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Triple play: How do we secure future benefits?

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ABSTRACT

Recent technological developments make it possible to provide all telecommunications services (TV, telephony and internet) via the TV cable and fixed telephony network. Moreover, a new infrastructure based on optical fibre (to the home) is emerging in some places, which may in the future replace both existing networks. Making use of the available economic literature, the paper analyzes some of the consequences of the emergence of one electronic communications market. It focuses on two policy issues: the consequences of convergence of technologies and competition between networks for regulation in the short and medium runs, and the role of public investment in the rollout of optical fibre. It concludes that the present state of regulation may have some undesirable effects in the face of convergence and that public investment in a new general purpose infrastructure may have important advantages.

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1. Introduction

In recent years, the telecommunications sector has undergone drastic technological changes. One important development is the recently discovered possibility of providing telephone services via cable, and even more recently, the possibility of providing television services via an updated version of the copper wire that has traditionally been used only to transport voice messages (telephony). What is particularly interesting is that it is not just new competitors entering the market, but that two former monopolists (each in their own domain/sector) entering into each other's markets. By doing so, they also simultaneously offer internet access so that they really can provide what is called a triple product (fixed telephony, television transmission and internet in one bundle) and the competition between the parties providing this triplet of products may be appropriately termed "triple play". Given the economies of scope in the provision of the three services and the increased use of internet protocol (IP) to provide fixed telephony and television, it can be expected that in the medium to long run consumers will take all three services from the same firm.¹

These developments present new challenges for telecommunications policy. One important policy question the paper addresses relates to the regulation of communications industries. The next section details some of the important asymmetries between cable and telephony companies. One of the asymmetries is due to that in the current regulatory framework. The new regulatory framework adopted by the EU is such that national regulators have to consider what type of regulation is most appropriate in a set of narrowly defined markets (European Commission, 2002; European Parliament,

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¹ In this paper, we focus on the communication services via fixed networks. Mobile networks have a lower capacity (especially when compared with optical fibre discussed later) and thus are not likely to be able to offer fast internet or TV.

2002). The paper will consider some of the effects that such a more narrowly focused regulatory policy may have on the future development of triple play.

A second policy question is whether private companies, incumbent or entrant, have the right incentives to invest in new technology. There will be too little investments if it would be socially optimal to invest in new technology, i.e. the social benefits are larger than total cost, but the two incumbents have incentives to continue using their old network, creating too much competition for potential entrants to introduce a network on their own. There may also be too much competition if incumbents and/or entrants all invest in new technology duplicating costs without appropriate compensation in terms of an increase in total welfare. The next section describes recent developments showing that local governments take an active role in investing in new infrastructure and the policy question is whether this role can be rationalized on economic grounds. This paper attempts to provide an overview of the advantages and disadvantages of public investment and ownership of infrastructure. Apart from the incentives to invest in new infrastructure, it also focuses on another important issue involved in the competition for the developing triple-play market, namely the vertical relation between infrastructure and content.

The rest of the paper is organized as follows. The next section provides an economics perspective on recent developments related to *triple play*. Section 3 discusses the need for a more global perspective when regulation is considered. Section 4 then analyzes the second policy issue, namely whether or not local governments should take an active role in developing an optical fibre network. Finally, Section 5 concludes.

2. Recent developments in triple-play markets

The two developments in the triple-play market on which the article focuses are (a) the possibility of offering telecommunications services on the TV transmission network and vice versa and (b) the rollout of local optical fibre networks (Fibre to the Home—FttH, Fibre to the Business—FttB or, more broadly, Fibre to the Premises—FttP).

Both (fixed) telephony and cable companies own a network of cables on which they can transmit signals. Often, the networks involved were initially government-owned, either by the central government or by local municipalities. Roughly speaking, until the mid-1990s, these networks were using analogue transmission and could only be used for the purpose for which they were designed, i.e. either telephony or television transmission. Throughout Europe, the telephone companies were privatized in the course of the 1990s and so were (some of) the cable companies. More or less at the same time, and sometimes as one of the important reasons for privatization, it became clear that if the networks were updated so that they could allow for digital transmission of signals, they could also be used for other purposes outside the realm of their original designation. The companies invested in a backbone of optical fibre and updated the infrastructure to the home so that more megabytes could be transmitted via that infrastructure.² Thus, large investments to make new services available, not only up to the present, but very likely also in the future, are an essential characteristic of both cable and telephony industries. By making these investments, these companies are able to enter into each other's "home markets". On the other hand, there remain significant technical, organizational and regulatory differences between networks. First, television transmission requires much more capacity than voice and the cable network is therefore much more easily adapted to the use of telephony services than vice versa. Cable companies are already able to provide triple-play services, while this service is still in its infancy if only the (fixed) telephony companies are considered.³ As a result, even though fixed telephony had a larger market share in a larger regional market, it is losing market share quickly to alternative providers, such as cable companies.⁴ Secondly, most of the telephony companies providing fixed telephony services were former state monopolies and still have a nationwide coverage. Cable companies, on the other hand, were more locally organized, usually region or municipality based, and the market in which they operate is thus (much) smaller. Thirdly, one service, namely television transmission requires contacts and contracts with content providers, i.e. TV stations/companies, while the content of fixed telephony is provided by the consumers themselves. As the cable companies have already established contacts, and sometimes long-lasting contracts, with content providers, this (non-)existence of vertical relations create another asymmetry.

Finally, there is regulatory asymmetry. The markets for telecommunication services and TV transmission remain to be regulated by separate legal acts. Fixed telephony is in most countries heavily regulated. The former state monopolies have to provide access to operators without networks so that the latter can compete in the market for telephony services. Moreover, in most countries, fixed telephony companies are not free to charge their own price to their consumers. Prices for basic services are also regulated. This severe form of regulation is usually not present in the cable industry where price and access regulation is very minimal.⁵ Cable companies therefore effectively have a local monopoly on providing television

² Up to 2003, the Dutch fixed telephony incumbent KPN had invested 1.3 billion in backbones and city rings (Het Financieele Dagblad, 2003, November 21). At the beginning of 2006, KPN launched IPTV. It also has plans to replace the copper cable with optical fibre down to the street level in the coming 4 years (see Trouw, 2006a, November 8).

³ In the Netherlands, KPN has only in 2006 begun with TV transmission via the internet, IPTV.

⁴ For instance, KPN lost 150,000 subscribers, mostly to cable companies, only in the second quarter of 2006 (Trouw, 2006b, November 1).

⁵ In 2004, the Dutch Competition Authority advised against obliging cable companies to provide access to their networks (see NMa, 2004), on the grounds that there exist other infrastructures that can be used for the same purpose (ignoring the fact that as a result of more than 90% cable penetration, the role of other infrastructures is very limited). The Dutch telecommunications regulator has only recently imposed some access obligations on cable

transmission on their own network. On the other hand, in some countries (e.g. in the Netherlands) cable companies are obliged to broadcast certain channels (the *must-carry* obligation).⁶

The second important development in the communication sector is the rollout of a third local network, namely optical fibre to the premises.⁷ This network is sometimes laid next to the existing networks, and sometimes it replaces one of the two older technologies (e.g. if laid by an incumbent). Optical fibre has a much larger capacity than either the copper wire traditionally used for fixed telephony or the cable used for TV transmission. Due to this larger capacity, FTTP makes it possible to offer high-quality triple-play services on one network, it opens possibilities for offering new, capacity intensive, services (distance learning, distance health care and telework) and it can boost competition in other services that require large capacity, e.g. TV transmission.⁸ Moreover, transmission over the optical fibre is typically cheaper: in OECD countries, the least expensive charges per bit are typically over fibre (OECD, 2007, p. 222).

From the point of view of competition, it is important who invests in the new network. In the Netherlands, there are several main categories of investors: the fixed telephony incumbent, new entrants active in the communication sector, municipalities and potential customers, such as housing associations, business associations and associations managing business areas. These different types of investors often operate together. An illustrative example is the rollout of an optical fibre network in Amsterdam. The investors include the municipality, an entrant into the communication sector Reggefiber, five housing associations (owning 70% of Amsterdam's rental housing, where 80% of houses in Amsterdam are rented) and additionally in ING Real Estate, a real estate investor (van der Woude, 2007). Interestingly, the fixed telephony incumbent, KPN, has also decided to roll out FttH in some areas of Amsterdam, which may result in some houses being connected to two optical fibre networks (Dekker, 2006).⁹

The investments of the fixed telephony incumbent (KPN), business associations and the administrators of business areas concentrate on Fibre to the Business.¹⁰ FttH is more the domain of municipalities, housing associations and the new entrants (such as Reggefiber and Lybrandt),¹¹ although KPN has also decided to connect all addresses in the city of Enschede (140,000 inhabitants). All in all, a relatively complex ownership structure seems to be emerging, with a mixture of private and public geographically fragmented ownership.

The participation of municipalities raises the question as to what extent the involvement of municipalities in laying out a new infrastructure is economically justified. The incumbents, in particular cable companies which already own a network with relatively high capacity (although lower than the optical fibre) and who in recent years have invested in digital telephony, are protesting heavily against municipal investments, arguing that the capacity of existing networks is sufficient for the customers' needs and that by cooperating with private parties municipalities become involved in unjustified state aid. Moreover, municipal involvement can discourage purely private investments. These doubts are shared by some representatives of both the national and European authorities: in 2006, a proposal was sent to Parliament to forbid municipalities to invest in optical fibre networks.¹² Also, the European Commission is not unambiguously friendly towards municipal investment.¹³ In Section 4, the paper delves into the question whether public investment should perhaps be treated with less distrust.

3. Regulatory issues

Dealing with the trade-off between static and dynamic efficiency is of utmost importance especially in markets where technological progress is (potentially) rapid and many new products are being developed. In these markets, regulatory choices can hamper or stimulate innovation and lead to welfare effects that can be a multiple of static inefficiencies due to

(footnote continued)

companies, but their scope is very limited (see OPTA, 2006). For instance, a condition for access is that the requesting party does not transmit the same TV stations as the cable company and that it does not have its own infrastructure. These two conditions exclude effective competition. A similar situation exists in Flanders (Belgium). Moreover, no access is granted if the requesting party has its own infrastructure that could potentially be used for the same purpose. An attempt of the Dutch Parliament to change the telecommunications law in order to open up the cable has met with resistance from the European Commission (see *Het Financieele Dagblad*, 2006, November 1). In the summer of 2008, the Dutch regulator announced its plans to impose access obligations on cable companies that are more comparable to those prevailing on fixed telephony networks (see OPTA, 2008a). It remains to be seen whether the regulator will succeed in putting these plans through.

⁶ Dutch Media Act, Section 82i.

⁷ What is meant is bringing an optical fibre connection to the final consumer, not replacing parts of one of the traditional networks by optical fibre while the last piece of the local loop is still of copper.

⁸ Presently, limited capacity of cable networks makes it difficult to introduce genuine competition in TV transmission. In 2006, the Dutch telecommunications regulator has recently imposed some access obligations on cable companies, but due to capacity problems a condition for access is that the requesting party does not transmit the same TV stations as the cable company (OPTA, 2006). This condition excludes effective competition.

⁹ In May 2008, KPN took 41% share in Reggefiber. As of September 16, the deal still waits for the approval of the Dutch Competition Authority (Dekker, 2008).

¹⁰ See e.g. press releases from 2007 and 2006 on the KPN website, www.kpn.com.

¹¹ See Bokkerink (2007).

¹² Eventually, the Dutch Parliament decided to forbid municipal ownership of networks, with some exceptions (*Staatsblad van het Koninkrijk der Nederlanden*, 2007).

¹³ It forbade a small municipality Appingedam rolling out its network (European Commission, 2006a), and Amsterdam is still waiting for its approval for its optical fibre initiative (European Commission, 2006b). Moreover, a number of other municipalities have been requested to provide information on their optical fibre projects.

imperfect competition. Empirical estimates of static inefficiencies show that their magnitude is in the order of several percent of GDP,¹⁴ which can be easily offset by a small increase in a country's GDP growth rate for several years due to innovation.

This section considers the first policy question that is central to this paper: how does regulation in general, and the current regulatory framework in the European Union in particular, impact on the outcome of triple play, the competition between incumbents and/or entrants. In particular, it will ask the question whether a narrowly focused regulatory policy can easily exacerbate the existing asymmetries described in Section 2 or be detrimental in other ways. It considers three types of “narrow mindedness”: (i) restricting attention to one market (say telephony) rather than the interaction between markets, (ii) restricting attention to one moment in time rather than allowing for intertemporal considerations and (iii) restricting attention to one layer in the product chain rather than the interaction between different vertical layers.

Consider the new regulatory framework adopted by the EU according to which national regulators have to consider what type of regulation is most appropriate in a set of narrowly defined markets (European Commission, 2002; European Parliament, 2002). The market definitions adopted are such that in different submarkets (cable, fixed telephony, etc.) the appropriate form of regulation, if any, has to be chosen. Given that submarkets are under review, there is no scope for considerations like the ones given in the previous two sections: how competition for the future market of triple play is affected does not (and cannot) play any role in the market analysis. This leads to a situation where a certain submarket may receive the appropriate form of regulation from the perspective of (the welfare generated by) that submarket considered in isolation. However, the consequences for the market development for triple play may be disastrous. In the Netherlands, this regulatory framework has led to a situation where cable and telephony “enjoy” asymmetric regulation (see Section 2). Recent developments suggest that cable companies have been successful in entering the market for telephony, while telephony companies have not yet been successful in entering the market for television. The fact that cable companies are able to make consumers switch away from their traditional telephony provider is certainly also due to asymmetric regulation, i.e. the fact that fixed telephony companies are not allowed to price discriminate between their consumers and offer attractive rates for groups of consumers. On the other hand, the fact that traditional telephony companies are not yet successful in entering the market for television may be due to problems related to being able to guarantee high quality.

At a more general level, regulators have been concerned that switching costs create a constraint on the level of competition between firms as consumers may not easily switch between different suppliers (see e.g. Klemperer, 1987a, 1987b). It is certainly true that once consumers are locked in, companies may have an incentive to charge higher prices. However, these (future) profits may easily be competed away (today) as firms are willing to pay up to their discounted sum of average future revenue per user (ARPU) in order to acquire the customer. Thus, regulators may want to impose a form of (price) regulation once consumers are locked in. However, if companies are uncertain about the extent of future regulation—as they can predict the regulators' incentive to adapt the regulatory framework to changing circumstances—firms do not have an incentive to engage in severe competition in the first place, which will slow down the speed of innovation.¹⁵ The regulators could consider policy instruments like regulatory holidays or regulation conditional on future market structure, but, due to the political context, it can be difficult for telecommunications regulators to commit to future regulation. This is, of course, also relevant for triple play: once consumers have decided to buy all their internet, television and telephony services from one supplier, it is usually more difficult for them to change suppliers. Knowing this, firms engage in severe (price) competition to acquire the consumer in the first place. Uncertainty about future regulation, or the certainty that regulation will change once triple play results in a winning, dominant firm, makes firms hesitant in investing heavily in new technology. Regulators should take these intertemporal considerations more seriously into account.

Thirdly, add-ons may also play an important role in triple play. Once consumers are “in”, firms may provide additional services at relatively high prices as consumers may not be searching around and comparing prices. This lack of consumer search, and not just the presence of switching cost, may result in profits being competed away to get consumers “in”. When add-ons are relatively important for consumers (in the sense that their demand for add-ons is sufficiently high), they will pay attention to the price of these extra services when deciding about the basic service. Thus, when consumers choose a network, they compare the prices of the whole bundle and choose the package that maximizes their surplus. If there is sufficient competition in the market for bundles, the competitive process will lead to package prices that maximize consumer welfare. Again, a global perspective, looking at products together, is needed and regulators should not be too narrow-minded about the profits firms may obtain in some submarkets (cf. Ellison, 2005).

4. The role of public investment

This section considers the second policy question and asks whether the present active role of some local governments as described in Section 2 can be justified on economic grounds. To do this, it must first ask the counterfactual question what is likely to happen if local governments do not take an active role in public private partnerships stimulating the investment in

¹⁴ See e.g. Church and Ware (2000, Chapter 2) for an overview of empirical studies on the subject.

¹⁵ In July 2008, the Dutch regulator announced its plans to impose access obligation on the broadband network of incumbent KPN, both the copper and optical fibre (OPTA, 2008b). This has led KPN and its partner Reggefiber to delay the rollout of optical fibre in Amsterdam. (Dekker, 2008). One problem is that OPTA is obliged by law to review its regulation every three years, which creates much uncertainty about the prices KPN will be allowed to charge in the future. Right now, OPTA and KPN are talking about the possibility to ‘freeze’ the regulation of optical fibre for a longer period.

infrastructure. This is what we will do in Section 4.1. Section 4.2 describes the importance of vertical relations for triple play. Section 5 considers some disadvantages of public investment and concludes.

4.1. Climate for investment

One of the important factors determining the incentives to invest is the degree of competition. Given the fixed costs needed to develop a new product, firms are only likely to bear these costs if they expect that the operational profits they can earn on that product exceed the size of the investment. Intensive competition will often lead to lower returns on the investment and thus reduced incentives to invest (Schumpeter, 1942). On the other hand, competition can also increase incentives to invest as by introducing new products or new technologies, firms can gain an advantage over their competitors and (temporarily) lessen price competition, which allows them to earn rents (see Arrow, 1962). Thus, it turns out that the impact of competition on investment is not unambiguous. There is a crucial difference between *pre-* and *post-*investment competition: more *pre-*investment competition increases incentives to invest due to a larger competitive pressure, while more *post-*investment competition reduces these incentives because the firm is not able to reap the benefits of its investment. Recent research suggests that the relationship between competition and investment can be represented by an inverted U-curve (see e.g. Aghion, Bloom, Blundell, Griffith, & Howitt, 2004 or Gustavsson Tingvall & Poldahl, 2006). The investment in innovation first increases as the level of competition increases, and then it decreases.

Investment in infrastructure could translate into upgrading the existing networks by increasing their capacity, quality or coverage, or rolling out a new network such as optical fibre that can replace the old networks. The rest of the section will focus on rolling out an optical fibre network to illustrate some difficulties with inducing the right amount of investment and the trade-off between static and dynamic efficiency. In particular, it will first discuss the possibility that a local optical fibre network will not be introduced (or will be introduced with delay) even if it would increase social welfare. Then, we will argue that if such a network is introduced, it is likely to eliminate, in the long run, the old infrastructures such as the traditional fixed telephony and TV cable networks. For social welfare, it may matter who becomes the future monopolist, and short-run regulation may have an influence on that.

4.1.1. Rolling out an optical fibre network

An optical fibre network enables more and higher quality communication services than the old infrastructures. The willingness to invest in a new network depends on the price that the investor expects to be able to charge in the future, as compared with the costs that have to be incurred now. A broadband network such as optical fibre is likely to have positive effects that the owner cannot appropriate. The first reason for this is that the surplus generated by the new digital services goes partly to consumers. Heterogeneous consumers value the additional services differently and the network owner will choose the subscription price in such a way that the marginal consumer is indifferent between joining and not joining, while benefits for most consumers are higher. A second reason is that due to more intensive competition (at least in the short run), consumers who keep using the old network will most likely pay a lower price. The investor will not be able to appropriate this positive effect of more competition.

The fixed sunk costs of rolling out a fibre-to-the-home network are very high as compared with the marginal exploitation costs, especially in existing neighbourhoods. On the other hand, the price that the network owner can charge—both the retail price that consumers pay and the access price for service providers—depends only on marginal, and not on fixed, costs. Thus, it may happen that the investor cannot earn its investment costs back and will decide not to invest even when that would be socially optimal. Due to the fact that network users cannot commit to paying a price before the network is in place, a *hold-up problem* can arise in the absence of government involvement, leading to suboptimal investment.

Another reason why there may be too little investment in the network is the *bandwagon effect*. Consumers' willingness to pay for being connected to the network depends on the supply of services on that network. Consumers will not join the network if a few valuable services are available. The potential investors may therefore prefer not to invest before it is clear that there will be enough service providers in the market. On the other hand, service providers may not want to invest in the development of new services before there are customers. It can thus happen that in the absence of government involvement both sides of the market wait until the other side "gets the bandwagon rolling". As a result of this coordination problem, it may take a long time before the new infrastructure is rolled out. The involvement of potential customers (such as business areas and housing societies) and network operators in the investment projects undertaken recently in the Netherlands, described in Section 2, can be interpreted as a market solution to the hold-up and bandwagon problems. By co-financing the network potential customers commit to buying its services (an equivalent of long-term contracts), while network operators (and municipalities) commit to providing some services. However, in places where potential customers are small and dispersed, these solutions to the above-mentioned problems may be insufficient.

Finally, the incentives to roll out a new network will be influenced by the nature of competition in the market as indicated above. When faced with potential entry, an incumbent may respond by rolling out a new network itself as a means of preemption. Gilbert and Newbury (1982) have shown that a monopolistic incumbent has more incentives to introduce a new invention than the entrant, because in that way it can protect its monopoly profits, while the entrant can only gain duopoly profits. Since potential entrants expect this, they are likely not to consider entry at all in which case the

incumbent will not even have to roll out a new network to keep them out—the mere possibility to do it will suffice. To make the threat of preemption more credible, the monopolist may engage in small investment projects—such as connecting all houses in one town to an optical fibre network—to signal that it is in principle ready to invest in new infrastructure.¹⁶

So far the paper has argued that there are some reasons to believe that in the absence of government involvement the incentives to roll out a new infrastructure are too low. On the other hand, there are also reasons why there might be too much investment in the new infrastructure. If that new infrastructure is so much superior that it would replace both old networks (optical fibre is superior, as some argue), then even in the absence of government involvement competitors might engage in a “race” to become the future monopolist. This is similar to the phenomenon of “patent races” (see Church & Ware, 2000 or Reinganum, 1988 for an overview of the literature). Each firm involved in a patent race tries to invest more than its competitor, because then it obtains the patent and becomes the monopolist. In the context of (tele)communications infrastructure, the first firm rolling out an optical fibre network may become the future monopolist. An investment race can lead to too much investment and waste when two costly infrastructures are put in place where one would be sufficient.¹⁷ However, although there are some sporadic examples of that (see the example of two optical fibre networks in some parts of Amsterdam, discussed in Section 2), this problem is likely to be fairly limited.

4.1.2. Winner takes all?

After analyzing the incentives to invest in optical fibre, the paper will discuss the possibility that if such investment takes place, a “winner-takes-all” situation will arise. A “winner-takes-all” market is a market which tends to a monopoly. In the context of rolling out a new, optical fibre network, it can be contended that the infrastructure market has “winner-takes-all” characteristics if (i) the rolling out of a new network would lead to the closing down of both old networks and (ii) it is unlikely that a particular household will be connected to two optical fibre networks. The paper will argue that if a player invests in optical fibre (whether it is one of the two incumbents or an entrant), it is very likely that in the long run, a situation arises where only one network survives. If one of the incumbents rolls out an optical fibre network, then the investor may either close down its old network and migrate all its consumers to the new one, or keep both networks operating in the short run. The latter may be a profitable strategy if the operating costs of the old network are low, as having two networks of different quality may facilitate price discrimination between consumers with different willingness to pay for quality. Moreover, it may be an effective way to push the competitor out (by product proliferation). Otherwise, it will be better to close down the old network.

In both cases, in the short run, the investor’s network(s) is (are) likely to compete with the old network of its competitor. The old network is already in place and the marginal costs of operating it are limited, and thus its exploitation may be profitable even if the presence of a much better alternative will bring the price down. In the long run, however, the owner of the old network will have to decide whether to invest in its maintenance or close it down. Although it is difficult to predict at this moment, it seems reasonable to assume that in the (very) long run only the optical fibre infrastructure will remain in place.¹⁸

Even if optical fibre becomes the dominant technology in the future, it does not mean yet that the communication infrastructure market will be monopolized. In principle, it is possible that two optical fibre networks are rolled out, implying that (almost) every household or firm can choose the network to which it wants to be connected. It does not seem, however, that such a scenario is likely. Rolling out of a “fibre-to-the-home” network requires a large investment due to the necessity of bringing the new optical fibre cable to each particular household. This investment may pay off if the network owner remains a monopolist, but it is unlikely that it can be earned back under duopoly. Next to high investment costs, one of the reasons is that competition between two high-capacity networks is likely to be intense: in the absence of capacity constraints (by definition of the high capacity), the prices for being connected would likely fall to a level close to the marginal costs of network exploitation. The expectation of low prices would then discourage potential investors.

The market for communication infrastructure may also be a “winner takes all” market in that in the long run, the owner of the optical fibre network will control what are now still three separate fixed communications markets: fixed telephony, TV transmission and the internet. The large capacity of the optical fibre will make it possible to provide all these services on one network, and the new communications technologies (such as IP protocol) make it possible to integrate these hitherto separate products into a single service. If in the future, optical fibre will become the only (or main) fixed communication infrastructure, then it may matter who will become the owner of this infrastructure. Important questions here are as follows: Should this be a private or a public monopoly? Is vertical integration with service providers or potential network users desirable? Is it better to have one national network, or a plethora of small interconnected local networks?

¹⁶ The incentive to keep a potential competitor out by threatening to invest remains in place in case of an oligopoly, although a free-rider problem can arise as follows: each oligopolist may prefer that the other firm bears the costs of keeping entrants away.

¹⁷ Of course, this problem may be mitigated if the race winner is willing to buy the unfinished network of the competitor and integrate it in its own infrastructure.

¹⁸ If an entrant invests in optical fibre, a similar conclusion holds.

4.2. Vertical relations

As far as the relation between infrastructure and services is concerned, consumers are of course mainly interested in the services that they can use on infrastructure and not so much in the infrastructure itself. That is, the demand for infrastructure is therefore always a “derived demand” as consumer’s willingness to pay is determined by the price, quality and variety of services—both communications services and content—available on that network. These variables themselves depend, in turn, on the price, quality and variety of services provided by the network owners themselves, as well as conditions on which other service providers—whether commercial or not—can use the communications network to broadcast their ideas. Thus, the structure of the network market is an important factor determining access conditions and therefore the competitive conditions in the content market.

The services offered on communication networks can be globally divided into communications services and content provision. Communications services consist of the transmission of information, such as telephony, internet provision or TV transmission. Content provision includes the production of information services, such as TV shows, internet pages or information services on the phone (e.g. weather forecast).

For regulators, the most important question is whether the conditions under which network owners make their infrastructure available to service providers lead to a socially optimal level of services. As has been argued in Section 4.1, if an optical fibre FTTP network is rolled out, one high-capacity (optical fibre) network is likely to dominate at the local level in the long run. A monopolist’s incentive to grant access depends among other things on the extent to which the services provided by parties seeking access compete with the services provided by the network owner itself. When an operator offers similar services as those provided by the party seeking access it may have, according to the *essential facility doctrine*, incentives to foreclose the potential competitors because it wants to sell its own services to the customers connected to its network. This problem is most likely to arise in the market for communication and transmission services, since network owners are often active in this market (see e.g. Cave, Majumdar, & Vogelsang, 2002; De Bijl & Peitz, 2002; Laffont & Tirole, 2001). Although the essential facility doctrine has been criticized by Chicago School economists using the *one-monopoly rent theorem*¹⁹; the general conclusion from the one-way access literature is that regulation of access is necessary to ensure sufficient competition in the market for telecommunication services.

On the other hand, a monopolistic network owner has in principle incentives to provide access to attractive services that do not compete with its own services as this increases the value of its network to consumers and their willingness to pay for being connected. That does not mean, however, that the access prices will be chosen optimally from the social welfare point of view. The monopolistic network owner will still tend to set prices too high just as any other monopolist, in order to extract more surplus from end users. The presence of positive externalities that content providers exert on consumers does not change the conclusion: they do encourage the monopolist to charge a lower price but on the other hand they also lower the socially optimal price so that the former stays higher (see Armstrong, 2005; Rochet & Tirole, 2003). Moreover, the literature on two-sided markets (see e.g. Rochet & Tirole, 2005 for an overview and Evans, 2002 for applications in antitrust) points to the fact that if such externalities are present, then not only the total price paid by both groups but also the pricing structure may be suboptimal. Rochet and Tirole (2003) and Armstrong (2005) show that with the exception of some special cases (such as linear demand) the pricing structure in such markets will typically not be socially optimal.

Vertical relations may be an additional reason, next to presence of investment costs, for a *winner-take-all* market in the future. At this moment, sport organizations, Hollywood studios and TV channels sometimes grant satellite and cable networks exclusive rights to broadcast their matches, movies and media content (see Stennek (2007) for examples from the US and Sweden, and Harbord and Ottaviani (2001), for examples from Great Britain). A dominant network owner may thus use its present position (large customer base) to try to arrange for exclusive contracts with service providers thereby foreclosing access to this content via other distribution channels and creating indirect network externalities.²⁰ Katz and Shapiro (1985) show that a large network may resist compatibility with a small network in order to protect its dominant position. Content providers may prefer to agree with such contracts rather than to have no access to the dominant network at all. In this case, a bandwagon effect may arise which will lead to self-fulfilling expectations. The infrastructure that is expected to be dominant will attract more service providers, which is likely to encourage more consumers to join that network which will in turn attract even more service providers.

To sum up, the possibility of one optical fibre network surviving in the future poses challenges to regulators as regards the regulation of access in a way that will stimulate the optimal level of competition in services. Unlike access regulation of fixed telephony networks, future regulation will have to consider not only competition in the telecommunications services, but also competition in the content market. Although a network owner should be willing to grant access to content providers if it does not provide content itself, it is still likely to charge too high prices leading to a suboptimal variety of services offered on the network. Moreover, it is possible that a network owner will use exclusive contracts with service providers to strengthen its dominant position. These competitive problems may be solved by access regulation, just as it is being done now with fixed telephony, but (partially) public ownership of the monopolistic network may also be worth

¹⁹ The one-monopoly rent argument (Bowman, 1957) says that a monopolist cannot increase its profits by monopolizing a complementary market.

²⁰ See e.g. Church and Gandall (1992) or Chou and Shy (1990) on indirect network externalities.

considering as a means of guaranteeing open and not too costly access and sufficient competition in the market for services.

5. Discussion and conclusion

Current developments in the communications markets raise new challenges for policymakers. The first challenge is related to the bundling of telephony, TV and internet into one triple-play product and the emergence of competition between cable and fixed telephony networks. One can expect that in a few years, very few consumers will still have single use subscription for telephony, internet and cable TV separately (at least in countries where the cable penetration is comparable to that of fixed telephony). The European regulatory framework is, however, backward looking and not forward looking. The EU directive forces individual member states to analyze what is the best form of regulation for each submarket, making it extremely difficult, if not impossible, to take the broader picture of competition for a future triple-play market into account. This article points out the importance of leaving such a narrow approach behind and focusing much more at the broader picture.

The second challenge is related to long-run developments in the market. In many countries, a new fibre-to-the-premises network is laid making new services possible, while improving the quality of existing services. Two policy questions arise with respect to the rolling out of the new network. First, will the market take care of the socially optimal level of investment in the network? Secondly, will optimal conditions for competition in services be created? Section 4.1 argued that without public involvement an FTTP network may not arise even if it would maximize social welfare. Moreover, if such a network arises, its technical superiority is likely to lead, in the long run, to the disappearance or marginalization of currently existing networks and a network monopoly. Section 4.2 argued that a private monopoly often leads to suboptimal access conditions and therefore typically should be regulated. Consequently, it may be worthwhile to investigate the pros and cons of an alternative scenario where some investments, such as the rollout of a new network, were carried out by, or be under the supervision of, public authorities. This would solve the problem of socially suboptimal investment and prevent foreclosure by making sure that a private monopoly does not arise. Examples of such government-owned networks still abound. One can think of the road system (especially within urban areas) and the electricity network. In case of optical fibre, acknowledging a positive role of public investment would mean accepting the involvement of municipalities in the rollout.

Of course, public involvement in optical fibre has disadvantages as well. Consider first the scenario in which no FTTP arises without public involvement. Then, creating a publicly owned FTTP network replaces a private duopoly with a public monopoly, which may lead to the usual welfare losses associated with monopoly, such as a dead-weight loss, X-inefficiency and a lower level of innovation. However, one should ask the question to what extent these problems play a role here. For instance, the classical dead-weight loss from monopoly arises because the monopolist restricts output. However, in case of an FTTP network this problem could be solved by introducing a universal service obligation. As far as X-inefficiency and the level of innovation are concerned, the technical superiority of an optical fibre network may amply compensate for the possible X-inefficiency and/or the lower level of innovation on the existing fixed telephony and cable networks. Further, X-inefficiency could possibly be mitigated by outsourcing the exploitation of the network to private parties, e.g. by means of periodic auctions.

Next consider the scenario in which a private FTTP would arise without public involvement. Then, as already argued, in the future it is likely that only one network will survive, and thus the relevant question is whether a public or a private (local) monopoly should be preferred. Since the liberalization and privatization wave, it is known that public ownership typically leads to higher levels of X-efficiency and lower levels of innovation (see e.g. *Meggison & Netter, 2001*). For instance, public (including municipal) companies may have less incentives to maximize profits, and since they tend to be bailed out when threatened by bankruptcy, they have lower incentives to operate efficiently.

Another possible drawback of public involvement refers specifically to municipal investment. The present situation (e.g. in the Netherlands) where municipalities decide individually whether to roll out an optical fibre network or not may lead to competition between municipalities which in the end may be socially suboptimal. An argument many municipalities use to roll out a network is that it will attract business and boost regional development. However, if the main effect will be that firms move from one region to the other, the overall effect of the investment may be negligible.

The paper has delineated the possible pros and cons for government participation in investment in optical fibre networks. Future research should be devoted to determining the empirical importance of the different arguments to establish whether or not government participation can be justified on economic grounds.

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