstream market, the market for retail broadband access is statically and dynamically efficient.

7 Concluding remarks

In this memorandum, we assessed the impact of regulation on the deployment of broadband. We first defined the characteristics of the telecommunications industry and the regulation for this industry. Afterwards, we looked into the regulation in a number of countries showing a relatively strongly developed broadband market. Finally, we analyzed how regulation affects the deployment of broadband, in particular in the Netherlands.

Contrary to other network industries, the telecommunications industry is more and more characterized by several, competing networks, such as cable, copper, and wireless. Ongoing technological developments enhance this competition. Each of these networks shows network externalities and economies of scale. As a result of the existence of competing infrastructures, the essential-facility character of the current networks is declining. In this respect, the telecommunications industry is becoming a less typical network industry compared to, for instance, the electricity industry. In the future, however, if a single superior transportation technology would emerge, the essential-facility component could become more important again.

The key issue of regulation of access to a network is dealing with the trade-off between static efficiency and dynamic efficiency. Favourable conditions for access to the network contribute to allocative efficiency and productive efficiency but can negatively affect incentives for investments in upgrading of existing infrastructures and developing new ones. Governments in the different countries, such as South Korea, Canada, Sweden and the Netherlands, made several similar policy decisions. All privatized the formerly state-owned incumbent telecommunications firms. Only Sweden still shows a rather strong state share in this industry. Moreover, South Korea as well as Canada imposed restrictions on foreign ownership. Many countries introduced unbundling of the existing local loop, but some countries, such as the United States, have given exemptions to investments in alternative infrastructures.

In the Netherlands, regulation of the telecommunication industry is designed to enhance competition between alternative infrastructures without affecting the technology choice of both incumbents and entrants. Based on European directives, OPTA (the Dutch telecom regulator) distinguishes three relevant markets within the provision of broadband through the copper infrastructure: the market for unbundled access, the market for wholesale broadband access and the retail market. The market for unbundled access and a part of the market for wholesale access, i.e. the high-quality market, are regulated. The impact of regulation on the deployment of broadband depends on how the key issue of regulation, i.e. dealing with both static and dynamic efficiency, is solved. Here we summarize the conclusions for each of these markets:

- In two markets, i.e. the market for unbundled access to the local loop and the market for high quality wholesale access, a trade-off exists between static efficiency and dynamic efficiency. This trade-off is due to the presence of the fixed costs of the infrastructure. Tariffs for access to the local loop reflect (average) actual costs of the existing copper infrastructure, giving entrants incentives to make efficient make-or-buy decisions. In addition, the threat of infrastructure competition in the local loop as well as the service-base competition between providers using different infrastructures, i.e. copper and cable, are incentives for the incumbent to increase efficiency. Consequently, the current regulation of the local loop does not bias the investment decisions of both incumbents and (potential) entrants. Formally, it does have a negative impact on static efficiency, because the access price is above the level of marginal costs. However, given the high level of fixed costs, marginal cost pricing would probably imply that the incumbent will not be able to recover its fixed costs. Therefore, prices based on average costs seem to be a good compromise between static and dynamic efficiency.

- An analogue conclusion holds for the high-quality part of the wholesale access market. This market closely resembles current market conditions in the market for unbundled access. Due to current regulation of this market, static efficiency is increased, but sufficient incentives remain for entrants and incumbents to improve the network

- In the market for low-quality wholesale access, a trade-off between static and dynamic efficiency does not exists. Competition has led to considerable investments in glass fibre backbones to such an extent that there is large overcapacity of these networks at present. Consequently, static efficiency is high. Further, the costs of deploying existing spare capacity are rather modest. Hence, investments in new capacity do not require high investments, which is good for dynamic efficiency.

- In the last market, i.e. the retail market, a positive relationship exists between the level of competition (static efficiency) and innovation (dynamic efficiency). This market appears to be both statically and dynamically efficient.

Our overall conclusion is that Dutch regulation of the telecommunication industry gives efficient incentives for technological development such as the deployment of broadband.

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