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The Internet Market Structure:
Implications for National and International Regulation

by

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The Internet Market Structure:
Implications for National and International Regulation*

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Abstract:

Internet connectivity may be seen as a composite good that is produced by the complementary inputs local and global access. In addition to the infrastructure components, software and content components affect the customers' demand for connection to the Internet. While components such as local access, Internet connectivity, and electronic communication services are charged separately, the consumers' demand is for the whole chain or system of components. Whereas the telecommunication incumbents seem to have market power in the input segment for local access, the global infrastructure is controlled by a limited number of American firms. Also in complementary segments such as content and software, there seem to be large companies with considerable market power. While access to the local input is domestically regulated both on price and quality, the complementary bottlenecks are unregulated. We argue that a cost oriented regulation of the local access input may be inferior to the domestic government in an open economy. A one-sided price regulation of the local input may lead to increased profit shifting to foreign countries. This underlines the importance of taking into account the interplay between complementary segments when the regulation policy is designed.

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Non-technical summary

There are large fixed costs and natural barriers to entry in major segments of the telecommunication industry, and this may generate considerable market power to a limited number of firms. It is therefore not surprising that firms controlling essential bottlenecks in this industry have been subject to comprehensive public regulation in order to create more competition and press down consumer prices. In most European countries this has resulted in so-called cost-based regulation for local access, which means that the national telecommunication incumbents are not allowed to charge higher prices than those reflecting their long-run marginal costs. While there are strong arguments in favour of this regulation policy when the majority of the traffic on the telecommunication network is traditional voice telephony, we maintain that the growth of the Internet may imply that a different kind of regulation policy is needed.

One of the distinguishing features of the Internet is that the services are produced by assembling a large number of complementary inputs. It should also be noted that access to the global backbone is an essential input, due to the fact that the majority of the content is located in the US. The American infrastructure is controlled by a few large companies, and local wholesalers who sell Internet connectivity to end-users in, e.g., Norway, have to purchase access to the global infrastructure as input. On this background we argue that cost-based regulation of local access may be detrimental to national welfare in Europe, since it may imply excessive profit-shifting to American firms. The reason is that the American firms may increase the price of global access if European regulation councils reduce the price of local access. The optimal regulation policy may therefore imply that the European regulation councils committing themselves to setting relatively high prices of local access, even if this should reduce domestic competition. We also discuss whether there is a need for some kind of supranational regulation of global access prices, but argue that this policy may reduce welfare by provoking the global access providers to engage in quality reducing actions towards their competitors.

1 Introduction

Internet connectivity may be seen as a composite good that is produced by the complementary inputs local and global access. In addition to the infrastructure components, software and content components affects the customers' demand for connection to the Internet. The value for consumers lies in the whole chain or system, and not in a particular segment. E-commerce without network access, for instance, is valueless. Similarly, the majority of new multimedia services have limited value for the users without a broadband access network.

In this paper we will concentrate on the infrastructure components local and global access sold to residential consumers as an example of the interplay between firms in complementary sub-segments, and how it affects the optimal regulation policy. In such context, a low regulated price of access to domestic bottlenecks is good news for firms in complementary segments, but we show that it may be detrimental to national welfare.

In the first part of this paper we provide a description of the market structure for Internet connectivity outside the US. In the unregulated retail market Internet Service Providers (ISPs) offer Internet connectivity to the end-users, and purchase the complementary essential inputs local and global access from other firms. The telecommunication incumbents seem to have market power in the input segment for local access, while the global infrastructure is controlled by a limited number of Internet Backbone Providers (IBPs).[1] Regarding regulation policy, the prevailing paradigm in the EU is to constrain the incumbents controlling the local loop to use cost-oriented access prices.

In the second part we argue that this policy may be inferior for a government in an open economy that seeks to maximize national welfare. If a cost-oriented access price should be optimal domestic policy, it would have to be true that foreign firms have no market power in essential complementary segments. For electronic communication services this assumption will rarely hold. If foreign input providers in complementary segments have market power, the domestic authority should set price on local access above costs.

A cost oriented regulation may *de facto* commit the domestic authority to set a low fee on local access, leading foreign firms to charge prices above those that would be the outcome in an unregulated market economy. Thereby regulation may result in an excessive profit flow to the foreign country. This underlines the importance of taking into account how foreign firms react when the competition policy is designed, and further makes it clear that there may

be a need for an international competition policy. In the input market for local access both the price and quality dimensions are regulated in most countries. The other input, global access, is currently unregulated. However, a two-sided price regulation that set the price of both local access and global access may be harmful to national welfare if the global access provider vertically integrates into the domestic downstream market. The reason is that if the access price is set too low, the vertically integrated global access provider may engage in non-price discrimination of the national firm. Somewhat surprisingly, this need not harm the domestic incumbent, but rather lead to even higher consumer prices than we would observe in an unregulated market economy.

Unregulated retail market for Internet connectivity is a key assumption in our analysis. This assumption corresponds to what is commonly observed.

The paper is organized as follows. In Section 2 we consider some key features of the market for communication services in general, and the market for Internet connectivity in particular. In Section 3 we use a simple model to highlight how the special Internet market structure may affect public regulation policy. Section 4 concludes.

2 Market structure

In this section we will briefly discuss some key features of the market for Internet connectivity sold to end-users outside the US. The purpose is to make a baseline for our analysis in the next section.

2.1 Current regulation in telecommunications

There are large fixed costs and natural barriers to entry in major segments of the telecommunication industry, and in a free market economy we would expect a few firms to have considerable market power. It is therefore not surprising that firms controlling essential bottlenecks in this industry have been subject to comprehensive public regulation.

The retail market for Internet connectivity is currently unregulated in most countries, while the input segment for local access is regulated both with respect of price and quality. According to Laffont and Tirole (2000) the regulators' decision not to regulate the retail market builds on two premises. First, if the local bottleneck is eliminated, then head to head competition in retail market ensures that there is no need for regulation. Consequently, regulation of the local access bottleneck is sufficient to ensure competition in the retail

[1] Also in complementary segments such as content and software, there seems to be large companies with

market. Second, the products and services in the retail market change very fast, and this makes it very costly to monitor the retail markets compared to the wholesale markets.

The former argument deserves a comment, since local access is not the sole input bottleneck for retail ISPs producing Internet connectivity. Consequently, there is an asymmetric regulation regime in two dimensions. First, the fact that the end-user market is unregulated creates an incentive for a vertically integrated provider of local access to discriminate against rivals in the retail segments. This issue has been examined by several researchers, see, e.g., Laffont and Tirole, 2000. Second, since the market for global access is unregulated, there is also an asymmetry between the two complementary infrastructure inputs, and this will be of particular interest due to the US dominance in provision of the unregulated input (global access).[2] We focus on the interplay between the regulated local input and the unregulated global input.

The prevailing regulation regime of local access in Europe is cost-oriented, which means that the incumbent is not allowed to charge higher access prices than those reflecting its long-run marginal costs.[3] The incumbent controlling the local telephone network often uses three main arguments against cost-based regulation. The first argument is that it is practically impossible to compute the long run marginal cost in an industry involving large joint costs. The second argument is that the local access network for telephony no longer constitutes a bottleneck, because cable-TV and wireless networks are bypass opportunities for residential users.[4] The third argument is that a cost oriented regulation will reduce the incumbent's dynamic incentives to invest into infrastructure and product innovation. The danger that regulation creates dynamic inefficiency is an important topic in all technologically advanced industries. These issues are discussed in detail by Laffont and Tirole (2000). We will not go into this discussion, which basically has the same arguments whether we consider the traditional market for telephony services or the market for Internet services.

In addition to the analysis of the interplay between the providers of the complementary inputs, we focus on the timing of the interaction between the domestic regulator and the

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considerable market power.

[2] Except for local access, all the major bottlenecks seem to be controlled by American firms. Cisco Systems, for instance, is the main supplier of the routers in the basic infrastructure, MCI WorldCom is the dominating provider of global access to the Internet backbone, Microsoft is close to a monopolist in providing PC operating systems, and AOL/Time Warner will presumably control an important part of the content market.

[3] See Mognes and Nord (1999) for an overview of current and future regulation of local access regulation with focus on the Norwegian market.

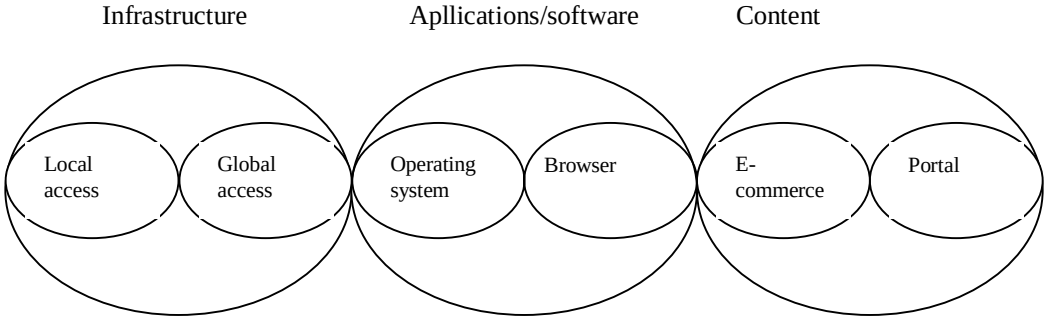
[4] There may be a contradiction in these two arguments since large common costs obviously may give rise to bottlenecks.

market players. The current sector specific cost-based price regulation for local access is often seen as a "hands-on" *ex ante* approach, while the competition rules are seen as a *ex post* regulation approach. This distinction may be misleading, since the current cost-based sector regulation *de facto* often will appear as an *ex post* regulation (see e.g. Laffont and Tirole (2000) and Foros, Kind and Sørgard (2000)). Our purpose is to compare a situation where the domestic regulator credible commits to a given price policy for local access before the input suppliers choose their wholesale prices with a situation where the domestic regulator do *not* make such a commitment. The former we refer to as *ex ante* regulation, while the latter we refer to as *ex post* regulation. Hence, in our context *ex ante* regulation does not imply cost-based price of local access.

2.2 Complementarity between segments

Figure 1, where we have distinguished between infrastructure, applications/software and content, illustrates the chain of complementary inputs. The important point here is that consumer demand is for the whole chain or system, not for a single component, and that the profit level that a firm can extract depends both on the competition in its own segment and the competition in complementary segments. Hence, a firm can extract a larger share of the total value when the complementary segments are highly competitive or strongly regulated. Note, however, that the value of such a chain can be extracted only once.

Figure 1: Structure of the Internet market



The complementarity between the Internet segments is important even for firms that have limited market power. For example, the lower the price of local access, the higher the price that Amazon.com can charge from their consumers. A strict price regulation of local access is thus good news for Amazon.com, and this is true irrespective of the competitive pressure from other booksellers operating through the Internet. Moreover, a firm such as Microsoft,

that has monopolized one component (the operating system), has no incentive to integrate into complementary segments where we are likely to have perfect competition or strictly regulated prices. Microsoft may, on the other hand, have incentives to enter unregulated market segments with imperfect competition.[5] In this sense it is not surprising that Microsoft has avoided the transport segment, but become an important player in the market for Internet browsers. [6]

It is hardly the welfare of consumers Bill Gates (Microsoft) and Steve Case (AOL) have in mind when they argue that the prices charged for telephone lines should be reduced (Davos meeting, February 2000). Rather, it is the fact that the telephone networks are complements to a large share of the goods sold by Microsoft and AOL. These companies will thus extract a larger share of the total Internet industry profit if telephone prices are reduced.

2.3 The retail market for Internet connectivity

Figure 2a shows a situation where Internet connectivity and local access is sold bundled to the end-users by local Internet Service Providers (ISPs), who in turn buy local access as an input from a Local Access Provider (LAP) and global access as an input from an Internet Backbone Provider (IBP). In that case regulatory pressure has obligated the LAP to open its network and sell high-quality local access as an input to potential rivals in the end-user market at price equal to long run marginal costs.[7] In Figure 2b, in contrast, the LAPs sell local access as a separate service to end-users, who possibly buy Internet connectivity from another firm. The end user then combines the two components into the composite good. These are presently the two dominating market constellations, and the discussion in this section holds independent of which of these constellations we consider.[8]

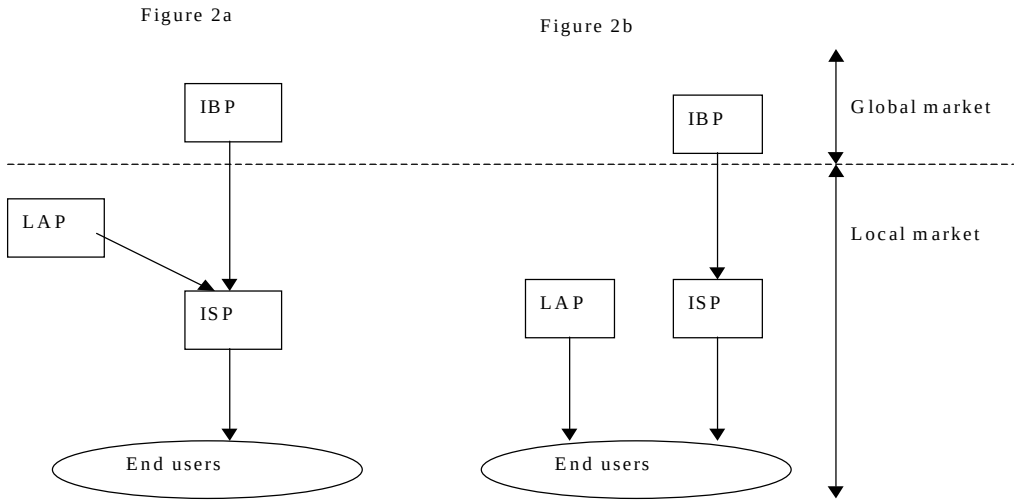
[5] For a further discussion, see Economides (1998c).

[6] An open question is to what extent we will see vertical integration between infrastructure providers of Internet connectivity and content and applications providers (see Figure 1). The experience from the past indicates that there will be few such mergers. Current high-level services are rarely bundled and sold together with connectivity from ISPs (Clark, 1999a). Recently, we have, however, seen several proposals for mergers between facility-based firms and content providers.

[7] It should be noted that cable-TV companies do not face this regulatory requirement, and that is presumably one reason why they have so far not offered local access to independent ISPs.

[8] In Section 3, where we discuss optimal regulation policy, we will focus on the situation described in Figure 2a.

Figure 2: The major market constellations for Internet connectivity.



2.4 Local access

Local access, or the "last mile into homes", seems to be a bottleneck component for all electronic communication services sold to the residential market. Obviously, and in contrast to other potential bottlenecks, local access has to be offered locally. Presently, there are at most two incumbents that can provide wire line local access in a given area; cable-TV companies (using cable modems over hybrid fiber coax) and telephone companies (using dial-up modem, ISDN or ADSL through the copper pair into homes). The high up-front investments of new wire line facilities, and the possibility of increasing the capacity and quality of existing local telephony and cable-TV networks, indicate that there will be no rush to enter this market and install additional wires to homes (Clark, 1999a). The competitive pressure in this segment is thus limited. Furthermore, cable-TV providers have not been offering local access as an input to independent ISPs. Therefore, the telephony incumbent has been the only provider of local access as an input to independent ISPs.

Technical innovations may certainly alter this picture, but the costs of installing additional wires to the homes are likely to be high also in the foreseeable future. Hence, some wireless technology with enough bandwidth seems to be one of the more promising technological innovations that may alter the picture. There exist several serious technical challenges (such as the scarcity of spectrum resources) that must be solved before companies offering wireless local access will be able to capture significant market shares. Note, however, that the technical problems regarding LMDS now seems to be solved, and broadband access is

currently offered via this technology.[9] Another alternative may be some kind of combination of different technologies, or what is often called hybrid technologies. One possibility is to use satellite in one direction and telephone cooper lines in the other direction.[10] Independent of the technological evolution, it is realistic to believe that the incumbent who is controlling the cooper pair into homes will still have considerable market power in the input market for local access. The reason is that the incumbent has access to every potential consumers, since almost all private homes have a telephony subscription from this incumbent.

2.5 Global access

Global access to the core Internet Backbone are controlled by a few firms, called Internet Backbone Providers (IBPs), that sit on the top of the hierarchy. In addition to giving access to information located on servers in the US, the input from the IBPs also secure access to the core routing structure, and access to all Internet addresses in the world (Milgrom et al, 1999, and Srinagesh, 1997). A limited number of core IBPs co-operate in creation of a consistent routing structure. These arrangements are called peering, and a key feature of these arrangements is to create full routing tables. The full routing tables is a part of the input supplied to regional ISPs, and they define the addresses that can be reached (Srinagesh, 1997).

The US government was the main financial sponsor of the Internet when the system was in its infancy. At that time the suppliers of Internet services seemed to be more interested in building new infrastructure and attracting new consumers on a non-profit basis, and the norm was cost-free interconnection between all ISPs. As the Internet matured the US government's position as financial sponsor ended. In 1993 the US government decided to leave the management of the core Internet Backbone to commercial IBPs, and this has resulted in a more commercial and hierarchical structure. While the core IBPs still have cost-free interconnection between each other, they now charge smaller regional ISPs for access to their global infrastructure and core routing services. In other words, the smaller regional ISPs have become customers (or resellers) of the core IBPs facilities and services. An example of this is UUNET (an MCI WorldCom subsidiary), who ended the cost-free interconnection regime in 1997 and started to charge smaller ISPs for access to their backbone.[11]

[9] Local multipoint distribution systems (LMDS) is a fixed wireless technology.

[10] For a further discussion of these issues, see Clark (1999a, 1999b) and Speta (2000).

[11] See Mackie-Mason and Varian (1997), Bailey and McKnight (1997), and Werbach (1997) for a summery of the Internet's history.

"In the good old days, network engineers didn't connect with another company; they connected with another engineer whom they knew and trusted. These "peering arrangements" typically were informal agreements to exchange traffic without money changing hands. But as the industry matures, settlement-free interconnect does not necessarily provide appropriate incentives to the industry players. "Why should I help my competitors by giving them free access to my network?" say the suits. "But the Internet won't work unless everything is connected to everything else," say the geeks. Both are right. Interconnection is healthy for the industry as a whole, but the current business model for interconnect may easily generate incentives for individual carriers to overcharge their competitors." Hal Varian (1998).

The core global infrastructure is controlled by a small number of American IBPs, such as MCI WorldCom, Sprint, GTE, AT&T and Cable & Wireless, that control between 85% and 95% of the total backbone traffic in the US (see Cremer et al (1999) for an overview). These firms see the regional ISPs as their customers, and the core IBPs in the US provide connection to the global backbone to regional ISPs all over the world. It should be noted that global access is much more essential for Internet connectivity than for conventional telephone services: while only a relatively small portion of world wide telephone calls go to the US, the majority of the Internet traffic has to go through the US. For the location of Internet facilities we thus have a clear asymmetry between the US and the rest of the world.

The core American IBPs are subsidiaries of the major facility-based telecommunications firms, and they also control the majority of the transatlantic lines. When European, Asian or Australian ISPs wish to connect to one of the US backbone, they must usually pay for communications both ways. Even if each IBP separately has limited market power, a group of co-operating IBPs may have considerable market power (Cremer et al, 1999, Milgrom et al, 1999). For instance, although the quality of the backbone is enhanced through the IBPs efforts to coordinate their core routers, it is clearly tempting to use this formalized co-operation as a collusive device (Varian, 1999). Recently, we have also observed that IBPs have vertically integrated into the retail market for Internet connectivity (the ISP segment) also in Europe. It is well known that when an input-segment monopolist integrates into a competitive retail-segment, it may have incentives to practice foreclosure against rivaling firms in order to give its own subsidiary a competitive advantage.[12]

[12] Another reason for the IBPs to vertically integrate into the retail market is the trend towards relatively more local Internet traffic. This tendency is probably due to new consumer-types and new services in the Internet. In non-English speaking countries, content intended for the mass-market must be produced locally or translated. Furthermore, for new interactive services, such as telemedicine, tele-education, and video conferencing, a larger portion of the communication are probably between consumers in the same geographical area than what is the

2.6 Vertical integration

Above we noted that both LAPs and IBPs recently have integrated vertically into the ISP segment. Even though both the LAPs and the IBPs control essential inputs, they do not have the same possibilities to engage in foreclosure. The reason is that the LAPs typically are subject to regulation of price and quality for local access as an input component, while there is no regulation of the global access input controlled by the IBPs. The domestic incumbent that is controlling the local bottleneck comes from the regulated telecommunication world, while the IBPs who are controlling the global bottleneck come from the unregulated Internet world. The ability and incentive for a dominating IBP to practices foreclosure was given attention during the MCI-WorldCom merger proceeding. It was pointed out that foreclosure could take a number of forms, including price increases on global access for the ISPs and non-price discrimination through quality degradation of the inputs. The EU is now raising the same concerns regarding the proposed merger between MCI WorldCom and Sprint.

For the EU it is not sufficient that the firms controlling a global input component are complying with US antitrust laws, and this fact has received some attention lately. This has led to discussions of whether there is a need for some kind of global regulation, which for instance may take place through WTO agreements that reduce the scope for foreign firms to utilize their global market power excessively.

Most Internet users have previously demanded services such as e-mail and web browsing. These services are not particularly sensitive to delays. The quality requirements have changed, however, not least because there is an increasing demand for interactive video that requires real time communication. The market thus becomes more sensitive to the quality of interconnection, and, hence, quality degradation can be an important strategic weapon. Integrated firms such as MCI WorldCom may therefore gain an advantage by offering premium services to the consumers of its own subsidiaries, and this fact has received a great deal of attention.[13] In such circumstances it is almost impossible for the regulation council to decide whether the integrated firm offers new functionality (higher quality) based on technological advantages, or whether the firm practices non-price discrimination through

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case for conventional Internet services such as web browsing. Hence, it may be important for the IBPs to be active in the local market since the importance of local traffic as a strategic variable increases (see Foros and Hansen, 1999a, 1999b).

[13] See Shapiro and Varian (1998) for a discussion of the MCI WorldCom case, and Economides (1998a, 1998b) and Foros, Kind and Sørgard (2000) for formal analysis.

quality degradation of the input sold to the rivals in the retail ISP-segment. The Microsoft case gives an illustration of the problem in such contexts (see Economides, 1998b). As long as the IBPs has incentives to practice foreclosure, it is hard to limit their ability to do so.

The telecommunication industry has a long history of using foreclosure as a strategic weapon. The Bell System (later AT&T) provides a good example of this. Some one hundred years ago the Bell System was the dominating telephone company in the US. Though it faced competition from a large number of local operators, it was the technical leader for long-distance calls. Bell refused to give the local rivals access to the national long-distance network, and could thereby offer a superior service to their own end-users. As a consequence, the local competitors were soon driven out of the market.

3 Regulation of local and global access. Who gains?[14]

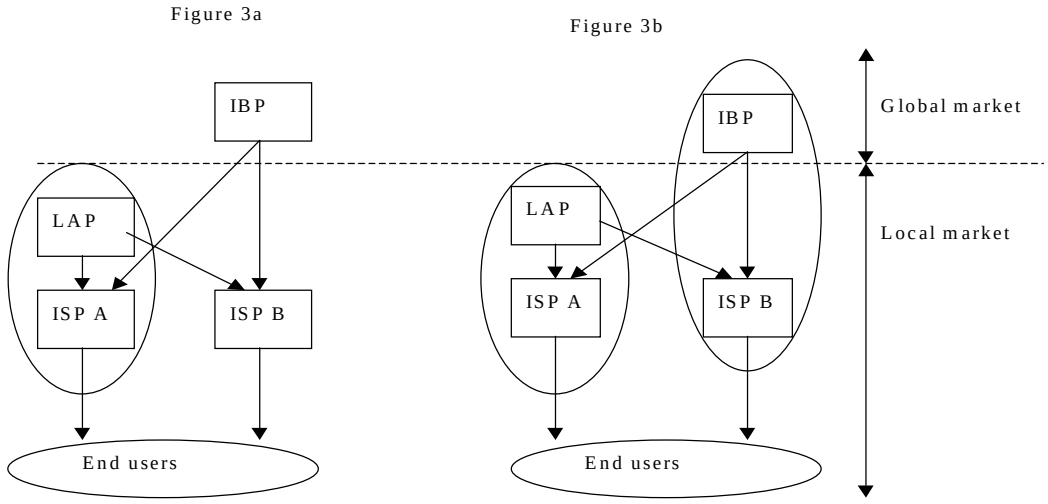
Few sectors have historically been so intensively regulated as the telecommunication industry, and the market structure we have described above indicates that the need to regulate will not be lower as the Internet becomes increasingly important. Below we will present a stylized model where we explicitly take into account that a few American firms dominate some of the market segments that are complementary to local access, and show how this may affect the optimal regulation policy outside the US. We will also discuss the scope for international regulation policies.

The discussion in this section is purely verbal, and is partly based on a formal analysis in Foros, Kind and Sørgard (2000). The analyzes is made as simple as possible in order to highlight how the Internet market structure affects the regulation policy. We have thus made no attempt at being "realistic", but rather set up a framework that allows us to point out some potentially important aspects of the interplay between the regulator and the firms providing local and global access.

Figure 3 provides a simple illustration of the vertical market structures for Internet connectivity that we will consider. In Figure 3a the LAP is vertically integrated with ISP A, while ISP B is an independent national firm. These firms in turn buy access to the global backbone from the IBP. In Figure 3b both the LAP and the IBP are vertically integrated, with ISP A and ISP B, respectively.

[14] This part is based on Foros and Kind (2000).

Figure 3: Vertical market structures for Internet connectivity.



3.1 One-sided cost oriented regulation of local access

In this section we discuss the effect of a one-sided regulation of the local access price. In a context like Figure 3a, where the IBP operates as wholesaler of global access, a regulation that sets the price for local access equal marginal costs is only optimal if the IBP has no market power. If the IBP vertically integrates into the retail market, as illustrated in Figure 3b, a cost-oriented regulation will never be optimal.

3.1.1 The upstream backbone provider is non-integrated

In this subsection we will assume that the LAP is vertically integrated with ISP A, while ISP B is an independent firm. Domestic shareholders own these firms, while foreigners own the IBP. We will first consider the case where the ISPs can costlessly connect to the backbone, and this is consistent with the "old" regime in the Internet. Recently, however, we have observed that the IBPs have begun to charge the ISPs for connectivity to the backbone, and presumably this pricing behaviour will become more widespread along with the increased commercialization of the Internet (Frieden, 1999). We will therefore also consider the case where the IBP chooses the price of backbone connection so as to maximize profit. It will be shown that the optimal regulation policy depends crucially on whether the backbone connection price is endogenously determined or not.

Exogenous input price for global access

Suppose that the LAP has a long-run marginal cost equal to c_l, and that it operates ISP A as a subsidiary. The LAP may also sell local access to ISP B, in which case ISP A and ISP B compete in the end-user market. The end-user market in turn consists of a number of consumers that differ in their willingness to pay for connection to the Internet. With a large number of consumers we will then have a downward sloping demand curve like *DD* in Figure 4, which measures quantity on the horizontal axis and price on the vertical axis. For the moment we will assume that access to the global backbone is costless. What is the optimal price strategy of the LAP?

Access to the local loop is an essential input, and the LAP is therefore able to foreclose ISP B. This can easily be done by setting a so high price of local access that ISP B cannot operate profitably.[15] In that case the integrated LAP avoids price competition in the end-user market, and will be in position to charge the monopoly price p_m and sell Internet access to q_m consumers. Thereby the LAP maximizes its profit level, which can be expressed as $\pi_{LAP} = (p_m - c_l)q_m$. This in turn is equal to total domestic profits π_D (since ISP B is inactive), see Figure 4.

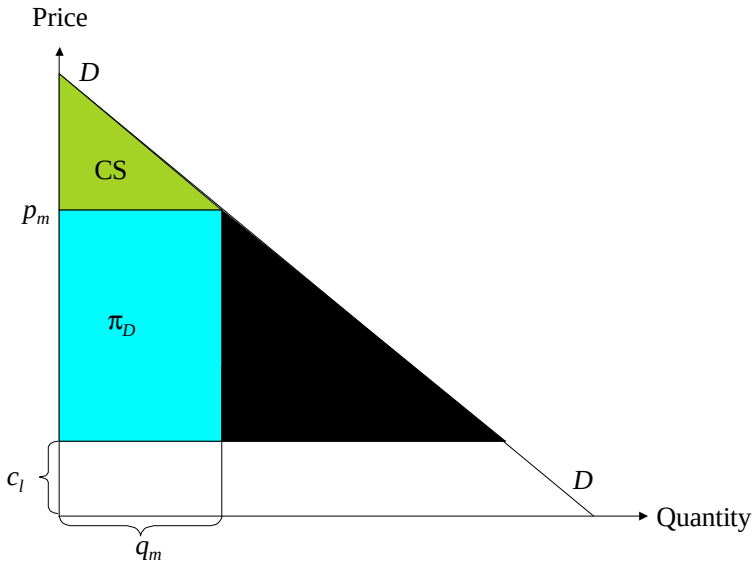
Consumer surplus is equal to the triangle denoted by *CS* in Figure 4. Since the domestic firms are owned by national shareholders, we will follow the standard procedure in economics and measure welfare as the sum consumer surplus and domestic profits, $W = CS + \pi_D$. Consequently, we do not value consumers higher than shareholders, or vice versa. This is not a critical assumption; the qualitative results go through even if we use different weights.

It is well known that monopoly pricing is socially inefficient, and the size of the inefficiency - the deadweight loss – is equal to the black tripod DW in Figure 4. The inefficiency arises because the LAP has to consider two effects of a change in the consumer price. Suppose, namely, that the LAP charges a price *p'* and sells Internet access to *q'* consumers. By charging a somewhat lower price the LAP will sell Internet access to one more consumer, and in isolation this increases the profit level by $(p' - c_l)$ units. In that case, however, it will also have to reduce the price on all the other *q'* units that it sells. These effects cancel each other at the monopoly price, while the latter (former) effect dominates for

[15] In order to make the discussion as simple as possible, we assume that the ISPs offer homogenous goods in this section. Product differentiation will be discussed in Section 3.2.

lower (higher) price levels.[16] In a socially efficient solution, however, the LAP should serve all consumers who are willing to pay at least c_l.[17]

Figure 4: Lack of competition creates a deadweight loss.



There will be no dead-weight losses if there is perfectly competition, but this is obviously not true for the telecommunication market. In an ideal world the government could replicate a perfectly competitive market by requiring that the consumer price for Internet connection is set to c_l, but that policy is not used in practice (see Laffont and Tirole, 2000). The prevailing regulation regime is, instead, to regulate the price that the bottleneck owner charges from other firms in the industry. The regulated price will typically be lower than the price that forecloses other firms in the industry, but never lower than long-run marginal costs. In the present context the former implies that both ISP A and ISP B will sell Internet connection, while that latter implies that the integrated LAP earns a non-negative profit on sales to ISP B. The consumer price will subsequently be determined by competition between ISP A and ISP B in the end-user market.

The less expensive it is for ISP B to connect to the local loop, the lower will be the price it charges from the consumers. Which price, then, should the regulator set for access to the local loop (given that it cannot be lower than c_l)? The answer to that question is simple;

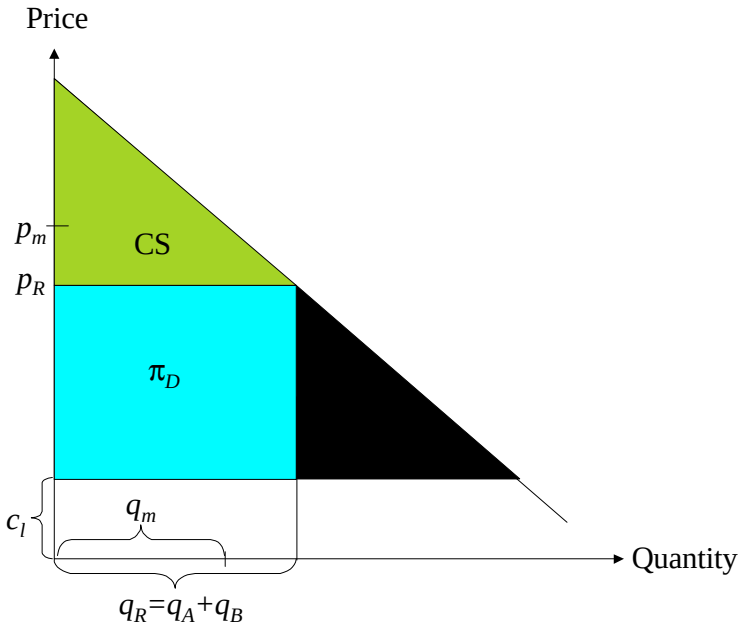
[16] Implicitly we have here assumed that the monopolist is unable to price discriminate.

[17] The profit loss that arises if consumers are charged less than p_m is just a transfer of money from domestic firms to domestic consumers. This is irrelevant from a social point of view, since *CS* and π_D are given equal weights in *W*.

the price should be set equal to c_l. The reason is that the regulator aims to minimize the deadweight loss, and thus the consumer price should be as close to c_l as possible.[18]

Figure 6 illustrates the new situation, where we have assumed that the consumer price is reduced from p_m in the unregulated economy to p_R when the price of access to the local loop is regulated. With this lower price more consumers are willing to buy access to the Internet, and the demand for Internet connection has thus increased from q_m to q_R. The total profit level is reduced, so that the area π_D in Figure 5 is smaller than in Figure 4 (it is impossible to generate a higher profit level than the one a monopolist obtains). Note also that π_D now is split between the integrated LAP and ISP B, so the profit level of the integrated LAP is significantly reduced due to the regulation. However, the lower consumer price implies that the deadweight loss is reduced. Therefore regulation increases domestic welfare, and it follows that the higher consumer surplus more than outweighs the loss of domestic profit.

Figure 5: The deadweight loss is reduced due to higher competition.



Endogenous price of global access

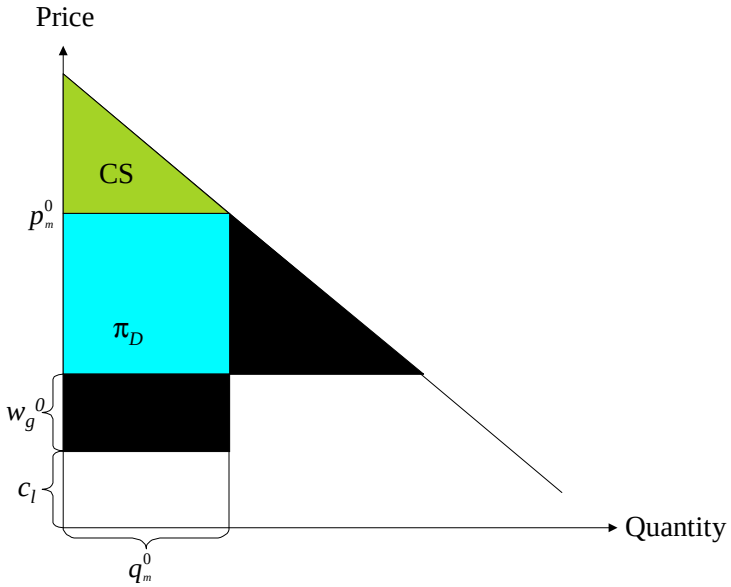
Above we argued that the integrated LAP has incentives to utilize its market power in the local loop and foreclose the independent Internet Service Provider, ISP B. However, we also

[18] Note that even if ISP B pays only c_l for access to the local loop, the consumer price will be higher. The firms

have a second essential input, namely access to the global network. This fact was not visible in the former analysis, since we assumed that the ISPs had free access to the backbone. Free access used to be the norm, but casual observations show that this is no longer the case (Frieden (1999), and Cremer et al (1999)). We will therefore extend the analysis, and assume that the IBP determine the price for backbone access so as to maximize its profit level.

It is obvious that the end-user price increases when the IBP uses a positive mark-up on its long-run marginal costs. How large the mark-up will be depends on how price sensitive consumer demand is, but the basic analysis in the unregulated market economy will be exactly the same as the one we used above. The integrated LAP will still have incentives to foreclose ISP B in order to avoid competition, and there will be a deadweight loss that calls for regulation of the price for local access. The outcome in the unregulated economy is illustrated in Figure 6, where p_m^0 is the monopoly price that the LAP charges in the end-user market, q_m^0 is the corresponding consumer demand, and w_g^0 is the price that the IBP sets for access to the global backbone. Total revenue to the IBP is equal to w_g^0 times the number of consumers connected to the Internet, q_m^0. This is represented by the black square in Figure 7. Since the IBP is a foreign firm, its revenue does not count in the measure of domestic welfare. We thus still have that $W = \pi_D + CS$.

Figure 6: Market equilibrium with endogenous price from the IBP



will therefore make some profit, and this is likely to be true unless there is a very large number of competitors.

The domestic deadweight loss occurs of exactly the same reason as in the first analysis; the integrated LAP charges an end-user price (p_m^0) that is higher than its long-run marginal costs ($c_l + w_g^0$). What is interesting, is how the regulation policy should be designed when w_g is endogenous. We will consider two cases. First we will consider so called *ex post* regulation. This implies that the regulator first observes the market prices for local and global access. If the regulator finds that the price of local access is not optimal, it can intervene and change that price. Secondly, we will consider *ex ante* regulation, whereby the regulator commits itself to use a certain price. Incumbent telecommunication companies repeatedly complain over the *ex ante* regulation, but below we will argue that there are strong arguments in favour of this regulation regime.[19]

Ex post regulation

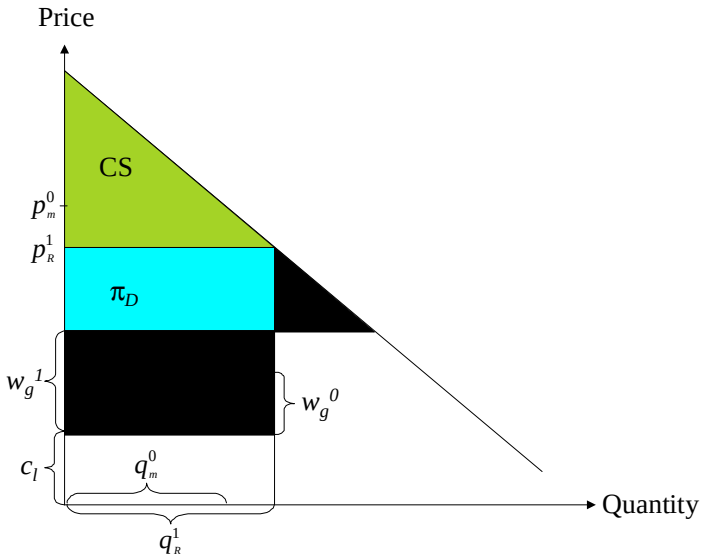
With *ex post* regulation – which is the dominating policy in most markets in both the EU and the USA – the regulator first observes the market equilibrium, and then decides whether it should intervene. Foreign firms lie outside the regulator's jurisdiction, and in the present context the regulator therefore has the same problem as in the earlier analysis: it has to determine the socially optimal access price to the local loop (i.e., the price that the integrated LAP is allowed to charge ISP B). In the following it is convenient to denote this access price by w_l.

It is, actually, very simple for the regulator to find the optimal value of w_l. Whatever price the IBP charges, the best the regulator can do is to set $w_l = c_l$. If it sets a higher value of w_l, the consumer price - and thus the deadweight loss – will be unnecessarily large. Figure 8, where p_R^1 and q_R^1 denote the end-user price and quantity, illustrates the outcome. As expected, the deadweight loss and the consumer price are reduced ($p_R^1 < p_m^0$), since regulation ensures competition between ISP A and ISP B. However, note also that the access price to the global backbone is now higher than in the unregulated economy; $w_g^1 > w_g^0$. The reason is that the IBP is aware of the fact that the regulator *ex post* always prefers $w_l = c_l$. This means that the consumer prices will be relatively low in any case, and therefore the IBP has an incentive to increase the price it charges from the integrated LAP and ISP B (and capture some of their profits). We may well expect that this effect more than outweigh the higher consumer surplus,

[19] Whether we have *ex ante* or *ex post* regulation does not matter if the price of access to the global backbone is exogenous. The reason for this will become clear later.

in which case domestic welfare ($W = \pi_D + CS$) falls as a consequence of the regulation policy. The net result of regulation is thus to increase the profit flow to foreign country excessively, and the domestic country would be better off in the imperfect and unregulated market economy. This result is, to the best of our knowledge, new to the literature. However, it reflects a basic insight that has been stressed in the political economy literature: what matter is not whether the market economy is imperfect, but whether the government can do better.

Figure 7: Ex post regulation may reduce domestic welfare.



Ex ante regulation

From the above it is clear that *ex post* regulation may be inferior, because part of the initial domestic profit is shifted to the foreign IBP without ensuring a sufficient increase in consumer surplus. The prevailing regime in the EU, however, is in principle to use so-called *ex ante* regulation for the telecommunication industry. In this sense there is an asymmetry, because most other industries are subject to *ex post* regulation.[20]

With *ex ante* regulation the regulator commits itself to set a certain price for access to the local loop. Which price should the regulator choose? Obviously not $w_l = c_l$; we have already seen that that is detrimental to welfare, and any value of w_l below the one chosen by an unregulated LAP increases profit shifting to the foreign firm. In fact, we cannot preclude the possibility that the best the regulator can do is to accept relatively high consumer prices, and allow the integrated LAP to become a monopolist in the end-user market. In that case the

outcome is the same as we had in Figure 7, where ISP B is foreclosed and the consumer price equals p_m^0. Note, however, that the regulator must *credibly commit* itself not to intervene. The reason is that the regulator *ex post* always will have an incentive to set $w_l = c_l$. Since the IBP is well aware of this fact, a simple announcement not to intervene is implausible. Whether the EU regulation policy is credible in this sense is open to debate, but for the rest of this paper we will take the intentions of the EU seriously, and only consider *ex ante* regulation.

3.1.2 The upstream backbone provider is vertically integrated into the retail market

The result that the integrated LAP forecloses ISP B illustrates a quite general insight from economic theory, namely that parent companies have incentives to give their subsidiaries a competitive advantage. This may be a particularly fruitful strategy to the extent that the parent controls an essential input, as is the case for local access providers. However, also the backbone providers control an essential input, and recently we have seen that the core American IBPs have vertically integrated into the market for Internet connectivity also in Europe. This raises two important questions that we will highlight in this section. First, how is domestic welfare affected if a foreign IBP vertically integrates into the ISP market? Secondly, what are the implications of this for the optimal regulation policy?

In order to answer these questions, we will assume that the IBP is vertically integrated with ISP B as illustrated in Figure 3b. This means, *de facto*, that the integrated LAP now faces competition from an Internet Service Provider that has cheap access to the backbone (at a cost equal to the IBP's long-run marginal costs, rather than w_g). The competitive pressure will therefore be higher than when the IBP was not integrated, and this in turn implies that consumer prices will be lower.[21] Consumer surplus will therefore increase. Indeed, we may also expect domestic welfare to increase, even though the profit of ISP B now accrues to the foreign firm (so that welfare is now equal to $W = CS + \pi_{LAP}$). The reason is that the IBP and the LAP in the present context are in a symmetric position, controlling each their essential input and each their end-user provider. Therefore we may foresee more aggressive competition between these firms, leading to a significant reduction of the welfare loss compared to the situation where only the LAP was vertically integrated.

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[20] The reason why the EU uses *ex ante* regulation is quite different from the one that we will stress below, and some pros and cons of that policy are discussed by Laffont and Tirole (2000).

[21] The fact that vertical integration may reduce consumer prices is well known in the economic literature, and goes under the name "avoidance of double marginalisation". See Spengler (1950) and Economides and Salop (1992).

What is more surprising, perhaps, is how the regulator will set the access price to local loop in this case.[22] In Section 3.1.1, where only the LAP was vertically integrated and ISP B was an independent national firm, we argued that the LAP's choice of access price to the local loop might be optimal also from a social point of view, even though it meant that ISP B would be foreclosed. The rationale for this "non-intervention" policy was to avoid excessive profit flow to the foreign firm. In the present case foreigners also own ISP B, and a low access price to the local loop will therefore directly transfer profit to foreigners (this is true even if the price from the IBP were exogenous). Nonetheless, the regulator may now prefer a lower access price than the LAP. The reason is that the IBP's response to a lower local access price is distinctly different when it is vertically integrated. First, the access price w_g is now less important, since it does not affect the costs of ISP B. Secondly, as argued above, the competition will be more aggressive when both the bottleneck owners are vertically integrated. This is beneficial for the consumers, and makes the regulator more willing to set a low access price to the local loop.

To sum up, we thus argue that it may be good news for the home country if foreign IBPs vertically integrate with domestic ISPs, and that the socially optimal access price to the local loop may then be lower than if the ISPs are independent.

3.2 Two-sided global regulation

Even though it may be favourable with a relatively low access price to the local loop when the IBP is vertically integrated, it will still be optimal for the regulator to set an access price above long-run marginal costs to avoid excessive profit shifting to the foreign country. This raises the question of whether there is a need for a global price regulation, which for instance may take place through WTO agreements that reduce the scope for foreign firms to abuse their international market power. In order to discuss the welfare effects of international price regulations in a meaningful way we must, however, take into consideration the fact that firms have other strategic choice variables than price alone. For the telecommunication industry it seems particularly relevant to consider whether there are incentives for using non-price discrimination of interconnecting and competing firms. More specifically, in this section we will discuss whether a price cap on backbone access generates incentives for the IBP to

[22] We assume *ex ante* regulation, and thus implicitly that the regulator is able to credibly commit itself. Otherwise we now from the previous discussion that the regulator ends up with a regulated local access price equal to long-run marginal costs.

reduce the quality of the backbone access sold to the local incumbent's subsidiary ISP.[23]

Consumer demand for connection to ISP A falls if the quality of its backbone access has been reduced. Thereby the IBP will capture a larger share of consumer demand, and this is more profitable the larger the profit margin the IBP has in the end-user market. However, with a smaller consumer demand ISP A will also have a smaller demand for connection to the backbone. This harms the IBP, and this negative effect is more pronounced the higher the profit margin the IBP has on its sale to ISP A. Due to these conflicting effects, it is not obvious if and when the IBP finds it profitable to practise quality degradation.

In the following it will be convenient to denote by $\overline{w}_g$ the regulated price on backbone access, and by w_g^* the price that the IBP would have chosen in absence of regulation. To avoid unnecessary notation we will assume that the IBP's own long-run marginal costs are equal to zero (this has no qualitative effects on the present discussion).

No regulation of the domestic market

Though the purpose of this section is to discuss the effect of two-sided regulation, it may nonetheless be instructive to first assume that only the IBP is price regulated. Suppose that $\overline{w}_g$ is set equal to zero. In that case the IBP does not make any profit from connecting ISP A to the backbone, and will therefore obviously have incentives to foreclose ISP A. By sufficiently degrading the quality of backbone connection for ISP A, the IBP thus becomes a monopolist in the end-user market. Obviously, it makes sense for the IBP to degrade the quality also if $\overline{w}_g$ is somewhat above zero, but as the price cap increases it becomes increasingly expensive for the IBP to forego the profits that it could have earned by selling connection to ISP A.[24] This effect is particularly strong if the Internet Service Providers offer differentiated goods, and there is a large consumer segment that prefers the services offered by ISP A. In any case, the IBP will not have any incentives to degrade the quality if $\overline{w}_g$ is equal to w_g^*: it will then be better off by extracting profits by serving ISP A with backbone access (even though that implies competition in the end user market). Actually, we may expect this effect to dominate also when $\overline{w}_g$ is somewhat below w_g^*, in which case the price

[23] See Section 2.3 for a further discussion of the potential for quality degradation, and why it may seem more relevant to discuss this point for IBPs than LAPs.

[24] This also demonstrates an important point, namely that degradation is not a goal *per se*, but only a means to transfer market power from the regulated global bottleneck to the retail market.

cap will affect domestic welfare positively. But how will welfare be affected if $\overline{w}_g$ is set so low that quality degradation is profitable?

The first thing to note is that the integrated LAP need not be harmed by the quality degradation. This may seem a bit surprising, but the important point here is that the LAP controls the local bottleneck. Thus, if the IBP sets high prices in the end-user market because it has become a monopolist – or at least the overwhelmingly dominating firm – the LAP can respond by setting high prices for local access. Thereby the LAP may be able to capture the larger share of the "monopoly" profit.[25] In order words, it may be more profitable to be a "bit-stream" wholesaler than to compete for consumers in the retail market. However, the higher consumer price implies that the deadweight loss increases.

Price regulation of both the LAP and the IBP

The optimal domestic regulation policy becomes quite complex if there is a price cap on backbone access and the IBP has the ability to practise quality degradation (or any other kind of non-price discrimination). However, it is immediately clear that the regulator will be unable to prevent quality degradation if $\overline{w}_g$ is close to zero, because the profit margin of selling backbone access to the integrated LAP is then very small. In that case the regulator should simply provide the integrated IBP with cheap access to the local loop, i.e., set a low value of w_l, in order to reduce consumer prices. Likewise, it is clear that the regulator should set a relatively low value of w_l if $\overline{w}_g$ is close to w_g^*: quality degradation is then not profitable in any case, and the regulator should stimulate competition. For some intermediate values of $\overline{w}_g$, which still are so low that there would be quality degradation if the LAP is unregulated, we may foresee a more surprising regulation policy. Suppose, namely, that the regulator sets a higher value of w_l than the one the LAP would choose. Then the profit margin ($p - w_l$) for the IBP of selling to the end user market will be relatively low, and it may therefore be better off by increasing the sales of backbone access to ISP A at the profit margin $\overline{w}_g$. We may thus end up with a regulated price that is *higher* than the one preferred by the LAP.[26]

Finally, Figure 8 shows how we may imagine that a price cap on backbone access affects domestic welfare. The broken line shows the welfare level when the IBP maximizes

[25] Note that we have a clear symmetry between this result and the result that the IBP profits from a one-sided regulation of the local access price. In both cases the key point is that the unregulated firm controls an essential input that is needed by the other firm.

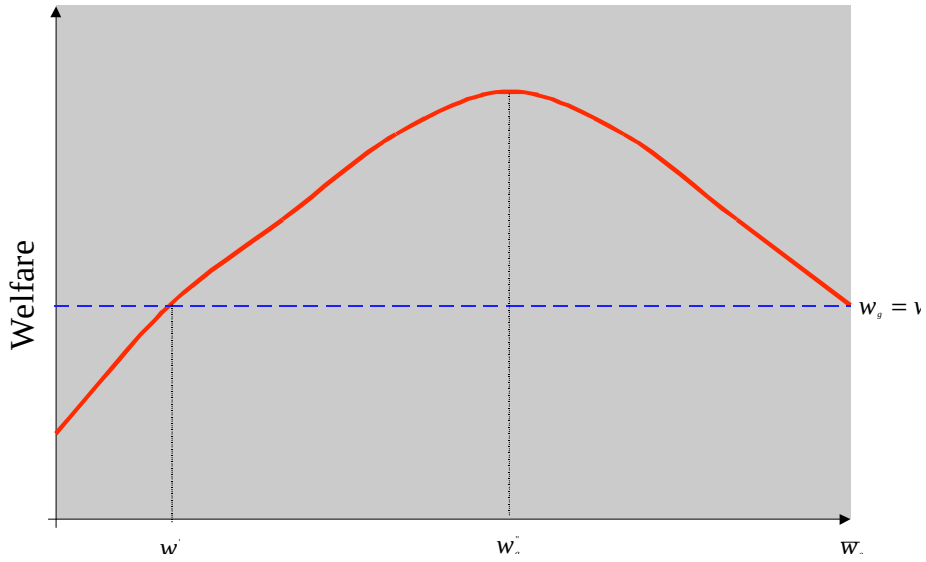
[26] Recall that the LAP may benefit from foreclosure due to the high consumer prices.

profit and charges $w_g = w_g^*$ (no price cap on backbone access), and the solid line shows the welfare level when the access price to the backbone is regulated.[27] The latter curve has an inverted U-shape, and lies partly below the broken line. The intuition for this is most easily understood if we consider the extreme values of w_g. At the far right we have $w_g = w_g^*$, and thus a non-binding regulation. Then welfare must necessarily be the same as in an unregulated economy. At the far left we have $\overline{w}_g$=0, and the IBP unambiguously will foreclose ISP A completely. Thereby the IBP will use monopoly prices in the end-user market; consumer prices will be high, and the welfare level at a minimum (in particular, it will be lower than when $w_g = w_g^*$). Due to the income generating effects of selling backbone access to ISP A, it is less beneficial for the IBP to degrade the access quality the higher the price cap $\overline{w}_g$. Simultaneously, the *direct* effect of a binding price cap is to reduce consumer prices and access prices for ISP A (that is the reason for controlling the access price in the first place). At some point $w_g = w_g^{'}$ we should thus expect that welfare is higher than when w_g is not regulated. For sufficiently high values of w_g - at $w_g^{''}$ in the Figure - it will no longer be profitable for the IBP to degrade the quality at all. This is the value of $\overline{w}_g$ that maximizes welfare; the only effects of increasing $\overline{w}_g$ beyond this value are to increase domestic prices and the profit level of the IBP.

The exact shape of the curve in Figure 9 should, of course, not be interpreted literally. The important point is that a price cap on backbone access should not be so low as to provoke socially wasteful foreclosure practises. That may turn out to be detrimental to welfare.

[27] The Figure is drawn under the assumption that connection to ISP A and ISP B is imperfect substitutes for the consumers.

Figure 8: Welfare effects of a price cap on backbone access



4 Conclusion

In this paper we have argued that a cost oriented regulation of the local access input may be inferior to the domestic government in an open economy. A one-sided price regulation that set price equal to long-run marginal costs for local access may lead to increased profit shifting to foreign countries. Moreover, any international regulation policy should take into account the fact that dominating firms in the communication industry may impose socially wasteful non-price discrimination if their prices are too strictly regulated.

We have abstracted from network externalities in our analysis, even though these clearly are present in the Internet. Some readers may thus question the robustness of our results, since the network externalities possibly imply that firms will charge low prices even in an unregulated economy. Network externalities do, however, not imply that one should offer services for free. It may rather imply that the optimal price is lower than it would otherwise have been, and this only has quantitative effects. In this sense the above discussion does not depend on whether we consider network externalities or not. The fact that the IBPs have begun to charge ISPs for backbone connection may further indicate that the larger share of the network externalities in this industry already has materialized.

Dominant firms often argue that *ex ante* regulation will have detrimental effects, but in our view there may be strong arguments in favour of *ex ante* regulation of local access. The access price should, however, not be so low as to generate excessive profit shifting to foreign countries. The optimal policy may be that the regulator commits to set an access price above costs, possibly the same price as in an unregulated market economy.

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