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SO FAR, SO CLOSE. COMPETITION ANALYSIS OF BACKBONE AND LOCAL ACCESS FOR BROADBAND INTERNET

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Executive summary

The first part of this Deliverable presents a competitive assessment of the global market for the provision of universal Internet connectivity (backbone market).

Two important merger cases scrutinized by the European Commission are described in order to outline the European Commission approach to the assessment of competition in the backbone market. These are *MCI/WorldCom and MCI WorldCom/Sprint*.

From this and other evidence collected, a detailed analysis of the market is provided, highlighting the structural characteristics and the main drivers of change. It is argued that the backbone market is subject to a restless structural evolution which is causing a transition from a highly concentrated US-centric industry, with a strict vertical hierarchy between Internet Service Providers and a neat separation between first-level ISPs and the rest of the market, to a more horizontally shaped configuration.

We argue that, as the landscape of the industry evolves, the approach followed by the EC Commission in assessing the competitive forces that drive the industry is likely to be no longer appropriate. New behavioral strategies, such as differentiation through the introduction of new enhanced Internet services based on the concept of Quality of Service, and, related to that, new competitive threats seem to characterize the foreseeable future of the Internet.

As regards the main concern raised by the EC Commission about unilateral effects by dominant US IBPs, we believe that an industry-wide regulatory intervention setting mandatory rules for interconnection agreements between IBPs would not be the proper policy, as the current evolution of the upstream Internet shows that the market auto-regulates and that there are sufficient market forces countervailing the strategic moves of dominant players.

The same cannot be said with respect to the competition policy interventions adopted during the late '90s, as there is no counterfactual evidence that the market outcome, absent the EC Commission interventions in the two merger cases examined, would have been virtuous as well. It is arguable that, at the time the EC Commission decided, there was a wide consensus about the U.S. centric feature of the upstream Internet structure, which is the pivotal prerequisite of the EC Commission assessment.

As to the new behavioral strategies the are likely to emerge, the issue about QoS is not self contained in the "backbone market". The provision of enhanced Internet services is carried out with the contribution of operators acting at several layers of the Internet value chain, i.e. telecommunication carriers, content providers, downstream Internet access providers and broadcasting service providers (on various technological platforms: cable, satellite, mobile and fixed telephony, terrestrial digital TV); v) client-software providers.

Therefore, it is far from clear which Internet operator will preside the key strategic layer and, thereby, will affect the delivery process throughout the Internet value chain. Even more difficult is to forecast that IBPs will be the ones to succeed in this task on their own forces, leveraging their proprietary fast-packet platforms.

What seems more arguable is that the QoS issue will spur competing processes of vertical integration between complementary economic agents and, therefore, the market outcome will depend on the competitive structures and dynamics at different layers of the value chain. Thus, it appears that competition law enforcers will have to carry out a careful assessment of the dynamics throughout the Internet value chain both horizontally and vertically, instead of a focused assessment on a layer which appears to be the strategic bottleneck of the delivering process.

In light of the above, Part II of the Deliverable presents a competitive analysis of Internet service access markets. This analysis refers to the last peripheral node of the Internet hierarchy.

We describe the alternative technologies that enable or are likely to enable local access to the Internet, but focus mostly on fixed telephone networks (PSTN), as to date this is the infrastructure that as the wider diffusion.

As consequence, our analysis of competition in the Internet access service markets mainly addresses the issue of strategic interaction between telecoms incumbents and rival ISPs, either vertically integrated operators of alternative platforms, or ISPs gaining access from existing local networks.

In doing so, we outline the approach followed by the European Commission in two important decisions concerning Internet access service markets, namely *Wanadoo Interactive* and the *Deutsche Telekom AG*. These decisions both concerned with abuses of dominance by telecom incumbents, the first in the form of predatory pricing, the second in the form of margin squeezing.

We argue that there are some weaknesses in the way the European Commission has come to the conclusion that the conducts examined were abusive. This leads us to point out several considerations.

First, as a general rule, to conduct a thorough competitive assessment it is necessary to enlarge the scope of the analysis beyond market definition, even though the Internet access market has been held to be separate, otherwise there is the risk that important vertical relationships that impact on the diffusion path of Internet access are dismissed. This requires to address the issue of broadband content application jointly with access, as content is the main driver of high-speed Internet access penetration.

Other considerations are more technical in nature and pertain to the application of Art. 82 of the EC Treaty to exclusionary pricing abuses and, in particular, to predatory pricing practices.

We argue that the subject matter of the price squeeze test is that of identifying those pricing abuses that, if successful, would lead to the ousting of competitors at least as efficient as the predator. This, however, amounts to a necessary but not sufficient condition for a finding of predation. Indeed, a sound proof of the predatory nature of a conduct should also include the assessment of the plausibility of recoupment (so called "consumer harm" test), as this only may provide for the sufficient condition for predation to occur.

Relatedly, given the above "division of labour" between "but for" and "consumer harm" tests, the implementation of the price squeeze test should exclusively aim at establishing whether an as-efficient competitor has been unlawfully foreclosed. Therefore, when computing downstream costs, economies of scale enjoyed by the incumbent should be factored in. Moreover, if the standard applied in the computation of downstream costs is that of AAC, then the incumbent's unavoidable costs that refers to self-provision of network elements which are not specific to the provision of local access to the fixed infrastructure should be factored in.

Lastly, with reference to the need to assess the probability of recoupment in weighing up the existence of entry barriers that are likely to facilitate the recoupment of initial loss, the sources of endogeneity that may cause a radical change in the market structure should be recognized. A market structure that is deemed to facilitate the strategic scheme for recoupment *ex-ante*, may well change in a way that no longer facilitates recoupment *ex-post*, as a result of a successful strategic scheme. These dynamic considerations are particularly important where the markets concerned are at their early development phases.

PART I

"Competition in the Internet Backbone Market"

1. Introduction

The Internet is a complex industry where local and global players co-operate and compete to offer end users a vast array of services. Some of these services (such as email and websites) are inherent to the Internet; others (such as music, banking, voice communication, video, etc.) are available through the Internet as well as through other channels. The most striking characteristic of Internet services is their global reach that allows users to communicate or conclude transactions with other users located everywhere in the world, reducing or eliminating the need of physical movements of people and goods. Competition in the Internet depends significantly on the availability of universal connectivity that inherently qualifies Internet services. Universal connectivity is provided by Internet Backbone Providers (IBPs) that form the Internet backbone market.

The aim of this paper is to provide the essential elements of the economic analysis required for the application of competition law in the backbone market. The point of departure of our investigation is the competitive assessment of the backbone market made by the EC Commission in two merger cases notified between 1998 and 2000, namely: MCI/WorldCom and MCI WorldCom/Sprint.[1] The Commission in both cases found that the proposed merger could negatively affect competition in the backbone market. Therefore it conditioned the first merger to significant undertakings and blocked the second merger. In this paper we discuss the assessment carried out by the Commission and come to the conclusion that the recent developments of the backbone as well as of vertically related markets make that assessment no longer appropriate.

Before going into the details of how the Commission worked out the competitive concerns arising from the notified mergers, it is necessary to succinctly describe the functioning of the Internet. Section 2 presents a brief and simple description of how universal Internet connectivity has been ever since delivered and about the way this seamless interconnection might be put into jeopardy by the development of distinct Quality of Service (QoS) proprietary platforms. Section 3 deals with the issues of network effects and compatibility which are both relevant to the Internet from economic perspective. Section 4 describes the two mergers assessed by the Commission. In Section 5 we take up the market definition problem and show why the backbone market has to be held separate from those for other Internet-related services as envisaged by the EC Commission. Section 6 goes through the EC Commission competitive assessment of the "backbone market", providing an articulated description of the different economic agents engaged and of the structural dimension affecting the competitive dynamics in the market. The reasons why the EC assessment may no longer fit the current market configuration

[1] *MCI/WorldCom,* Decision of 08/07/98 (OJ L 116 , 04/05/1999 p. 0001 – 0035); and *MCI WorldCom/Sprint*, Decision of 28/06/00 (OJ L 300 , 18/11/2003 P. 001 – 0053).

are treated in Section 7. Section 8 describes the "next thing", i.e. the competitive concerns that could arise in the backbone market in the future. It provides the outlook for a "balkanized" Internet or, even more, a monopolized Internet due to, respectively, the development of several non-compatible proprietary QoS platforms and the overwhelming imposition of that platform possessed and operated by a dominant IBP. Section 9 concludes about possible future directions of competition policy in Internet-related markets. Appendices I and II, respectively, describe the model of selective degradation by Cremer and describe how to measure the incentive to degrade.

2. How the Internet works

The Internet is a system of interconnected computer networks which are autonomous and self deterministic and communicate with each other without being controlled by a central authority. The role of each network cannot be predicted in advance, since the Internet is based on a connectionless transmission technology. No dedicated end-to end connectivity is required and no fixed route has to be set up between the sender and the receiver in order for them to communicate. All is needed is a packet-switching technology to transmit data across the network, that is a technology that is independent of any specific characteristic of the individual networks comprising the Internet.

Today the operation of the Internet is supported mainly by two basic transmission protocols: the Internet Protocol (IP) and the Transmission Control Protocol (TCP). IP is responsible for routing individual packets from their origin to destination. Each computer has at least one globally unique identification address (IP address). The IP address contains information about the network, the computer belonging to it, as well as its location in that network. Each packet transmitted over the Internet contains a "header" where both the sender's IP address and the receiver's IP address are codified. TCP controls the assembly of data into packets before transmission and their reassembly at destination. TCP is a connection-oriented transmission mode that ensures that all data will be delivered to the other end in the same order as sent and without duplications. TCP is actually built on IP, adding more reliability and traffic control to the Internet.

The best route for transmitting a packet from its origin to destination is determined at each router-computer that the packet passes on its trip. The router's decision about where to send the packet depends on its current understanding of the state of the networks it is connected to. This includes information on available routes, their conditions, distance and cost. The packets, having the same origin and destination, travel across any network path that the routers or the sending system consider most suitable for that packet at each point of time. If at some point in time some parts of the network do not function, the sending system or a router between the origin and destination detects the failure and forwards the packet via a different route. The conventional IP/TCP packet-handling rule a router implements is the first come-first served (or First In First Out – FIFO).

Given the need for interoperability in order to provide universal Internet connectivity to customers, IBPs have spontaneously achieved seamless interconnection through a system known as peering. Peering agreements present several distinct features (Bailey, 1997): (*i*) Peering partners reciprocally exchange traffic that originates with the customer of one network and terminates with the customer of the other peering network. Consequently, as part of the peering arrangement, a network would not act as an intermediary and accept the traffic from one peering partner and transit this traffic to another peering partner (peering is not a transitive relationship); (*ii*) In order to peer, the only costs are those borne by each peering network for its own equipment and for the transmission capacity required for the two peers to meet at each peering point; (*iii*) routing is governed by a conventional rule known as "hot-potato routing", whereby a backbone passes traffic to another backbone at the earliest point of exchange.

Lastly, it is worth noting that as peering incurs between pairs and does not imply any kind of payment, recipients of traffic promise to undertake "best effort"[2] when terminating traffic, rather than ensuring a level of performance in delivering packets received from peering partners.

2.1. Quality of Service

Regarding the interconnection setting, the *status quo*, as managed through the "best effort" conventional rule, has proven to be unsatisfactory in dealing with ever increasing and bursty traffic flows ingenerating congestion at the routing nodes of the Internet. Congestion is particularly concerning given the increasing adoption of new web applications which are strongly demanding in terms of traffic throughput, requested capacity and network affordability, as they are live applications (real time provision and/or interaction). All this has put forward the importance for an IBP to guarantee high standard of quality in terms of connectivity provision (bandwidth capacity, redundancy, affordability, scalability, etc.). These features are usually summed up by a synthetic index of performance: Quality of Services (QoS).[3] QoS refers to the probability of the network meeting a

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[2] In a "best effort" setting, when congestion occurs, the clients (software) are expected to detect this event and slow down their sending rate, so that they achieve a collective transmission rate equal to the sending throughput capacity of the congested point. The rate adjustment is implemented by the TCP. The process runs as follows: a congestion episode causes a queue of packets to build up; when the queue overflows and one or more packets are dropped, this event is taken by the sending TCPs as an indication of congestion, so that the sender can slow down. Each TCP then gradually increases its sending rate until it again receives a congestion signal.

[3] *See* e.g., Junseok and Weiss (2001). For a technical perspective visit the Internet Engineering Task Force – IEFT web site: http://www.ietf.org/home.html.

given traffic contract, or, more informally, to the probability that a packet will go through between two points in the network. A traffic contract, usually labeled as a Service Level Agreement (SLA), specifies the level of performance/throughput/latency a given network has to guarantee based on traffic prioritizing. Such agreements are designed to avoid transmission hiccups.

A given QoS may be necessary for certain types of network traffic, such as Streaming multimedia that requires a guaranteed throughput, IP telephony or video conferencing that require strict limits on jitter and delay, or safety-critical applications such as remote surgery.[4]

There are essentially two ways to provide a QoS guarantee. The first is simply to deploy enough transmission capacity to meet the expected peak demand with a substantial safety margin. However, if the peak demand increases faster than forecasted, this solution could not suffice. Moreover, it is expensive and time-consuming in practice.

The second one is to require people to make reservations and only accept the reservations if the routers are able to serve them reliably. This solution amounts to a sort of priority scheduling, whereby bandwidth capacity allocation among customers is accomplished by creating transmission service classes of different priority to serve customers with different needs.[5] The way a customer applies a reservation is by negotiating with the ISP a SLA contract that specifies what classes of traffic will be provided, what guarantees are needed for each class and how much data will be sent for each class.[6] Having negotiated this, the sender will set the "type of service" and fill in the IP header according to the class of data, so that better classes get higher priority.

In order to prioritize traffic the ISP has to split traffic in classes (special handling). This may be done in at least two ways: (i) by allowing more recent higher precedence packets to jump the queue over old lower preference packets (preferential forwarding); (ii) by allowing buffer space for higher preference packets to grow at the expense of lower precedence packets which are discarded (preferential discarding).

The technical implementation of a SLA contract makes use of a set of alternative transmission protocol modes usually clustered under the definition of "fast-packet

[4] These types of applications are called "inelastic", meaning that they require a certain level of bandwidth to function (no less/no more).
[5] For an exhaustive analysis of usage-sensitive pricing schemes, *see* McKnight and Bailey (1997).
[6] Traffic requirements are made up of four categories: (1) bandwidth, (2) delay, (3) delay jitter, and (4) traffic loss.

services" or "cloud technologies".[7] These protocols form one of the "virtual networks" (Gong and Srinagesh, 1997) built on top of facilities and layered services provided by telecommunication carriers. The need of an additional underlying transmission protocol is due to the fact that the IP/TCP protocol, as it was originally conceived with its FIFO routing rule, is unable to count for differentiated class of services and, thus, cannot manage a prioritizing allocation of bandwidth resources. Yet, this lack turns out to be the main reason for the success of IP/TCP, since it has effectively provided a minimum common denominator for granting universal interoperability between private operators competing among each others for transit revenues and managing networks with different architectures, routers and switching facilities. Thus, the prioritizing function is handled at a virtual layer just below that of the IP/TCP.

So far, the significance of this issue in the assessment of relevant markets for the provision of universal Internet connectivity has been of less relevance than the imperative for IBPs to be facility based so as to preside different regions and maintain a widespread customer base. Ti this extent, private peering interconnection between IBPs has coped fine with the connectivity requirements implied by the current applications massively carried over the Internet. This situation may no longer hold with new application requiring QoS. Before going into the details of how these developments may affect market definition and competition dynamics, it is worth focusing on two economic features that are relevant to the Internet: network externalities and compatibility. The next section will be devoted to these arguments.

3. Network externalities and compatibility

The Internet is a "network of networks" that enables distinctive domains possessed and administered by separate commercial entities to compete for the provision of universal connectivity. This definition points out two important features of the Internet. First, that consumers request universal connectivity, that is their demand is characterized by the presence of strong network externalities. Second, that single networks have to find a means of interconnecting so as to achieve the universal connectivity demanded by consumers. So far IBPs have achieved this goal by coordinating through peering agreements. IP/TCP global connectivity is the result of such coordination among IBPs. It is a legacy of the cooperative spirit characterizing the Internet in its early days, that made basic services, such as e-mail and Web access, universally available (Kende, 2000). The same might not be granted in respect to future developments, since IBPs might pursue quality differentiation strategies by waiving interoperability with competing IBPs with regards to the provision of enhanced Internet services. Thus,

[7] The term "cloud " refers to the geographic area covered by the collection of routes and links between them that delimitates the network area over which the protocol uniformly applies.

the issues of network externalities, compatibility, interoperability and coordination of quality of service (QoS) have to be treated together as they are of paramount importance for the next-to-come Internet. We present an overview of the literature on network effects and compatibility. For the reasons above the exposition is focused on the specific issue of QoS and the connection between the presence and intensity of network externalities and the likely market structure. In particular, our interest is confined to within-generation market structure, whereby competing technological standards are perceived as perfect substitutes for the provision of QoS services.

3.1. Network effects: some definitions

Networks are identified by strong complementarities between components (*nodes*) necessary for the provision of specific services. These complementarities are accomplished by connecting components through *links*. Nodes and links outline the topology of the network. The linkage between components can be either **one-way** or **two-way**, the distinction between the two being a matter of interpretation of the network structure and of the economic role of nodes. In a typical one-way network there are two complementary sets of substitute components and the provision of composite goods requires the combination of a component of each type (customers are not usually identified with components but demand composite goods instead).[8] In a two-way network, links let both directions feasible and valuable for customers (customers are usually identifiable with the peripheral nodes of the network topology). Thus, in a two-way network all possible combinations between nodes identify different services the network can provide (Economides, 1996).

Because of the complementarities between components, network markets are said to exhibit increasing returns in adoption termed as positive **network externalities or network effects**.[9] Thus, a network effect is the increasing utility a user derives from consumption of a product as the number of users who consume the same product increases (Katz and Shapiro, 1985). In a broader sense, a network externality is the increase in the net value of an action that occurs as the number of agents taking equivalent actions increases (Liebowitz and Margolis, 1995).[10]

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[8] Examples of one way networks are broadcasting and paging.

[9] Liebowitz and Margolis (1994) argue that the term "network externality" should be reserved to a specific kind of network effect whereby the net value of an action depends on the number of other agents taking the same actions , since the common understanding of "externality" implies market failures which do not necessarily apply to every case exhibiting a network effect. In this paper the two terms are used indifferently.

[10] Although positive externalities have received greater attention from the literature, negative network externalities, or congestion externalities may also arise. See, on the issue, MacKie-Mason and Varian (1994).

Network effects can generally be classified into two types: direct and indirect (Katz and Shapiro, 1985; Economides, 1996). **Direct network effects** are caused by demand-side (user) externalities, whereby the utility from consumption increases with the number of agents consuming the same good.[11] **Indirect network effects** are caused by supply-side user externalities and arise when the value of a product increases as the number and variety of complementary goods or services increases. There is a relation between direct and indirect effects, on one side, and one way and two way networks on the other side. One-way networks enable the exploitation of indirect network externalities only; whereas two-way networks can sustain both direct and indirect network externalities. In other words, direct network effects arise from technical networks (e.g. communication networks); whereas indirect network effects work mainly through virtual networks[12] (e.g. "hardware/software paradigms"; Katz and Shapiro, 1994).

Goods and services that derive their value from network effects can be classified with respect to the incidence of network effects. A peculiar class of services is formed by **pure network goods** which derive their value all and only from network externalities (Economides, 1997). Customers find useless any isolated component of a pure network good, as the good is valuable insofar as it generates a positive externality through the network (e.g. telecommunication services).

The provision of universal Internet connectivity fits the definition of a pure two-way network good, and, therefore, the Internet backbone market can be modeled as a two-way network market whereby direct network externalities are the main value driver to customers.

3.2. Demand of network goods: expectations and critical mass

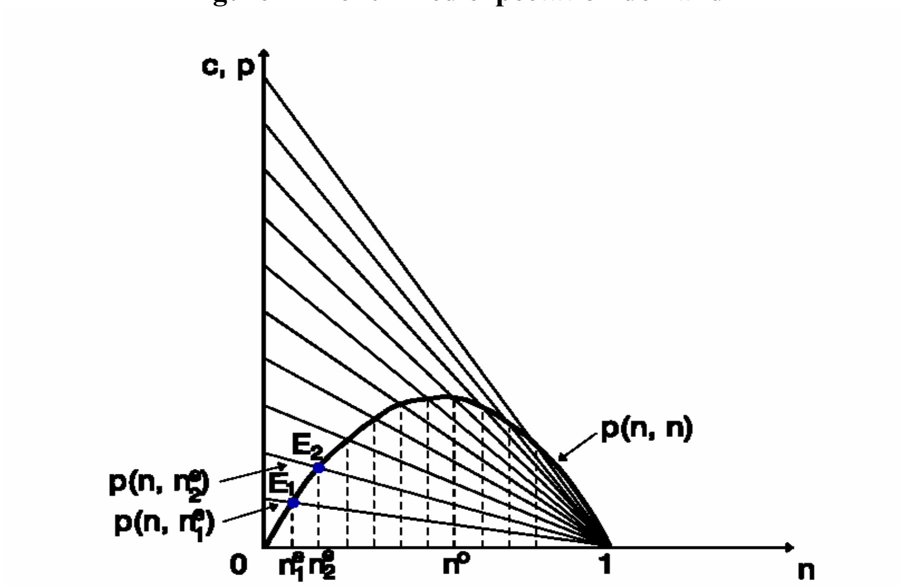
The presence of network externalities makes expectations of customers about future network size a critical determinant of their adoption decision. From a dynamic perspective, current adoption depends on the expected behavior of potential late adopters. There are two polarized approaches to modeling expectations: **fulfilled and myopic expectations**.[13] In the fulfilled expectations approach, customers are assumed to be foresight and attention is restricted to those equilibria where customers expectations are indeed correct (Katz and Shapiro, 1985, and Economides and Himmelberg, 1995). The alternative approach assumes that customers have myopic expectations in that their utility is only based on the network size at the time of purchase (Regibeau and Rockett, 1996).

[11] Direct network effects occur only with use; purchasing the product is not sufficient.
[12] A virtual network is a collection of compatible goods with a common platform. For instance, all PCs running the same operating system form a virtual network. Virtual network are always one way.
[13] See, Gandal (2002).

With fulfilled expectations indirect market demand may initially slope upward, so that overall demand exhibits a flipped-U shape. This result derives from the fact that the willingness to pay which normally decreases if the number of expected units sold is held constant, will on the contrary increase if sales are expected to grow. It follows that the upward sloping side of demand, capturing the network effect, is due to increasing expectations about total sales (Katz and Shapiro, 1985, and Economides and Himmelberg, 1995).

A typical fulfilled expectation demand is depicted in Figure 1.

Figure 1 The fulfilled expectation demand



Source: Economides (2003)

Let $n \in [0,1]$ be the extent to which demand of a network good is covered. The function $p(n, n^e)$ denotes the price consumers are willing to pay for the n^th^ unit of the good if they believe that n^e units will be sold. Since the network good exhibits network externalities, the willingness to pay function is increasing in n^e, whereas it is decreasing in n as any demand function. The downward sloping segments in Figure 1 describe this demand for any level of expectations. Given two levels of expectations n_1^e and n_2^e, such that $n_2^e > n_1^e$ consumers show a higher willingness to pay when their expectation is n_2^e. This is shown by the fact that $p(n, n_2^e)$ always lies above $p(n, n_1^e)$. In equilibrium we impose $n = n^e$ so that expectations are fulfilled, and derive the fulfilled expectation demand function $p(n, n)$ out of all points $p(n^e, n^e)$ such as points E_1 and E_2 in Figure 1. This demand exhibits an upward sloping portion when a network has limited coverage, reaches a maximum for a given size n^0 of the network, and tends to zero as the network tends to cover all potential customers.

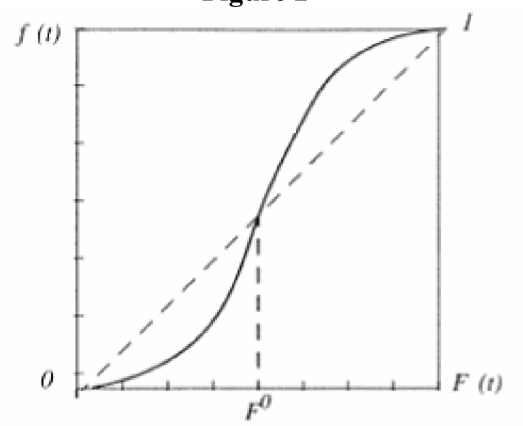
Since demand exhibits a flipped-U shape, it is said to have a positive critical mass. Assuming constant marginal costs, under perfect competition (marginal cost pricing), there are three equilibria: two at the intersection points between the marginal cost curve and the demand curve, and one at the origin of the demand curve where no adoption occurs. The first non-zero equilibrium identifies the critical mass: the minimum positive network size that can be sustained in equilibrium. However, this solution is unstable as a small variation in the number of network adopters shifts the market to either of the two extreme (stable) equilibria. Although this approach is the most rigorous from a modeling standpoint, it leads to models that are quite difficult to solve analytically and, therefore, limited in their descriptiveness (Gandal, 2002).

The relation between network effects and adoption dynamics can be grasped more intuitively by modeling customers as myopic, so that choices by individuals in a population depend on how frequently a given behavior has been pursued. Thus, a sort of vertical interdependence arises between individual behaviors and macroscopic variables (e.g. distribution of market shares, installed bases). In case of competing network goods, Arthur et al. (1987) model this form of vertical feedback as a *frequency dependency effect*: "the marginal change in the relative frequency of behaviors within the population will depend itself on the macroscopic variables of the relative frequency itself" (Schoder, 2000, p. 184).

Witt (1994) develops a model with a continuum of adopters who do not inherently care about what product to adopt (products are perceived as close substitutes), and only want to coordinate themselves. At each instant of time some adopters may change their move in response to current shares. Thus, each adopter has a common probability distribution among alternatives and this probability depends on the cumulative distribution (the relative frequency of adoption in the discrete case). In case of increasing returns in adoption, this function slopes upward, as the more widespread is an alternative the more attractive it will be.

Observations suggest this relationship to be non-linear: the probability of choosing an alternative (the utility of the service) increases nonlinearly with its relative frequency of adoption (e.g. market share/installed base).

Figure 2



In Figure 2 this non linear relationship between probability of adoption at time t, $f(t)$, and installed base, $F(t)$, is depicted. It identifies a turning point, F^0, that divides the relative frequency of adoption interval into two regions (Markus, 1990). In the left-side region there are negative returns in adoption (the share of adopters of the selected alternative is too low to induce new adopters to join the network); in the right-side region there are positive returns in adoption (the utility from adoption increases more than proportionally with the increase in the relative share of adoption of the selected alternative). This turning point is the critical mass in the sense that at this point small fluctuations have large effects upon the diffusion process of a network good.

A main consequence of the existence of a positive critical mass (and of multiple equilibria) is that as long as the critical mass is not exceeded, demand synergies develop only to a limited extent. The pace of diffusion will initially be slower (negative returns region) and then, once the critical mass is reached, it will accelerate toward either a stable equilibrium whereby network externalities are fully exploited, or to a non-adoption (stable) equilibrium that forces the network product out of the market. Thus network effects generate extreme and often unpredictable outcomes since success and failure are equally likely.[14]

3.3. Demand for competing network goods

The choice among competing network goods is governed by individual preferences and aggregate conducts. Consumers usually face uncertainty about performance characteristics of new sophisticated products and this might slow down the speed of diffusion. Moreover, in case of incompatible and competing network goods, consumers might find additional uncertainty about which

[14] For a survey on these stylized facts, see Koski and Kretshmer (2004).

competing product will lead in terms of population coverage and, if risk averse, they might postpone adoption to avoid being stranded on the failing alternative.[15]

This last point introduces the issue of coordination among potential adopters in order to achieve efficient outcomes. In case of a single network good (e.g. a number of compatible network goods) efficiency requires to avoid under-adoption;[16] in case of competing network goods (e.g. incompatible network goods performing the same functionalities), inefficiency in adoption will normally arise when preferences differ and/or adopters fail to coordinate on the efficient equilibrium.[17]

In both cases, efficient coordination depends crucially on expectations and the way they are formed, which, in turn, depends on the *institution* governing the adoption decision. At the level of adopters two institutions may support efficient coordination: communication and sequential choice (Farrell and Klemperer, 2005). As regards communication, cheap talk might work bad in case of a multitude of adopters and of conflicts across them. Conflict may arise because competing technologies are in place and because of installed base or consumer heterogeneity.

Fully sequential adoption can successfully deliver efficient coordination if a chain of backward induction (from the last adopter to the first one) rationalizes that the efficient outcome is the optimal choice as soon as the diffusion process is in place. Unfortunately, it seems hard for this logic to hold in reality, especially in a context with many heterogeneous and conflicting participants. Coordination failure might occur whenever enough early adopters fail to see this logic or do not trust it (i.e. because of technological strategic uncertainty).

Adopters usually look at imperfect cues while coordinating. If all adopters employ the same cue, coordination will be reached, although not necessarily on the

[15] Koski (1999) studies a panel of eight European countries and their PC diffusion rates and finds that diffusion is indeed slower where Apple and IBM/Intel/Microsoft have relatively similar shares. Similarly, Gruber an Verboven (2001) and Koski and Kretschmer (2002) study the diffusion for 1G and 2G mobile telephony, respectively, and find that standardization (i.e. reduction of uncertainty as to the future technological standard) accelerates diffusion.

[16] When a single network good has strong network effects, a simultaneous-adoption game has multiple equilibria: no-adoption and full-adoption equilibria. Each group will adopt if and only if it expects other to adopt (*expectations are king)*. The equilibrium with full adoption Pareto-dominates non-adoption as well as other equilibria (Farrell and Klemperer, 2005).

[17] In simultaneous-move non-cooperative games with sufficiently "strong" network effects, the full adoption of either competing good will constitute a non-cooperative Nash equilibrium. Consumers are said to have "similar" preferences if they agree on the ranking of those extreme equilibria. If preferences are similar and consumers do coordinate the efficient equilibrium is reached (Farrell and Klemperer, 2005).

efficient outcome.[18] One such cue is tradition. If new network products are launched by already existing network providers, it could be the case that customers address strategic uncertainty by ranking competing offerings according to the current market position of their providers.

In particular, if expectations track past success, the market will behave much like markets with switching costs even if there is no physical installed base, since the diffusion process is at its inception (Farrell and Klemperer, 2005). If this is the case, as the product with the largest "expected" network coverage will be deemed the product delivering the highest service quality, competing network products will be perceived as vertically differentiated even though they are perfectly identical in terms of functional characteristics.[19]

Moreover, it may be the case that switching costs indeed exist in that the new network product integrates and upgrades a pre-existing service provision. In this setting, it is likely that a consistent portion of potential adopters presents some sort of vested interests in that, in order to avoid switching costs, they would rather adopt the new network product offered by the same current provider. These customers are like a virtual installed base facing switching costs due to pre-existing complementary investment with the network provider that is already serving them. Once again, if the rational expectation and optimal coordination assumption is relaxed and replaced by the assumption that past success (i.e. installed base) tracks expectations, those "early" adopters might award the leading current provider with an initial competitive advantage.[20]

In network industries with competing incompatible network products which are perceived as close substitutes by potential adopters and where the institution for coordination among adopters is the sequential choice of cohorts of customers, early cohorts of adopters are pivotal for the diffusion outcome. In the literature it is said that the process of diffusion exhibits *excess inertia* at the adoption level, as early adopters wield disproportionate power in respect to later ones, since by moving first they gain the commitment edge and, if network effects are strong, they can lock-in the diffusion process to their early choice.

Farrell and Saloner (1986) developed a duopoly model with two firms identical except for their standard. The customer base is partitioned in two parts according

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[18] Imperfect coordination is discussed, among others, in Friedman (1993), Farrell (1998) and Bolton and Farrell (1990).
[19] Baake and Boom (2001) discuss a static model of competition with network effects and inherent quality differentiation; Bental and Spiegel (1995) develop a model in which network effects are a source of vertical differentiation and customers have different willingness to pay.
[20] Farrell and Katz (2001) develop a duopoly model of vertical differentiation due to network effects with non-optimal expectation processes and find that a lead in installed base might impede incompatible entry by a more efficient competitor.

to customer preferences. Customers face a disutility cost in case of less preferred adoption. If the disutility cost is less than the network effect, two polarized equilibria exist and each of the two technologies monopolizes the market. A range of additional possible 2-standard equilibria (the presence of both technologies) exists, provided that the disutility cost is relatively small with respect to the shares of typified customers. In any event, the incompatibility outcome will always prove to be socially inefficient.

This model can be alternatively interpreted as an evolutionary model where the partition represents market shares instead of preferences. Thus, customers can choose to switch facing the relative cost. This model is of poor significance for the issue of QoS, because it does not address the decision on compatibility as an endogenous variable. However, it provides some guidance over the possible solutions where incompatibility is the outcome at the first stage.

Arthur (1989) developed a stochastic-dynamic model describing the sequential-choice process of adoption between competing horizontally differentiated technological standards under increasing returns to scale (in adoption). Customers have idiosyncratic preferences between competing standards and their payoff functions depend on these preferences as well as on the numbers of previous adoptions of the technology they pick. Preferences can be modeled as asymmetric and competing standard as unsponsored and with different efficiency rates.[21] Customers face incomplete information about how each alternative technology will perform as it gains in adoption.

Moreover, customers must commit to a standard and cannot defer their adoption, nor are they allowed to coordinate through side-payments. Customers are picked up sequentially and randomly, and make their choices looking at the best currently performing alternative (past success tracks expectations). The sequence of choices gives rise to a stochastic process which eventually will lead one of the competing technology to monopolize the market (winner-takes-all outcome). Intuitively, if the relative network size becomes lopsided enough to outweigh the strongest idiosyncratic preferences, that size is an absorbing state (in Markov chain language). In this interpretation, strong network effects make technology adoption largely random (Farrell and Klemperer, 2005).

[21] An inefficient standard would be one with high intrinsic benefits to early adopters but small network effects (e.g. a non-pure network good). This standard would "win", because its high intrinsic benefits are attractive to early adopters when the network is small. However, it becomes inefficient as later adopters come on board because it generates relatively small network benefits (Stango, 2004).

This outcome presents some interesting features: *(i)* no predictability about which technology will, with certainty, lock-in the market[22]; *(ii)* inflexibility in that once an outcome (a dominant technology) begins to emerge, it becomes more locked-in; *(iii)* non-ergodicity: the process exhibits path dependence in that "historical small events" are not averaged away and forgotten by the dynamics (the current state of the process depends on its entire history, so that it is impossible to draw some general rule out of a single process realization). If competing technologies have varying efficiency rates along the adoption process, adopters have incomplete information about this feature and prices are independent of market shares (e.g. installed base), the market could be monopolized by the alternative that is not necessarily the most efficient. This may be the case if the technology that proves to be the most efficient at maturity exhibits in its first stage of development a lower efficiency rate relatively to an inferior alternative.

The strong results above rest on even stronger assumptions. Technology is assumed to be unsponsored, so that a penetration pricing strategy is unfeasible, as it is for any other strategy that is plausible in a standard war (i.e. vapourware, licensing). However, this assumption represents a minor shortcoming in the descriptiveness of the model if we consider that the provision of QoS connectivity refers to a pure-network good whose value is only delivered through network externalities. Therefore, for a pure network good competing standards should be treated as equally efficient. For example, a penetration pricing strategy from the more efficient provider in which future greater network benefit are fed through early penetration prices in order to countervail early intrinsic advantage of the inefficient competing standard, simply is not an issue. However, other elements could be important to affect the standard war outcome: deep pockets, marketing/advertising, tradition/reputation. On the other hand, in these cases there is no inefficient lock-in to an inferior technology, but "just" a problem of market monopolization.

Another simplifying assumption is that customers have identical willingness to pay. Adopters heterogeneity is limited to their inherent preferences for one standard or the other. Indeed, different degree of willingness to pay may imply a sort of market sharing among competitors serving different sectors characterized by different level of price/quality, where different qualities stem from the relative strength of the network effects delivered. This calls for some sort of vertical differentiation among competing offerings. Nevertheless, what complicates this line of reasoning is that, given the crucial role of expectations in determining market dynamics and the assumption of myopic adopters (past success tracks expectations), the same idiosyncratic preferences and their eventual asymmetric distributions among competitors would be a prior source of vertical

[22] In case of asymmetric preferences the process has a drift in favour of the most preferred technology, which, thus, has the greater likelihood of winning competition "for the market".

differentiation, since those providers awarded with larger idiosyncratic preferences by potential adopters would be "expected" to reach a larger network coverage and deliver greater network benefits, thus capturing those adopters with a greater willingness to pay. Therefore, there would be both horizontal and vertical differentiation, but with the first one engendering the second.

Arthur's model prescribes that in case of increasing returns a lock-in scenario (e.g. the market standardizes on a common *de facto* standard) occurs "with probability one" (Arthur, 1989). However, for such an extreme outcome to happen, it is essential to assume linear and unbounded increasing returns to scale.[23] Bassanini and Dosi (1999) proved that Arthur's results hold only when returns increase linearly and agents heterogeneity is relatively small. The emergence of technological monopolies depends on the nature of increasing returns with respects to the degree of heterogeneity of the population. They show that *de facto* standardization need not ensue even with unlimited, but decreasing network effects.[24]

3.4. Firms strategic behavior to affect expectations

So far, firms have been modeled as passive players. However, they can act strategically in order to manipulate the market outcome. Strategies can be developed along several dimensions: compatibility, product differentiation, price. Following a game theoretic approach, strategic interaction can be studied as a multistage game in which firms make long run decisions in early stages and short run decision in the final stage. The order of different stages depends on the time required to change the strategic choice made with respect to a variable. Clearly, price (or quantity) decisions come after having decided on compatibility. However, in what follows we adopt the opposite order and discuss short term strategic decisions first.

Under compatibility, firms offer substitute (possibly differentiated) network goods and compete on price or quantity to win customers. Their strategies depend on the degree of competition existing among them. In a perfectly competitive market where price equals marginal cost, firms are unable to reach an efficient market

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[23] Arthur (1989) describes sequential choice adoption as an infinite stochastic process because the likely extension of the potential market is unbounded. In case of finite number of potential adopters, and, thus, of bounded increasing returns to adoption, the same results apply, provided that the number of adopters is large enough in respect to the gap between the absorbing barriers identified by switching costs incurred by each customer type whenever he chooses the least preferred standard.

[24] Swann (2002) derives the shape of an aggregate network benefit function from individual utility functions. In fact, Swann finds that linear network benefits are only likely to materialize under very restrictive conditions and argues that most two-way communication networks will have decreasing marginal network benefits.

configuration as the network size is smaller than optimal. This is due to the fact that the marginal social benefit of a larger network is larger than the marginal private benefit because of the presence of network externalities. The first best seems not attainable in a decentralized and unregulated market. But what happens if firms possess some degree of market power?

In the opposite setting, monopoly, Economides and Himmelberg (1995) show that in equilibrium a even smaller network emerges. Although a monopolist recognizes that it can influence demand expectations, which, in turn, creates incentives to expand production, the long-established tendency toward output restriction entailed by the exertion of market power prevails, so that eventually consumer and social welfare shrinks.

In oligopoly, firms still have an influence on demand expectation and therefore can favor the creation of a larger network to exploit network externalities. However, in this case too their ability to increase profits through output reductions leads them to an inefficient outcome that lies between the perfectly competitive and the monopolistic outcome.

These results show that the ranking of market structures based on their allocative properties is not affected by network externalities. Network effects cannot justify market power. However, it is important to recognize that the welfare benchmark for the assessment of the consequences of a less competitive market structure is not the first best, as price-taking behavior would not guarantee a Pareto optimal allocation of resources in this case.

Much more interesting and instructive is the analysis of short run decisions in the case of incompatible network goods. Recalling how early adopters are crucial in determining success in the diffusion process of a new network good, incompatible competition tends to feature fierce competition for pivotal early adoptions and little competition for late adopters (Farrell and Klemperer, 2005). This circumstance is strengthened by the argument that such a diffusion pattern matches a strategy that fixes quite aggressive prices in the launch of a new enterprise (penetration pricing) and then, once the process has locked-in successfully, recoups the eventual losses incurred in the initial stages of the diffusion process.

We have previously stressed that in network industry incompatible competition implies rival-weakening incentives to erode rivals' installed bases. This is particularly true in the first stages of development, since an initial lead may signify the future dominance of the market. All this suggests a broader scope for predation policy. Notwithstanding the ambiguities and difficulties to distinguish harmful predation from fierce and beneficial competition,[25] in network industries rival-weakening strategies may indeed be competitive, since network effects are the main source of quality differentiation. Moreover, network effects are a source of *inter-temporal* increasing returns to scale.[26] Therefore, in a dynamic competitive setting under incompatible competition, a "sponsor" of a competing network product ("technology") competes for early adopters through penetration pricing. Considering inter-temporal increasing returns in a simple two period horizon, second-period network benefits feed through into first-period penetration pricing (Farrell and Katz, 2001).

While a penetration pricing strategy may or not reveal a predatory intention, a non-price predation strategy might involve (even truthful) product preannouncements that harm rivals engaged in a "standard war"[27] by encouraging adopters to wait for an updated product from the announcing firm, rather than going with an otherwise attractive product of a rival. This preempting strategy can be effective since it may manipulate expectations that are crucial in determining market dynamics in network industries.[28]

All these peculiarities highlight a distinctive feature of competition in network industries with incompatible goods, namely the fact that competition is *for* the market rather than *in* the market. In network markets subject to technological progress, competition may take the form of a succession of "temporary monopolists" who displace one another through innovation. Such Schumpeterian rivalry suggests to reconsider public policy interventions in network industries, since market dynamics and structures diverge from the case of non-network industries (Economides, 2003; Bresnahan, 2001; and Kende, 2000). In particular, competition policy should recognize that competition is difficult in network markets and instead of pushing for one competing network solution over another or being based on a theory that the wrong standard has been chosen (lock-in) or

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[25] While predation may be more likely in network markets, it is not so clear how one should prevent it: because of legitimate real intertemporal links and other complementarities, simple conventional "cost" rules against predatory pricing in a network market are unlikely to be efficient. See Cabral and Riordan (1997), and Farrell and Katz (2001).

[26] The same kind of rival-weakening incentives are presents in markets that exhibit experience effects (learning curves), whereby greater past sales translate into lower current production costs through the accumulation of experience. Experience and network effects are both sources of inter-temporal increasing returns to scale. However, equilibrium dynamics—particularly the role of consumer expectations—can be very different. In markets subject to network effects, consumers may have to form expectations about *future* sales, and this may lead the process to a lock-in absorbing state. No such effects arise in standard models of markets with learning by doing. For a discussion of policy issues against predation in markets with experience effects *see* Cabral and Riordan (1994 and 1997) and Benkard (2000).

[27] For a survey on "standard war", see Stango (2004).

[28] Preannouncement is also labelled "vapourware" since it was firstly studied in the software industry. See, Levy (1996), Haan (2003).

that an old standard has lasted too long (excess inertia), it should ensure a full market test (even though imperfect).

Going back to the initial decision about compatibility, the first strategic choice arises if the decision to be compatible/incompatible is endogenous in nature. If firms can decide to offer non-compatible network goods, they must trade off several consequences of this choice on their profits. Generally speaking, the decision to opt for compatibility allows firms to expand demand as network effects become stronger. However, on one hand, compatibility increases the level of competition in prices or other short run strategic variables; on the other hand, incompatibility with strong network externalities may trigger the form of competition for the market outlined before, in which possible future monopolistic rents are competed away.

In the economic literature several approaches have been proposed to model firms decision about compatibility. The *mix-and-match* (or component) approach purported by Matutes and Regibeau (1988) and followed by Economides (1989) studies a market for systems of complementary products, called components (e.g. CPU and monitors). In these markets there are no *a priori* network externalities, though network effects arise with compatibility, because some consumers demand systems composed of components produced by different firms. The results of this approach are useful to identify the main factors that influence the compatibility decision, absent strong network externalities. The decision to offer compatible components increases demand because it makes *mixed* composite goods available, but also strengthens competition for single components. Thus, if demand for *mixed* composite goods is large relative to demand for integrated systems, then firms prefer to sell compatible goods.

A different, but similar, approach is termed “supporting services approach” (Chou and Shy, 1990, 1993; Church and Gandal, 1992). These models study markets in which consumer utility stems also from the availability of complementary goods (such as supporting services) whose compatibility across competing brands is endogenous. The typical example is that of operating systems and software packages. In these models too, network externalities are indirect. Consumers of one brand do not benefit directly from the existence of other users of the same brand. Rather, they derive an indirect benefit from an increased demand for the brand they purchase, as more complementary goods will become available. The trade-off on profit outlined above, coming from increased demand and increased competition, characterizes also the supporting service approach. However, this class of models allows compatibility to be asymmetric. In this situation firms may fail to coordinate and choose incompatibility also when compatibility is Pareto improving from their point of view. Indeed, suppose that there are two firms selling product A1 and A2 for which there are a number of complementary goods available, denoted B1 and B2, respectively. If firm 1 makes its product compatible with all complementary goods, while firm 2 chooses to restrict compatibility only to B2 products, then producers of complementary goods will decide to increase the offer of those products compatible with A2, as these products will be purchased also by consumers of A1. This will reduce the variety of complementary products specifically designed for A1 and increase the variety of complementary products available for A2. This dynamic could tip the market in favor of firm 2 that did not opt for compatibility.

If we consider pure network goods, it makes a great difference to compete under compatibility rather than under incompatibility. In case of compatibility, the network size is like a public good: if a firm poaches a customers to a rival, it does not affect competition for other customers since both firms are still offering the same compatible product. If a firm wins an unattached customers it improves the network-size quality of all competing firms. Under incompatible conditions, if a firm wins an unattached customer it affects only its offering and not those of its rivals; if a firms poaches a customer to a rival it strengthens its offering and, at the same time, weakens its rival in the competition for other customers. Thus, under incompatible competition there is an anticompetitive (rival-weakening) incentive in that the "marginal effect" from winning a customer to a rival is stronger than under compatible competition (Farrell and Katz, 2001).

Economides and Flyer (1998) developed a two stage model where firms choose their technical standards in the first stage and compete *à la Cournot* in the second stage. This model modifies the basic model of vertical differentiation in that quality differentiation is here exclusively attributable to the relative dimensions of the customer base served by the same standard (network effects) and firms quantity and quality decisions are made simultaneously, since relative quality is determined by the level of network externalities. Firms are identical except for the standard implemented. They may choose to form a coalition by adhering to the same technical standard. Firms in a coalition may or not have veto power over the would-be-entrant. In the first case, the equilibrium concept applied is a consensual one; in the second case, equilibrium is non-cooperative. Customer types are uniformly distributed over the unit interval as regards their willingness to pay for benefits from network externalities.

The conclusions reached by Economides and Flyer are quite strong. For pure-network goods the only consensual equilibrium is total incompatibility where each firm runs its own proprietary protocol.[29] A non-cooperative equilibrium does not exist. In the total incompatibility scenario market equilibria (for different number of firms) exhibit extreme inequalities in terms of output and, more so, in terms of prices. Entry after the third firm has no significant influence on output, prices and

[29] In respect to the backbone market, the incompatibility scenario is often labelled as "the balkanization of the Internet" (Kende, 2000).

profits of incumbents, as well as on consumer and producer surplus. Strikingly, in such a setting a monopolist would perform better in maximizing total surplus. Moreover, when compared to the total compatibility scenario (not reachable if firms are left to interact freely), this solution proves to be more inefficient along the same dimensions.

For such an inefficient result to arise, no anti-competitive practice is required, as it is the natural outcome of free market forces and strategic interaction among competitors. This implies that the "but for" benchmark against which anticompetitive actions in network industries are to be judged should not be that of "perfect competition" under total compatibility, but that of total incompatibility and strong inequalities across the competition field (Economides and Flyer, 1998).

The descriptiveness of this model is bounded to cases where the network services launched are brand-new and where potential customers do not face any constraint as regards to the provider choice. Moreover, the model assumes a level field competition with identical firms and with no possibility to predict which firms will gain an advantage over the rest of the industry. As we have already pointed out, adopters try to address technological uncertainty and coordinate by signaling which alternative has the greater likelihood to win the standard war.

Indeed, customers may exhibit *a priori* preferences in respect to alternative technological standards. This feature is usually modeled by introducing a partition of the customer base whereby customers are grouped according to their first choice preferences and the disutility cost they incur whenever choices depart from the preferred technology. This assumption differentiates IBPs' offerings horizontally. It may be significant where IBPs offer QoS provisions to customers already served and "captured" with sophisticated transit agreements. In this scenario, it seems plausible that QoS provisions would integrate current transit relationships and that for a customer to select a QoS provider other than the current transit provider would imply a switching cost. If this is the case, it follows that the *a priori* partition will coincide with market shares in the backbone market.

4. Mergers in the backbone market

Between 1998 and 2000 two mergers concerning the Internet backbone market were notified to the EC Commission under the EC Merger Regulation. The first operation involved MCI and WorldCom, two large US operators providing the full range of telecommunication services. The second merger was between MCIWorldCom, the entity resulted from the 1998 merger, and the US telecom operator Sprint. The first operation was given conditional clearance with the imposition of structural remedies; for the second one, authorization was denied on the grounds that it was incompatible with the common market.[30]Boxes 1 and 2 below give some details about the two Commission decisions, respectively.

The 1998 merger case was the first occasion for the Commission to examine Internet-related markets from a competition law perspective. The Commission found that the backbone is a relevant market on its own, as second-level ISP who do not manage backbones cannot achieve universal connectivity other than by purchasing transit from IBPs.

Box 1 – Case 1: MCI/WorldCom

In 1998 MCI and WorldCom notified to the European Commission their proposal to merge into a single entity. In order to clear the parties' request for authorization, the Commission identified the products/services on which the parties competed (relevant markets), the identity of players in such markets, their geographical scope and the extent to which competition in such markets would have been affected by the proposed merger. As both MCI and WorldCom are large telecom operators, the relevant markets all related to the provision of telecommunication services, from voice telephony to data communication.

The Commission focused its attention on the provision of universal connectivity, as this was the market where the merger was most likely to impair competition because of the overlapping activities of the parties. According to the Commission, this market comprised the connectivity provisioned by IBPs, but not that provisioned by second level ISPs.. IBPs own and manage Internet backbones and are vertically integrated so as to have their own internal networks. They secure themselves global reach by means of settlement-free peering agreements with other vertically integrated networks, whereby they reciprocally accept to terminate all traffic originated by the other party's network. Second level ISPs do not have independent networks and, therefore, are not eligible for peering. They reach global connectivity for their customers insofar as they purchase transit from IBPs. Therefore, since they cannot avoid to use top level networks, second level ISPs cannot react to an hypothetical price increase in transit by switching to another source, simply because there is no other source available. This suffices to say that second level ISPs do not compete directly with IBPs, hence they belong to a different market.

In order to identify the structure of supply in the market as defined, the Commission reviewed all peering and transit connections between ISPs and isolated those who only get connectivity internally (i.e. from their customer base) or from peering agreements with other IBPs. This brought to a list of 16 actual competitors. Market shares were calculated from both revenue and traffic figures. Even though the number of competitors was artificially large and their market shares underestimated, these figures clearly indicated that the merger between the two largest players would have lead to a combined entity with over 50% of the market, with its two nearest competitors combined enjoying only half of its size. [31] Therefore, the merger would have created

[30] In September 2004, the Court of First Instance overturned the Commission decision declaring that the Commission did not have the authority to prevent the merger because the parties had withdrawn their notification. The court ruling was based only on procedural considerations and did not deny validity of the Commission assessment.

[31] As there are no statistics available, the Commission was forced to make several assumptions in order to the determine the number of competitors and their market shares on the basis of the information at its disposal. However, all assumptions made by the Commission run in the parties' interest in that they overestimate the number of competitors and underestimate their market shares. Appendix II tracks the methodology followed by the Commission in computing market shares.

a network of such absolute and relative size that the combined entity could have behaved to an appreciable extent independently from its competitors and customers.
However, a thorough assessment of the competitive impact of a merger should also analyze whether the combined entity would be able to act strategically to maintain of reinforce its dominant position at the detriment of consumers. The Commission found that the market was characterized by the presence of entry barriers, as a would be IBPs would need to have a network of comparable status in order to peer with the existing IBPs. Since ISPs cannot offer connectivity incrementally, these operators would also have to purchase transit while bearing the cost of building a comparable network. This sharpens the entry barrier due to the large initial sunk cost required to build a network. According to the Commission the combined entity would also have been in the position to act strategically against potential competitors. This is because at present WorldCom, though incumbent, cannot deny peering to a suitable candidate top-tier ISP without incurring the risk that the candidate peer would turn to a rival network. However, had the merger to go ahead the new entity would acquire such a bargaining power that the adverse consequences of declining peering would be substantially reduced. Thus, the candidate peer would be forced to purchase transit from the new entity, thereby remaining at a cost and quality disadvantage.
The new entity would also have been in the position to act independently from its actual competitors. The Commission considered that MCI WorldCom would have been able to raise the costs of rival networks and/or decrease their QoS, simply because the size of the new entity would have been such that these networks would be forced to continue offering their customers connectivity with MCI WorldCom. If these networks were to change adversely the cost and quality of connection to the MCI WorldCom network, their customers would migrate away and new customers would be deterred from going to anyone other than MCI WorldCom. MCI WorldCom would also have been in the position to degrade rival network service offerings by deciding not to upgrade capacity at private peering points, as its customers would lose connectivity to a smaller portion of the Internet compared to those of rival networks. Lastly, by growing larger MCI WorldCom would have been able to reduce the independence of its competitors by changing the nature of the interconnection agreements with them, for example by obliging them to pay for peer or transit whilst offering no such payments in reverse.
In order to solve the competitive threats from a player hardly challengeable in the market, the parties proposed the Commission to divest MCI Internet business.. In assessing the adequacy of such undertaking, the Commission observed that given the level of concentration in the market the divested business should be preserved as far as possible as a single unit, and hence as a potential competitive force, and should be divested to an acquirer who was capable of replacing the departing player in the market.
The identity of the potential acquirer was of great importance because in the case of MCI the same physical cable infrastructure was used to carry both telecoms and Internet traffic, with the former being the bulk of the activity. In view of the relatively small proportion of total capacity which was dedicated to the carriage of Internet traffic, it would not have been possible to split out a separate physical cable network for Internet traffic alone. Under the parties' proposed remedies, therefore, an acquirer would be given leases of cable facilities, together with appropriate rights of access and co-location, to enable him to run a virtual network over MCI's physical network. It was recognised, however, that such a dependency arrangement might not provide a long term solution, since to be “facility based” is a strategic factor of success. Thus, an acceptable buyer ought to be in a position either to migrate its traffic more or less immediately onto an existing alternative network, or to build its own network in a reasonable period of time and then migrate traffic onto it. The most suitable type of acquirer would have been, therefore, either a telephone company with existing physical facilities but no Internet customer base, or an existing Internet player not currently operating as a top level ISP but with the potential to do so if given the appropriate customer base. Under these circumstances the undertakings proposed by the parties were judged sufficient to prevent the anticompetitive effects of the merger. Therefore, the Commission cleared the merger subject to the remedies proposed by the parties.

The structure of supply on this market had to be derived by the Commission as there were no available official statistics on market shares. The Commission drew a list of 16 actual competitors and calculated that in terms of traffic flow and revenues the merging parties would have had the largest share of the market, with the two nearest competitors enjoying only half the size of the combined entity. The great absolute and relative size achieved by the combined entity after the merger suggested that there was the risk that it could behave to an appreciable extent independently from its competitors and customers.

This conclusion was strengthened by the circumstance that the combined entity could also act strategically to maintain or reinforce its dominant position by denying peering requests by potential competitors and by raising costs to actual rivals and/or degrading their connection. The Commission examined also the remedies proposed by the parties to relieve the competitive concerns. The main remedy consisted in the divestiture of MCI Internet business. The Commission felt that the divestiture to an acquirer capable of replacing the departing player would have restored competition in the market. Therefore, the merger was authorized conditionally to the divestiture of MCI's Internet business.

In the 2000 merger case the Commission maintained that the backbone market was to be held separate from other Internet-related markets and that the merger would have affected competition in this market as the merging parties were the two largest providers. As in the previous case, an in-depth investigation showed that the merger would have led, through the combination of the merging parties' extensive networks and large customer base, to the creation of such a powerful force that both competitors and customers would have been dependent on the new company to obtain universal Internet connectivity (unilateral effect).

Box 2 – Case 2: MCIWordCom/Sprint

In 2000 MCIWorldCom notified to the European Commission its proposal to merge with Sprint Corporation, a US company providing global communication services in Europe through the joint venture Global One with Deutsche Telekom and France Télécom.
As far as the Internet is concerned, the merger affected the market for the provision of top level universal Internet connectivity, as already defined by the Commission in the appraisal of the merger between MCI and Worldcom (see Box 1). MCIWorldCom is the world's leading provider in this market, with Sprint being one of its main competitors.
An in-depth investigation by the Commission showed that the merger would have led, through the combination of the merging parties' extensive networks and large customer base, to the creation of such a powerful force that both competitors and customers would have been dependent on the new company to obtain universal Internet connectivity (unilateral effect). The structure of the market at the time of the notification was determined as in the previous MCI/WorldCom case, that is by reviewing all peering and transit connections and isolating those who only get their connectivity internally or from

peering agreements with other networks. Similarly, market shares were computed using revenue and traffic figures. This gave the following picture for the first five top-tier operators:

Company	Market share (traffic)
MCIWorldCom	32-36%
Sprint	5-15%
AT&T	5-15%
Cable&Wireless	0-10%
GTE	0-10%

These figures indicated that the combined entity would have gained a market share of between [37-51]%, while its nearest competitor would have never exceeded 15% of the market. Thus, the merged entity would have a market share based on traffic four times higher than its closest competitor. The Commission examined also the percentage of traffic "staying on-net" out of the network total traffic as a proxy of the degree of independence from the market. The combined entity would have more than 40-80% of its traffic staying on-net, whereas other networks have no more than 32%. Other IBPs would exchange around 20% of their total traffic with the combined entity, while the traffic this would exchange with other IBPs would represent less than 0-5%.

The rest of the competitive assessment made by the Commission resembles closely that of the MCIWorldCom merger (Box 1). It is argued that the market is characterized by entry barriers (backbone infrastructure, global reach) that obstruct potential competition and that unilateral effects may strengthen the foreclosure of the market. Particularly, the combined entity could implement a selective degradation strategy and/or raise rivals' costs, thereby threatening both actual and potential competitors. The Commission estimated that if the merged entity were to degrade the connectivity of one of its four largest competitors, this would only affect about 0-10% of its overall traffic (as implied by on-net traffic percentages), but it would amount to more than 10-20% of such traffic for any of the largest competitors exchanging with the merged entity (off-net traffic). The new entity would act independently of its competitors also with respect to technical progress by developing its own proprietary standard and refusing to concede interoperability with other networks.

The reasoning above suggested that the proposed merger would have resulted in an entity of such absolute and relative size that it would have been able to increase prices and impose its own standard to the industry. In order to relieve these competitive concerns, the parties undertook to divest Sprint Internet business. The Commission considered that the proposed remedy would have significantly altered the economics of the divested entity by separating it from other activities such as the underlying Internet network infrastructure used also for other Sprint's telecommunication needs. The absence of facilities and systems for the entity the parties were proposing to divest would have lead to significant risks as to efficiency and competitiveness of the divested entity, which would be dependant for a significant time on its main competitor (the transition period would have required between two to four years). The Commission, therefore, rejected the proposed remedy and declared the concentration incompatible with the common market.

This lead the Commission to the same conclusion as in the 1998 case about the ability of the post-merger dominant operator to obstruct competition by implementing a selective degradation strategy and foreclosing entry to potential competitors. As in the 1998 case, the parties proposed as a remedy to divest Sprint Internet business. However, this time the remedy was deemed insufficient to relieve the competitive threats from the merger, as the efficiency and competitiveness of the divested entity would have been seriously jeopardized by the separation from the underlying Sprint telecommunication infrastructure. Authorization was thus denied.

In both cases the Commission had to conduct a thorough assessment of competition in the markets affected by the proposed mergers before clearing the parties' request for authorization. The line of reasoning set forth by the Commission in these two cases is more deeply described in the next two sections before illustrating from Section 6 onward why the framework depicted by the Commission is no longer appropriate.

5. Market definition

The market definition for the provision of top level or universal Internet connectivity draws upon the hierarchical structure and topology of the Internet. The hierarchy is a matter of technical constraints, but its main reflections are commercial. IBPs are network operators who own, run and upgrade long-distance transmission networks that together form the global Internet international 'backbone', which connects to multiple countries in more than one region of the world. These infrastructures constitute an essential facility for every ISP wishing to provide its customers with global connectivity. The US-centric topology of the Internet is a historical legacy of its inception.[32]

The hierarchical topology of the Internet is the outcome of the evolution of ISPs interconnection policies. Since its initial development, the commercial Internet was managed through voluntary peering agreements. Initially, most exchange of traffic under peering arrangements took place at Network Access Points (NAPs), as it was efficient for each backbone to interconnect with as many backbones as possible at the same location.
The ever increasing diffusion of the Internet and the penetration of new traffic-demanding web applications (such as voice over IP, video conferencing, video and music streaming) caused traffic flows to growth steadily. The rapid growth in Internet traffic soon caused the NAPs to become congested, which led to delayed and dropped[33] packets. As a result of the increased congestion at NAPs, many backbones began to interconnect directly with one another. This system has come

[32] For an historical overview of the Internet from its academic take off to the current commercial era, *see* Kende (2000).
[33] When, at a router, the incoming rate exceeds the outgoing rate, packets can be temporarily queued and delayed, and eventually discarded ("dropped").

to be known as private peering, as opposed to the public peering that takes place at the NAPs.[34]

The EC Commission has grasped this evolution, as it is arguable by comparing how the Commission has handled the assessment of the relevant markets for universal Internet connectivity in the two cases in 1998 and 2000 respectively.

In the 1998 WorldCom/MCI case, in order to identify IBPs and to distinguish them from ordinary ISPs (i.e. second-level ISPs), the EC Commission defined top level operators as those able to grant themselves global reach by means of peering agreements, both public and private, without purchasing "transit"[35] from anyone.[36] In theory, second-level ISPs could reach global connectivity also through peering agreements between each other. The benefits from entering into a peering agreement relative to a transit one, would be lower transit costs and lower latency in traffic delivering. However, since this would imply managing a great number of contractual relationships, it is actually implausible that second-level ISP would make such a choice. Rather, second-level ISPs will prefer to gain global connectivity by entering into a single transit agreement with any of the existing IBPs. Therefore, the products offered by IBPs are differentiated in that the connectivity is supplied entirely by peering agreements between those top-level networks or internally.

In the WorldCom/MCI market definition the Commission deemed both private and public peering as valid proxies to identify IBPs. Therefore, the possession of, for example, peering agreements at public NAPs with all other ISPs might well have guaranteed the ISP concerned the status of a top level network. However, the Commission argued that this was a week definition, necessarily bounded to lose any signalling power in the short term, due to the increasing congestion at public peering points.

In the 2000 WorldCom MCI/Sprint case a more rigorous and strict defining criterion was adopted by the EC Commission for defining relevant markets. As congestion at NAPs had increased and large providers had increasingly began to form their own private peering arrangements at points away from the NAPs, the smaller IBPs, who previously had peered only at the NAPs, were refused settlement-free private peering by the largest networks. As a consequence, these

[34] For a game theoretic analysis of the choice for an IBP between private and public peering, *see* Badasyan and Chakrabarti (2003).
[35] Transit is a commercial service granting access to the Internet for a fee and it is a vertical contract of service provision from an upstream ISP to a downstream customer (ISP, business or consumer). Transit can take three forms: dedicated access (a dedicated line to another network provider or large customer), retail dial-up access (to residential and business customers) or wholesale dial-up access to Internet service providers.
[36] For a comparison between peering and transit, *see* Norton (2001).

were no longer capable of acting as top-level networks, and, therefore, were dropped out of market definition.

In order to be an operator to peer with at a private level, one needs to demonstrate comparable traffic throughput, flows and geographic scope, since actual IBPs cautiously settle private peering agreements only with pair-status operators.[37] Actual IBPs even require operational dimensions on would-be peering partners so as to prevent the latter from free riding.[38] Traffic asymmetry could cause free riding if, for example, one of the two peering partners has focused its offering toward content providers and the other partner, given the hot-potato routing rule, has to carry over its network cumbersome returning flows of web-content in response of content requests originated with its consumer base. Under these circumstances, the IBP will normally refuse to private peer with IBPs specialized in web hosting, or with IBPs with a customer base composed in large proportion of web sites and content providers.

Given the reasons above, the Commission concluded that an IBP should be able to gain universal connectivity solely on the basis of its own network (and its customers' networks) and the networks of its private peering partners (and their respective customers' networks) in order to qualify for a top-tier status.

6. Competitive issues

The present section outlines the competitive assessment of the "backbone" market, as laid down by the EC Commission. The detailed description of the market is essential to grasp the competitive concerns expressed by the Commission in the two mentioned cases.

6.1. The competitive field

The Internet is not subject to any sector-specific regulation governing interconnection between IBPs. One consequence of the lack of any regulatory framework is the absence of specific reporting obligations on ISPs about Internet revenues, and, therefore, of a consistent reporting standard. The Commission could not find a reliable publicly available estimate of the size of either the Internet sector as a whole or of any relevant sub-sector, not to mention the possibility to obtain accurate figures about market shares. Also, there was no sort

[37] Recently, many IBPs have published their private peering policies and prerequisites on line. The prerequisites for peering with IBPs vary but generally include a peering presence in four or more regions where both parties have a presence along with sufficient transport bandwidth and traffic volume to warrant direct interconnections. See, e.g. www.uu.net/peering/; www.level3.com/us/info/network/interconnection; www.genuity.com/infrastructure/interconnection.htm.

[38] For an analysis of the peering decision making process of IBPs, *see* Norton (2001).

of industry consensus about a preferred and proper unit of measurement of market shares. Therefore, the Commission had to collect data on a variety of key operational dimensions before choosing the one(s) that best described the market. These are:

- Traffic flows;
- Revenues from basic Internet access;
- Aggregate capacity in interconnection links;
- Number of addresses reachable;
- Numbers of points of presence;
- Actual bandwidth used for traffic exchange.

The lack of a reporting standard and of consistent figures implies the use of conjectures and estimates in order to identify actual competitors and assess their markets shares.[39] As stated before, the minimum identification criteria used by the Commission looked for ISPs who peered at least with all the main renown IBPs, since the failure, on the part of an ISP, to peer with just one of these dominant IBPs would have implied a substantial absence in coverage of the Internet as a whole. [40]

A common feature to both merger cases examined by the Commission is the strong concentration observed in the market for the provision of universal connectivity.In *WorldCom/MCI*, beyond the two merging parties, the Commission registered the presence of two other large IBPs - Sprint and GTE (ex-Genuity) – and twelve small competitors. Even though the Commission did not provide detailed data, it stated that the combined entity would have held over 50% of the market, however widely defined, and would have been significantly larger than the size of its nearest competitor (Sprint), on either revenue or traffic flow, bearing in mind that the next other competitor, GTE, was about half the size of Sprint.

In *WorldCom MCI/Sprint* the main operators were WorldCom MCI, Sprint, AT&T, Cable & Wireless and GTE and a fringe of twelve minor operators. The largest five IBPs' combined market share amounted to roughly [42-86] %.

Another proxy measure frequently quoted by the Commission to map the competitive field and the IBPs relative position of strength is the percentage of

[39] According to the Commission, there is no clear-cut dividing threshold between the smallest IBP and the biggest second-level ISP. Therefore, there is the need for a conventional proxy in order to identify IBPs..

[40] In both merger cases, the Commission inquiries resulted in the identification of a cluster of 4/5 big backbone operators and a fringe of minor competitors.

traffic "staying on-net" out of a network's total traffic flow.[41] The Commission argued that these structural figures capture the degree of "strategic" independence of an IBP from other actual and potential competitors.

In respect to potential competitors, the hierarchical structure of the Internet and its peculiar peering interconnection architecture suggest that likely new entrants are actual transit customers striving to grow in terms of both geographic coverage and customer base in order to become eligible as private peering partners. Thus, the trajectories pursued by potential competitors are necessarily bottom-up and internal (captive) to the ISPs' hierarchy. This condition creates competitive concerns in so far as potential competitors are, at the same time, the main source of revenues for IBPs who would be more reluctant to accommodate a former customer than an outsider new entrant.[42] Furthermore, incumbent IBPs would likely foreclose new entrants not only because they represent former customers paying for transit, but also because, given the imperative for an IBP to preserve its status of peering partner, IBPs have to maintain their consumer base and, even more, to attract new transit customers, rather than accommodate their entry.

Besides the strategic ones above , the backbone market is characterized by other entry barriers. In order to provide universal connectivity, an ISP has to build its own network infrastructure (backbone). Moreover, the would-be IBP has to reach a traffic throughput and geographic coverage comparable to that of actual top tier operators in order to be an operator to peer with at a private level. As the Internet grows hastily and IBPs strive to catch up with ever increasing bandwidth capacity requirements, it would be more and more difficult for would-be IBPs to gain a pair status that will enable them to be eligible as private-peering partners. The market is thus characterized by the presence of strategic and dynamic entry barriers.

Transit customers could be functionally subdivided into the following categories (Badasyan and Chakrabarti, 2003):

- Downstream ISPs serving individuals, businesses and even smaller providers. They pay upstream IBPs for connectivity, the price of which depends on the location and amount of data. Potential competitors are more likely to be previous downstream ISPs;
- Online service providers, like AOL, who earn revenues by providing Internet access and focusing on content and ease of use. Online service providers lease connectivity from backbones or other upstream

[41] The term "on-net" refers to traffic which is end-to-end comprised within the boundaries of a network and, thus, is independently carried over by a sole IBP.
[42] In the language of the Peering Community: "Once a Customer, Never a Peer." (Norton, 2002).

ISPs and manage the network points of presence (POPs) that connect dial-up customers to the Internet;

- Web hosting companies, like Exodus, who host websites that are accessed by the Internet public. It is important to note that web hosting ISPs create unidirectional traffic, as websites originate a lot of traffic, while not requesting much. As a result, IBPs demand that web hosting providers, which typically do not maintain a national network, purchase connectivity from a backbone or downstream ISPs.
- Big businesses, whose ubiquitous global presence and traffic induce a direct relationship with IBPs rather than a mediated one through downstream ISPs. Indeed, the provision of universal connectivity is usually part of a composite service[43] delivered to large undertakings and, therefore, it may be misleading to assess customers' reaction of large businesses and other transit customers alike.

This competitive landscape suggested the EC Commission that the horizontal mergers scrutinized would have created a dominant IBP in the backbone market capable of increasing prices regardless of the constraints on its market power put forward by existing rivals, potential competitors and the countervailing power of buyers (unilateral effects).

6.2. Unilateral effects through selective degradation

According to the Commission, each of the two notified concentrations raised serious competitive concerns about the creation of a dominant position in the market for the provision of universal Internet connectivity, as both operation would have enabled the entity resulting from the merger to operate independently from its actual and potential competitors as well as customers. Thus, the economic rationale underpinning the Commission arguments was that of unilateral effects.

In the Commission view, the key tactic a dominant player would implement is that of "selective degradation" (SD). This consists in decreasing bandwidth capacity at private peering points, or refusing to increase it when requested. Since peering points are private and in a peering agreement partners exchange traffic only for termination purposes, this tactic hits directly the selected network operator and affects other top tier ISPs only indirectly and marginally. The tactic of SD is rational when a dominant IBP can act independently of its competitors. Given the strong network externalities in interconnection policies, which provide IBPs incentive to cooperate with its competitors to provide seamless universal

[43] In *WorldCom MCI/Sprint* the Commission argued that there exists a separate relevant market for the provision of telecommunication services to multinational corporations (MNC). Given the complex blend of needs and requirements expressed by MNCs, their procurement decisions refer to a bundle of telecommunication services (Global Telecommunication Services) of which the provision of universal connectivity is a basic component.

connectivity, to be rational the choice of SD has to generate a payoff that outweighs (dominates) that from a seamless interconnection strategy. As an indicator of independence and, thus, of dominance of the SD strategy, the Commission adopted the percentage of traffic "staying on-net" out of one network's total traffic flow, since a dominant IBP relies only marginally on each of its smaller competitors, whereas it will be a major source of connectivity to each of these.[44]

The EC Commission position is largely based on theoretical arguments developed by Cremer et al. (2000) in a seminal paper on backbone competition They develop a model in which backbones have some installed base of customers and compete for new ones.[45] The model incorporates positive externalities in consumption: the greater the number of customers attached to the backbone, the better is the quality of service. Quality increases also with better interconnection among backbones. Demand functions depend on prices and qualities of service. Within this setting the authors show that in case of backbones of different size, the larger backbone prefers a lower quality of interconnection compared to the smaller backbone. Indeed, even though a higher quality of interconnection expands demand, it also reduces the quality differentiation between the two networks with asymmetric customer base. Therefore, the larger IBP prefers to sacrifice some demand expansion in order to preserve (or increase) its quality advantage.

We already noticed that the strategic goal pursued by the dominant IBP through the implementation of SD shall not be necessarily to foreclose competitors.[46] A dominant IBP could also raise rivals' costs, or discipline the market signaling its intention to retaliate against those who deviate from his behavioral prescriptions. More in detail:

- A dominant IBP could increase the relative price of its customers connections. In doing so, the dominant IBP would not be constrained by the presence of competitors, as these would be exposed to the threat of SD;
- A dominant IBP could discipline the market by the mere threat of selectively degrading the connectivity of its competitors. This will allow it to control both actual and potential competitors, as well as customers in the market,

[44] In *WorldCom MCI/Sprint*, for example, if the merged entity were to degrade the connectivity of one of its four largest competitors, this would only affect about [0 to 10] % of its overall traffic (as implied by on-net traffic percentages), but, it would amount to more than [10 to 20] % of such traffic for any of the largest competitors exchanging with the merged entity (off-net traffic).
[45] The details of the model are illustrated in Appendix I.
[46] See Section…….above.

In response to a degradation at a private peering point, an actual competitor could by-pass the damaged node by recurring to multihoming.[47] However, this strategy is virtually unfeasible as multihoming proves effective for out-going traffic but not for returning traffic flows (over which the degraded network could not exercise any significant control). Furthermore, actual competitors would also have to face the reaction of their customers. Indeed, when comparing the quality of connectivity being offered by the dominant IBP to that being offered by its competitors, customers would find it more beneficial to switch a bulk of their traffic away from the degraded network to the dominant IBP.

As to potential competitors, in addition to the offensive moves against them by the dominant IBP, these would face the very same reactions by the other actual IBPs which would strive to maintain their pair status and, consequently, keep the pace of the dominant player (in terms of traffic throughput and geographic coverage)

Lastly, given the importance of being connected to the dominant IBP's network, its own customers too (second level ISPs, and MNCs) would not be able to retaliate to an increase in price or to a degraded connectivity. Unless all customers can act as a unit (and there is no evidence that the customer base is sufficiently concentrated to permit this) no individual customer will take the risk of moving to obtain a possibly inferior service without having any assurance that a sufficient number of other customers would take the same step.

The reasons above suggested the EC Commission that the US dominant player resulting from any of the proposed mergers would have been unfettered in increasing transit fares in the EC market and, thereby, access prices to European Internet final users. This conclusion stemmed also from the fact that at the time the assessment was conducted, European largest ISPs were only classifiable as second level ISPs and, as such, could not exercise a countervailing power against the dominant IBP.

Recent years have witnessed intense competitive dynamics which have profoundly changed the structure of the backbone market. In light of these changes, the EC Commission assessment of competition in the backbone market may no longer be appropriate. Next section discusses the main directions of change and the new threats to competition that are posed by these recent developments.

[47] The practice of network providers and Internet access providers of being connected to more than one network is referred to as 'multihoming'.

7. A less hierarchical Internet structure

The pivotal element underpinning the EC Commission competitive assessment was that the international backbone infrastructure, which is the "essential facility" for the provision of universal Internet connectivity, was almost all possessed and operated by the five larger US IBPs, and that within this group, as a result of the two notified concentrations, a dominant IBP capable of exercising substantive market power independently of its rivals would have emerged.

This argument is progressively losing its significance as countervailing centrifugal forces are driving a de-agglomeration process of the Internet traffic, with traffic flows that are no longer tightly knitted to specific physical places. The result of this evolution is that the original U.S. centric Internet architecture is progressively eroding.

As Giovannetti and Ristuccia (2003) argued, these centrifugal forces are:

- the European investment wave in backbone infrastructure;
- the development of trading marketplaces for IP/transit exchanges;
- the proliferation of European IXPs;
- a process of cultural and linguistic differentiation of web contents;
- the application of new technologies and practices: catching, multi-homing and mirroring.[48]

As regards the first point, the process of liberalization in the TLC sector both in the U.S. (with the 1996 Telecommunication Act) and all across Europe, spurred carriers of both side of the Atlantic to deploy "end-to-end" infrastructure on global and national routes. Several European large companies have deployed their own "backbone" running throughout the U.S, thus avoiding payment of transit fares.[49] These achievements were made feasible by a range of different options: building a network infrastructure; partnering with a U.S. carrier; purchasing dark fibre capacity and services; swapping capacity; purchasing a U.S. company; sharing a company (OECD, 2002a).

The second point made by Giovannetti and Ristuccia refers to trading platforms that gather IBPs in a single marketplace wherein bandwidth trading occurs through a centralized process with transparent prices and QoS information. For

[48] Catching is the storage of already accessed data; multi-homing is an alternative IBP which to recur in case of transmission hiccups; mirroring is the geographical or backbone multiplication of a web site content.
[49] See, e.g. Telia, France Telecom, Deutsche Telekom, Telecom Italia, KPN.

example, Band-X trading place provides from its trading floors in London and New York daily prices for monthly Internet transit at different bandwidths.[50] The increased transparency generated through these platforms allows transit customers to perform their decisions more consciously and to reduce switching costs.. As a result, market-mediated transactions increase the competitive pressure on U.S. dominant IBPs exerted both by the customer base and existing competitors.

The third argument mentioned by Giovannetti and Ristuccia refers to the development in Europe of Internet Exchange Points (IXPs). These are physical network infrastructures operated by single entities with the purpose of facilitating the exchange of Internet traffic between ISPs through second-level peering agreements, thereby reducing dependency on their respective upstream transit providers. Any ISP that is connected to an IXP can exchange traffic with any of the other ISPs connected to the same IXP, using a single physical connection and, thus, overcoming the scalability problem of individual interconnections. Also, by enabling traffic to take a more direct routes between different ISP networks, an IXP can improve the efficiency and the fault-tolerance of the ISP' provision (Marcus, 2001). Most European IXPs are non-commercial co-operatives funded by membership fees paid by the connected ISPs. The actual saving will depend on the cost of membership (the range of membership fees is quite wide) and the amount of traffic that can be exchanged in relation to the ISPs total traffic.[51] The growing number of IXPs allows traffic to be exchanged on a regional basis rather than going through transcontinental backbone networks (OECD, 2002a).

The last two points by Giovannetti and Ristuccia were keenly grasped by the EC Commission, but it was argued that at the time of the Commission merger decisions their effectiveness in easing the dependency of large European ISPs from U.S. IBPs was overweighed by the persisting U.S. centric feature of the Internet.

The likely consequences of the first three centrifugal forces are far-reaching as regards market definition both in its product and geographical dimensions. The product boundaries of the "backbone market" may be enlarging as: (i) second-level ISPs achieve IBP-status (the vertex of the hierarchy is flatting); (ii) trading floors ingenerate a process of commoditization and the diffusion of second-level public peering platforms; (iv) IXPs, ease the dependency of ISPs for transit provision. As to the geographical extension of the market, this may no longer be global but regional, as the combined effect of the centrifugal forces is bringing about a denser matrix of interconnected networks, which, in turn, allows and implies a greater proximity in the provision of universal connectivity.[52]

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[50] *See* the Band-X's web site: www.band-x.com.

[51] *See* the European Internet Exchange Association's web site, www.euro-ix.net.

[52] See Malecky (2002), Malecky (2004), and Rutherford et al. (2004). For an assessment of the geographical boundaries for the provision of universal connectivity in the UK, *see* Ofcom (2001b).

In so far as this trend will consolidate, the argument for the creation of a dominant U.S. IBP able to act independently worldwide, regardless of the reactions of buyers and competitors, may lose its significance. This is not to say that the "backbone market" shall no longer be monitored, since the foreseeable development trajectories cast new concerns over the next-to-come Internet.

8. The next competitive concerns

The economic framework underpinning the model of selective degradation outlined in Section 6.2. prescribes that a dominant IBP aims at vertically differentiating its offering as a higher quality IP connectivity relative to the one of the targeted rival. Given the IP/TCP perfect interoperability, this is the only kind of product differentiation available for the provision of basic IP connectivity.

Given the ongoing commoditization of the provision of universal IP connectivity outlined in the previous section, IBPs might look for other strategies in order to differentiate their offering and, therefore, price at a premium. These strategies might pursue an horizontal differentiation through the provision of enhanced Internet services delivered on a proprietary QoS protocol platform. If strategic interaction makes other IBPs follow suit the first one to implement such a strategy, the result could be a market where future voluntary interoperability between private networks is in jeopardy, and IBPs would leverage strategically the fast-packet service they run onto their network as a means to differentiate their market position.

Indeed, fast-packet services are enhanced Internet services that transit-customers must pay for and, thus, these cloud technologies constitute a foreseeable source of revenues for IBPs, once interactive application spread across final users. The fact that, so far, no standard protocol spontaneously emerged shows that the need for interoperability on different cloud technologies among IBP peering partners is not an argument in private peering negotiations, and that the "best effort" *status quo* is far from being substituted by some form of deeper cooperation among private peering partners.

8.1. The "balkanization of the Internet"

The concept of relative independence of a dominant IBP and the incentive to differentiate its offering against the countervailing incentive to cooperate in the provision of seamless universal connectivity (pursuing positive network externalities), evokes a widely discussed issue about a concerning likely development of the next-to-come Internet: "the balkanization of the Internet".[53]

[53] *See* Kende (2000), Kende and Sicker (2000) and Frieden (1998).

In order to provide QoS for enhanced Internet services, such as voice over IP, video conferencing and Internet banking, the reliability of Internet connections is very important. Therefore, IBPs would have to agree on a standard transmission protocol (fast-packet service), which runs just below the IP/TCP layer, and guarantees interoperability across competing private networks. Currently, no agreed protocol exists for such cloud technologies. This could entail an Internet truly universal only for basic services, such as WWW and e-mail, but subdivided among networks for the provision of enhanced Internet services (balkanization).

From a private perspective, the decision to interconnect for the provision of QoS services appear to be relatively similar to the one IBPs have so far made when deciding whether to peer with one another by balancing out the costs and benefits of interconnecting. The benefits stem from the positive network externalities from interconnection that attract new consumers and encourage consumption by the existing ones; the costs come from competitive network externalities: a backbone decision to interconnect with another backbone makes the other backbone more attractive to customers (Kende, 2000).

There is, however, a difference between the current interconnection arrangement and new ones for the exchange of QoS traffic. Universal connectivity achieved through peering agreements is a legacy of the cooperative spirit characterizing the Internet in its early days that made basic services, such as e-mail and Web access, universally available. In this context, no IBP could differentiate itself based on the unique provision of these services. On the contrary, in the commercial spirit that pervades the Internet today, IBPs view the new services that rely on QoS as a means of differencing themselves from their competitors, and, if the strategy proves to be successful, of charging a premium to its own transit customers.

8.2. A more extreme scenario

The "balkanization of the Internet" describes a static configuration of the backbone market, whereby differentiated QoS protocol platforms compete simultaneously. The same analysis conducted in a dynamic fashion could lead to a more extreme outcome, whereby a dominant IBP would have an incentive to develop a proprietary standard for such fast-packet services that would be offered only on its network, thus internalizing network economies by refusing to concede interoperability to other networks. Given the large consumer base relative to competitors, the QoS protocol platform of the dominant IBP might become the *de facto* industry-wide standard, thereby allowing the dominant IBP to tip the market and exclude other competing technologies, or, at least, to impose and control the industry technological development.

The economic foundations of this scenario are grounded on the analysis of allocation under increasing returns by Arthur (1988). Therein, a model is presented where users chose between technologies competing for a market of potential adopters and where each technology improves as it gains in adoption. The model prescribes that if one alternative technology gains an early lead in adoption it may eventually “corner the market” of potential adopters, with the other competing technologies becoming locked out. This framework fits well with high technology markets that call for compatibility with industry standard, and where increasing returns are due to network effects that benefit users each time a new user joins the market. Thus, the economics of networks applied to Internet-based new markets suggests a tendency toward winner-take-all outcomes. In the case of the emerging market for the provision of QoS services a dominant IBP could leverage its existing large customer base in order to gain a substantive first mover advantage and thereby monopolize the market.

8.3. Implications for competition policy

The two possible scenarios outlined above point out the risk that the Internet will develop in a suboptimal manner. Lack of interoperability or (maybe worse) monopoly power may reduce consumer and social welfare. On one hand, this risk seems to call for some public intervention. On the other hand, the spectacular expansion of the Internet in very few years, absent any form of regulation, indicates that market forces may prove much more reliable in fostering the adoption of new technologies and the surge of economic benefits. Moreover, uncertainty about the pros and cons of competing technologies and the fast pace of their development should induce public administrative authorities to refrain from meddling with technical and complex issues. Even the most benevolent regulator runs the risk of getting it completely wrong.

In this complex state of affairs competition policy may play an important role. Even if it is not immune from mistakes, its *ex post* character makes it more apt to correct market avenues leaning toward anticompetitive settings without interfering with initial technological choices. This is even more true if one believes (as we do) that the analysis of the backbone market contained in this paper proves that consolidation in this market should not raise competitive concerns and, therefore, should not warrant the strict application of the merger regulation that the EC Commission reserved to previous cases. Competition law provisions regarding agreements and dominance will probably constitute the main tools to preserve competition. With respect to horizontal agreements, the EC Commission and National Competition Authorities should have a permissive attitude towards those agreements concerning technical standards and interoperability. Their pro-competitive effects are likely to be sufficiently high to outweigh the risk of a collusive outcome. Moreover they seem to be the best way out the unpleasant choice between balkanization and monopoly.

The main reason for believing that firms will not opt for this cooperative solution, given the presence of strong network externalities, is that each of them (or most of them) believes to be able to win the war for standard and gain monopoly rent afterwards. In the recent *Microsoft* case, the EC Commission has made clear that it is not going to tolerate such strategy as it is willing to demand interoperability to the dominant operator that should emerge from a war of standards. If firms anticipate such attitude by an antitrust authority, the incentives to keep developing their cloud technologies in isolation should disappear. If network effects are significant, then a cooperative solution is likely to prevail.

Vertical relationships deserve further considerations. Both vertical mergers and vertical contractual arrangements could alter the prospects faced by Internet operators and modify their attitude toward cooperative solutions. Indeed, a way to win the war for standard is to secure complementary products such as premium content or exclusive access to advanced services (e-health, e-government, etc.). These links have two opposite effects. On one side they can help mitigating double marginalization problems, if the complementary product market is not competitive. On the other side they may stabilize an inefficient equilibrium with multiple standards and a balkanized Internet as the benefit stemming from the complementarities between the Internet and the "proprietary" advanced services could offset the loss due the unexploited network externalities. One way to solve this problem might be to treat these complementary products as part of the technical standards and to require their sharing if a concrete risk of balkanization materializes.

9. Conclusion

As regards the competitive assessment of the backbone market, the main concern raised by the EC Commission was that of unilateral effects by a dominant US IBP. Undoubtedly an industry-wide regulatory intervention setting mandatory rules for interconnection agreements between IBPs would not be the proper policy, as the current evolution of the upstream Internet shows that the market auto-regulates as there are sufficient market forces countervailing the strategic moves of dominant players.

Regarding competition policy interventions during the late '90s, the same cannot be said, as there is no counterfactual evidence that the market outcome, absent the EC Commission interventions in the two merger cases, would have been virtuous as well. It is arguable that, at the time the EC Commission decided, there was a wide consensus about the U.S. centric feature of the upstream Internet structure, which is the pivotal prerequisite of the EC Commission assessment.

The issue about QoS is not self contained in the “backbone market”. The provision of enhanced Internet services is carried out by the contribution of operators acting at several layers of the Internet value chain: i) telecommunication carriers; ii) content providers; iii) downstream Internet access providers; iv) broadcasting service providers (on various technological platforms: cable, satellite, mobile and fixed telephony, terrestrial digital TV); v) client-software providers. Thus, it is far from clear which Internet operator will preside the key strategic layer and, thereby, will affect the delivery process throughout the Internet value chain. Even more difficult is to forecast that IBPs will be the ones to succeed in this task on their own forces, leveraging their proprietary fast-packet platforms. What seems more arguable is that the QoS issue will spur competing processes of vertical integration between complementary economic agents and, therefore, the market outcome will depend on the competitive structures and dynamics at different layers of the value chain. Thus, it appears that competition law enforcers will have to carry out a careful assessment of the dynamics throughout the Internet value chain both horizontally and vertically, instead of a focused assessment on a layer which appears to be the strategic bottleneck of the delivering process.

PART II

"Competition in the Internet Access Market"

1. Introduction

This part presents a competitive analysis of Internet service access markets. As it is well known, the Internet is a hierarchical network infrastructure (i.e. a network of networks). The analysis refers to the last peripheral node of the hierarchy. All ISPs need to get access to this node in order to achieve capillary reach. This suggests that telecom incumbents operating national fixed telephone networks (PSTN) play a crucial role, as PSTN is to date the infrastructure that enables the deepest reach. We, therefore, address the strategic interaction between telecoms incumbents and rival ISPs, either vertically integrated operators of alternative platforms, or ISPs gaining access from existing local networks.

Section 2 deals with technological aspects, illustrating the alternative technologies that enable or will likely enable capillar local access to the Internet. In Section 3 we discuss the relevance of these technologies in the definition of antitrust markets. We describe in Section 4 the actual market structure of Internet access services, highlighting the structural dimensions that are likely to create competitive concerns. Section 5 critically discusses the approach followed by the European Commission in assessing competition in Internet access service markets as set forth in two antitrust cases, notably *Wanadoo Interactive* (Wanadoo) and the *Deutsche Telekom AG* (DT). Finally, Section 6 draws some concluding remarks.

2. How access to the Internet is provided

ISPs deliver to their customers connectivity to the whole Internet, that is to any point on the Internet to which a customer may want to have access. Therefore, a demand exists for basic Internet access services. Several alternative technological platforms may be used to deliver Internet access. Some of these are legacy infrastructures enjoying a first-to-market status (e.g. copper pair local loop, cable networks); others are relatively new infrastructures, each striving for diffusion. Technically speaking, these alternatives can be ranked in respect to their being wire-line or wire-less platforms. We briefly describe them below. Table 1 (page 112) summarizes their relative points of strength and weakness.

2.1. Fixed/Wire-line platforms

There are several alternative wire-line infrastructures over which to deliver access. Some of them are widely diffused, other are still under development. We briefly discuss them below.

2.1.1. Copper pair Local loop

Local loop is primarily an infrastructure that allows access to and the delivery of retail telecommunication services. Originally, Internet access service over the telephone network were provided through dial-up connections. Dial up access is like a phone connection, in that the POPs (points of access to the ISPs) usually consist of local telephone numbers on a PSTN exchange. In the past, the maximum speed of connection with analogic dial-up access was 56 Kbps, but new technologies such as digital ISDN have provided faster rates up to 128 Kbps.

Nowadays dial-up access tends to be replaced with always-on DSL (digital subscriber line) access. The DSL technology converts the telephone line into a high speed digital line by transmitting data at higher frequencies than those used for voice. Therefore, DSL technologies allow for simultaneous use of voice telephony and data transmission services. There are various forms of DSL capable of providing high connection speed, from 256 Kbps to 52 Mbps: Asymmetric DSL (ADSL), Symmetric DSL (SDSL) and Very High Data Rate DSL (VDSL). The strength of DSL is its use of ubiquitous infrastructures; its weakness is that the quality of the service degrades with the local loop getting longer.

2.1.2. Cable networks (CATV)

Similarly to DSL, cable platforms use a multi-frequency modem to transmit data as well as TV channels. Connection speed ranges from 1 to 10 Mbps. However, unlike copper loop, cable networks are not uniformly diffused across Europe. Moreover, traditional CATV have only a one-way link to the customers' premises and need to be upgraded to two-way links in order to provide Internet access. Also, since users share bandwidth with their neighbours, the available bandwidth per user depends on the number of users connected to the same cable.

2.1.3. Fibre to the Home/Curb – FTTH/FTTC

Fibre optic is the standard technology used in backbone networks. Its diffusion as an access platform is hampered by the relatively high cost of installation, which usually requires trenching labour-intensive work. This technology uses light waves for transmission and enables huge access speeds between 10 Mbps and 10 Gbps, depending on whether the fibre connects all the way to the user (FTTH) or to the curb (FTTC).

2.1.4. Power lines communication – PLC

PLC makes use of existing electric low-voltage distribution networks to transmit data signals. This technology is still under development and only few market tests have been undertaken so far in Spain, Scotland and Germany. Although its ubiquity makes PLC a potentially universal platform, there are still important technical concerns to be solved before providing access through that platform. Nonetheless, PLC may represent a potentially optimal solution for rural areas where DSL and cable access solutions are not viable.

2.2. Mobile/Wireless platforms

2.2.1. Satellite

Satellite can act as a bridge between the user's PC and the ISPs' POPs on the fixed Internet protocol. Similarly to PLC, because of its ubiquitous coverage and its rapid deployment, this solution may fit to rural areas better than DSL. However, satellite connections are usually one-way, allowing downstream transmission only, at a speed between 300 Kbps and 3 Mbps. Two-way satellite diffusion is still limited because of expensive terminal equipment, limited upstream bandwidth and problems of congestion.

2.2.2. Wireless local area network – WLAN (WiFi)

This technology enables users to connect to the Internet by means of the radio spectrum. The dominant standard, WiFi (Wireless Fidelity), allows available bandwidth to be shared between connected users up to 50 Mbps around 1000 metres. Although WLANs have been originally deployed as an adjunct to fixed or mobile broadband networks to provide for hot-spot coverage, these technologies are also being used to supply a self-reliant Internet access service that substitutes entirely wire-line platforms.

2.2.3. Mobile (3G)

3G mobile networks are being deployed by mobile operators across Europe. The European 3G UMTS standard provides for Internet access rates of 2 Mbps for stationary phones, 344 Kbps for a person walking and 144 Kbps in a moving vehicle. These data transmission rates are comparable with many existing DSL and cable broadband offerings.

2.2.4. Fixed Wireless Access and Free of Space

Fixed Wireless Access (FWA) and Free Of Space (FOS) are wireless solutions that transmit data signals through radio spectrum and laser, respectively, with transmission speeds between 2 to 40 Mbps for FWA, and up to 1 Gbps for FOS. Both technologies require a line of sight connection between the sender and the receiver and may suffer from distortions and disruptions because of atmospheric conditions. Therefore, their primary use is most likely to be for small-medium enterprises in suburban areas, as a cost-effective alternative to the deployment of cable or copper pair links.

3. Relevant market definition issues

Antitrust markets are typically defined along two dimensions: product and geographical scope. In the case of Internet access, the latter definition seems more troublesome. In fact, in all antitrust and merger cases involving Internet access, the European Commission ruled that the geographical boundaries had to be held national, due to the need for wire infrastructures such as local loop or cable. However, in the *Vodafone/Vivendi/Canal Plus* merger decision the European Commission recognised that with the use of mobile telephones to access the Internet, relevant markets may become Europe-wide in scope.[54]

As regards product market definition, several criteria have been applied by the European Commission thus far. In what follows we will discuss them briefly.

3.1. Low speed vs high speed Internet access (narrow-band vs broad-band)

The distinction between broadband and narrowband Internet access builds upon different uses and technical performances. Although both types of access in principle allow the same basic range of uses (e.g. e-mail, information sources, navigation, chatting, downloading), some high-speed uses are possible with low speed access only under extremely dissuasive conditions that entail losses in quality and convenience. In fact, audio-visual delivery, both in download and streaming modes, is accessible only through broadband connections to the Internet. Some important differences also emerge with respect to the way users exploit their connections. Broadband Internet access subscribers connect more frequently and for longer sessions to the Internet and use their greater bandwidth for audio-visual applications mostly. Another difference in use relates to the always-on feature of high-speed access that allows users to make calls while connected to the Internet.

As regards technical differences in performance, there is no standard threshold between low-speed and high-speed Internet access. However, a broad consensus has been reached over what is meant for high-speed access: a connection mode that allows a speed of download appreciably greater than that made possible by ISDN technology (128 Kbps). On the basis of this definition, narrowband services refer only to dial-up Internet access over the copper local loop.

[54] See Dec. 03/12/EC *Vodafone/Vivendi/Canal Plus*, OJ (2003) C 118 at par. 37.

The differences in use and technical performance reflect into price levels. A consistent comparison should be based on un-metered offerings, if available, since unlimited flat-rate low-speed Internet access appears to be the closest substitute to un-metered high-speed Internet access.[55] In *Wanadoo Interactive*, the European Commission argued that "in the period from January 2001 to October 2002, high-speed Internet access offerings for residential customers were approximately twice as expensive as low-speed access offerings" (par. 190).

Although not conclusive, these differences lead to the definition of two distinct relevant market, one for high-speed Internet access services, the other for low-speed Internet access services. This distinction was confirmed by a quantitative analysis carried out by the European Commission in *Wanadoo Interactive* (see Box 3).

Box 3 – SSNIP test using survey data

In the *Wanadoo Interactive*, the European Commission carried out a survey among a representative sample of French residential subscribers of high-speed packages in order to assess their reactions to a 10% increase in high-speed subscription price.[56] The evidence collected was used to estimate the loss of sales that an hypothetical monopolist would face as a consequence of the price increase, so as to assess whether the price increase would be profitable.[57] As it is well known, this would be the case if the sum of the extra-revenue earned from retained customers and the marginal cost saved from lost sales outweigh the revenue lost from customers who substitute away from the service as a result of the price rise. In order to make such an assessment, the European Commission compared the actual loss of sales with the critical loss. The critical loss is the percentage reduction in demand for which the SSNIP leaves profits unaffected. A loss in demand larger than the critical loss makes the SSNIP unprofitable. Assuming constant marginal cost, c:

$$\pi_1 - \pi_0 = p_1 q_1 - p_0 q_0 - c(q_1 - q_0); \quad (1)$$

with $p_1 = p_0 (1 + s)$, where s is the size of the SSNIP; $q_1 = q_0 (1 + L)$, where L<0 is the percentage loss of demand; $c = \alpha p_0$. By substituting these definitions in (1), specifying

[55] In *Deutsche Telekom AG*, the EU Commission noted that no flat-rate low-speed package was available in Germany at that time (par. 75).

[56] The appropriate benchmark price, to which the hypothetical price increment is applied, should be the competitive price. The European Commission working assumption was that "current prevailing prices [were] set at competitive level. If, however, a service or product is offered at a regulated, cost-based price, then such price is presumed, in the absence of indications to the contrary, to be set at what would otherwise be a competitive level" (European Commission, 2002a at par.42).

[57] This procedure in known as SSNIP (*Small but Significant Non-transitory Increase in Price*) test, see; Motta (2004), ch. 3. Note, however, that it is questionable whether the SSNIP test assuming as a benchmark current prevailing prices is applicable in antitrust allegation of predation. If current prevailing prices are below the prices that would prevail under undistorted competitive conditions, there would be the risk of a too narrow market definition.

$\pi_1 - \pi_0 = 0$and rearranging we obtain the critical loss:

$$L = -\frac{s}{1+s-\alpha} \qquad (2)$$

To substitute for marginal costs the European Commission opted for a figure of recurrent variable costs and considered the lost margins up to these costs. From the survey, it emerged that 80% of subscribers would keep their high-speed Internet subscriptions in response to a 10% price increase, 7% would cancel all Internet connections and 13% would switch to low speed Internet access. The always-on feature and the speed of connection were the most cited reasons for keeping high-speed connections in spite of the price increase. The actual loss that Wanadoo would have suffered in case of a SSNIP was calculated to be 20%. Therefore, given the margin level on recurring variable cost, a 10% SSNIP would prove to be profitable (par. 199).
The Commission did not give the percentage figure of the critical sale loss applicable to the case at hand. Instead, it indicated the percentage figure of the critical margin level (40%) above which a 20% actual loss would have made a 10% SSNIP unprofitable. In terms of equation (2), posing $L = 20\%$ and solving for α we obtain $\alpha = 60\%$, where $\alpha = 1 - \pi$ and $\pi = 40\%$ is the critical margin level. In order to go back to the critical sale loss L we need the actual percentage figure of the margin level π. The Commission gave the absolute margin levels for the two alternative residential broadband Internet access products that Wanadoo was selling in 2001. These absolute margins corresponded exactly to a percentage figure of 10%. Therefore, posing $\alpha = 1 - \pi = 1 - 10\% = 90\%$, and solving equation (2) for L, we obtain a critical sales loss threshold of 50%, which is greater than the actual sale loss of 20%.
(
The survey confirmed a strong asymmetry in the diversion ratios between the two access services: a significant migration exists from low-speed Internet access to high-speed Internet access (in the case of worsening relative prices from the point of view of low-speed subscribers), but not the vice versa (par. 194-195). A similar analysis had been conducted by Ofcom in a survey regarding customer behaviour in the Internet market[58]. It emerged that over four out of five (80%) residential broadband consumers claimed that they would continue to use a broadband package in response to a 10% hypothetical price increase, while 1 out of 10 (10%) thought they would switch to narrowband. Thus, a 10% SSNIP would cause a loss of sales of at most 15%. On the basis of ADSL marginal cost and average retail price estimates, Ofcom assessed that a 10% SSNIP would give rise to a critical loss of between 18,5% and 29,4%.

These pieces of evidence suggest that low-speed and high-speed Internet access form two separate relevant markets. However, some cautions has to be made owing to possible shortcomings of the survey methodology. First, there is a consensus that, when asked hypothetical questions, customers tend to overestimate the extend to which they will take actions. Therefore, consumer survey evidence on the likely amount of sale lost in response to a SSNIP may be useful in providing an indication of the maximum likely loss. Moreover, the foreseeable downward trend in broadband retail prices (due to

[58] Ofcom opted for directly calculating the marginal costs of supplying retail broadband Internet access services for an hypothetical vertically integrated ISP. This choice results in a conservative approach. As Ofcom stressed: “By using the estimate of a vertically integrated provider’s own marginal costs, Ofcom has adopted an approach that would be more likely to result in a broader market definition (because this approach results in lower critical values than if LLU shared access charges had been used as the basis for the marginal cost)”. See, Ofcom (2003).

decreasing upstream costs), suggests that, by surveying consumer reactions to a SSNIP at current prevailing prices, we might overestimate the resulting loss. Another shortcoming of this methodology is that it oversights the likely negative effect of a broadband SSNIP on narrowband consumers who are considering whether to upgrade their connection to broadband at current prices. Moreover, if current high-speed customers have a willingness to pay for broadband Internet access greater than potential consumers (as they have experienced its advantages), the proportion of existing consumers that switch away from broadband will be lower than the proportion of potential consumers that renounce to take broadband owing to a SSNIP in broadband Internet access.

3.2. Residential vs business Internet access

Within the broadband Internet access market an additional distinction could be made between residential and business customers. Business customers technical and performance requirements are more demanding in terms of transmission speed (in particular, upstream), web-hosting capacities, multi-terminal use, networking operation and customer service. Moreover, business customers, in particular large corporations, often ask for a tailored provision, which is not viable in mass markets, or for a more sophisticated communication service wherein Internet access is just one element of the bundle.

This performance gap translates into higher prices for business relative to residential customers (three to five times higher). Since business customers are willing to pay higher prices for Internet access, they can opt for a greater variety of solutions compared to residential consumers. Indeed, leased lines (dedicated access) and wireless platforms have not been viable options to residential customers so far, whereas they are currently available to business clients.

To date, the European Commission has always argued for two distinct relevant markets for residential and business Internet access. A different approach has been taken by Ofcom, which in its review of the broadband Internet access market made a case for a unique relevant market comprising both residential and business Internet access services.[59]

According to Ofcom, the forward looking approach in market definition of the new regulatory framework entails a strong emphasis on foreseeable technical and market dynamics. These dynamics suggest that residential customers might become even more demanding in terms of service levels and speed of access. This would be supported by both the increasingly widespread awareness among residential customers of the advantages of broadband, and the development of content and services tailored to broadband delivery platforms. In this scenario,

[59] See Ofcom (2004).

new residential products are likely to be launched with quality levels closer to actual business packages. Therefore, Ofcom argued that a chain of substitution on the demand side may arise between residential and business segments. This would imply that an hypothetical monopolist in the supply of residential Internet access would not profitably sustain prices above competitive levels because sufficient numbers of residential customers would switch to competitively lower-priced business products (assuming that in both segments prices are at competitive levels).

3.3. Intra-platform vs. inter-platform competition (access based vs. facility based competition)

In this section, the analysis of the distinction between intra-platform and inter-platform competition in Internet access provision is limited to antitrust market definition, leaving aside the broader issue of the desirability of promoting competition between platforms running significantly different technologies.

From a demand side point of view, inter-platform competition requires retail Internet access packages delivered over different platforms to be perceived by end-users as close substitutes. Demand side substitutability suggests that fixed networks (copper loop, cable drop and fibre optic, PLC) should be part of the same antitrust market, whereas mobile networks belong to a different market. This distinction is based on the fact that, currently, mobile solutions make only a fraction of the Internet accessible. Moreover, accessibility and interactivity is constrained by the lack of a full size screen and a keyboard on mobile handsets.

An exception may be provided by WiFi, which is somewhat an hybrid solution. However, the European Commission has so far deemed this solution as a potential substitute to xDSL and cable for business customers only, because of prohibitive installation costs for residential customers.[60]

Within fixed platforms, the European Commission has recently changed its view. In *Vodafone/Vivendi/Canal Plus* (July 2000), it argued that cable was a distinct market from Internet access through the copper pair, because "both the demand-substitutability test and differences in the characteristics of interactive services that can be delivered via television sets and via personal computers, lead to the conclusion that they constitute separate access markets (par. 33)". On the contrary, in *Wanadoo Interactive* (July 2003) the European Commission affirmed that "it was apparent that, on the demand side, substitutability between these different offerings was sufficient to justify their inclusion within the same service market here (par. 170)".

[60] See *Wanadoo Interactive* at par. 171 and *Deutsche Telekom* at par. 85.

From a supply side point of view, inter-platform competition implies actual comparability in terms of geographic coverage and penetration provided by competing platforms and of the degree of consolidation of the network's proprietary structure. The European Commission has stressed these last requirements in the DT case, where it argued that "broadband cable services are not a substitute for ADSL access services, because the cable distribution network is still extremely fragmented. […] There are over 100 commercial level-4 operators active in Germany at present, so that an Internet service provider would have to conclude a great number of distribution agreements with these operators in order to achieve a coverage comparable to that of DT's network (par. 88)."

3.4. Wholesale vs retail Internet access

In principle the definition of relevant markets at the retail level logically precedes that of wholesale markets, because the demand for wholesale services is derived from the demand for retail services. Therefore, once the market boundaries at the retail level have been outlined, the starting point for defining market at the wholesale level should be to consider a candidate market at least as broad as the demand side substitutes at the retail level.

Among the alternative platforms deployed to deliver retail Internet access services, only the copper pair local loop is available at the wholesale level. This availability is due to the introduction of regulatory requirements for unbundling of the local loop (LLU) in European Member States. In general, it is not clear whether suppliers of copper loops or potential substitutes would actually make Internet access products available at the wholesale level absent a mandatory requirement. As a matter of fact, in all the other platforms it is customary that vertically integrated operators self-supply network access to deliver retail Internet access and do not provide voluntarily unbundled Internet access at the wholesale level to downstream competitors (in particular, integrated cable operators).

The reasons for this asymmetrical treatment go beyond the focus of antitrust market definition. However, this circumstance suggests the wholesale Internet access market to be limited to the copper pair, because alternative platforms, which may be substitutes at the retail level, are actually not substitute at the wholesale level for their supply unavailability. Therefore, the wholesale Internet access market should be framed within the concept of intra-platform competition. The European Commission has applied this framework when defining Internet access service market at the wholesale level (see both *Wanadoo Interactive* and *Deutsche Telekom AG*).

A reason in favour of a broader market definition would be the presence of indirect substitution effects at the wholesale level exerted by vertically integrated suppliers whose Internet access services are effective substitutes at the retail level.

The ability of end users to switch to an Internet access competing package provided by a vertically integrated supplier (inter-platform competition), may constrain the pricing conduct of an hypothetical monopoly wholesale supplier of loop-based Internet access.[61]

As regards the distinction between residential and business markets at the wholesale level, if the wholesale component used in the provision of the two access services at the retail level is the same, there should not be separate wholesale markets for residential and business use. However, while for intra-platform competition (copper pair local loop) this statement is correct, in an inter-platform competition framework, as long as competing platforms such as leased lines, satellite and mobile are not likely substitutes for residential use at the retail level, residential and business market should be kept separate also at the wholesale level.

In respect to the narrowband/broadband criterion, the analysis is necessarily framed in terms of intra-platform competition, as the copper pair local loop is the sole platform over which low-speed Internet access is delivered. In this regard, it is essential to look at the ways wholesale access is made accessible to downstream not vertically integrated ISPs (or, equivalently, OLOs – Other Licensed Operators). If a wholesale supplier delivers this essential input only through LLU, then the wholesale local access market cannot be further subdivided into narrowband and broadband services, as OLOs have to purchase the all bandwidth in the local loop, whatever service they may want to deliver at the retail level.[62] On the contrary, if it is possible to purchase and make use of limited portion of the disposable bandwidththrough line sharing, bit-stream access and resale of end-to-end low-speed packages, the definition of two distinct wholesale Internet access markets might be warranted.

With respect to this last point, the available wholesale alternative solutions over the local loop are (Figure 1):

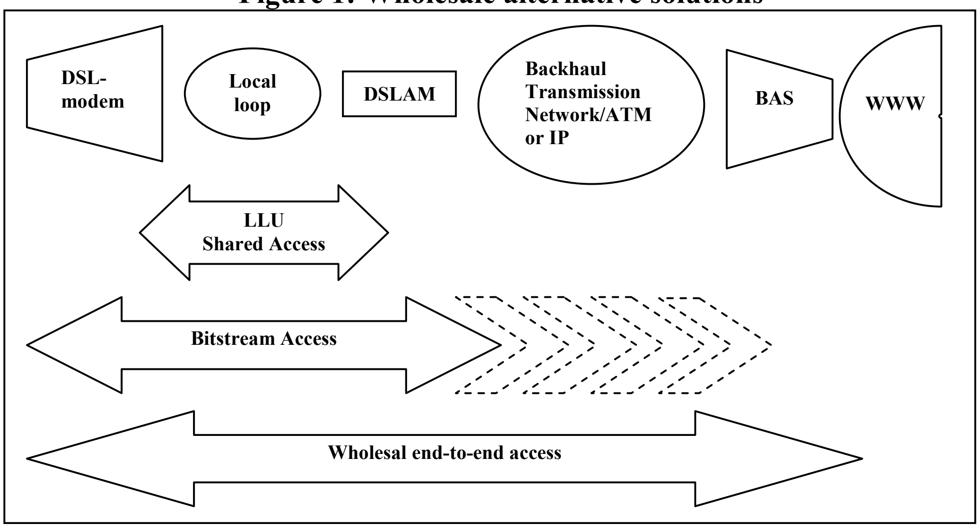
i) *Fully unbundled lines (LLU)*: LLU entails taking the copper pair between a local exchange to an end customer and passing over use from the incumbent to the competitor. In this case, rival ISPs need to provide equipment both at the end user premises (a DSL modem) and at the local exchange (a digital subscriber line multiplexer - DSLAM).

ii) *Shared lines*: in line sharing, by splitting the local loop, the new entrant provides broadband services using high frequencies, while the incumbent

[61] Ofcom has applied this argument in its review of the wholesale broadband Internet access market by comprising cable platform as an indirect substitute to ADSL-based broadband wholesale access products. See Ofcom (2004), at par. 3.64-3.65.
[62] This was the case in the DT decision (par. 67).

continues carrying on telephony services over low frequencies. This solution enables to overcome the likely customer inertia entailed in LLU due to its requirement to switch both voice telephony and broadband provider. As for LLU, alternative service providers have to provide necessary equipments at the extremes of the copper pair.

Figure 1: Wholesale alternative solutions



iii) *Bitstream access*: the incumbent provides OLOs with transmission capacity from an handover point to end-users premises. According to where the handover point is placed, there are different bitstream options, from the most basic whereby the incumbent hands over the bitstream directly after the DSLAM, to the most vertically-integrated option, whereby the incumbent provides the DSL access link plus a backhaul service and hands over the bitstream to the OLO at its IP-POP (which is technically operated over a broadband access service – BAS). The more far to the right (Figure 1) is the handover point, the lower the up-front investment for the new entrant to be present at the DSLAM level.[63] Bitstream access can vary according to the bandwidth and the level of reliability provided. This wholesale service allows new entrants to differentiate their packages by offering their own value added features to clients.

iv) *Simple resale*: in this case the competitor is a reseller of a product that is commercially similar to that of the incumbent. This solution covers the local loop access network and the regional backhaul transmission network,

[63] See ERG (2003).

in order to convey customer traffic to the BAS, which is the gateway where the traffic is passed over to the client ISP. Therefore, the ISP presides sales activities of customer acquisition and marketing, customer support, billing and credit control. This solution is not a substitute for the previous ones, since it does not enable competitors to differentiate their offerings from those of the incumbents. On the other hand, this solution implies relative small start up investment and, thus, it represents the less risky entry strategy.

The first two wholesale services are facility-based solutions, whereby new entrants have discretion as regards most technical choices about the equipment used. The last two are service-based solutions. Facility-based wholesale access enables a strong differentiation of service features at the retail level. Even though also bitstream access enables some sort of differentiation, its scope is inevitably limited when compared to that of the first two solutions. On the other hand, a new entrant opting for a facility-based solution runs the risk of being stranded with technical solutions which might be subject to rapid technological obsolescence.

Technical obsolescence is not the only source of uncertainty in opting for a facility-based wholesale solution when implementing an entry strategy in the Internet access market. There might be a strategic source of uncertainty in that the incumbent would try to foreclose potential competition, or at least to raise rival costs by hindering the delivery of this essential upstream input, or pricing it unfairly to downstream competitors.

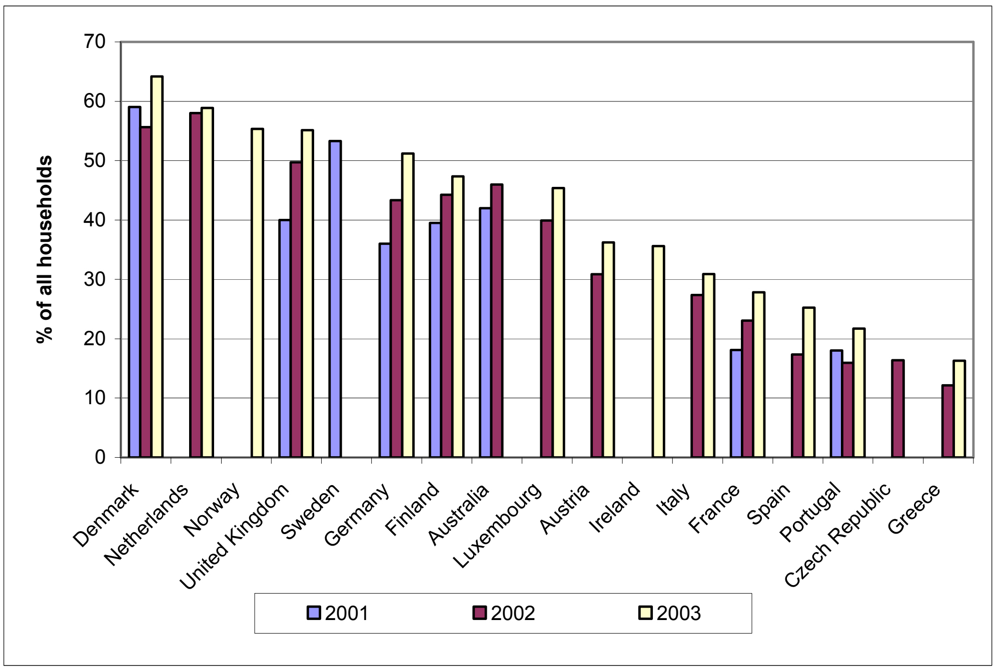
4. Markets structure

This section presents the current market landscape. Notwithstanding the impressive variety of alternative platforms mentioned in the previous sections, the current market situation is far more simple to describe: DSL plays the role of the undisputed leading technology across Europe, with cable representing an effective alternative in few countries (e.g. Austria, Portugal, Belgium and the UK). Thus, in many countries the analysis would be best framed in terms of intra-platform competition and, consequently, in term of viable wholesale services to promote access-based competition. In this regard, a very recent upsurge in the diffusion of facility-based wholesale solutions may herald stronger and deeper competition in several countries and wider Internet access diffusion across the population, particularly in terms of broadband penetration.

4.1. Overall broadband penetration and platform competition across Member States (MSs)

The diffusion of Internet access across Europe is not uniform. As illustrated in Table 2 (page 113) and the corresponding Figure 2, Internet access diffusion in the residential segment, measured as a percentage of all households, ranges from 64,3% in Denmark to16,3% in Greece.

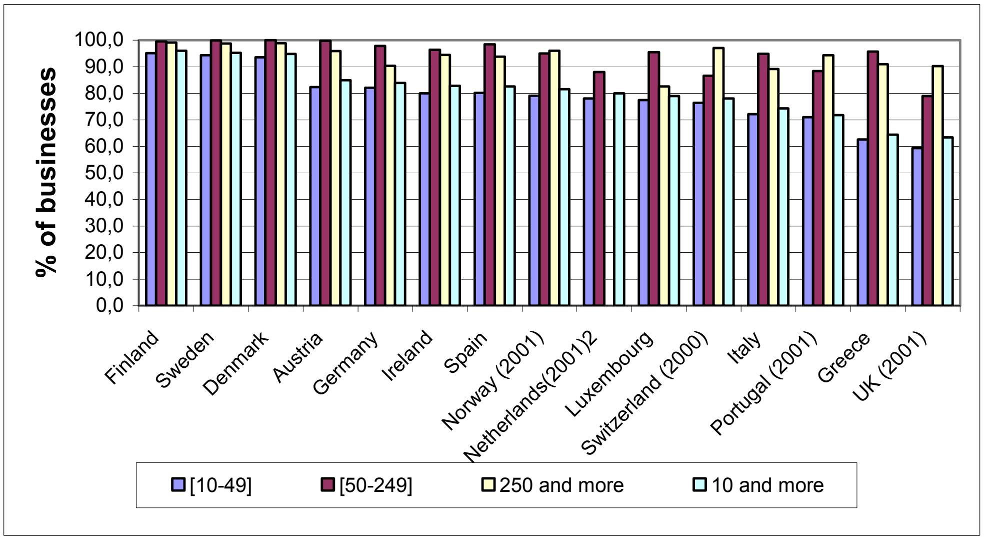
Figure 2: **Households with access to the Internet**



Source OECD

On the contrary, in the business segment Internet access is more uniformly distributed among MSs, in particular with respect to large companies. (Table 3 – page 114 - and Figure 3).

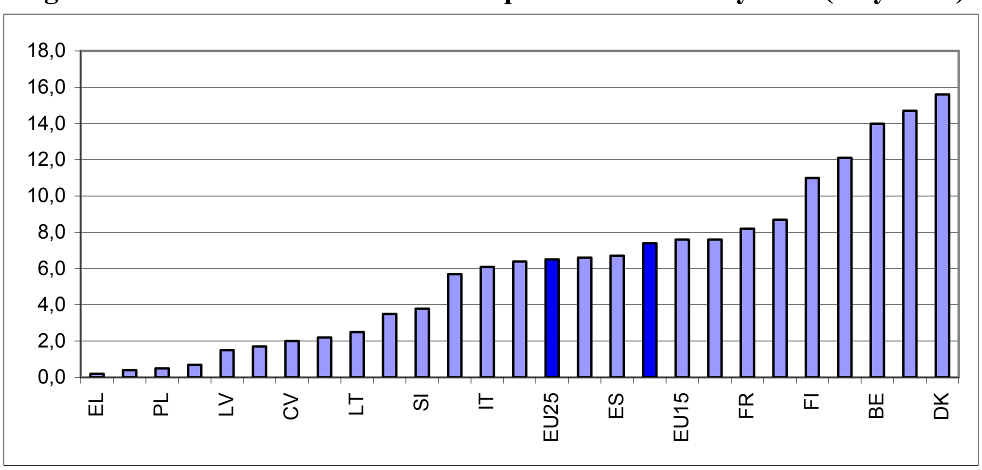
Figure 3: Business with access to the Internet (by number of employees)



Source OECD

As regard the diffusion of broadband Internet access, the broadband penetration rate, measured as a percentage of the population with a broadband access, also varies widely across EU MSs, ranging from 0,2% in Greece to 16% in Denmark (Figure 4). On average, the current penetration rate is 6,5% in EU25 and 7,6% in EU15.

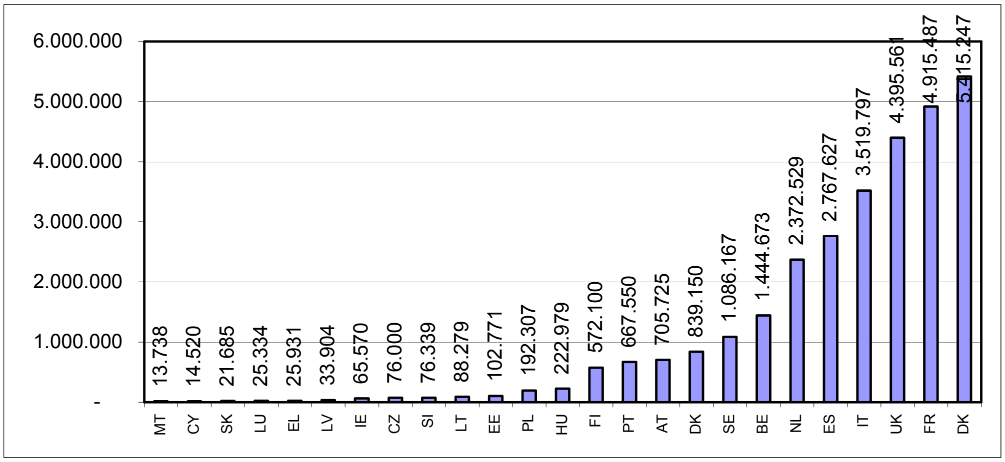
Figure 4: EU25 Fixed broadband penetration rate by MSs (July 2004)



ource EITO 2004

In 2004, there were roughly 29,6 million broadband fixed connections across EU25 (Figure 5). However, almost 80% of these connections were deployed in six MSs only (Belgium, Netherlands, Spain, Italy, UK and France).

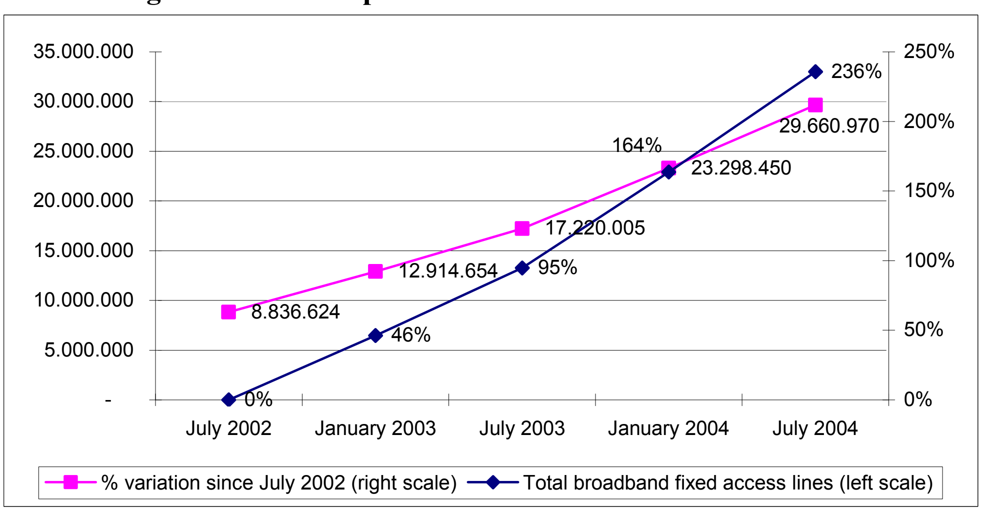
Figure 5: European fixed broadband lines by MSs (July 2004)



Source EITO 2004

From a dynamic perspective, broadband Internet access has exhibited a steady strong growth rate in recent years, rising by more that 72% in 2004 (Figure 6).

Figure 6: European total broadband fixed access lines

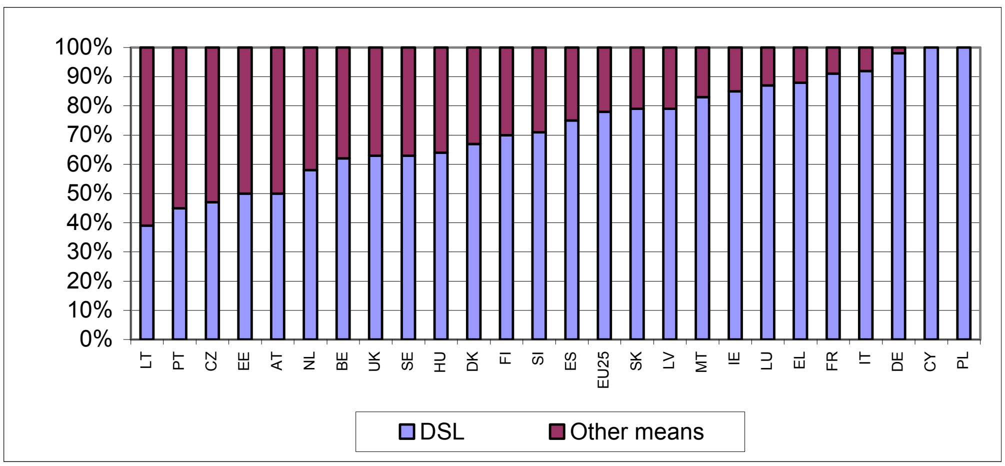


Source EITO 2004

4.2. Inter-platform and intra-platform competition and wholesale unbundling of the local loop

As regards competing Internet access platforms, the leading technology is by far DSL, owing to the ubiquitous reach of PSTN. DSL accounted for 78% of the total EU25 broadband connections in July 2004 (73% in July 2003). Of the other available technologies, the main competing platform is cable which, in 2004, reached 22% (Figure 7). However, the success of cable as an alternative platform requires the upgrading of existent cable infrastructure.[64] Other alternative broadband technologies have negligible penetration rates, apart from some exceptional circumstances, notably FTTH in Italy and in Sweden.[65]

Figure 7: Total fixed broadband retail lines by technology (July 2004)



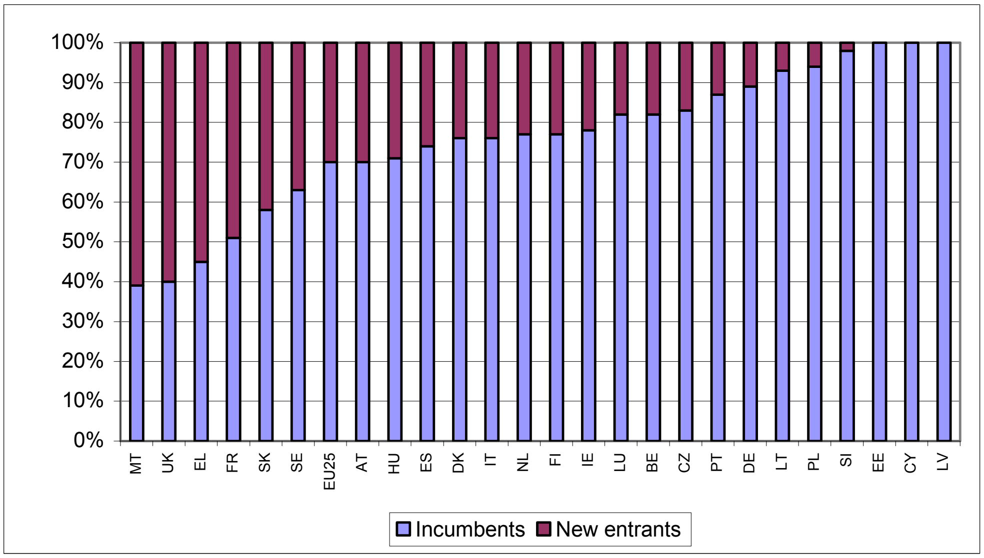
Source EITO 2004

Since competition is mostly within the DSL platform, the key figure is the incumbent market share on the DSL retail market (Figure 8). At the EU25 level, in 2004 fixed incumbent operators detain 70% of the retail DSL segment, down from 78% in July 2003. Relative to the overall residential broadband segment, the average incumbent market share has fallen from 58,7% in July 2003 to 56,4% in July 2004.

64 For example, cable broadband penetration in Germany is negligible, despite extensive cable infrastructure. This reflects the failure of domestic companies to invest in upgrading the infrastructure, which in turn can be linked to the unusual ownership structure and regulatory obstacles to industry consolidation (See Maldoom et al., 2003).

65 See Maldoom et al. (2003).

Figure 8: DSL retail market share by operator (July 2004)



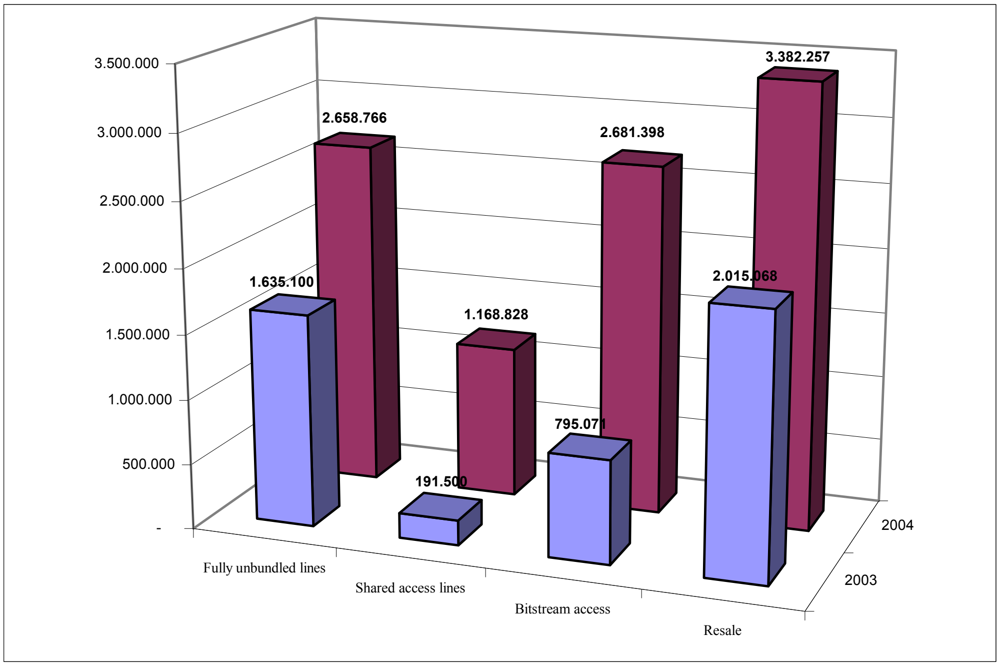
Source EITO 2004

New entrants penetration capability depends on the availability of wholesale access solutions. Figure 9 shows the recent evolution in adoption of the four wholesale Internet access services across Europe. Even though service-based wholesale solutions (bitstream access and resale) are still the most used by new entrants (61% of the new entrants DSL lines in July 2004), there has been a recent impressive upsurge in the use of facility-based wholesale access (110% increase, from 1,8 million in July 2003 to 3,8 million in July 2004, with shared access increasing by 505%).[66]

Prices for wholesale unbundling of the local loop have decreased over the year: the average EU15 price for LLU (monthly rental plus 1/12 of the yearly connection fee) have fallen by 3% to 16,70 euro; the average EU15 charge for shared access has dropped by 21% to 9,01 euro

[66] However, not all the fully unbundled lines are used for delivering Internet access services.

Figure 9: Availability of wholesale access in the Europe (July 2004)



Source EITO 2004

This is particularly worth noting, since the European experience with wholesale unbundling of the local loop had been quite disappointing until this recent turnaround. Indeed, at the end of 2002, there were just 900.000 fully unbundled lines on a Europe-wide basis, and shared access was even less developed.

This dismal result in the adoption of wholesale unbundling of the local loop imposes to reconsider public policies aimed at promoting the adoption of broadband technologies through enhanced competition.[67] In this respect, a main issue is whether competition should be introduced and promoted between different technological platforms through investment subsidies or tax reductions (inter-platform competition), or within the same platform through telecom markets openness and compulsory access to essential network infrastructures (intra-platform competition).[68]

Advocates of the superiority of inter-platform competition argued that broadband diffusion uptake has been faster in those MSs where cable infrastructure was sufficiently deployed and upgraded (e.g. Belgium, Denmark, Austria and

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[67] See OECD, (2001, 2002b, 2003).

[68] For an argument in favour of inter-platform competition, see Maldoom et al. (2003). For a theoretical model empirically tested supporting inter-platform competition as the most effective policy, see Distaso et al., (2004).

Sweden). On the contrary, in those MSs where DSL was the dominant platform, broadband penetration has been disappointingly slower (e.g. Italy, France and Germany). The slow adoption of wholesale unbundling of the local loop was regarded as supporting evidence to this argument.

However, the existence of regulatory requirements that mandate incumbent telecom carriers to provide competing ISPs with LLU does not *per se* entail the achievement of an industry setting promoting intra-platform competition in the DSL segment. As it will be cleared in the following section, incumbents might well hinder the adoption of LLU, regardless mandatory regulations.

Indeed, LLU is a cumbersome process wherein cooperation between incumbents and competing ISPs is essential. Moreover, the issue of access pricing to the local loop is all but a plain one, in that despite the regulatory requirement of fair pricing, incumbent have sufficient discretion to pursue anticompetitive strategies, such as predatory pricing and margin squeezing. The recent decisions by the European Commission[69] expressively dealt with anticompetitive practices of this sort. This is to say that the disappointing results of wholesale LLU, and its recent upsurge, may be correlated to a lack of intra-platform competition (due to strategic foreclosing practices adopted by incumbents) rather than to its ineffectiveness in promoting broadband diffusion.[70]

5. Competitive concerns

5.1. Abuse of dominance – exclusionary pricing

This section describes the main anticompetitive concerns that may arise or have already arisen in the Internet access service market, and the approach set forth by the European Commission to deal with them. Our departing point will be the competitive assessments made by the Commission in *Wanadoo Intercative* and *Deutsche Telekom AG*. In both cases the Commission ended up in declaring that the incumbent's pricing practice for Internet access services was abusive within the meaning of art. 82(a) of the EC Treaty. Particularly, the Commission argued for the exclusionary purpose of these practices, claiming that the incumbents were aiming at foreclosing new entrants from gaining a viable foothold into the retail high-speed Internet access market.

For a pricing strategy to be deemed as exclusionary it is necessary that a vertically integrated firm (the telecom incumbent), with substantial market power in the

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[69] *Wanadoo* and *Deutsche Telekom AG*.

[70] In particular France is a worth noting case. Broadband penetration has risen from 4,05% in July 2003 to 8,24% in July 2004. This increase has been primarily driven by intra-platform competition in the DSL market based on shared access and bitstream access.

provision of an essential upstream input (wholesale Internet access over the PSTN platform),[71] prices it, and/or its downstream service (Internet access service), so as to severely undermine the capability of an equal or more efficient downstream rival to remain in the market, thus preventing him from recovering reasonable profits for a sufficiently long period of time. This definition makes clear that the key element is the downstream margin and its impact on downstream entry and exit, rather than the price level of the upstream input *per se*.

5.1.1. Predatory pricing

A vertically integrated dominant player could leverage its market power to adversely manipulate a rival's downstream margin by increasing its upstream price, lowering its downstream price, or both. A relevant distinction hinges on the ability of the downstream operator to discretionally fix the price of the upstream input.[72] If the vertically integrated firm is cost regulated upstream (as it is the case for regulatory LLU), it would incur into losses if it decided to lower its downstream price below the joint costs of upstream and downstream operations plus a reasonable margin (thus, below the price level that would prevail under competitive conditions).[73] This would amount to a predatory pricing strategy.[74] Formally, predation occurs if

$$p^d - p^u - c_d \leq m; \text{ when } p^u = c_u; \quad (2)$$

where p^d is the downstream (retail) price; p^u is the upstream (wholesale) price; c_d is the downstream cost; c_u is the upstream cost; and m the (absolute) "normal" margin.

The chart below (Figure 10) provides a synopsis of an ISP's downstream and upstream costs, the latter being related to the provision of Internet access by means of LLU.

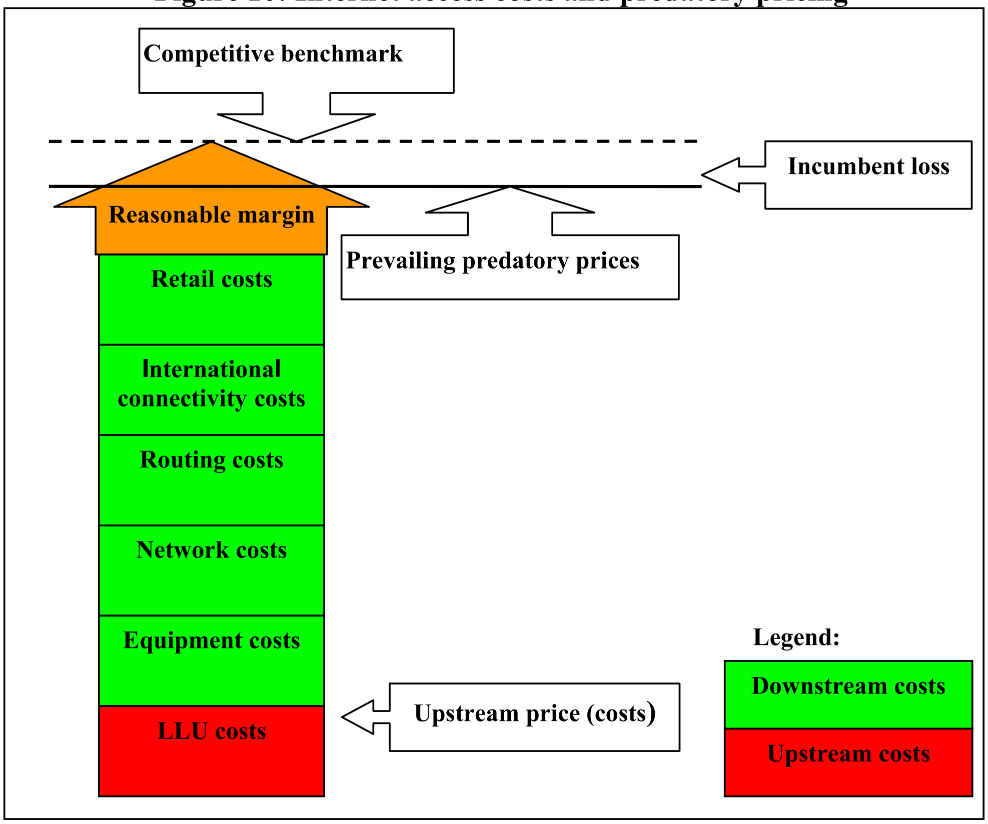
[71] The wholesale provision could take the form of either ULL, shared access, bitstream access or resale of end-to-end access.

[72] A further distinction depends on whether the upstream input price can be discriminated, that is, whether the vertically integrated firm can charge its downstream competitors a price higher than that charged to its own downstream division.

[73] This scenario implicitly assumes that the vertically integrated operator has control over downstream prices, that is, it is dominant also in the downstream market. In both the Wanadoo and the DT cases the Commission has assessed the dominance of the incumbents both upstream and downstream.

[74] *See* Bouckaert and Verboven (2003).

Figure 10: Internet access costs and predatory pricing



Upstream costs derive from the following services:

i) Services used by incumbents and OLOs in equal proportions (e.g. loop rental and maintenance);

ii) Services used by incumbents and OLOs in different proportions, due to operational conditions and scale of output (co-location services: site space, energy, security);

iii) Services used exclusively by OLOs (on-site assistance to OLOs' personnel).

Downstream costs derive from elementary activities developed and used on their own by incumbents and OLOs to provide their respective final services (e.g. exclusive use of some network equipment and segments, or commercial activities). These costs include:

i) Equipment costs to set up a broadband link from the end user's premises to the local exchange (a DSL modem at the end user's premises and a DSLAM at the local exchange);

ii) Network costs to provide transmission capacity from the DSLAM up to the BAS (backhaul service);

iii) Routing costs to convey traffic from BASs to a central site which acts as a service platform for Internet access subscribers (interconnection to the Internet backbone);

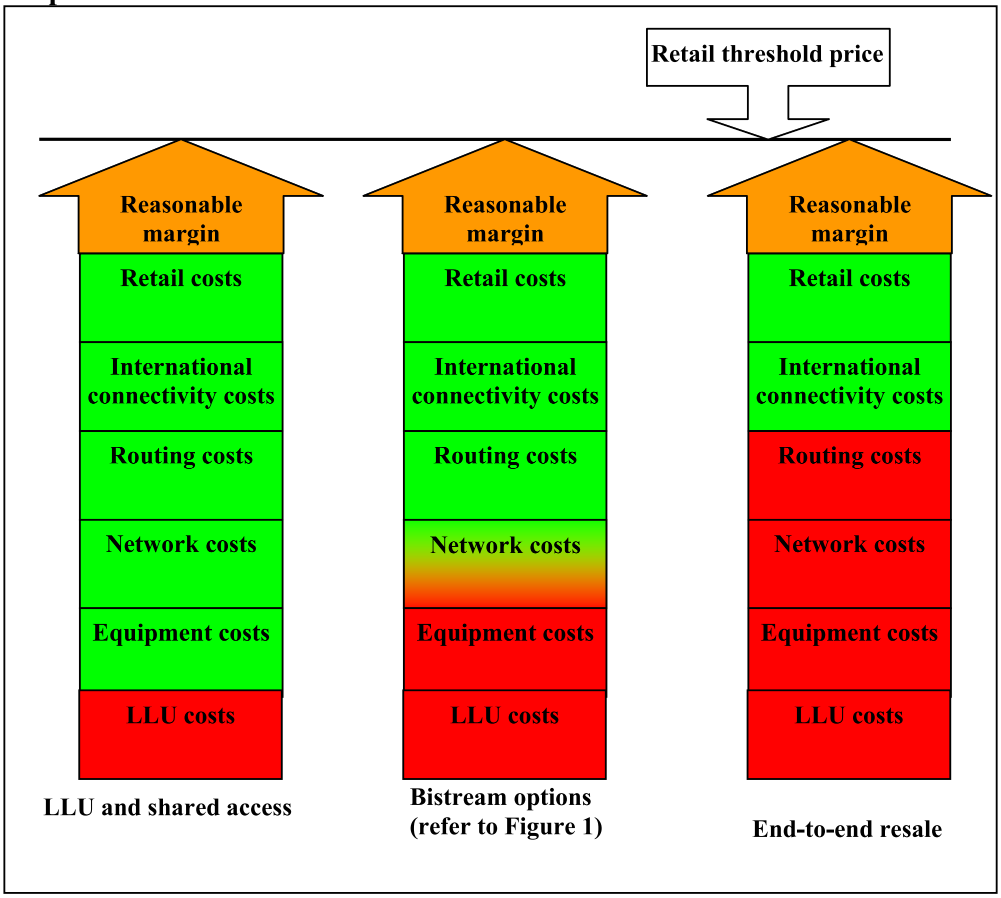
iv) International connectivity costs, due to the need to connect end users to the WWW;

v) Retail costs, which refer to customer acquisition, support and billing activities.

Some downstream services can be either developed by OLOs or purchased from incumbents. The most important example is the use of backhaul facilities to link the co-location site to an OLO's network. Indeed, this service constitutes a bottleneck whenever the OLO's initial traffic volume makes establishing an alternative link inefficient.

The subdivision between upstream and downstream costs changes with the specific wholesale solution concerned: LLU, shared access, bitstream and resale (Figure 11). However, in the case of predatory pricing this distinction is of poor relevance, as all wholesale prices are presumed to be cost-oriented and, consequently, the threshold price level (below which retail prices are found to be predatory) will be the same whichever wholesale solution is actually concerned.

Figure 11: Downstream costs with alternative wholesale solutions and predation



5.1.2. Margin squeeze

When a vertically integrated firm can price the upstream input to competitors discretionally, the exclusionary practice might take the form of a margin squeezing. In a margin squeeze the incumbent charges its downstream competitors such an high upstream price to deny them to make a margin sufficient to operate viably.[75] Formally, let

[75] While in the case of predation the vertical integrated dominant firm is necessarily dominant in the downstream market too, for margin squeeze to occur it may suffice upstream dominance. In this regard, *see* Crocioni and Veljanovsky (2003) and Motta and Streel (2003). For an argument in favour of dominance both upstream and downstream, *see* Faull and Nikpay (1999) and Bellamy and Child (2001).

$$p^d - p^u - c_d \leq m; \qquad (1)$$

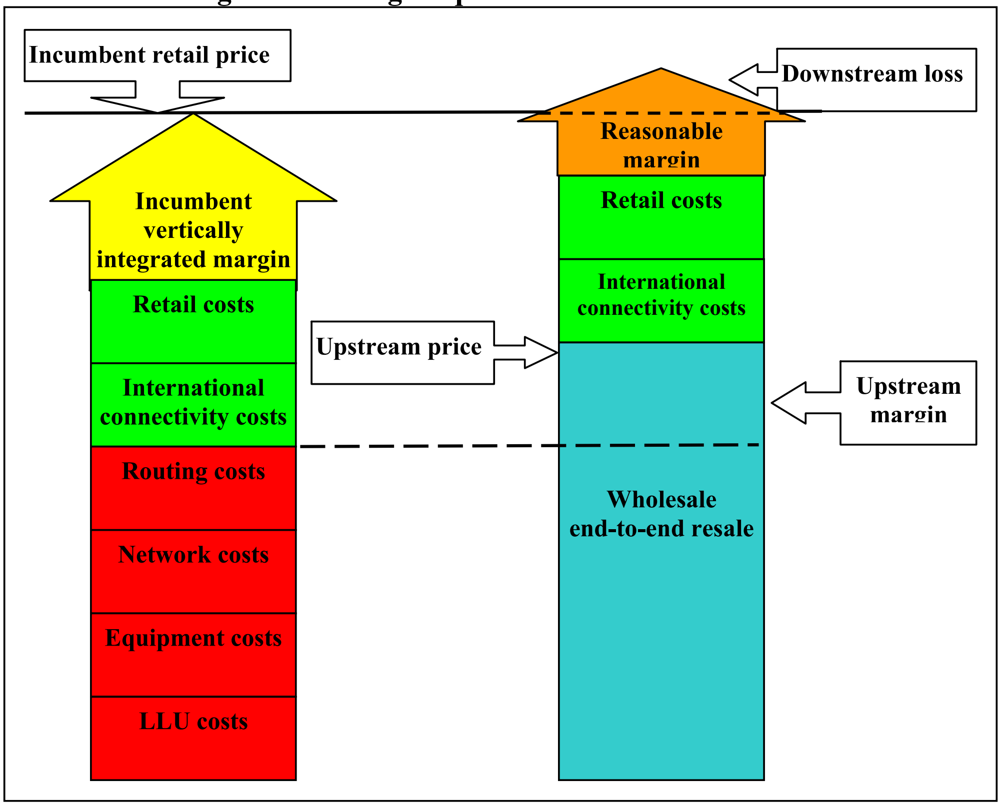
p^d be the downstream price, p^u the price of the upstream input, c_d the downstream cost and m a reasonable unit net margin.[76] A margin squeeze occurs if the real margin of the vertically integrated firm remains unchanged, as it would simply cross-subsidise its loss-making downstream operation from its profitable upstream division (raising-rival-costs strategy). However, there is a source of ambiguity in that downstream rivals are also upstream customers. A vertically integrated dominant firm might lose more by losing upstream customers than it could gain as a result of their withdrawal from the downstream market.[77]

When the exclusionary pricing practice takes the form of a margin squeeze, it is essential to discriminate among different wholesale alternatives (LLU, shared access, bistream and resale) in order to correctly identify the incumbent upstream margins that would subsidize downstream losses. The chart that follows (Figure 12) illustrates a case of margin squeeze where the wholesale solution concerned is resale of end-to-end Internet access (as in *Wanadoo Interactive*).

[76] Among the downstream costs an ISPs sustains in delivering Internet access to end users there are network costs (to deliver universal connectivity beyond the local loop), costs of customer acquisition, support and invoicing.

[77] King and Maddock (2002) show that if the downstream market is not perfectly competitive (firms competing *à la Cournot*), and the downstream product is homogeneous, then the vertically integrated firm, which has a monopoly over the upstream input, always has an incentive to increase the upstream input price, as its profit increase with it. However, the more differentiated the downstream product, the weaker is the incentive to price squeeze.

Figure 12: Margin squeeze with wholesale resale



Note that the incumbent's overall margin is larger than the downstream reasonable margin. While in a case of predatory pricing prevailing prices must be below the competitive benchmark (when upstream services are cost oriented), with margin squeeze prevailing prices must be at least equal or above the competitive benchmark. Therefore, with predatory pricing the incumbent's overall margin is necessary lower than the downstream reasonable margin, while with margin squeeze the former may even be larger that the latter.[78]

This aspect has significant implications for European competition law. While in some cases it is possible to frame price squeeze as an excessive price abuse in the upstream market, or as a predatory price abuse in the downstream market, there might be circumstances where neither of the two mentioned exclusionary abuses are actually in place, but the price squeeze derives from a combination of the

[78] The incumbent might even apply both exclusionary practices at the same time, by setting retail prices below the competitive benchmark and charging upstream prices above costs. In this case, while the incumbent overall margin would not be affected, OLOs' margin would be even lower that in the case of pure predatory pricing (at equal prevailing prices).

two.[79] Under such circumstances, if price squeeze cannot be challenged as an independent abuse from excessive or predatory pricing, it would be possible for the dominant firm to foreclose equal or more efficient competitors without breaching art. 82 of the EC Treaty.[80]

5.1.3. "But for" test and "consumer harm" test

The circumstance that predation is a loss-making practice should entail that in order to test for predatory pricing an assessment of whether the predator can reasonably recoup the short term losses suffered in the medium-long run, once competitors have been forced out of business, is required. Otherwise, it would be difficult to discriminate between anticompetitive and competitive pricing practices. As Baumol (2003) notes, there is "no generally effective way" of determining whether a pricing decision is a legitimate business practice or an unlawful one, in particular, in a fast changing environment.

Industrial organization theory has demonstrated that predatory pricing, that is below-cost pricing that is profit-maximizing only because of its exclusionary effect, is a plausible scenario especially where reputation and financial effects are important. Predatory pricing (which entails short-run losses) would not be profitable, or make business sense, "but for" its tendency to eliminate or lessen competition (by deterring and/or disciplining rivals).[81] We argue that the "but for" test should be regarded as a necessary but not sufficient condition for predation to occur. Otherwise, a penetration pricing strategy in an emerging market, which by its very nature is aimed at pre-empting rivals in order to gain an early leadership, would be caught as predation (assumed that a position of dominance in an emerging market does exist). Instead, a necessary and sufficient test should lead to challenge only those exclusionary practices by dominant firms that might foreclose rivals whose presence enhances consumer welfare.[82] Therefore, predation occurs in so far as it would ultimately leave consumers worse off.[83] In

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[79] For a treatment of margin squeeze as an excessive pricing abuse, *see* Motta and de Streel (2003).

[80] In *Continental Can*, the Court of Justice considered that art. 82 list of abuses was not exhaustive: "the [art. 82] is *not only* aimed at practices which may cause damage to consumers *directly*, but also at those which are detrimental to them through their impact on an effective competition structure. (par.26)" (emphasis added). Judgment of the Court of 21 February 1973, Case 6-72 *Europemballage Corporation and Continental Can Company Inc. v Commission*, ECR [1973], p. 215.

[81] *See* Vickers (2004).

[82] *See* Vickers (2004).

[83] The consumer-harm test is a necessary condition to the extent that the aim of antitrust policy is protecting consumer welfare. Otherwise, if antitrust enforcers pursue total (consumer plus producer) welfare, this test will only provide a sufficient condition, since consumer loss may be offset by producer gain. See Fox (2002).

other words, there should not be predation without exploitation.[84] Thus, for predation to occur there must be a case for recoupment of short run losses by means of consumer exploitation (excessive prices or output restriction),[85] once competitors have been successfully foreclosed. This scenario entails a facilitating market structure to exist, whereby the dominant firm enjoys a large market share and there are both entry and exit barriers. It follows that the more contestable the market, the less plausible is the recoupment scenario.[86] As Vickers (2004) puts it: "Competition to serve the needs of the general public of consumers - not some abstract notion of competition for its own sake – is the point of competition policy".

As regards margin squeeze, since this practice resembles a raising rivals' costs strategy in that it does not impose a loss to the dominant firm, the "but for" test is not significant at all. According to some school of thoughts, the same holds for the "consumer harm" test, as a practice essentially consisting of excessive pricing upstream while leaving unaffected prevailing downstream prices could not be caught under the "consumer harm" test, unless we accept to broaden the meaning of consumer harm so as to embrace harm to the competitive "process".[87] Thus, anti-consumer effects are not a necessary condition for margin squeeze to be condemned. It could be condemned as long as we accept the principle that, where market power cannot be eliminated (as it is the case with upstream monopoly of telecom incumbents), dominant firms should act *as if* constrained by competition.[88]

This line of reasoning is in full compliance with the principles emerging from European case law, according to which the dominant firm has a special responsibility not to allow its conduct to impair genuine undistorted competition. Therefore, the dominant firm cannot eliminate a competitor or strengthen its position by recourse to means other than those based on competition on the merits.[89]

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[84] See Fox (2002).

[85] On a broader interpretation output-limiting exploitation could refer to quality, or even to innovation dimensions, not just quantity. However, to assume that the exclusionary practice could lead to anti-consumer effects by means of reduced innovation dynamism in the market could be a too vague and hardly demonstrable argument, leading to unattractive protection of the competition "process" rather than consumer welfare protection. *See* Vickers (2004).

[86] See Bolton (2001).

[87] As long as the dominant firm fills in the vacuum caused by the foreclosure of rivals leaving unchanged downstream prices, there are no losses in consumer welfare resulting from the exclusionary practice. As a consequence, there is no need for a recoupment stage, contrary to predation.

[88] This principle roots back to the "ordo-liberal" school of Frieburg in the 1920s and 1930s (*See* Gerber, 1998, ch. 7; and Amato, 1997, ch.5).

[89] See, for example, Whish (2003, ch. 5).

The trickiness inherent in discerning between anticompetitive and competitive pricing practices is even more acute if we consider the difficulty in concretely modelling and applying a legal test to assess alleged pricing abuses. The ideal would be to compare prevailing prices against marginal costs. However, as it is concretely unachievable to figure out marginal cost curves, competition law enforcers must somehow proxy theoretical marginal costs. Moreover, as it will be discussed more extensively in the following Section, antitrust enforcers' discretion extend also to other hotly debated modelling choices. All in all, a trade-off arises between the administrability of the test (which points to a *per se* rule, based on a simply enforceable standard) and the soundness of its economic principles (which advocates for a concept-based test, tailored to the specific case at hand).[90]

5.2. The European Commission practice

In this section we illustrate the practice set forth by the European Commission in dealing with pricing abuses in the Internet access markets, as it emerges from *Wanadoo Interactive* and *Deutsche Telekom AG*. In light of the previous insights and the economic debate on these exclusionary practices, we critically discuss the EU approach. We first analyse when there could be a case for price squeeze in the Internet access market, or, in other words, what the examination of price squeeze necessarily implies. Then we discuss how *Wanadoo Interactive* and *Deutsche Telekom AG* have been framed with respect to the choice between predatory pricing and margin squeeze. We also discuss the European Commission's approach to the issue of recoupment as it emerges from *Wanadoo Interactive*. Finally, we discuss in detail the price squeeze test applied by the European Commission in *Wanadoo Interactive* and *Deutsche Telekom AG*; and its approach to the issue of the market-expanding efficiency defence.

5.2.1. The essentiality of the upstream input

In the context described, the assessment of an exclusionary pricing abuse entails proving the existence of a number of structural and economic conditions which must hold for a predatory pricing practice to be successful, notably: *i)* the vertically integrated firm must enjoy substantial market power in the upstream input market; *ii)* the downstream market must not be effectively competitive; *iii)* the predator must be vertically integrated; *iv)* the upstream input must be essential; *v)* the alleged predatory pricing practice must have the likely effect of foreclosing the downstream market to equally or more efficient rivals by making them unprofitable; *vi)* the last condition must endure for a sufficiently long period.[91]

[90] *See* Durand (2004) and Kovacic (2004).
[91] See Crocioni and Veljanovsky (2003).

The fourth condition is not straightforward as it appears. The "essentiality" must simultaneously exist at different levels. The upstream input must be essential to downstream competitors (no close substitutes exist for the essential input in their production process) and also to downstream competition (no close downstream substitutes that do not use that upstream input).

As regards the first requirement, the PSTN local access network is an essential facility for the provision of DSL Internet access services, since this infrastructure is not reasonably replicable by non vertically integrated ISPs. Moreover, as the copper pair local loop is used in fixed proportions in the provision of Internet access (one for one), rival ISPs cannot switch the mix of input in response to worsened terms of trade in the supply of this essential input.

The appropriateness of this analysis is confirmed by the fact that the very first regulatory requirement has been local loop unbundling. However, as explained above, there are alternatives to LLU. Service-based alternatives (bitstream access and resale) comprise other activities which are complementary to LLU (provision of equipment at the customers' premises and at the local exchange, and backhaul conveyance of Internet traffic to an Internet gateway), but which are not deemed as essential to competitors.

When an alleged predatory pricing abuse is framed around a service-based upstream solution as in *Wanadoo Interactive*, it should be previously assessed whether this commercial wholesale solution is also the most efficient solution among the available wholesale alternatives. Obviously, this is all but a trivial task, since an ISP opting for a facility based solution would face incremental sources of risks (financial, operating and technical) and, thus, would have a greater expected rate of return out of its capital investments. Therefore, under these circumstances, the reasonable margin, which triggers the legitimacy of a pricing scheme, would be higher (what is referred to as m in equation (2)). However, to utterly avoid such an assessment would be misleading, as there is the risk to unduly protect competitors who prefer to piggyback on the incumbent's infrastructure, rather than committing themselves to more entrepreneurial business models.[92]

In *Wanadoo Interactive*, the Commission omitted to assess whether rival ISPs were forbidden from choosing a wholesale solution other than resale owing to their inefficiency. Therefore, it appears that to allegedly price squeeze in the sole resale vertical value chain is a predatory practice *per se*.

Curiously, the European Commission dealt with this issue when describing entry barriers that should have supported the prospect of a recoupment of losses (See

[92] This last point assumes that facilities based solutions (LLU and shared access) are not precluded to rival ISPs.

par. 359-366). It argued that the LLU entry strategy "exposes a company, […], to obstacles which do not arise in the case of the mere retailing of the wholesale access and routing services provided by France Télécom" (par.360). The European Commission stressed that entry barriers should not be necessarily insurmountable, because of the potential risk of an over-restricting approach to entry barriers (See par. 337). This sounds well-grounded as it refers to the contestability of the retail market. However, this is not the same as to argue that the LLU solution is less efficient than resale.

In respect to the second requirement (the essentiality of downstream competition), where the relevant downstream market (Internet access) is wider than the downstream product requiring the input in question (DSL), it is unlikely for the upstream provider to leverage its upstream monopoly power downstream. However, it is firstly disputable whether alternative access platforms are effective substitutes to the local loop (intra-platform vs. inter-platform competition). Secondly, even though there were a case for inter-platform competition, the fact that rival platforms are all run by vertically integrated network operators, which have so far refused to open up their infrastructure to non vertically integrated ISPs, would leave those ISPs, which depend on the wholesale copper loop, without alternatives to this upstream input. Therefore, the copper pair local loop appears to be an essential upstream input to non vertically integrated rival ISPs.

5.2.2. Framework switching

Even though Wanadoo's exclusionary abuse was formalized as predatory pricing, there are significant elements suggesting that the margin squeeze model would better fit to the case. Actually, the European Commission implemented a "predation test" by assessing Wanadoo's net unit margins during the relevant period (from January 2001 to October 2002). This would be a consistent approach insofar as the upstream price is effectively cost-oriented, so that it would suffice to scrutinize Wanadoo's performances, as the upstream division of France Télécom selling the upstream input could not earn a profit from sales of it (wholesale Internet access). On the contrary, if the vertically integrated firm were to earn a profit from its upstream operations, it would be more consistent and proper to label this practice as margin squeeze.

In this respect, the European Commission commented that "the cumulated profits earned by FT from its wholesale services, (…) can be contrasted with Wanadoo Interactive's cumulated losses from its ADSL services between 2000 and 2002 (…)"(par. 288).[93] Moreover, the European Commission argued that FT's

[93] Moreover, the EU Commission explicitly argued that "The France Télécom group chose instead to confine the losses associated with developing high-speed access to its retailing subsidiary, thereby diverting the market growth to its advantage. (par. 312)"

wholesale tariffs were approved by the Minister for Telecommunications, and the NRA did not have veto power over this approval. Therefore, FT had sufficient margin to set tariffs on its own initiative (See par. 289).

In *Deutsche Telekom AG*, the European Commission argued that DT's abuse consisted of a margin squeeze in the retail access services to the local network (narrowband and broadband local access markets). According to that decision, DT had to set wholesale tariffs on a cost-oriented basis, which had to be authorized in advance by the NRA (par. 17). In that decision the wholesale solution concerned was LLU, which had to be uniformly priced across the board. When implementing the "margin squeeze test", the European Commission assessed the net margins of the vertically integrated undertaking as "the difference between the retail prices charged by a dominant undertaking and the wholesale prices it charges its competitors for comparable services (par. 107)". The passage that mostly reminds of the margin squeeze framework states that "to show that there is a margin squeeze [..] it has also to be shown that the undertaking subject to price regulation has the commercial discretion to avoid or end the margin squeeze on its own initiative" (par. 105).

However, DT's alleged discretion stemmed from its possibility to cross-subsidise the losses suffered in the retail access service market with positive margins earned from other downstream operations (e.g. local voice telephony service), rather than from its upstream profitable operations.

The rationale underpinning this argument drew from the fact that DT's retail tariffs fell under a price cap comprising a price adjustment guideline for a basket of services. Therefore, the European Commission argued that DT could have avoided the margin squeeze by restructuring entirely its retail tariff system on the basis of the specific costs of the individual services forming part of the basket (See par. 165).

Over the period covered by this decision two distinct price-cap systems were introduced. In the first system (1998-2001), two baskets were established, one for residential customers and the other for business customers. Each basket contained access services (standard analogue and ISDN subscriptions) and the full range of telephone products offered by DT. The European Commission argued that during this period DT could have avoided the margin squeeze by decreasing local calls charges in order to offset an increase in access subscription tariffs. Since January 2002, a new system was introduced whereby access services had been grouped together, excluding voice telephony services. In such a setting, the European Commission posed that DT could have avoided the margin squeeze by increasing its ADSL tariffs, which were unregulated under both systems.

It appears that this case could have been more properly framed as a predatory price abuse. As a matter of fact, DT's vertically integrated operations in the residential narrowband and broadband access service market were running at a loss. The European Commission *implicitly* took the view that DT recouped these losses from its contemporary profitable activities in *related* retail markets, that is in markets others than those where DT was implementing its exclusionary abuse.

The effects of an abusive practice are likely to be the same whether the resulting losses are sustained by cash flow from other activities within the same company (which may belong to unrelated markets), or from some other sources, such as capital markets or financial reserves (deep pockets). However, absent a context in which the *source* of funding for downstream losses is a profitable upstream (dominant) market, it seems difficult to understand what a cross-subsidy analysis would add to the substantive inquiry on margin squeeze abuse.[94]

5.2.3. The recoupment (missed) standard

As illustrated above, *Wanadoo Interactive* was framed as a predatory pricing abuse implemented by the FT's subsidiary, Wanadoo, in the residential DSL Internet access market. In Section 4.1.4, we explained that for predation to occur it should be demonstrated that recoupment is a probable scenario (the necessity of the "but for" test). Moreover, it should also be proved that recoupment would cause a consumer welfare loss (the necessity and sufficiency of the "consumer harm" test). Bolton et al. (2001) argued that the assessment of probable recoupment draws jointly from the plausibility of the predatory strategic scheme and the supporting post-predation market evidence (e.g. ex-post market structure – exclusion of rivals – and/or evidence of market power exploitation – output restriction/price raising). Where, however, the strategic predatory scheme is robust, the post-predation evidence standard should be less demanding, though of course still required.

Unfortunately, since *Tetra Pak II*, the European Commission outspoken position is that it is not necessary to prove that the alleged predator as a chance of recouping its losses. This approach is in neat opposition with the standard of proof required before the US courts after *Brooke Group*.[95] It has been argued that since art. 82 applies only to the extent of dominance, while in US the law is engaged only if there is a casual link from conduct to market power, dominance implies ability to recoup (*see*, Vickers, 2004; Fletcher, 2005). This argument is rebuttable for at least two reasons.

[94] See Gerardin and O'Donoghue (2004).
[95] *Brooke Group Ltd v Brown & Williamson Tobacco Corp*, 509 U.S. 209 (1993).

First, if inferences about dominance are made from a conduct allegedly abusive, there is a risk of circularity or vacuity such that false inferences can be made about competitive conducts.[96] A special case of misjudgement of this kind would arise if the SSNIP test has been applied in order to delineate market boundaries, so that its result would be aligned as a piece of evidence for the existence of a dominant position in the relevant antitrust market thereof. As anticipated in Box 3, the use of prevailing allegedly predatory prices as a benchmark for applying the SSNIP would imply a serious bias toward a too narrow market definition that, in turn, supports the existence of dominance. Therefore, to presume that the existence of dominance implies the ability to recoup might be a flawed judgement because of circularity.

Second, the statement that dominance implies ability to recoup apparently dismisses the contestability theory and its insights about the competitive constraints that potential entrants may exert on the incumbent. The degree of contestability should not be omitted from the assessment, as it would provide useful hints about the existence of a facilitating market structure that may support a strategic scheme of predation. Therefore, antitrust enforcers should at least check for the existence of relevant sunk costs owing to, for example, fast technological changes (risk of technical obsolescence), large expenditures in advertising and branding, sources of information asymmetries or the possession of exclusive access to strategic distribution facilities.

In *Wanadoo Interactive*, the European Commission clearly stated that "the proof of recoupment of losses is not a precondition for a finding of abuse through predatory pricing" (par. 335).[97] Paradoxically, when arguing that predation may simply consist in dictating or inhibiting the competitive behaviour of an existing or potential rival (and not necessarily in a radical ousting of competitors from the market), the European Commission stated that "a predatory price is simply one which leads to a maximization of profits through its exclusionary or other anticompetitive effects" (par. 266).[98]

This statement implies that the predator must be able to recoup somehow the losses suffered. Instead, the European Commission advanced the argument that as "a rational objective associated with predation, other scenarios are perfectly conceivable" (par. 334). It argued that for a public enterprise the need for ultimate

[96] As Coase (1972) warned, "If an economist finds something − a business practice of one sort or another − that he does not understand, he looks for a monopoly explanation. And as in this field we are very ignorant, the number of un-understandable practices tends to be very large, and the reliance on monopoly explanation, frequent".
[97] This approach was previously laid down in the Tetra Pak II decision where the EU Commission made clear that "it is not necessary to demonstrate specifically that the undertaking in question had a reasonable prospect of recouping losses so incurred." See Decision 92/163/EEC *Tetra Pak International SA*, OJ (1992) L 72.
[98] See Bolton et al. (2000).

recoupment of initial losses is less imperative then for a privately owned company, in particular if the public company can offset these losses with earnings from other lucrative activities. Conversely, the purpose for a predation strategy could be envisaged in the effort to enlarge its customer base as a way to boost the financial valuation of its assets (par. 334).[99]
Again, when describing the objectives pursued by Wanadoo, the European Commission argued that "first of all, the position occupied on the high-speed market was intended to make it possible in the long term to rebuild the company's margins on its ADSL products" (par. 293).

Notwithstanding this approach, in *Wanadoo Interactive* the European Commission described some sources of entry barriers that would make the recoupment scenario plausible. These are: the disincentive to mobility on the part of existing customers; the need to build up a brand image to acquire a critical mass; and the cost of alternatives to the wholesale offering proposed to ISPs by FT. [100] These barriers will be discussed in detail in the next Section. Moreover, the European Commission, when assessing the existence of dominance in the retail market, argued that Wanadoo enjoyed a competitive advantage because of its link with FT and, in particular, because of its exclusive access to FT's distribution network (par. 238-243) and its real-time access to information on the eligibility of phone lines to be upgraded to ADSL lines (par. 231-237). All in all, it seems that the European Commission collected supporting pieces of evidence for the assessment of the probable recoupment, but it preferred to stay to its unquestionable case law.

5.3. Price Squeeze test

<u>5.3.1. The as-efficient competitor test?</u>

When dealing with exclusionary pricing abuses, competition law enforcers should seek to ensure and promote efficient entry conditions by preventing dominant firms from ousting rivals whose presence enhances consumer welfare. In light of this policy objective, there are a number of discretional choices to be made as to how to device and implement a test which not only should be administrable but also concept-based and effect-oriented.[101]

The promotion of efficient entry conditions is not a plain argument. The definition of what kind of efficiency to be pursued through the implementation of the price

[99] This point reminds of the (once hot) debate over market value of Internet enterprises that attach significant value to the (projected) dimension of their customer base beside (or, even worse, rather then) the viability of its business plan.
[100] In this case, the wholesale service concerned was the resale of France Telecom's end-to-end ADSL Internet access.
[101] See Kovacic (2004) and Durand (2005).

squeeze test goes beyond the technicalities that are discussed in the next Section, and characterise competition policy in its fundamentals.

There are several notions of efficiency: *i)* Allocative efficiency is reached when goods and services are allocated to the uses in which they have the highest value. *ii)* Productive efficiency entails minimizing production costs subject to technological constraints. *iii)* Dynamic efficiency requires that firms have the right incentives to invest and innovate so as to improve the quality and range of products, increase productivity and lower costs. This latter concept encompasses allocative and productive efficiency in an ongoing process.

From a *static* point of view, allocative efficiency necessarily implies productive efficiency. Therefore, in dealing with exclusionary practices, antitrust enforcers should promote entry conditions so as to prevent the foreclosure of rivals that are no less efficient than the dominant firm (the as-efficient competitor test).

However, in markets characterized by very low degree of contestability there might be a trade-off between allocative and productive efficiency, in that if the dominant player monopolizes the market, entry by a less-efficient rival may improve social welfare because of the gain in allocative efficiency through lower prices (and larger outputs) that outweigh the loss in productive efficiency due to higher costs (Williamson, 1968).

As regards price squeezing, this latter scenario may be relevant insofar as both downstream and upstream prices are raised above costs and margin are squeezed for less efficient rivals. Under such circumstances, entry by a less efficient rival would improve social welfare and, arguably, this should be factored in when applying the price squeeze test.

On the contrary, in the case of predation, this trade-off cannot arise. Therefore, to promote entry from inefficient rivals would inevitably imply a price rise or quantity restriction and thus a decrease of both productive and allocative efficiency. It follows that in case of predation the price squeeze test should enforce viable entry conditions only for no less efficient competitors.

However, even this guideline is not unquestionable, as by enforcing the as-efficient standard where below-cost pricing is in place, would inevitably entail a loss of static (short run) consumer welfare, which is the more pronounced, the more the product is homogeneous (as it is the case with service-based wholesale Internet access solutions, such as bitstream or simple resale, as in *Wanadoo Interactive*). Thus, the mere enforcement of the as-efficient price squeeze test, challenging below-cost pricing *per se*, would not be beneficial for consumers unless the gains from plural competition outweigh the mentioned loss in the short run and ultimately leave consumers better off. This last assessment would by no means be straightforward, especially in emerging industries characterized by the presence of network effects that could worsen the loss in allocative efficiency, once positive externalities from the demand side are properly factored in.[102]

From a *dynamic* perspective, the analysis is inevitably more nuanced and each admissible argument could be matter of debate. As exposed above, dynamic efficiency refers to the ongoing permanence of those conditions that would best preserve allocative and productive efficiency in the future. The preservation of dynamic market efficiency ultimately depends on the rate of innovation.

The factors believed to affect innovation are the extent of technological opportunity (the Schumpeterian "escape from competition" incentive), appropriability (the likelihood of the firm being able to appropriate returns) and market size (the base over which to capture the returns). Theories of innovation make diverse predictions about the impact of competition on the innovative behaviour of firms. Models variously conclude that innovation is a decreasing (Scherer 1967, Loury 1979), increasing (Lee and Wilde 1980, Reinganum 1982, Aghion et al. 2001), or intialially increasing then decreasing (Peretto 1999, Mukoyama 2003, Aghion et al. 2004) function of the level of competition.

Therefore, there is no consensus on the role of antitrust enforcement with respect to the promotion of dynamic efficiency. This lack of consensus on the positive attributes of antitrust rules (how economic agents behave in response to antitrust rules), should suggest a prudent approach regarding the prescriptive attitude of antitrust enforcers (what rules - or interpretation of existing rules - should be adopted to advance specific ends). In other words, to promote entry conditions which would allow less efficient operators to enter the market, with the aim of pursuing dynamic efficiency, would at least be debatable. This argument is reminiscent of the debate about the "consumer harm" test discussed in Section 4.1.4. Indeed, the similarity is such that the same line of reasoning should be applied.

When implementing the price squeeze test in case of predation, antitrust enforcers should focus on efficient entry condition in terms of static (allocative and productive) efficiency (as-efficient competitor test). At the same time, it should be rigorously and openly conducted an analysis of the probable recoupment scenario, as this is the only way to effectively factor in concerns on dynamic efficiency and future exploitation from dominant firms. Therefore, the price squeeze test addresses only the "but for" standard, which, as explained in Section 4.1.4, is a necessary but not sufficient condition for predation to occur. This administrable test should be complemented with a concept-based assessment of the probable

[102]See Section 5.4.2.4.

recoupment, in order to address the “consumer harm” standard, which provides a sufficient and necessary condition.

5.3.2. The actual test

In the “Notice on the application of the competition rules to access agreements in the telecommunications sector”, the European Commission outlined a framework to test for price squeeze.[103] A price squeeze exist if “the dominant company's own downstream operations could not trade profitably on the basis of the upstream price charged to its competitors by the upstream operating arm of the dominant company” (par. 117). Alternatively, a price squeeze could also be demonstrated by assessing whether a “reasonably efficient service provider in the downstream market could not make a “normal” return” (par. 118). The two versions of the test make use of the same set of information except for downstream costs: in the first one the downstream costs are those of the vertically integrated incumbent (equally efficient operator test); in the second the costs are those of an efficient downstream operator (reasonably efficient operator test).

These alternatives are not necessarily reminiscent of the previous debate about the as-efficient competitor test, as the choice seems to depend on the concrete availability of sufficient data. Instead, the compliance with the as-efficient standard results from the specific discretional choices that enforcers must make regarding the configuration of downstream costs and the treatment of scale economies.

5.3.3. Downstream costs

In both *Deutsche Telekom AG* and *Wanadoo Interactive*, the European Commission opted for the “equally efficient operator” test. However, a difference exists in the two cases, as in *Deutsche Telekom AG* the European Commission explicitly calculated DT’s downstream costs, while in *Wanadoo Interactive* it assessed them implicitly by looking at Wanadoo’s net margins, without making any distinction between downstream and upstream input costs.[104]

The latter methodology is appropriate for testing the existence of predatory pricing practice, since to assess this allegation one needs to look at the net downstream margin. However, it requires upstream input prices to be cost oriented, otherwise, it would be preferable to use a margin squeeze framework and identify downstream costs.

[103] See EU Commission (2002b), par. 117-119.
[104] See DT decision at par. 155-159 and the Wanadoo decision at section E.

In *Deutsche Telekom AG* the wholesale solution concerned was LLU and the European Commission directly figured out the downstream costs specific to the provision of retail narrowband and broadband access services.

Regarding the kind of downstream cost figure to be used, there is a hiatus between the cost standard that competition law enforcers most often use and the cost test that sound economic principles regard as to more closely approximating the theoretically correct marginal cost standard.

The European Commission precedents have set two cost standards, one based on average variable cost (AVC) and the other on average total cost (ATC). Under Community case law, a price above ATC is conclusively lawful, while on the other extreme, a price below AVC is in itself sufficient to justify a finding of abuse. A price between AVC and ATC is deemed unlawful if and only if there is evidence of an intention to eliminate competitors.[105] Several economists regard these thresholds as being no longer appropriate. Baumol (1996) proposed to substitute AVC with average avoidable cost (AAC) as the lower bound. AAC is the average per unit cost that the predator would have avoided during the period of below cost pricing had it *not* produced the predatory increment of sales. Bolton et al (2001) integrated this proposal suggesting to substitute ATC with long run average incremental cost (LAIC) as the upper bound. LAIC is the per unit cost of producing the predatory increment of output whenever such costs were incurred.

In the case of a new product, the predatory increment of output is the total output produced. Therefore, downstream avoidable costs are those the vertically integrated dominant firm could avoid if it decided to close its downstream operation, while continuing to provide rival ISPs the upstream essential input. Incremental costs refer to the costs that a new entrant would face in order to efficiently operate in the Internet retail access service market.[106]

However, by calculating downstream avoidable costs as explained above, there could be pitfalls which might lead to an unfair price squeeze test. Among downstream costs there are network costs which refer to the need to provide end users with universal connectivity (beyond the local exchange point). In the case of a vertically integrated operator, these costs are mainly unavoidable costs, since they refer to the network infrastructure that the operator would anyway continue to manage and operate. Therefore, downstream avoidable costs would arise from any special equipment required to provide narrowband and broadband access services and from the customer relations of the downstream division. However, when implementing the equally-efficient-operator test, to exclude these costs from downstream avoidable costs would be unfair, as an equally efficient operator has

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[105] See also *AKZO Chemie v. Commission*, Case T-62/86, (1991) ECR I-3359, at par 71. The initial cost test was proposed by Areeda and Turner (1975).
[106] See Crocioni and Veljanovsky (2003).

no choice but to sustain these costs in order to deliver universal connectivity to end users. In doing so, the price squeeze test would risk to be under-inclusive.

A solution may be to redefine avoidable downstream costs as those costs that a vertical operator could avoid if it decided to close its downstream operation, while continuing to provide rival ISPs the upstream essential input, plus those unavoidable costs that refers to self-provision of network elements which are not specific to the provision of local access to the fixed infrastructure.

In this respect, the European Commission took different approaches in *Wanadoo Interactive* and *Deutsche Telekom AG*. In the first case, it implemented the "adjusted" AVC standard, by allowing for the amortisation (over a four year period) of non-recurrent customer acquisition costs (par. 107-109). On the other hand, in the DT decision the European Commission approximated the AAC method, as it excluded network costs from downstream costs (these are labelled "product-specific costs", par. 155-158).

5.3.4. Scale economies

As explained above, when dealing with exclusionary pricing abuses, competition law enforcers should seek to ensure and promote efficient entry conditions. In light of this policy guideline, the issue of economies of scale and scope is a complex matter of debate.

Does the equally-efficient-operator price squeeze test, by focusing on the incumbent's efficient downstream costs, mean that economies of scope and scale should be factored in?[107] This line of reasoning is consistent with Stigler's view on entry barriers, whereby an economic entry barrier is defined as a cost that must be incurred by a new entrant and that incumbents do not or have not had to incur.[108] Therefore, economies of scale cannot be regarded as entry barriers insofar as new entrants have access to the same technology.

However, some authors argue that this definition of entry barriers fails to capture the dynamics of over time equilibrium adjustment, that is, the ability of potential entrants to thwart the incumbent from monopolizing the market and to undo any anticompetitive effect deriving from an alleged abuse (Carlton, 2004; Hovenkamp, 1999; Schmalensee, 2004). In this respect, McAfee et al. (2004) proposed an antitrust definition of entry barriers, whereby "an antitrust barrier to entry is a cost that delays entry and thereby reduces social welfare relative to immediate but equally costly entry." Thus, while all Stiglerian barriers are antitrust barriers, the vice versa is not true. Moreover, they argue that where

[107] For an advocacy of this approach, see Crocioni and Veljanovsky (2003).
[108] See Stigler (1968)

frictions in customer mobility are present owing to switching costs, scale economies might well deter entry. Therefore, while scale economies are not entry barriers on their own, they are "ancillary barriers to entry" in that they delay entry by reinforcing the entry-deterrent effect of switching costs (e.g. brand loyalty), which is viewed as a "primary barrier to entry". Consistently with this approach, economies of scale and scope should not be factored in when figuring out efficient downstream costs in the price squeeze test (provided that new entry is welfare enhancing).

In *Wanadoo Interactive*, the European Commission has apparently endorsed this approach in full. Among the downstream costs faced by Wanadoo, there were the costs of routing ADSL traffic provided by the parent company, FT. Until October 2002, routing charges were sharply metered according to traffic volume. This circumstance conferred Wanadoo a cost advantage so long as its competitors did not attain a certain dimensional threshold. In a suggestive passage the European Commission argued that "while the search for scale economies [..] may be included among the rational justifications for predatory behaviour, it may not serve to legitimise that practice from the point of view of competition law, since it has the effect of conferring a more favourable cost structure on the dominant undertaking to the detriment of its competitors" (par. 309).

Even more suggestive in arguing that scale economies are ancillary barriers to entry which reinforce the entry-deterrent effect of brand loyalty is the fact that the European Commission treated directly the latter as a main strategic entry barrier, but not the former. As a matter of fact, two of the three strategic entry barriers identified by the Commission were the disincentives to mobility on the part of existing subscribers and the costs of acquiring a sufficient notoriety in a mass market (par. 339-358).

5.3.5 A more subtle perspective on scale economies

By treating scale and scope economies as "ancillary" barriers to entry, antitrust enforcers are implicitly assuming that scale and scope economies would ultimately facilitate the alleged predator in exploiting its market power, once predation ceases. This modelling choice seems to apparently address the consumer-harm standard, as, by factoring out scale economies (ancillary antitrust entry barriers), the enforcement of the price squeeze test would ultimately forestall dominant firms to foreclose rivals whose presence enhances consumer welfare (by preventing the predator from passing to the exploitation phase). In other words, the treatment of scale and scope economies as "ancillary" entry barriers refers to the assessment of the ex-ante market structure as supporting the strategic scheme of predation because it facilitates recoupment.

However, the correctness of this presumption depends on a more subtle presumption: the ex-ante market structure remains unchanged afterwards the fulfilment of predation. The argument *ad absurdo* goes as follows: the fulfilment of predation would arguably result in a changed ex-post market structure (as this is the main strategic pursuit of the predator); it may be the case that the resulting ex-post market structure will no longer support the ex-ante strategic scheme for predation, owing to a lessening of the same strategic "primary" entry barriers that ex-ante would have facilitated recoupment (e.g. switching costs - brand loyalty); thus, the very same fulfilment of predation would cause an averse change that eventually makes recoupment less probable (the ex-post degree of contestability is therefore endogenously determined by the dominant firm's pre-emption); indeed, what ex-ante apparently is predatory may turn out to be lawful ex-post.

If this argument *ad absurdo* reasonably conforms to the actual market structure concerned, scale (and scope) economies should *at least* be factored in, so as to properly assess static (allocative and productive) efficiency, which is the distinctive subject matter of the equally-efficient price squeeze test. At least but not at best. If this scenario described above is plausible, a rigorous assessment of probable recoupment should not be omitted. If, given the fulfilment of the alleged predatory scheme, the resulting ex-post market structure is less facilitating than the ex-ante market structure, how would this eventually deteriorate the probability of recoupment? [109]

In *Wanadoo Interactive* the European Commission outlined Wanadoo's strategic scheme of predation in terms of a pre-emption strategy combining below cost pricing and substantial sales volumes aimed at maximizing revenue and margins on ADSL subscription in the long run (par. 292-299). As anticipated in Section 5.3, the European Commission described in detail a number of obstacles to entry and growth of competitors that would facilitate recoupment, namely: the disincentives to mobility on the part of existing customers; the need to build up a brand image to acquire a critical mass size;[110] and the cost of alternatives to the wholesale offering proposed to ISPs by FT.

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[109] Beggs and Klemperer (1992) developed an infinite horizon model with continuing arrival of new consumers and attrition of old ones. Therein, price wars initially occur when both firms have few captive customers, but when the population is stationary (as in an established market) the competitive process converges monotonically over time to a stationary configuration of prices and market shares. In particular, an incumbent's monopoly can be challanged by an entrant who eventually achieves a large share. This model casts doubt on interpreting switching costs as barriers to entry in stable markets: switching costs induce an incumbent to price high in order to exploit its captive market, enabling an entrant to capture new arrivals at lower but still profitable prices.

[110] Inasmuch as customers acquisition costs are specific to identifying the trademark concerned (when different from the corporate brand), they are irreversible and, thus, sunk.

The first two entry barriers are strongly interrelated (the third barrier is discussed in detail in the Section 5.4.2.5). The first refers to the presence of switching costs due, for example, to brand loyalty and customer satisfaction. The European Commission argued that "owing to the disincentives to mobility on the part of existing subscribers, the bulk of the effort involved in the conquest of market shares by competitors must therefore be concentrated on new customers" (par. 345). However, it advanced that "not only is the advertising and promotion expenditure competitors must incur if they are to acquire a certain visibility substantial, but it is less effective than that of Wanadoo Interactive owing to the advantages in terms of notoriety on the relevant market already enjoyed by that company" (par. 357). Therefore, "the foreseeable difficulty for competitors to acquire a critical size on a mass market enabled Wanadoo to envisage as perfectly plausible a market sufficiently concentrated to allow a recoupment of losses" (par. 358). The relationship between scale economies, switching cost and the cost of achieving a critical mass can be fully appreciated in the following passage: "in order to benefit from scale economies in the activity in question, […] it is necessary to acquire several tens of thousands of customers, which in itself calls for a very substantial advertising and promotion outlay on top of the other customer acquisition costs" (par. 355).

This line of reasoning portrays a facilitating market structure which consistently ascribes plausibility to the predatory strategic scheme of market pre-emption. However, the picture described is based on the ex-ante market structure: the European Commission's argument actually projects ex-post the conditions prevailing ex-ante as unaffected by the fulfilment of the pre-emption strategic design. Instead, to correctly figure out the foreseeable recoupment scenario it is necessary to account for two relevant conjectures: *i)* the struggle of competitors to enter the market takes place during the exploitation phase, rather then during the pre-emption phase; *ii)* the absolute dimension of the market will be larger than the ex-ante market dimension (from an early phase of market development to a stabilized phase of development/maturity).

The first guesswork arguably entails that existing customer satisfaction would be harmed and, consequently, their brand loyalty would be at least partially eased, because of Wanadoo's exploitation through price-raising/output-restriction. The second assumption suggests that the costs of entering and acquiring a critical mass market be changed in nature, efficiency and efficacy.

This cost is due to advertising and promotion expenditures. To the extent that advertising provides information, a firm that advertises is selling a joint product: the sheer product plus information. A firm's advertising is a shift parameter that moves the demand curve for the firm's product. When a new product is launched, advertising main goal is to convince potential adopters to buy/discover the unknown product. Under such circumstances, each brand-new product can be conceptualised as an “experience good”. An experience good is a product or service whose characteristics such as quality or price are difficult to observe. These characteristics can be ascertained only upon consumption (the concept is originally due to Nelson, 1970). However, not every new product is an experience good. Some of them may be thought of as post-experience goods, that is goods for which it is difficult for consumers to ascertain the quality even *after* they have consumed them.

Broadband Internet access can be conceptualized as an experience good both for residential potential customers who have not yet experienced it, and for low-speed existing customers. As explained in Section 2.1, the distinction between broadband and narrowband Internet access is based on differences in use and technical performances, so that the two products allow very different usage profiles (and, ultimately, experiences). On the contrary, existing (experienced) broadband customers can easily define their usage profile and satisfaction in terms of technical performances described objectively. Thus, existing broadband customers can easily compare competing alternatives on the basis of their performance profile: once it has been experienced, residential broadband Internet access can be properly thought of as a search good (i.e. products or services with features and characteristics easily observable before purchase).

In the pre-emption phase, when a new product has to be launched and a new market developed, the dominant firm’s promotional and advertising campaigns are aimed at shifting the overall demand curve for an “experience” product. When the pre-emption/predation phase comes to an end (i.e. the population of end-users is stationary), and the dominant firm starts exploiting its market power, new entrants’ advertising and promotional campaigns are aimed at shifting their respective (residual) demand curves. As a consequence, they will mostly address incumbent’s existing customers, who by this time have fully appreciated broadband features and, thus, found it easy to acquire information in advance of consumption. Therefore, the very nature of marketing effort changes, relatively to that of the dominant firm: even though the target is the same, the perception of product evolves (upgrades) over time.

The evolution in perception affects the efficiency and efficacy of new entrants’ advertising and promotional campaigns. In case of an experience good, to lure away incumbent’s existing customers is more difficult than in case of a search good. Consumers cannot easily compare competing products and so they rely on reputation and create inertia. Moreover, experience goods typically have lower price elasticity than search goods, as consumers fear that lower prices may be due to unobservable problems or quality issues. Under such circumstances, first mover advantage would be of strategic importance and brand loyalty would be a strong entry barrier. Thus, recoupment would be probable. Instead, in case of search goods, consumers can easily verify the quality/price ratio of the competing product and make sure that the products are comparable. Therefore, search goods are more subject to price competition. Moreover, given the exploitation pursuit of the incumbent, existing customers may themselves actively search for comparable alternatives at a lower prices.[111]

Why would then the incumbent accommodate entry instead of re-deterring it aggressively? This is an instance of a general effect that Fudenberg and Tirole (1986) define as “fat cat”: a “fat cat” incumbent with a large stock of ‘goodwill’ with customers (due to switching costs or perhaps advertising) prefers to exploit its existing stock rather than countering entrants.[112]

All this suggests rivals’ marketing effort to be more efficient and effective than in the case where market structure is ex-post unaffected by the fulfilment of the pre-emption strategy. Therefore, to overlook the endogenity in ex-post degree of contestability when assessing the plausibility and probability of recoupment might be misleading.

5.3.5. Retail prices

The definition of the incumbent’s downstream price (p^d in equations 1 and 2) raises several issues relating to the implementation of the price squeeze test. Above all, upstream and downstream prices should be comparable. In the case of a single downstream product the comparison is straightforward, provided that the non-linearity of the two prices is treated uniformly.[113]

When there is more than one downstream product, it is essential to look at the economic relationships between them. If these retail products are mutually exclusive (not necessarily substitute), a separate price squeeze test should be performed for each of them (arguably starting with the cheapest retail service, given that this service is the most likely to create a price squeeze).[114] On the other hand, when downstream products are complements, it must be assessed whether each product should be subject to a separate test or whether a combined price squeeze test should be applied.

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[111] Even the search attitude of practiced broadband customers supports their pro-activity in searching for close substitutes to the incumbent’s Internet access service.

[112] The incumbent may choose its prior investment in goodwill to take this effect into account, either investing in goodwill and conceding entry, or not investing at all and deterring entry.

[113] Usually, both wholesale and retail access prices to the local network take the form of a two-part tariff.

[114] By way of contrast, in an *ex ante* regulatory environment, NRAs cannot identify individual retail services with great specificity. Under such circumstances, it is admissible to refer to a basket of retail services where each service is weighted according to a given driver (e.g. sales volumes). See EU Commission (2001).

In the context of Internet access over the PSTN, the LLU enables the delivery of mutually exclusive retail solutions (analogue, ISDN and DSLs) which can even refer to distinct relevant antitrust markets. Otherwise, especially for broadband solutions, basic Internet access revenues (connection and subscription fees) might underestimate overall revenues from an Internet access customers, insofar as there are complementary services (e.g. e-commerce and content-related services) that are inseparable from Internet basic access.[115] Under such circumstances, the revenues resulting from these services should be incorporated into the analysis.

The European Commission applied opposite standards in *Wanadoo Interactive* and *Deutsche Telekom AG*. In the first case, it conducted a separate predation test for each of the two ADSL retail alternatives which Wanadoo was selling at the time under scrutiny. Regarding complementary services, it incorporated in the overall revenue figure the revenues resulting from online advertising, e-commerce and audience fees, although these products related to activities distinct from Internet access" (par. 35). Conversely, in *Deutsche Telekom AG* the European Commission opted for a basket of three mutually exclusive access solutions actually marketed by DT (analogue, ISDN and ADSL access products), weighted for their quantitative quotas. Moreover, it rejected a defendant claim to include additional sources of revenue (resulting from telephone calls), arguing that "the primary consideration here is the effect on market entry by competitors, and not the question whether the end-user regards access services and calls as a single bundle of products" (par. 127).[116]

5.4. Market expanding efficiency defence

As exposed above, in *Wanadoo Interactive*, the European Commission dismissed the defendant's claim that below-cost pricing was justified as a means to achieve economies of scale. The European Commission argued that scale economies were conferring a competitive cost advantage to the dominant firm that would have deterred competitors from entering and expanding into the market (in particular, where the dominant firm was enjoying brand loyalty).

When the relevant market is experiencing a period of sustained expansion, there may be other legitimate justifications for below-cost pricing.[117] These

[115] These complementary products may even be bundled together and sold at a bundled price that could be lower than the combined price of the two products sold separately, and possibly the wholesale price of the essential input.

[116] Ofcom dismissed a complaint by BT claiming that it could offer a retail subscription at a price below its wholesale price because it expected additional revenues from e-commerce and advertising. See Ofcom (2001a)

[117] The market expanding efficiency defence cannot be a valid defending argument in a case of margin squeeze, since the alleged predator does not sacrifice any current profit for future fficiency gains.

justifications refer to foreseeable dynamic efficiency gains to compensate for current losses. Market expanding efficiency defence raises difficulties in sorting out pro-competitive price cutting from predatory pricing, as it involves an aggressive move by the defendant. Bolton et al (2001) proposed three concurrent criteria of justification: *i)* plausible efficiency gains; *ii)* no less restrictive alternative; *iii)* efficiency-enhancing recoupment (rather than recoupment from increased profit through eliminating or disciplining rivals). The defendant would have the burden of proving the first and the third element, while competition law enforcers would have to identify one or more plausible less restrictive alternatives, before shifting the burden back to the defendant which will then have to show that such alternatives are either unfeasible or no less restrictive.

In *Wanadoo Interactive*, the defendant argued that a plausible efficiency gain, justifying its below-cost pricing, would have been the positive externalities deriving from broadband diffusion, as the ensuing widespread awareness (of broadband advantages) among broadband end-users would have ended up benefiting its competitors and the market for specific high-speed content (par. 310).

The European Commission maintained, first, that there was no proof corroborating this line of reasoning, secondly that there was a less restrictive alternative whereby the FT group could have fostered a more balanced growth path of the ADSL market by pricing all its wholesale products at low levels and encouraging the entry of competitors (par. 314).

With respect to the second point, the European Commission counterargument was consistent with the description of positive network effects proposed by Wanadoo. According to Wanadoo, the overall network size (overall broadband customer base) is to be conceptualized as a public good, in that the IP/TCP standard provides competing local networks (operated by rival ISPs) with a common platform which assures compatibility across the Internet (compatibility has been exogenously determined, as the IP/TCP standard is a legacy from the early non-commercial Internet era; Kende, 2000). Therefore, the network size is characterized by non-rivalry and non-exclusivity. Under condition of compatibility, competing ISPs do not have rival-weakening incentives, [118] so that positive network externalities cannot justify market power (*see*, appendix on network economics).[119]

[118] Economides and Himmelberg (1995) show that under condition of compatibility the ranking of market structures based on their allocative properties is not affected by network externalities. Network effects cannot justify market power. However, it is important to recognize that the welfare benchmark for the assessment of the consequences of a less competitive market structure is not the first best, as price taking behavior would not guarantee a Pareto optimal allocation of resources in this case.

[119] See Part I, Section 3.

However, the same rigorous consistency should be applied throughout the analysis, even when discussing probable recoupment. As exposed above, the European Commission argued that one main entry barrier was the costs of acquiring a critical size in a mass market. The economic concept of "critical mass" refers to the minimum positive network size that can be sustained in equilibrium. However, this solution is unstable as a small variation in the number of network adopters shifts the market to either of two extreme (stable) equilibria: the first equilibrium where adoption does not occur; and the second one where network externalities are exploited in full.[120] A main consequence of the existence of a positive critical mass (and of multiple equilibria) is that as long as the critical mass is not exceeded, demand synergies develop only to a limited extent.

However, under conditions of compatibility among local network, rival ISPs do not have to achieve a critical mass on their own, in order to benefit from network synergies from the demand side, as the relevant critical mass size is that of the overall local network (the Internet). Instead, what the European Commission referred to can be better captured by means of the economic concept of minimum efficient scale: the minimum network size needed to benefit from scale economies (production synergies from the supply side).[121]

Compatibility among rival ISPs helps in defining sources and degree of uncertainty regarding broadband adoption. Technology adoption is governed by individual preferences and aggregate conducts. With large sunk costs, demand uncertainty makes irreversibility of capital investment a powerful entry deterrent. McAfee et al. (2004) described sunk costs and uncertainty as ancillary antitrust entry barriers, as both do not deter entry on their own (non economic barriers to entry), but their combined presence delays entry until the realization of uncertainty. Therefore, the need to commit to a large irreversible capital investment is not sufficient to deter or delay entry, absent demand uncertainty.

A common (systemic) source of uncertainty is linked to the consumer uncertainty about the performance characteristics of new sophisticated products. This might slow down the overall speed of diffusion. Instead, contrary to the case of incompatibility among competing local networks, consumers do not find additional (specific) uncertainty about which competing product will lead in terms of population coverage. Therefore, they do not face the risk of being stranded on the failing alternative (strategic technical uncertainty).[122]

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[120] Ibidem.

[121] For an in depth analysis of scale economies, see Sections 5.4.2.2 and 5.4.2.3.

[122] Koski (1999) studies a panel of PC diffusion rates in eight European countries and finds that diffusion is indeed slower where Apple and IBM/Intel/Microsoft have relatively similar shares. Similarly, Gruber an Verboven (2001) and Koski and Kretschmer (2004) study the diffusion for

The absence of strategic technical uncertainty excludes that sunk costs could be a source of asymmetric competitive advantage in favor of the incumbent, which would likely possess and operate the largest local network. Nevertheless, sunk costs might deter entry across the board, due to overall (systemic) demand uncertainty.

In this regard, Economides (1999) argued that "a close examination of the issue of uncertainty in the local telecommunication network reveals that: *i)* for most unbundled network elements, there is little demand uncertainty; and *ii)* that those elements that face significant uncertainty, do not have sunk value."

On the contrary, Pyndick (2004) made a case that mandatory unbundling of the local loop allows the entrant to rent facilities in small increments for short duration, with no long-term contracts required and at prices reflecting what it would cost a new, efficient, large-scale network to be built (which is usually lower than the historic cost of local network development). These flexible sharing opportunities let the entrant not to bear the sunk cost, thus leading to an asymmetric allocation of risk and return that is not properly accounted for in the pricing of network services.

In any case, the presence of both demand uncertainty and sunk costs should be treated in light of the strategic interaction among competitors that have the option to invest in the same market, and the managerial flexibility regarding the timing of investment/entry.[123] The option is commonly exercisable (non exclusivity) and repeatable (non rivalry). Under such circumstances, there can be both a first-mover advantage and a second-mover advantage. If a commitment is credible, pre-emption can award a first-mover advantage to the winner, thereby forcing the other players to act contingent on the first mover's action.[124] On the other hand, the option to defer investment can give an advantage owing to the information spillover that helps followers in resolving uncertainty.[125]

1G and 2G mobile telephony, respectively, and find that standardization (i.e. reduction of uncertainty as to the future technological standard) accelerates diffusion.

[123] The real option theory addresses the issue of investment decisions under uncertainty (*see*, Dixit and Pyndick, 1994; McDonald and Siegel, 1986). In this literature Nature chooses a state of the world at each point in time that influences the profitability of the investment project. The problem is then to find the optimal threshold level of an underlying variable (e.g. price or output of the firm), above which the investment should be undertaken. For an overview of the interplay of real option and sunk costs in antitrust, *see* Pyndick, 2005.

[124] The equilibrium concept used in pre-emption games was developed by Funderberg and Tirole (1985).

[125] The equilibrium concept used in "war of attrition" games was developed by Hendricks et al. (1988).

For our purposes, it is not essential to define what source of competitive advantage outweighs the other; instead, it is sufficient to accept that there is a value in postponing entry, in that demand uncertainty can be solved by observing the first-mover's performance/strategy.

As for the relationship between scale economies and brand loyalty, it is important to capture the endogenity in the ex-post degree of contestability due to the strategic scheme pursued by the incumbent. The fulfillment of pre-emption by the incumbent/first-mover helps rival ISPs in resolving (systemic) demand uncertainty. Absent demand uncertainty, sunk costs alone cannot deter entry. Thus, the presence of large sunk costs is not an obstacle to entry on its own supporting the probability of recoupment, which should be the subject matter of the competitive assessment in a case of predation.

In *Wanadoo Interactive*, when assessing the plausibility of recoupment, the European Commission argued that "the construction of an alternative telecommunications network and the recourse to local loop unbundling solution result in considerable delay and the initial tying-up of large sums of money. In these circumstances, this model, which alone makes it possible to break free from the technical and financial constraints, is being implemented only very gradually and, at the time of this Decision, very marginally. […] They must therefore also be interpreted as barriers to entry" (par. 364).

Once again, from this passage it appears that the European Commission based its assessment on the ex-ante (unaffected/exogenous) market structure and omitted to consider that the assessment of the plausibility of recoupment should be contextualized during the exploitation phase, rather than while the incumbent is pursuing the pre-emption strategy by means of low prices and large volumes.

5.4.1. More on market expanding efficiency defence

As explained above, if the Internet is mainly thought of as a common platform providing rival ISPs with horizontal compatibility, then it is framed as a pure two-way network good wherein direct network externalities are the main value driver to customers.[126] Thus, the need to achieve a critical mass refers to the overall

[126] Direct network effects are caused by demand-side (user) externalities, whereby the utility from consumption increases with the number of agents consuming the same good; indirect network effects are caused by supply side user externalities and arise when the value of a product increases as the number and variety of complementary goods or services increases (*See*, Katz and Shapiro, 1985; and Economides, 1996). There is a relation between direct/indirect effects, on the one side, and one-way/two-way networks, on the other side. One-way networks enable the exploitation of indirect network externalities only; two-way networks can sustain both direct and indirect network externalities.

Internet subscriber base, so that ISPs do not have rival-weakening incentives in the development of their own local network.

However, two way networks enable the exploitation of indirect network effects too. To this extent, what counts most is vertical compatibility (hardware-software paradigm), as some broadband audio-visual applications are one-way services through which an upstream content provider broadcasts premium events to Internet subscribers. According to the proprietary (vertical) structure of content performance rights,[127] these applications can be classified in:

i) Content-related applications which imply the transition of content-related performance rights from content providers to downstream ISPs (e.g. sport events and life performances);

ii) Content-related applications where content providers maintain the ownership of audio-visual contents and distribute them through ISPs' platforms (e.g. downloading and streaming of music files).

When the network effect is indirect, consumption benefits do not depend directly on the size of the network (the total number of subscribers) *per se*. When indirect network effects are present, consumers benefit from others adopting compatible hardware (subscription to the same broadcasting ISP), because it allows them to consume a wider variety of software (access to more premium events). It is the number of *different* software that matters, not the quantity (or price) of a particular one. This entails that within this setting adoption externalities with indirect network effects are the result of *variety effects,* not price effects.[128]

However, the manner in which inframarginal consumers benefit from indirect effects is identical to the manner in which they benefit when there are direct effects (the ability to create new systems of complementary products). Therefore, network externalities that arise in settings with indirect network effects have the same microfoundations as network externalities that arise in settings with direct network effects.

Indeed, to conceptualize these vertical relations in terms of vertical compatibility/incompatibility is incorrect, as (vertical) incompatibility is due to exclusive access to content by subscribers, rather than to the use of different protocol standards. Thus, it is more accurate to refer to vertical accessibility.

The similarity described above can be clearly appreciated in the case of (vertical) audio-visual applications. Where performance rights are purchased by ISPs, they

[127] This vertical framework does not apply to peer-to-peer downloading systems, which instead are two-way network where direct network effects are present.
[128] *See*, Church and Gandal (2004).

would arguably trigger their procurement decisions of premium contents with respect to their actual (or expected) subscriber base: the larger their subscriber base, the greater their willingness to pay for premium content performance rights, and the more compelling their offering is to their customers.[129] Instead, where ISPs distribute content only, there would be a case of two-sided market whereby indirect network externalities arise between the ISP's subscriber base and proprietary content providers, with the ISP acting as an intermediary platform.

Notwithstanding this similarity, the accent on variety rather than on sheer network size impacts on the definition of critical mass in settings where indirect network effects are present. The threshold that fosters demand synergies is not the number of subscribers connected to the same ISP, but the portfolio of premium events to which subscribers can access (individually). This leads to unintuitive consequences: if network effects are indirect, there may be a critical mass beyond which an additional variant of a (vertical) complementary (accessible) product does not confer any additional value to the network platform.[130] For example, it is well known that game console software has a highly skewed sales distribution, with "blockbuster" games accounting for a large chunk of overall sales within a platform.[131] This "blockbuster" feature has significant consequences for market structure: if a large proportion of subscribers wants to access a tiny selection of premium contents only, any delivering platform that can provide a sufficient number of "blockbuster" contents is viable and, thus, unlikely to be crowded out by a platform that offers more complementary (accessible) products.

How does the analysis above apply to the competitive assessment of predatory abuses in the Internet access market? As exposed in the previous section, Bolton et al. (2001) proposed three concurrent criteria of justification: *i)* plausible efficiency gains; *ii)* no less restrictive alternatives; *iii)* efficiency-enhancing recoupment.

A plausible efficiency gain from the pre-emption strategy in the Internet access market could lie in the (actual or expected) achievement of that threshold in the incumbent's subscriber base which triggers the mass development of broadband audio-visual services (through the exploitation of indirect network effects). Under such circumstances, firms may compete hard for early adoptions, notably with penetration pricing.[132] Moreover, for audio-visual applications where content providers maintain the ownership of performance rights (two-sided markets), the

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[129] However, this may be seen as economies of scale a broadcaster obtains from speading content costs over a larger base of subscribers.
[130] *See*, Kosky and Kretschmer (2004).
[131] *See*, Bayus and Shankar (2003).
[132] *See*, Farrell and Klemperer (2005).

very nature of the economic incentives in place would suggest that the ISP prices below costs in order to bring both sides of the market on board.[133]

The European Commission argued that a main difference in use that distinguishes broadband from narrowband Internet access refers to content-related applications (e.g. streaming and downloading). Moreover, in *Wanadoo Interactive* it recognized that content-related activities are inseparable from basic broadband access provision. Arguably, the capillary deployment of broadband lines is a necessary prerequisite for content-related services to be (conveniently) mass marketed, thus to foster proprietary broadband local access through penetration pricing may be a rational choice.

As regard the second point, the absence of less restrictive alternatives is due to the need to sufficiently develop a proprietary subscriber base, in order to make premium-content procurement viable.

With respect to the efficiency-enhancing recoupment criterion, if the market expanding strategy proves to be successful, it would lead to a deeper penetration of broadband Internet access and an increased customariness among subscribers in the fruition of audio-visual broadband applications. As regards the anticompetitive concerns of dominance exploitation (price-raising/output-restriction) by the incumbent in order to recoup its losses, even in the worst scenario wherein telecom incumbents have monopolized their respective national broadband Internet access service markets, could they reasonably foreclose potential competitors from undoing them to earn monopoly profits either in the basic Internet access activities, or in content related activities?

As regards basic Internet access, provided that regulatory unbundling of the local loop will be in place (especially in the forms of bitstream access and end-to-end resale), potential competitors will have access to this essential network element in order to let end-users switch away from the incumbent (whenever they choose to do so).

This point is intertwined with the regulatory methodology applied by NRAs to define wholesale charges. As far as the wholesale access is concerned, telecommunications regulators have generally relied on two principal methodologies: long run incremental cost (LRIC) and retail-minus. The first methodology would prevent incumbents from excessive pricing abuses; while the second system better fits to price squeeze exclusionary abuses.[134] Thus, when the

[133] *See*, Rochet and Tirole (2003)

[134] In the DT decision, the EU Commission has stressed that in Germany LLU charges were cost oriented and uniform across the board. Instead, it noted that "the easiest way to ensure comparability between different access services at wholesale and retail level is to set a different

main anticompetitive concerns is excessive pricing (because the incumbent is trying to recoup its losses), the presence of a retail minus approach should require close scrutiny by NCAs and NRAs.

Moreover, as explained in the previous Sections, the fulfilment of the pre-emption scheme would likely impact on the ex-post market structure in such a way that ex-ante entry barriers (switching costs and sunk costs) would be eased.

With respect to content-related services, once broadband has capillary penetrated across national markets, incumbents cannot technically foreclose a rival web-based content distributor (maybe active on a regional or global scale) to deliver its premium content offering over the Internet. Moreover, the diffused awareness among broadband users of the advantages of high-speed usage would make subscribers keener to quality-based features of audio-visual services rather than to an uncritical brand loyalty. Horizontal compatibility due to the IP/TCP common standard implies that control of local access can not enable incumbents to control end-user access to content.

Certainly this scenario raises other competitive concerns, such as bundle and tying of basic Internet access with content related services. These issues clearly require a close scrutiny. However, it is admissible that below-cost pricing could unleash a virtuous circle that would lead to a deeper penetration of broadband Internet access across Member States.

6. Conclusions

What emerges from the previous Sections can be summed up in two groups of considerations. Firstly, notwithstanding that Internet access service can be held to be a distinct relevant market, to conduct a competitive assessment it is necessary to enlarge the scope of the analysis, as to properly account for the strong vertical relationships that impact on the diffusion path of Internet access. This requires to address the issue of broadband content application (in particular, digital broadcasting) as one of the main driver of high-speed Internet access penetration. This will inevitably complicate the analysis, but we suggest that dismissing this part would lead to more frequent Type I errors (i.e. antitrust enforcers' ruling against practices that, in fact, are competitive) when applying competition law to such emerging dynamic contexts. For a further discussion of the issue of content provision, see Buccirossi et al (2005).

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wholesale charge for each retail service, determining the wholesale charge by subtracting a reasonable margin from the comparable retail charge (the retail-minus approach). (par. 113)"

The second group of considerations is more technical in nature and focuses on the application of Art. 82 to alleged exclusionary pricing abuses and, in particular, to predatory pricing practices. First, the subject matter of the price squeeze test should be to identify those pricing abuses that, if successful, would lead to the ousting of competitors at least as efficient as the predator, in order to promote and protect allocative efficiency. Therefore, the test addresses the so called “but for” test, which provides a necessary but not sufficient condition for a finding of predation.

Second, a sound competitive assessment should include the plausibility of the recoupment scenario. This part of assessment refers to the so called “consumer harm” test, which provides both a sufficient and necessary condition for predation to occur.

Third, given the above “division of labour” between “but for” and “consumer harm” tests, the implementation of the price squeeze test should exclusively aim at establishing whether an as-efficient competitor has been unlawfully foreclosed. Therefore, when computing downstream costs, economies of scale enjoyed by the incumbent should be factored in.

Fourth, if the standard applied in the computation of downstream costs is that of AAC, incumbent’ unavoidable costs that refers to self-provision of network elements which are not specific to the provision of local access to the fixed infrastructure should be factored in.

Lastly, with reference to the need to assess the probability of recoupment in weighing up the existence of entry barriers that are likely to facilitate the recoupment of initial loss, it is important to recognize the sources of endogeneity that may cause a radical change in the market structure. A market structure that is deemed to facilitate the strategic scheme for recoupment *ex-ante*, may well be changed as a result of the same successful strategic scheme in a way that no longer facilitates recoupment *ex-post*. These dynamic considerations are particularly important where the market concerned is at its early development phases and, thus, their omission would be jeopardize the analysis.

References

Aghion, P. N. Bloom, R. Blundell, R. Griffith and P. Howitt (2004), "Competition and Innovation: An inverted U relationship", *NBER Working Paper series, No 9269*, http://ideas.repec.org/p/nbr/nberwo/9269.html.

Aghion, P., C. Harris, P. Howitt and J. Vickers, (2001), "Competition, Imitation and Growth with Step-by-Step Innovation", *Review of Economic Studies,* vol. 68, pp. 467-492.

Amato, G. (1997), *Antitrust and the Bounds of Power: The Dilemma of Liberal Democracy in the History of the Market*, Oxford, UK. Hart Publishing.

Areeda, P. and D. Turner (1975), "Predatory Pricing and Related Practices Under Section 2 of the Sherman Act", 88 *Harvard Law Review*, 697.

Arthur, W. B., (1989), "Competing Technologies, Increasing Returns, and Lock-In by Historical Events", *Economic Journal*, vol. 99, Issue 394, 116-131.

Arthur, W. B., Yu.M. Ermoliev and Yu.M. Kaniovski, (1987), "Path-dependent processes and the emergence of macro-structure". *European Journal of Operational Research*, vol. 10, 294–303.

Baake, P. and A. Boom, (2001), "Vertical Product Differentiation, Network Externalities, and Compatibility Decisions", *International Journal of Industrial Organization*, vol. 19, Issue 1-2, 267-284.

Badasyan, N. and S. Chakrabarti (2003), "Private Peering Among Internet Backbone Providers", *Economics Working Paper* Archive NO. 0301002, WUSTL.

Bailey, J.P. (1997), "The Economics of Internet Interconnection Agreements", McKnight, L.W. and Bailey J.P. (eds), *Internet Economics,* Cambridge MA, The MIT Press.

Bassanini, A. and G. Dosi, (1999), "Competing Technologies, International Diffusion and the Rate of Convergence to a Stable Market Structure", Sant'Anna School of Advanced Studies, *LEM Working Paper Series,* No. 1999/03.

Baumol, W (2003), "Principles Relevant to Predatory Pricing", Chapter 2 in Einar Hope, ed., *The Pros and Cons of Low Prices*, Stockholm: Konkurrensverket/Swedish Competition Authority, pp. 15-37.

Baumol, W (1996), “Predation and the Logic of the Average Variable Cost Test”, *Journal of Law & Economics*, vol. 39, No. 1, pp. 49-72.

Bayus, B. and V. Shankar (2003), “Network effects and competition: An empirical analysis of the home video game industry”, *Strategic Management Journal*, vol. 24, pp. 375-384.

Beggs, A. and P. Klemperer (1992), “Multi-Period Competition with Switching Costs”, *Econometrica*, vol. 60, pp. 651-666.

Bellamy C. and G. Child, (2001), ”*European Community Law of Competition”*, edited by Roth P, 5th Ed, London, UK, Sweet & Maxwell.

Benkard, L., (2000), “ Learning and forgetting: The dynamics of aircraft production”, *American Economic Review*, vol. 90, Issue 4, 1034-1054.

Bental, B. and M. Spiegel, (1995), “Network Competition, Product Quality, and Market Coverage in the Presence of Network Externalities”, *Journal of Industrial Economics*, vol. 43, Issue 2, 197-208.

Besen, S.M., Spigel, J.S., Srinagesh, P.(2002) “Evaluating The Competitive Effects Of Mergers Of Mergers in the Internet Backbone”, *ACM Transactions on Internet Technology (TOIT)*, vol. 2, Issue 3, pp. 187-204.

Bolton, P., J, Brodley and M. Riordan (2001), “Predatory Pricing: strategic theory and legal policy”, *Georgetown Law Journal*, vol. 89, pp. 2495-2529.

Bolton, P. and J. Farrell, (1990), “Decentralization, Duplication, and Delay", *Journal of Political Economy*, vol. 98, Issue 4, 803-826.

Bouckaert J. and F. Verboven (2003), “Price Squeezes in a Regulatory Environment*”*, *CEPR Discussion Paper* No 3824.

Bresnahan, T. (2001), “Network Effects and Microsoft”, Stanford University, Department of Economics, *Working Paper*.
Carlton, D.W., “Why Barriers to Entry are Barriers to Understanding?”, *American Economic Review*, vol. 94, No. 2, pp. 466-470.

Cabral, L.M.B., and M.H. Riordan, (1994), “The Learning Curve, Market Dominance, and Predatory Pricing”, *Econometrica,* vol. 62, Issue 5, 1115-1140.

Cabral, L.M.B., and M.H. Riordan, (1997), "The Learning Curve, Predation, Antitrust, and Welfare", *Journal of Industrial Economics*, vol. 45, Issue 2, 155-169.

Carlton, D.W., "Why Barriers to Entry are Barriers to Understanding?", *American Economic Review*, vol. 94, No. 2, pp. 466-470.

Chou, G. and O. Shy (1990), "Network Effects without Network Externalities", *International Journal of Industrial Organization*, vol. 8, 259-270.

Chou, G. and O. Shy (1993), "Partial Compatibility and Supporting Services", *Economic Letters*, vol. 41, 193-197

Curch, J. and N. Gandal (1992), "Network Effects, Software Provision and Standardization" *Journal of Industrial Economics*, vol. 40, 85-103.

Church, J. and N. Gandal (2004), "Platform Competition in Telecommunications" *CEPR Discussion Paper No. 4659;* http://ssrn.com/abstract=629206.

Coase, R. (1972), "The Appointment of Pigou as Marshall's Successor", *Journal of Law and Economics*, vol. 15, Issue 2, pp. 473-85.

Crémer, J., P. Rey and J. Tirole (2000), "Connectivity in the Commercial Internet", *Journal of Industrial Economics;* vol. 48(4), pp. 433-72.

Crocioni P. and C. Veljanovsky (2003), "Price Squeezes, Foreclosure and Competition Law- Principles and Guidelines", *Journal of Network Industries*, vol. 4 No. 1 pp. 28-60.

Distaso, W., P. Lupi, and F.M. Manenti (2004), "Platform Competition and Broadband Uptake: Theory and Empirical Evidence from the European Union", *Paper presented at the 2004 EARIE and ITS Conferences.*

Dixit, A. and R. Pindyck (1994), Investment Under Uncertainty; *Princeton University Press*, *Princeton*, *New Jersey.*

Durand, B. (2004), "Pricing abuses under art. 82: A closer look at predation", p*resentation at the Global Competition Law Center Sixth Lunch Talk*, http://www.gclc.coleurop.be/lunchtalk20041102.htm.

Economides, N., (2003), "Competition Policy in Network Industries: An Introduction", *NYU, Ctr for Law and Business Research Paper* No. 03.

Economides, N. (1999), "Real Options and the Costs of the Local Telecommunications Network," in Alleman, J and E. Noam, (eds), *The New Investment Theory of Real Options and its Implications for the Costs Models in Telecommunications*, *Kulwer*.

Economides, N., (1996), "The Economics of Networks" *International Journal of Industrial Organization*, vol. 16, Issue 4, 675-699.

Economides, N., (1989), "Desirability of Compatibility in the Absence of Network Externalities", *American Economic Review*, vol. 79, 1165-1181.

Economides, N. and F. Flyer,(1998), "Compatibility and Market Structure for Network Goods" Stern School of Business, N.Y.U., *Discussion Paper* No. *EC-98-02*.

Economides, N. and C. Himmelberg, (1995), "Critical Mass and Network Size with Application to the US Fax Market", Stern School of Business, N.Y.U., Discussion Paper No. EC-95-11.

ERG (2004), "Bitstream Access", *ERG Common Position – Adopted on 2nd April 2004*, http://www.erg.eu.int/doc/whatsnew/erg_0333rev1_bitstream_access_common_position.pdf.

European Commission (2002a), "Commission guidelines on market analysis and the assessment of significant market power under the Community regulatory framework for electronic communications networks and services", 2002/C 165/03.

European Commission (2002b), " Notice on the application of the competition rules to access agreements in the telecommunications sector", 1998/C 265/02.

European Commission (2001), "Unbundled access to the local loop; implementation of the Regulation", ONPCOM01-10rev2.

Farrell, J., (1998), "Cheap Talk and Coordination", *The New Palgrave Dictionary of Economics and the Law*, McMillan, 224-227.

Farrell, J. and M.L. Katz, (2001), "Competition or Predation? Schumpeterian Rivalry in Network Markets", U.C. Berkeley, Department of Economics, *Working Paper* E01-306.

Farrell, J., and P. Klemperer, (2005), "Lock-in and Compatibility", forthcoming in Amstrong, M. and R.H. Porter (Eds), *Handbook of Industrial Organization Volume 3*, Hardbound, Holland, Elsevier.

Farrell, J. and G. Saloner, (1985), "Standardization and Variety", *Economics Letters* 20, 71-74.

Faull J. and Nikpay A., eds. (1999), "The EC Law of Competition", *Oxford University Press*, Oxford, UK.

Fletcher, A. (2005), "Exclusionary pricing and the CAT", *presentation at the Workshop on Antitrust and Regulation, Bocconi University*.

Foros, Ø and J. Hansen 2001, "Competition and compatibility among Internet Service Providers", *Information Economics and Policy*, vol. 13, 411–425.

Fox, E. (2002), "What is Harm to Competition? – Exclusionary Practices and Anticompetitive Effect", 70 *Antitrust Law Journal*, vol. 7, Issue 2.

Frieden, R. (2000), "Does a Hierarchical Internet Necessitate Multilateral Intervention? paper presented at the 28th Telecommunications Policy Research Conference, September 23-25, Alexandria, Virginia.

Friedman J.W. eds., (1993), "Problems of Coordination in Economic Activity", Kluwer Academic Publishers, Boston.

Fudenberg, D. and J. Tirole (1985), "Pre-emption and Rent Equalization in the Adoption of New Technology", *The Review of Economic Studies*, vol. 52, pp. 383-401.

Fudenberg, D. and J. Tirole (1986), *Dynamic Models of Oligopoly*. *Chur: Harwood Academic Publishers.*

Gandal, N., (2002), "Compatibility, Standardization, & Network Effects: Some Policy Implications" *Oxford Review of Economic Policy*, vol. 18, 80-91.

Gerardin, D. and R. O'Donoghue (2004), "The Concurrent Application of Competition Law and Regulation: the Case of Margin Squeeze Abuses in the Telecommunications Sector", *The Global Competition Law Centre Working Papers Series, GCLC Working Paper 04/05*.

Gerber, D.J. (1998), "Law and Competition in Twentieth Century Europe: Protecting Prometheus", *Oxford University Press*, Oxford, UK.

Giovannetti, G. and C.A. Ristuccia (2003), "Estimating Market Power in the Internet Backbone Using Band-X Data", *DAE Working Paper* No. 0332, University of Cambridge.

Gong, J. and P. Srinagesh (1997), "The Economics of Layered Networks", McKnight, L.W. and Bailey J.P. (Eds.), *Internet Economics,* Cambridge MA, The MIT Press.

Haan, M., (2003), "Vapourware as a mean of entry deterrence", *Journal of Industrial Economics*, vol. 51, Issue 3, 345-358.

Hendricks, K., A. Weiss and C. Wilson (1988), "The War of Attrition in Continuous Time with Complete Information", *International Economic Review*, vol. 29, pp. 663-680.

Hovenkamp, H., (1999), Federal antitrust policy, 2nd Ed. *St. Paul*, MN: West, p. 40.

Junseok, H. and M. B. H. Weiss (2001), "The Economics of QoS Allocation Strategies: An Empirical Study", http://web.syr.edu/~jshwang/resource/isqe-hwang-paper-mit.pdf.

Katz, M. L. and C. Shapiro, (1985), "Network Externalities, Competition, and Compatibility" *American Economic Review*, vol. *75*, Issue 3, 424-40.

Katz, M. L. and C. Shapiro, (1994), "Systems Competition and Network Effects", *The Journal of Economic Perspectives*, vol. 8, 93-115.

Kende, M., (2000), "The Digital Handshake: Connecting the Internet Backbones", Federal Communication Commission, OPP Working Paper.

Kende, M. and D.C. Sicker (2000), "Real-time Services and the Fragmentation of the Internet", paper presented at the 28th Telecommunications Policy Research Conference, September 23-25, Alexandria, Virginia.

King, S. and R. Maddock (2002), "Imputation rules and a vertical price squeeze", *Australian Business Law Review*, vol. 30, No. 1, pp. 43-60.

Koski, H., (1999), "The installed base effect: Some empirical evidence from the microcomputer market", *Economics of Innovation and New Technology*, vol. 8, 273-310.

Koski, H. and T. Kretschmer, (2004), “Survey on Competing in Network Industries: Firm strategies, market outcomes, and policy implications”, *Journal of Industry, Competition and Trade*, vol. 4, Issue 1, 5-31.

Kovacic, W.E. (2004), “Rebates as Abuse of Dominance: From Categories to Concepts”, *presentation at the ACE 2004 Siena Conference*.

Lee, T. and L. Wilde (1980), “Market Structure and Innovation: A Reformulation”, *Quarterly Journal of Economics*, vol. 94, pp. 429-436.

Levy, S., (1996), “Vaporware”, Federal Trade Commission: Mimeo.

Liebowitz, S. J. and S.E. Margolis, (1994), “Are Network Externalities a New Source of Market Failure”, *The Journal of Economic Perspectives*, vol. 8, Issue 2, 133-150.

Liebowitz, S. J. and S.E. Margolis, (1995), “Path Dependence, Lock-In, and History”, *Journal of Law, Economics and Organization*, vol. 11, Issue 1, 205-226.

Loury, G. (1979), “Market Structure and Innovation”, *Quarterly Journal of Economics*, vol. 93, pp. 395-410.

MacKie-Mason., J. K. and H.R. Varian, (2004), “The Economic FAQs About the Internet”, *Journal of Economic Perspectives*, vol. 8, Issue 3, 75-96.

Maldoom, D., R. Marsden, J.G. Sidak, and H.J. Singer (2003), "Competition in Broadband Provision and its Implications for Regulatory Policy", *http://ssrn.com/abstract=463041*

Malecky, E.J. (2002), "The Economic Geography of the Internet's Infrastructure," *Economic Geography*, vol. 78, Issue 4, pp. 399-424.

Malecky, E.J. (2004), "Fiber Tracks: Explaining Investment in Fiber Optic Backbones," *Entrepreneurship and Regional Development*, vol. 16, Issue 1, pp. 21-39.

Marcus, J.S. (2001), "Global traffic exchange among Internet service providers (ISPs)", paper presented at OECD- Internet traffic exchange, Berlin, June 7.

Markus, M.L., (1990), “Critical mass contingencies for telecommunications consumers”, In: Carnevale, M., M. Lucertini and S. Nicosia, (Eds.), Modelling the Innovation: Communications, Automation and Information Systems, IFIP.

Matutes, C. and P. Regibeaus, (1988), “Mix and Match: Product Compatibility without Network Externalities”, *RAND Journal of Economics*, vol. 19, 221-234.

McAfee, R.P., H.M. Mialon, and M.A. Williams (2004), “What is a barrier to entry?”, *American Economic Review*, vol. 94, No. 2, pp. 461-465.

McDonald, R. and D. Siegel (1986), “The Value of Waiting to Invest", *Quarterly Journal of Economics*, vol. 101, Issue 4, pp.707-727.

McKnight, L.W. and J.P. Bailey (1997), (Eds.), *Internet Economics,* Cambridge MA, The MIT Press.

Motta, M. (2004), *Competition Policy. Theory and Practice*, Cambridge, MA Cambridge University Press.

Motta, M. and A. de Streel (2003), “Exploitative and Exclusionary Excessive Prices in EU Law”, *8th Annual European Union Competition Workshop*, June 2003, forthcoming in C.D. Ehlermann and I. Atanasiu, Eds., “What is Abuse of a Dominant Position”, *Hart Publishing*, 2005.

Mukoyama, T. (2003), "Innovation, Imitation and growth with cumulative technology", *Journal of Monetary Economics*, vol. 50, pp 361-380.

Nelson, P. (1970), “Information and Consumer Behavior”, *Journal of Political Economy*, Vol. 78, Issue 2, pp. 311-329.

Norton, W.B. (2001), **“**Internet Service Providers and Peering”, draft version 2.5, http://www.ecse.rpi.edu/Homepages/shivkuma/teaching/sp2001/readings/norton-peering.pdf.

Norton, W.B. (2002), “The Art of Peering : The Peering Playbook”, draft version 1.2, http://www.xchangepoint.net/info/wp20020625.pdf.

OECD (2003), “Broadband Update Driving Growth: Policy Responses”, *Working Party on Telecommunication and Information Services Policies*.

OECD (2002a), “Internet Traffic Exchange and the Development of End-to-End International Telecommunication Competition”, *Working Party on Telecommunication and Information Services Policies*, DSTI/ICCP/TISP(2001)5/FINAL.

OECD (2002b), “Broadband Infrastructure Deployment: The Role Of Government Assistance”, *Working Party on Telecommunication and Information Services Policies.*

OECD (2001), “The Development of Broadband Access in OECD Countries”, *Working Party on Telecommunication and Information Services Policies*.

Ofcom (2004), “Review of the Wholesale Broadband Access market”.

Ofcom (2003), “Consumers’ use of Internet”.

Ofcom (2001a), “ADSL margin squeeze” *Competition Bulletin*, No. CW/00304/11/00.

Ofcom (2001b), “Effective competition review of Internet connectivity”, v0.6, 23, London.

Peretto, P. (1999), "Cost Reduction, entry and the interdependence of market structure and economic growth", *Journal of Monetary Economics*, vol. 43, pp. 173-195.

Pyndick, R.S. (2005), “Sunk Costs and Real Option in Antitrust”, forthcoming in *Issues in Competition Law and Policy*, W. D. Collins, Ed., ABA Press.

Pyndick, R.S. (2004), “Mandatory Unbundling and Irreversible Investment in Telecom Networks”, NBER Working Papers, No. 10287, http://www.nber.org/papers/W10287.

Reinganum, J. (1982), “A Dynamic Game of R and D: Patent Protection and Competitive Behavior”, *Econometria*, vol. 50, pp. 671-688.

Regibeau, P. and Rockett K., (1996), “The timing of product introduction and the credibility of compatibility decisions”, *International Journal of Industrial Organization*, vol. 14, Issue 6, 801-823.

Rochet, J. and J. Tirole (2003), “Platform Competition in Two-Sided Markets”, *Journal of European Economic Association*, vol. 1, Issue 4, pp. 990-1029.

Rutherford, J., A. Gillespie and R. Richardson (2004), 'The Territoriality of Pan-European Telecommunications Backbone Networks”, *GaWC Research Bulletin 136 (A)*, Loughborough University.

Scherer, F.M. (1967), “Research and Development Resource Allocation under Rivalry”, *Quarterly Journal of Economics,* vol. 81, pp. 359-394.

Shmalensee, R. (2004), “Sunk Costs and Antitrust Barriers to Entry”, *American Economic Review*, vol. 94, No. 2, pp. 471-475.

Schoder, D., (2000), “Forecasting the success of telecommunication services in the presence of network effects”, *Information Economics and Policy*, vol. 12, Issue 2 181- 200.

Stango, V., (2004), “The Economics of Standard Wars”, *Review of Network Economics*, vol. 3, Issue 1.

Stigler, G.J. (1968), “Barriers to Entry, Economies of Scale, and Firm Size”, in G.J. Stigler, *The organization of industry*. Homewood, IL: Irwin.

Swann, P., (2002), “The functional form of network effects”, *Information Economics and Policy*, vol. 14, pp. 417-429.

Whish, R. (2003), *Competition Law*, 5th Ed, London,UK, Butterworths.

Vickers, J. (2004), “Abuse of Market Power,” speech to 31st EARIE conference (Berlin, September 3), http://www.ibanet.org/images/downloads/John%20Vickers%20-%20Paper1.pdf.

Williamson, O.E. (1968), "Economies as an Antitrust Defence, The Welfare Tradeoffs", *American Economic Review*, vol. 58, Issue 1, pp.18-36.

Table 1: Relative strengths and weaknesses of Internet access platforms[135]

	Copper loop				Cable	FTTH/C	PLC	Satellite	WiFi	Mobile 3G	FWA	POS
	ISDN	DSL										
		ADSL	SDSL	VDSL								
Deployment												
Current availability	5	5	3	2	4	3	1	3	3	3	3	1
Suitability for urban areas	5	5	5	4	5	4	4	3	4	5	4	4
Suitability for rural areas	2	2	2	1	1	1	4	5	3	3	3	2
User mobility	1	1	1	1	1	1	1	2	3	5	2	2
Quality of service												
Transmission speed	Up to 128 Kbps	Up to 8 Mbps	Up to 2 Mbps	Up to 52 Mbps	128Kbps – 10 Mbps	2-100 Mbps	Up to 45 Mbps	300Kbps– 2 Mbps	Up to 54 Mbps	Up to 2 Mbps	2 – 40 Mbps	Up to 1 Gbps
Symmetric speed	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes[2]	Yes	Yes	Yes	Yes
Degradation to:												
• capacity/shared line	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
• length of line or link	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Yes
Cost & development												
Maturity of technology	5	5	5	3	5	5	2	4	4	3	4	1
Equipment cost	5	5	4	2	5	2	3	3	3	1	3	2
Customer installation cost	5[1]	4[1]	4	2	5[1]	2	3	4	4	5	4	4

This is a rough approximation only, where 5 indicates the strongest and 1 the weakest.
1 Assumes that copper or cable connections are already in place; otherwise installation costs would be much higher, as is the case for VDSL or FTTH.
2 Two-way satellite only

[135] Adapted from Maldom et al (2003).

Table 2: Internet access[1] as a percentage of all Households

	2001	2002	2003
Denmark	59	55,6	64,2
Netherlands		58,0	58,9
Norway			55,3
United Kingdom	40	49,7	55,1
Germany	36	43,3	51,2
Finland	39,5	44,3	47,4
Luxembourg		39,9	45,4
Austria		30,9	36,2
Ireland			35,6
Italy		27,3	30,9
France	18,1	23,0	27,8
Spain		17,4	25,2
Portugal	18	16,0	21,7
Greece		12,2	16,3

1 Internet access via any devices (desktop computer, portable computer, TV, mobile phone etc.).

Source: OECD, ICT database and Eurostat, Community Survey on ICT usage in households 2002, June 2003. Included in the OECD Information Technology Outlook 2004.

Table 3: Internet access penetration[1] in the business sector by size class (2001 or latest available year)

	[10-49]	[50-249]	250 and more	10 and more
Finland	95,1	99,6	99,1	96,0
Sweden	94,3	99,9	98,8	95,2
Denmark	93,6	100,0	98,8	94,8
Austria	82,3	99,7	95,9	85,0
Germany	82,1	97,8	90,4	83,9
Ireland	80,0	96,4	94,5	82,8
Spain	80,1	98,4	93,8	82,6
Norway (2001)	79,0	95,0	96,0	81,5
Netherlands(2001)[2]	78,0	88,0		80,0
Luxembourg	77,4	95,5	82,5	79,0
Switzerland (2000)	76,4	86,6	97,0	78,0
Italy	72,1	94,9	89,1	74,3
Portugal (2001)	71,0	88,3	94,3	71,8
Greece	62,7	95,7	90,9	64,4
UK (2001)	59,4	78,9	90,3	63,4

1. In European countries, only enterprises in the business sector, but excluding NACE activity E (electricity, gas and water supply), NACE activity F (construction) and NACE activity J (financial intermediation), are included. The source for these data is the Eurostat Community Survey on enterprise use of ICT.
2. For the Netherlands, 50-199 employees instead of 50-249.

APPENDIX I – A Model of selective degradation

This appendix presents a model developed by Crémer et al. (2000) addressing the issue of connectivity among private network operators who compete for the provision of universal Internet connectivity to customers. Cremer et al. claim that a dominant IBP would find it profitable to leverage its larger installed base of customers by selectively degrading the connectivity with a targeted peering partner. In order to illustrate this result, a duopoly model of network externalities is stylized first. This simple setting allows to frame the determinants of interconnection agreements between IBPs, which will then serve to deal with the issue of selective degradation in a more complex oligopoly setting.

Base-duopoly model

The base-model is a two stage game where two IBPs (IBP_i; $i = 1,2$) are connected through a peering interface and compete *à la Cournot* over unattached customers. In the first stage of the game, IBPs exogenously choose a quality level, $\theta_i \in [0,1]$, for their side of the connection. The common value will result as the minimum level of commitment between the two IBPs, $\theta = \min(\theta_1,\theta_2)$. In the second stage, IBPs fix their capacities for market expansion simultaneously. Then, given IBPs' capacities, prices, p_i, adjust so as to clear the market. IBPs have asymmetric installed base of customers, with $\beta_i \geq 0$ and $\beta_1 \geq \beta_2$. Actual customers are locked-in in that they face high switching costs (i.e. they are committed into long term non-disposable contracts). Unattached customers value positively network externalities in that their perceived quality of connectivity provision, s_i, depends linearly on the number of connected customers, where the number of customers connected to the other IBP is weighted by the quality of connectivity parameter, θ:

$$s_i = v\left[(\beta_i + q_i) + \theta(\beta_j + q_j)\right], \quad (1)$$

with v reflecting the value of positive network externalities[136] and q_i and q_j the numbers of unattached customers enrolled by IBP_i and IBP_j respectively. Prices adjusted for quality are:

[136] The parameter v has an upper limit: $v < ½$. This upper bound is intended to provide the model with stability conditions: it implies the slopes of the reaction functions being less than unity for any $\theta \in [0,1]$, so that the system will turn back to the equilibrium solution if perturbed. A more intuitive explanation is that the model rules out "corner solutions" whereby the bigger IBP monopolizes the market by foreclosing the rival through selective degradation, because positive network externalities are extremely important in the utility function of customers.

$$P_i = p_i - s_i \tag{2}$$

Demand is given by the following linear equation:

$$Q = 1 - P; \tag{3}$$

and the two equilibrium conditions are:

$$q_1 + q_2 = Q; \tag{4}$$
$$P_1 = P_2 = P. \tag{5}$$

Combining equations (1), (2), (3), (4) and (5) we obtain:

$$\begin{aligned} p_i &= 1 - (q_i + q_j) + s_i; \\ p_i &= 1 + v(\beta_i + \theta\beta_j) - (1 - v)q_i - (1 - \theta v)q_j. \end{aligned} \tag{6}$$

Let c be the constant marginal cost and suppose the cost for IBP_i to provide a level of connectivity θ_i is zero. Being θ_i the private level of connectivity, the level of connectivity at the peering interface is $\theta = \min(\theta_1, \theta_2)$. Given that the profit earned over the installed base is constant, IBPs select quantities so as to maximize their profits:

$$(p_i - c)q_i = [1 + v(\beta_i + \theta\beta_j) - (1 - v)q_i - (1 - \theta v)q_j - c]\, q_i. \tag{7}$$

We solve the game by backward induction.

Stage 2 (quantity).
For any level of θ, the equilibrium quantities can be expressed as:

$$q^*_i = \psi(\theta) + \rho(\theta)\Delta_i, \tag{8}$$

where $\Delta_1 = \beta_1 - \beta_2 = -\Delta_2 \equiv \Delta \geq 0$, $\psi(\theta)$ and $\rho(\theta)$ are respectively increasing and decreasing functions of θ capturing the following effects:

- *Demand expansion effect*: a better connectivity benefits customers and, in equilibrium, increases total demand. This can be viewed by observing that the first term of the right-hand side of (8) is an increasing function of the quality of interconnection parameter θ, and $(q_1^* - q_2^*) = 2\psi(\theta)$;
- *Quality differentiation effect*: as unattached customers perceive *a priori* the two IBPs as perfect substitutes, the dominant IBP will be better

off decreasing the quality of interconnection because of a greater vertical differentiation advantage: the second term of the right-hand side of (8) models this effect where $\rho(\theta)$ decreases as θ grows and $\left(q_1^* - q_2^*\right) = 2\rho(\theta)\Delta$;

Stage 1 (quality of interconnection).
Given the equilibrium strategies of stage 2, each backbone faces the following profit function (up to the constant profit from the installed base):

$$\pi_i = (1 - v)\left(q_i^*\right)^2. \tag{9}$$

Since $\Delta_2 < 0$, $\partial\pi_2/\partial\theta > 0$ for any feasible θ. Therefore, IBP_2 has an incentive to increase quality as much as possible. On the contrary, IBP_1 trades off the positive impact of quality on the market size (described by $\psi(\theta)$) with the quality differentiation effect (described by $\rho(\theta)\Delta_1$). Since quality is determined by the lowest level chosen by the two IBPs, the Pareto efficient equilibrium of the first stage will be:

$$\theta^*_1 = \arg\max\ (1 - v)(q^*_1(\theta))^2;$$
$$\theta^*_2 = \theta^*_1;$$

which means that the quality of interconnection will be lower than what it is desired by the minor IBP.

Note that the equilibrium quality depends negatively on the existing asymmetry between the two IBPs as measured by Δ. In the limit case of $\Delta = 0$, the quality differentiation effect vanishes and both IBPs are better off if they provide perfect connectivity. As long as Δ increases the optimal choice of the dominant IBP in stage 1 is to adopt lower quality of interconnection as the quality differentiation effect becomes stronger and stronger.

These insights are robust over a range of variants of the basic model, such as when quality of connectivity is chosen cooperatively through a Nash bargain with side payments, IBPs compete a *à la Bertrand* in the second stage, or quality of connectivity is endogenously determined on the basis of a bandwidth capacity choice at the peering interface, thus introducing the costs of traffic congestion.

The duopoly model is based on the following simplifying assumptions:

- The installed base of customers cannot switch. This is far from realistic. However, it's dubious whether lower moderate switching costs would favour or not the minor IBP (i.e. with modest switching costs the minor IBP could be commercially aggressive against the dominant IBP or, conversely, be the target of an aggressive commercial offering by the dominant IBP). Moreover, in a dynamic perspective with low switching costs, customers will anticipate that a dominant IBP will increasingly expand its market power and its quality differentiation advantage, and, therefore, would not sign a long term contract with an IBP bounded to marginality. Assuming infinite switching costs is against the dominant IBP, thus making the model more prudent.

- The level of connectivity θ is not contractible by the parties. Instead, it could well be the case that the parties negotiate the level of connectivity. The arrangement would fix a lateral payment to the rival by the IBP that expressed a greater demand for connectivity and, consequently, the resulting level of connectivity would be between the preferred private levels rather then coincide with the lower one. Nevertheless, the authors prove that this alternative assumption does not affect the main results of the model.

- The model prescribes that IBPs compete *à la Cournot*. This assumption implies that IBPs' strategic choices are strategic substitutes and, therefore, their approach in the market is inherently aggressive against competitors.

Oligopoly model
To describe how the targeted degradation strategy works it is necessary to enlarge the competitive field by introducing more than two IBPs. The main results of the preceding analysis will apply as well. Suppose there are four equivalent IBPs ($\beta_i = \beta/4$, with $\beta = \sum_i \beta_i$ for i = 1,2,3,4), two of which merge together: IBP_1 and IBP_4. Thus, the concentration creates a dominant IBP, labelled here IBP_1, with an installed base of size $\beta/2$, competing against two minor players, IBP_2 and IBP_3, each serving an installed base of size $\beta/4$.

First of all, the equilibrium solution, prior to the merger, is the same as the duopoly case with symmetric firms: each of the four equal IBPs agrees to provide costless perfect connectivity with all other IBPs, $\theta^* = 1$, since there is no business stealing effect. Symmetric IBPs enlist an equal number of new customers and earn identical profits.

After the concentration, while minor IBPs prefer to keep perfect connectivity as in the symmetric case, IBP_1 may find it profitable to choose a lower level of connectivity to exploit the business stealing effect by differentiating itself vertically. However, IBP_1 would never wage against both minor IBPs simultaneously (global degradation strategy), because this strategy would restore a situation of symmetry between IBP_1 and the two others targeted together, where each provider could deliver perfect connectivity only to half of the total installed base. Thus, IBP_1 would not enjoy any vertical differentiation advantage. Instead, a demand restriction effect would damage all IBPs proportionally to their relative sizes.

IBP_1 would rather prefer to target only one of the two minor operators, say IBP_3, while maintaining perfect connectivity with the other (targeted degradation strategy). On one hand, this move creates a quality differentiation advantage *vis-à-vis* the targeted IBP; on the other hand, it induces a contraction of demand due to the lack of connectivity over the quarter of the installed base served by IBP_3 and from a quality differentiation disadvantage *vis-à-vis* IBP_2, which would maintain perfect connectivity to all the Internet.

It is necessary to compare the payoff of a selective degradation strategy with the payoff of an accommodation strategy (maintaining perfect connectivity, $\theta^*= 1$, with both minor IBPs). Crémer et al. prove that for sufficiently large values of positive network externalities (modeled by the parameter v) the strategy of selective degradation leaves the dominant IBP better off. A targeted degradation strategy will be even more appealing to IBP_1 if the quality of interconnection were to be costly (indeed, whether or not $F(\theta) > 0$, perfect connectivity will never be the optimal choice from both social and private perspective).

The strategy of selective degradation would be feasible unless IBP_2 provides IBP_3 with transit service and, therefore, restores a situation of perfect connectivity all over the installed base, overturning the quality differentiation advantage the dominant IBP would have gained over IBP_3.

From a static point of view, IBP_2 would find it profitable not to deliver transit to IBP_3 because, by refusing it, IBP_2 (connected to all the installed base) would gain a quality advantage over both IBP_1 (connected to ¾ of the installed base) and IBP_3 (connected to only ½ of the installed base), and thus would exploit a business stealing effect even stronger that the one pursued by IBP_1. If the payoff from this business stealing effect overshadows transit revenues, to refuse transit to IBP_3 would be the preferred strategy for IBP_2.

From a dynamic point of view, it might be myopic to refuse transit to IBP_3, because, once IBP_1 has succeeded in driving IBP_3 out of the market, or, at least, in downgrading IBP_3, IBP_2 could be the next target of IBP_1. Therefore, IBP_2, anticipating this, might support IBP_3 to counter IBP_1's attack by providing transit even if not economically convenient in the short run. However this argument is not conclusive either, because by refusing transit IBP_2 might increase its market share period after period to a threshold such that IBP_1 would prefer an accommodation strategy, since the two remaining competitors are no longer sufficiently asymmetric to justify a degradation strategy ($\Delta = \beta_1 - \beta_2 > 0$ has shrunk so much that the business stealing effect would be less than the demand restriction effect). The lower the positive network externalities and the greater the total installed base of customers the more likely the accommodation for IBP_1.

In any case, IBP_1 could actively pre-empt IBP_2 from overturning its aggressive move against IBP_3 (by providing IBP_3 with transit): IBP_1 could constrain the interface with IBP_2 so as to make transit provision unfeasible unless traffic congestion at the peering interface between IBP_1 and IBP_2.

Comment

The previous model describes a game where IBPs are vertically differentiated and compete *à la Cournot*. This framework entails that IBPs' choices on quantities are strategic substitutes and, therefore, IBPs interact aggressively against each others. With respect to the selection of the degree of connectivity, this setting implies that the equilibrium level of interconnection quality will be lower then the socially preferred level, as each decision maker will disregard the benefits from a higher level of connectivity to the rival IBPs' customers.

However, alternative competition frameworks are equally plausible and, consequently, conclusions may be quite different. Notwithstanding the importance of vertical differentiation, IBPs may also be perceived as horizontally differentiated by customers, in that geographic proximity may be valued as an important feature in the offering of an Internet connectivity supplier. Insofar as this assumption is plausible, horizontal differentiation makes competition *à la Bertrand* a more interesting setting. Indeed, assuming that IBPs choose prices rather than quantities and that they are horizontally other than vertically differentiated, IBPs' moves will be strategic complements rather than substitutes. Therefore, their attitudes towards competitors will be cooperative instead of aggressive and this suggests an opposite outcome to the Cournot-like case, as regards the degree of connectivity at equilibrium.

Foros and Hansen (2001) presented a duopoly Hotelling model of price competition with spatial differentiation. In this model the quality level chosen by the two IBPs exceeds the socially optimal one. This is due to a strategic externality. Each firm raises its price twice: because of higher consumer valuations due to positive network externalities, and because of the price increase by the competitor (prices are strategic complements).

APPENDIX II - How to measure the incentive to degrade

In both the *WorldCom/MCI* (1998) and *WorldCom MCI/Sprint* (2000) merger decisions, the EC Commission took the view that the notified concentrations would have created a network of such absolute and relative size that the combined entity could have behaved to an appreciable extent independently of its competitors and customers. In the Commission view the post-merger dominant IBP would have had the incentive and ability to exert its market power by selectively degrading the connectivity of its competitors. This would have allowed it to control both actual and potential competitors as well as customers in the market. In order to demonstrate that the merger would have seriously threatened competition in the common market, it was essential that market shares be recorded accurately. Yet, the Commission registered the lack both of any reliable publicly available estimate of the size either of the Internet sector as a whole or of any relevant sub-sector, and of a general consensus on a preferred measurement unit. Given that there were no available statistics, two alternatives were available to the Commission for calculating market shares: the first one relied on revenue figures, the other on traffic flows.

Market shares based on revenues
Revenue figures for calculating market shares should be those from the provision of dedicated access only. However, not all respondents to the Commission inquiry were able to provide revenue figures disaggregated for different lines of Internet services. Therefore, the Commission took into account revenues of IBPs from the overall range of Internet services (dial-up, dedicated access, hosting, etc.).

Market shares based on traffic flows
The use of traffic flows was reckoned to be even more troublesome as there are accounting differences among the various sources of information. Moreover, there are topological differences in network architectures across IBPs (geographically distributed vs. centralized architecture) which imply different amount of backbone traffic simply as a result of the network architectures deployed rather than of the differences in relative market size across IBPs. Notwithstanding these difficulties, market shares based on traffic flows were deemed to be a better proxy of the size and dimension of the firms, and, therefore, of market power.

Since there are no statistics directly available on the overall traffic volumes sent or received by networks, the EC Commission employed relative traffic ratios instead of aggregate traffic figures. The total traffic flow of any given network includes its internal traffic (on-net traffic) and the traffic exchanged with other identified networks through peering interconnection points (off-net traffic). Assuming, for simplicity, the presence of just three IBPs, labelled *A*, *B* and *C*, then:

$$t_A = o_A + e_A;$$
$$e_A = e_{A,B} + e_{A,C};$$

where t_i is the overall amount of traffic of any given network *i*, o_i and e_i are respectively its on-net and off-net traffic volumes, and $e_{i,j}$ is the quota of off-net traffic exchanged with an identified peering partner *j* with $i,j = A, B$ and C; $i \neq j$. Note that $e_{i,j}$ refers both to the traffic sent from network *i* to network *j* and to the traffic received by network *i* from network *j*. The ratio of the market share of, say, network *A* to the market share of network *B*, s_A/s_B, is equal to the ratio of relative share of network *A* to the total traffic flowing through network *B* to the relative share of network *B* to the total traffic flowing through network *A*:

$$s_A = \frac{t_A}{t}; \frac{s_A}{s_B} = \frac{t_A}{t}\frac{t}{t_B};$$
$$\frac{s_A}{s_B} = \frac{t_A}{t_B}\frac{e_{B,A}}{e_{A,B}} = \frac{e_{B,A}}{t_B}\frac{t_A}{e_{A,B}};$$

Where $t = \sum_{i=A,B,C} t_i$. Therefore, market shares ratios can be calculated using two variables generated by the two networks separately. These are the ratios $e_{i,j}/t_i$, i.e. the volume of off-net traffic over the total traffic of the same network. If the network uses different measurement methodologies and these affect in the same way the measurement of both off-net and total traffic, then the ratio between these two values should not change, thus providing a consistent and comparable measure:

$$s_A = \left(1 + \frac{s_B}{s_A} + \frac{s_C}{s_A}\right)^{-1}.$$

Other measurement units

The EC Commission mentioned several alternative value drivers in order to estimate IBPs' market shares, notably:

- Aggregate capacity in interconnection links;
- Number of addresses reachable;
- Numbers of points of presence (POPs);
- Actual bandwidth used for traffic exchange.

As regards aggregate capacity, the Commission claimed that "the obtainable data were not comprehensive to enable any firm conclusion to be reached on the basis of using capacity figures only". The second unit of measure was deemed of no significance because it appeared that most network were capable of delivering to 100% of reachable addresses. On POPs it was argued that network architecture differences across IBPs could invalidate the apparently strong relationship between the number of POPs and the size of a network.

Comment

Going back to the traffic ratio methodology, it is worth highlighting that, in order to deliver significant information about market power and the relative incentive to exert it by targeting IBP competitors, this computational method implies strong assumptions about IBPs' network architectures and the Internet hierarchical structure. According to Besen et al. (2002), easing each of these assumptions would make the industry picture provided by the use of traffic ratios no longer appropriate or, even worse, misleading.

Insofar as the strategic leverage of a dominant IBP is its relatively large base of connected end users (served either directly or through its ISP customer) and, accordingly, its relative independency in respect to competitors, measuring market power by the use of traffic ratios is misleading unless there is an equal size distribution among IBPs' customer base (i.e. second level ISPs).

The problems that arise from the use of traffic ratios in measuring market shares can be illustrated by an example. Assume, for simplicity, that there are only two IBPs each connecting to an equal number of end users, but the first one serving two ISPs each with 4 end users, and the second serving four ISPs each with 2 end users (Figure 1). Here, the Internet is outlined as a rigid hierarchy in that the two IBPs' hierarchies can connect only through a primary peering relationship between the two IBPs (no secondary peering relationship is available). Assume that each end user communicates equally with every other end user (one unit of traffic *per* every other end user).

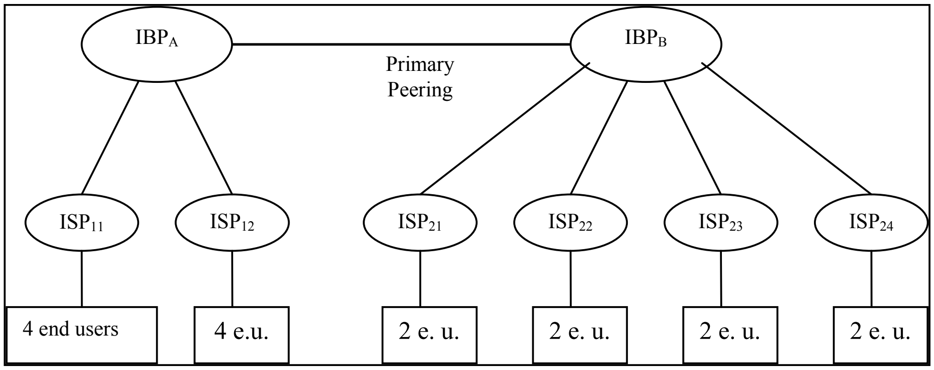

Figure 1

As the aggregate number of end users each IBP serves is exactly the same, no one should have incentives to degrade the primary peering interconnection because of the perfect symmetry in terms consumer base. Accordingly, the index used to proxy market power should signal a perfect balance among competitors and, hence, no incentive to degrade. Instead, the EC Commission traffic ratios methodology provides a misleading picture.

Since there are 16 end users, each of them will send and receive 15 units of traffic. The total volume of traffic is 240 units. Of this traffic, an amount of 32 units will be directly delivered by ISPs as it is exchanged between end users connected to the same ISP. The remaining 208 units of traffic, *t*, will be exchanged using the network of at least one IBP. Each ISP served by IBP_A will send to IBP_A 12 units of traffic *per* subscriber, 4 of which will be delivered on-net to the end users connected to the other ISP in the IBP_A's hierarchy. Considering all end users encompassed within IBP_A's hierarchy, this amount to a total volume of on-net traffic, o_A, of 32 units and a volume of outgoing off-net traffic of 64 units (from the perspective of IBP_B, this corresponds to the volume of incoming off-net traffic). The same for IBP_B's hierarchy gives $o_B = 48$ and a volume of outgoing traffic of 64 units. Hence, summing up outgoing and incoming off-net traffic gives: $e_{A,B} = 128 = e_{B,A}$; $t_A = o_A + e_{A,B} = 160$ and $t_B = o_B + e_{B,A} = 176$. Traffic ratios are: $e_{A,B}/t_A = 4/5$ and $e_{B,A}/t_B = 8/11$. Finally, the ratio of IBP_A's market shares to that of IBP_B is: $s_A/s_B = 10/11 < 1$. Hence, the traffic ratio methodology will mistakenly signal that IBP_B is bigger than its rival and will have incentives to selectively degrade the primary peering connection. The more asymmetric are customer size distributions among IBPs, the more distorted is the industry picture provided by traffic ratios.

The informative distortion will be even more serious if the assumption of a rigid hierarchy is relaxed. The most significant technique to make ISP customers less dependent on their vertical linkages with IBPs is to establish secondary peering arrangements between themselves in order to directly deliver each other traffic at destination within each other consumer base. By reducing the amount of traffic exchanged over the primary peering interfaces, these second-level peering agreements should restrain the room of manoeuvre for IBPs to strategically degrade top-level peering linkages, since the quotas of degradable traffic to the total traffic is reduced. Accordingly, other things being equal, the proxy used to signal the extent of market power among IBPs should register this shift. The following example shows that the traffic ratio methodology not only ignores it, but also provides opposite signals.

To isolate the distorting effect of the sole introduction of a secondary peering linkage between an ISP served by IBP_A and another served by IBP_B, it is assumed an equal ISP size distribution between the two IBPs' hierarchies (each ISP serves three end users). To make the example meaningful it is assumed that IBP_B has a larger end user installed base (IBP_A connects with two ISPs while IBP_B connects with three ISPs), such that before setting up a secondary peering interface in accordance with the approach adopted by the EC Commission, IBP_B will have some incentive to degrade the primary peering interconnection ($s_A/s_B = 7/9 < 1$) (Figure 2). So far, no distortion has occurred. Once a secondary peering has been established, say, between ISP_{12} and ISP_{21}, computation of traffic ratios becomes trickier because some traffic from subscriber to an ISP with secondary peering can follow alternative routes from origin to destination.

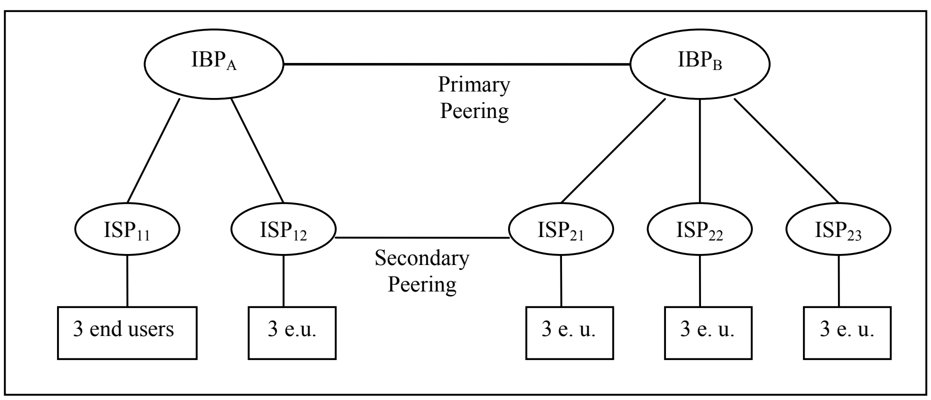

Figure 2

Since there are 15 end users, each of them will send and receive 14 units of traffic. The total volume of traffic is 210 units. Of this traffic, an amount of 30 units will be directly delivered by ISPs as it is exchanged between end users connected to the same ISP, and 18 units will be transmitted over the secondary peering interface between ISP_{12} and ISP_{21} (absent the secondary peering agreement, this volume will be part of the off-net traffic and the total traffic of each IBP, $e_{i,j}$ and t_i). The remaining 162 units of traffic, t, will be exchanged using the network of at least one IBP. ISP_{11} will send to IBP_A 12 units of traffic *per* subscriber, 3 of which will be delivered on-net to the end users connected to ISP_{12}, while ISP_{12} will send to IBP_A only 9 units of traffic *per* subscriber, 3 of which destined on-net to ISP_{11} end users. Thus, the amount of on-net traffic for IBP_A is 18 units, o_A, and the volume of outgoing off-net traffic of 45 units (from the perspective of IBP_B, this corresponds to the volume of incoming off-net traffic). The same for IBP_B's hierarchy gives $o_B = 54$ and a volume of outgoing traffic of 45 units. Hence, summing up outgoing and incoming off-net traffic gives: $e_{A,B} = 90 = e_{B,A}$; $t_A = o_A + e_{A,B} = 108$ and $t_B = o_B + e_{B,A} = 144$. Traffic ratios are: $e_{A,B}/t_A = 5/8$ and $e_{B,A}/t_B = 5/6$. Finally, the ratio of IBP_A's market shares to that of IBP_B when a secondary peering has been established is: $s_A/s_B = 3/4 < 7/9$.

Thus, contrary to the model of selective degradation, when market shares are computed using traffic ratios, the larger IBP appears to gain market power as the extent of secondary peering increases. The misleading picture that results from the use of traffic ratios whenever the Internet underpins an increasing dynamics toward a proliferation of secondary peering arrangements is as much the same as where ISPs succeed in reducing their reliance on IBPs by the use of techniques such as multihoming, catching, mirroring and content delivery. Indeed, the more intense is the use of these techniques and, thus, the lower is the amount of degradable traffic, the less appropriate is the information provided using traffic ratios.

The EC Commission (2000) recognized the developments the Internet has recently underscored because of the increasing adoption of these new techniques. However, the Commission kept the view that "despite increased use of such techniques, there is a continued strong dependence on top-level connectivity providers to obtain universal (global) connectivity" [2000, para. 58]. This implies that the traffic ratio methodology will be granted continuing significance until new technologies will reduce dependency upon IBPs.