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Ralf Dewenter

Jürgen Rösch

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Department of Economics
Fächergruppe Volkswirtschaftslehre

Autoren / Authors

Ralf Dewenter
Helmut Schmidt Universität Hamburg
Department of Economics
Holstenhofweg 85, 22043 Hamburg
Germany
dewenter@hsu-hh.de

Jürgen Rösch
Helmut Schmidt Universität Hamburg
Department of Economics
Holstenhofweg 85, 22043 Hamburg
Germany
roesch@hsu-hh.de

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Helmut Schmidt Universität Hamburg / Helmut Schmidt University Hamburg
Fächergruppe Volkswirtschaftslehre / Department of Economics

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Koordinator / Coordinator

Klaus B. Beckmann
wp-vwl@hsu-hh.de

Helmut Schmidt Universität Hamburg / Helmut Schmidt University Hamburg
Fächergruppe Volkswirtschaftslehre / Department of Economics

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RALF DEWENTER

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Zusammenfassung/ Abstract

This paper analyses the incentives of a vertical integrated Internet service provider (ISP) to block competitors from content markets. Using a simple model we find that the ISP does not block competing content providers as long as the contents are differentiated sufficiently. Exclusion only takes place when the competitor offers perfect homogeneous content and the ISP has a local monopoly over its Internet access customers or if network effects are strong. In this case, however, the abuse of market power can at least in Europe be prohibited by competition authorities. That is, according to our model there is no need for a regulation of net neutrality.

JEL-Klassifikation / JEL-Classification: L12; L82; L86; K20; D40

Schlagworte /Keywords: net neutrality; competition; Internet service providers

1 Introduction

Network neutrality is still a hotly debated issue in the United States as well as in Europe. Broadly speaking, net neutrality is the principle that all data on the Internet should be treated equally and non-discriminatory – independently from the source or the contents of the data. Proponents of net neutrality claim that a neutral net has numerous advantages over non-neutrality, including non-discriminatory behaviour of network operators or higher incentives for innovation at the edge of the net.

Technical innovations such as deep packet inspection made a much more efficient handling of data feasible. Applying these technologies, however, require a stronger discrimination of data as before and thus lead to a non-neutral Internet. Deep packet inspection allows for innovations at the core as well as at the edge of the net and for the application of different new services and pricing schemes. It may also come with some drawbacks such as possible discrimination of competitors or welfare-reducing price discrimination. Proponents of net neutrality thus argue that all data should still be treated equally.

The literature on net neutrality distinguishes between different effects of non-neutral Internet: Blocking or exclusion of competitors, quality discrimination (this is usally referred to as quality of service), price discrimination and effects on innovative activity. Another strand of literature argues that there should be a zero-price rule, meaning that ISPs are not allowed to charge content provider a to reach their customers (Schuett, 2010), as this would equal a termination fee. Currently, end-users as well content provider pay an ISP to access the Internet. The zero-price rule says that content provider do not have to pay further fees to access networks of other ISPs. One of the most notably proponents of the zero-price rule, Lee and Wu (2009), argue that it can be welfare enhancing and lead to a higher degree of innovation. Armstrong (2006) shows in a more general two-sided market model that membership fees may reduce welfare. Economides and Tåg (2012) also find that for some parameter constellation the zero-price rule increases welfare. The result, however, depends strongly on the parameter range. Welfare increasing effects are, nevertheless, found for both monopoly and duopoly.

Quality discrimination instead means that data package may be treated differently when transported over the net. This may help to prevent congestion and to price consumers according to their preferences and willingness to pay (see e.g. Litan & Singer, 2006). End-users having a higher willingness to pay for uninterrupted traffic could be prioritized in case of congestion. Users of Voice-over-IP, online games or other time critical applications could buy a guaranteed prioritized treatment which applies in case of congestion. Users of non-time critical applications would not notice this prioritization as short interruptions or delays do not matter to them. Economides (2008) and Van Schewick (2006), however, see potential competition problems as ISP could either give priority to certain content providers and thus harm other content providers. The ISP could then extract the higher willingness to pay of the not-prioritized content provider. This, of course, depends on the market power of the ISP. Van Schewick (2006) additionally argues that a vertically integrated ISP could lower the quality of competing content providers, which would lead to higher profits in the end-user market.

Price discrimination is assumed to have positive effects on welfare as long as quantities are increased (see e.g. Varian, 1989). Price discrimination and net neutrality is considered for example by Hermalin and Katz (2007) and Krämer and Wiewiorra (2012). Schuett (2010) gives a neat overview over their arguments. Innovation and net neutrality is debated controversially by e.g. Choi and Kim (2010), Economides (2008), Wallsten and Hausladen (2009), Hermalin and Katz (2007), or Vogelsang (2007).

In this paper, we focus on the incentives of an integrated ISP to excluded or discriminate competitors from content markets. A vertically integrated Internet service provider could thus have incentives to prioritize own content over competitors' content or, even worse, to fully block competitors' content in the downstream market. The situation that the ISP holds a regional monopoly in the access market could be considered analogous to a simple essential facility problem (see Laffont & Tirole, 1994). The aim of this paper is, in absence of any other net neutrality issues, to identify cases in which a monopolistic ISP has an incentive to exclude content providers from its network.

The one-monopoly-rent theorem Bowman (1957) claims that a monopolist in the primary market has no incentive to additionally monopolize the secondary market.

With respect to net neutrality it means that an integrated ISP which has a monopoly over end-users, does not have an incentive to exclude its competitor from the content market. Even more, according to the internalizing-complementary-efficiencies (ICE) concept (see Farrell & Weiser, 2003) the integrated ISP has an incentive to allow the competing content provider access to its end-users (if this access is efficient). However, several factors, however, can lever out the ICE: a) Regulation or possible regulation in the monopoly market, b) the possibility to price discriminate which leads to an efficient monopolization of the content market, c) the access leads to higher competition in an affiliate market (e.g. advertisement), d) irrational behaviour of the monopolist, e) problems in the negotiation process between ISP and content provider and finally g) incomplete complementarity between the content provider the ISP market (Farrell & Weiser, 2003).

Van Schewick (2006) applies the arguments of Farrell and Weiser (2003) to formulate incentives of monopolistic ISP to block competing content providers. She inter alia states that there are three possible situations where (i) integrated and monopolistic ISPs can increase their profit in the content market by blocking competing competitors , (ii) integrated and monopolistic ISPs can increase their advertisement revenues in the content market if they foreclose it and (iii) integrated and monopolistic ISPs can monopolize the global content market by excluding all competitors. Of course, case (iii) cannot be taken as a serious objection, as in most if not all cases, the uncountable number of content providers in the Internet makes it impossible to monopolize the global markets. To put differently, it would turn out to be a Sisyphus task to fight all new content providers.

Chen and Nalebuff (2006) show in a model with complementary goods whereas one is essential (upstream market), that the owner of the essential good does not have an incentive to exclude the other producer. This holds true whether the owner of the essential good competes in the non-essential good (downstream) market or not. In case of competition in the downstream market, the owner of the essential good would compete in the downstream and enhance the price in upstream market to extract to monopoly rent. This is in line with the one-monopoly-one-rent theorem. Empirical evidence, however, shows that integrated cable networks in the US, which offer both cable service and TV programs, offer fewer competing TV stations than non integrated networks (Chipty, 2001). Also, in Europe some mobile telephony networks chose to block Skype, as the Voice-over-IP service competes directly with the telephone revenues of the operators. In the Madison River case the FCC prohibited the blocking of Voice-Over-IP services by the DSL provider Madison River Communication.

In this paper, we theoretically analyse the incentives of an integrated Internet service provider to block competitors from the content market. We add to the discussion on net neutrality by focusing explicitly on the blocking incentives in two-sided markets. Blocking is, under the absence of collusive behaviour, only likely to occur in monopolistic markets, thus we model an vertically integrated ISP which holds a monopoly in the access market as well as in the content market. The ISP sets optimal quantities in both markets as well as an access fee for a possible newcomer in the upstream market.[1] The content provider is assumed to be able to enter the content market only through the ISPs essential facility, i.e. access network.

Vertical integrated Internet service provider serving access markets as well as content markets. End-users benefit from more and better content and content providers benefit from a higher number of users (or recipients). Vertically integrated ISPs are therefore characterized by two-sided indirect network effects (see e.g. Rochet & Tirole, 2003; Armstrong, 2006). Indirect network effects between content providers and end-users may contradict the incentive of the integrated ISP to block competitors: In case that end-users benefit greatly from the existence of further content, the integrated ISP may allow competitors to enter its network and charge end-users higher prices. The increasing utility of end-users through more content and hence the internalization of the indirect network effects could outweigh losses due to higher competition in the content market. Thus, the integrated ISP faces two effects: first, competition leads to reduced profits in the content market and, second, stronger indirect network effects increase its profits in the end-user market. If indirect network effects play a minor role,

[1] We chose a Cournot model with quantity setting as indirect network effects depend on the quantity of the other market not on the price. This also differentiates the model from the multi-product monopolist or normal complementary goods. Here, the price of the other product is not important for the utility of the other group of consumers but solely the realized quantity on the other market.

the competition effect may dominate the network effect and the integrated ISP may find it profitable to block competitors.

Assuming, at first, totally differentiated products (contents) we find no incentives to block entry, independently whether end-user in the local access market benefit from the additional content or not. This result is very intuitive as the ISP is able to extract additional profits in the access market. In case that the ISP and the content provider offer imperfectly differentiated content, however, blocking can possibly occur. But this is only likely if contents are sufficiently homogeneous or if network effects are strong. That is, if the ISP losses on the content market are high or if exploiting additional network effects is not profitable. In case that contents are considered perfect substitutes the ISP always blocks entry.

The remainder of the paper is organized as follows. In the following section we develop a model of a vertically integrated monopolistic Internet service provider serving both an access market as well as a content market. We then analyse the incentives of the ISP to prevent entry in the content market by setting prohibitive access fees for a newcomer. At first we assume that content is financed by charging end-users for content. The paper concludes with a discussion of the results and some policy implications.

2 Model

The core of the model is a monopolistic and vertically integrated Internet Service Provider (ISP). The different markets served by the integrated ISP are partially connected via indirect network effects. The ISP offers four services: Internet access and free content to end-users, advertising space to advertisers and access to its local network to other content providers.

Internet access customers benefit over an indirect network effect d from (local) content the ISP provides. The inverse demand function of that market is shifted outwards by the amount of content (which is proxied by advertising space) multiplied with the network effect. The more content the ISP offers, the more valuable is the Internet access for end-users. On the other hand, the demand for content is also shifted outwards by the amount of Internet access customer the ISP attracts. Thus, we consider a typical two-sided market with positive network externalizes. The more users decide to join the network of the regional ISP, the more local content is offered. And likewise: the more local content is offered, the more attractive it becomes for end users in the region to join the network of the local ISP.

For matters of simplicity, we assume that the influence of the content market to the Internet access market is measured by the amount of advertisement space. The advertisement space is therefore used as a measure of the size of the content market. If consumers perceive advertisement as disturbing the influence the indirect network effect would decrease. But even without this effect the ISP would still behave in the same way, he would – as we will show – still deny access when the products are perfectly homogeneous. The indirect network effect to the Internet access market, however, shows the trade-off the ISP faces and therefore models the decision of the ISP more realistic.

We assume, furthermore, that the market is not emerging and that there is no additional market enlargement effect caused by indirect network effects. Thus, the sum of indirect network effects $d + (1 - d)$ always adds up to one. It is important for the ISP to identify the market which exerts the stronger indirect effects. The market which benefits stronger from the connection then subsidizes the market which exerts the stronger indirect network externalities. By these means, the network effects can be optimally internalized by a monopolistic ISP (Dewenter & Rösch, 2012).

We analyse the incentives of the ISP to exclude rivals from the content market by setting prohibitive access fees in five different cases. With every case we gradually enhance the degree of competition between the content offered by the ISP and the content provider. Furthermore, the integrated ISP may also benefit from allowing additional content in its local network. Internet access for customers can become more valuable as more content is available (Case III-VI).

Table 1 shows inverse demand functions of the integrated ISP and the content provider as well as profit functions for the five cases. Case I serves as the benchmark case. In absence of any content provider the integrated ISP offers internet access, free content to its local customers and advertisement space to advertisers. Internet access becomes more valuable the more content is available. Customers in the content market, on the other hand, also benefit from more Internet access. Case II shows that the integrated ISP benefits from allowing access, even though the local customers do not benefit from the additional content. Case III and IV analyse how the access fee t changes when local customers benefit also from the content provided by the content provider (Case III) and when the content provider also benefits from local customers (Case IV). Case V introduces competition between the integrated ISP and the content provider. Content is assumed to be differentiated, however, internet access customer benefit more, from differentiated contents on sense that additional contents or services are then available.

Case	Vertically Integrated ISP	Content Provider	Competition	Network Effect of CP
Case I	$p = 1 - q + ds_I$ $r_I = 1 - s_I + (1-d)q$ $\pi_I = (1 - q + ds_I)q + (1 - s_I + (1-d)q)s_I$	- -	no	-
Case II	$p = 1 - q + ds_I$ $r_I = 1 - s_I + (1-d)q$ $\pi_I = (1 - q + ds_I)q + (1 - s_I + (1-d)q)s_I + ts_C$	$r_C = 1 - s_C$ $\pi_C = (1 - s_C - t)s_C$	no	no
Case III	$p = 1 - q + d(s_I + s_C)$ $r_I = 1 - s_I + (1-d)q$ $\pi_I = (1 - q + d(s_I + s_C))q + (1 - s_I + (1-d)q)s_I + ts_C$	$r_C = 1 - s_C$ $\pi_C = (1 - s_c - t)s_C$	no	one-sided
Case IV	$p = 1 - q + d(s_I + s_C)$ $r_I = 1 - s_I + (1-d)q$ $\pi_I = (1 - q + d(s_I + s_C))q + (1 - s_I + (1-d)q)s_I + ts_C$	$r_C = 1 - s_c + (1-d)q$ $\pi_C = (1 - s_c + (1-d)q - t)s_C$	no	two-sided
Case V	$p = 1 - q + d(s_I + (1-\theta)s_C)$ $r_I = 1 - s_I - \theta s_C + (1-d)q$ $\pi_I = (1 - q + d(s_I + (1-\theta)s_C))q + (1 - s_I - \theta s_C + (1-d)q)s_I + ts_C$	$r_C = 1 - s_c - \theta s_I + (1-d)q$ $\pi_C = (1 - s_c - \theta s_I + (1-d)q - t)s_c$	yes	two-sided

Table 1: Structure of the Model

2.1 Basic Set-up

To analyse the incentives to exclude rivals from its access network in the upstream market, we assume the existence of an integrated ISP who offers Internet access (upstream market) to end-users and other Internet platforms. The ISP also provides free content in the downstream market (see figure 1) in order to sell advertising space to advertising customers. In the Internet access market the ISP is assumed to have a local monopoly. Customers in the respective region can access the Internet only through this monopolistic access provider. Given that vertical market size as well as the slope of the demand function is normalized to one, the ISP faces the inverse demand function for Internet connections:

$$p = 1 - q + ds_I. \tag{1}$$

where p is the access charge, q the demand for internet access, s_I the advertisement space provided by the ISP and d is an indirect network effect measuring the impact of the amount of content on the end-users' willingness to pay for access. Customers benefit from the Internet access as well as from the (regional) content provided by the integrated ISP. As the content is offered at no charge, we use the advertisement space as a proxy for content.[2] Advertising space can only be sold in a bundle with content, so the amount of advertisement space measures content and can therefore be interpreted as a measure of the amount of content or even its quality. Note that even if consumers perceive advertisement as disturbing, the net utility of content bundled with advertisement must be positive. The stronger the ad aversion of the consumers, the smaller the indirect network effect d. Hence, the model also incorporates the case when the net utility from the content and advertisement bundle is zero ($d = 0$) or even negative ($d < 0$).

The inverse demand function for advertisement is:

[2] Especially Internet platforms are not able to provide unlimited amount of advertising space. With each website or article provided there is only a limited number of banners, pop-ups or integrated ads to be sold. We therefore assume that there is a fixed ratio of content and advertising space and therefore also a limited advertising capacity. By this means, Cournot competition in hte advertising market as well as in the access market seem to be a valid assumptions.

$$r = 1 - s_I + (1-d)q, \tag{2}$$

where r is the advertising rate. The sum of network effects $(d+(1-d))$ is normalized to one to prevent strong shifts of the inverse demand functions caused by indirect network effects.

Furthermore, the integrated ISP is also able to grant access to its network to a pure content provider (CP) which then serves end-users with its own content in the downstream market. Suppose that also the content provider offers free content and sells advertisement space to advertisers itself. If the content provider decides not to serve the local customers of the integrated ISP (but Internet users from other regions instead) he faces the following demand function:

$$r_C = 1 - s_C, \tag{3}$$

where r_C is the price for CP's ads and s_C is the amount of advertisement space provided. As services such as streaming platforms generate significant traffic per customer, we assume the ISP will not charge a lump sum fee for access but an access charge t depending on the amount of usage.

In this case, for simplicity we assume that advertising demand is independent from the local customers, that is, there are no indirect network effect at work.

2.2 Case I: Benchmark Case

In our benchmark case the ISP is assumed being monopolist in the local access market and and also serving a monopolistic content market. When assuming at first the absence of a competitor in the downstream market and also that costs are negligible the ISP's profit function is:

$$\pi_I = \big(1 - q + ds_I\big)q + \big(1 - s_I + (1-d)q\big)s_I. \tag{4}$$

Maximizing profits with respect to the amount of Internet access and the amount of advertisement space optimal quantities, prices and profits can be derived. The vertical integrated ISP offers $q = 1$ for the price of $p = d$. In the advertisement/content

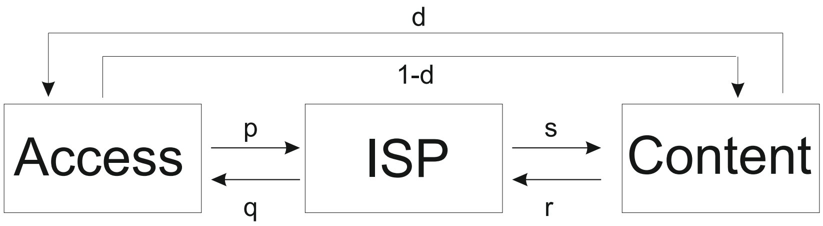

Figure 1: Benchmark Case

markets the optimal quantity is also $s = 1$ which leads to a price $r = 1 - d$. The network effect d directly affects the optimal access charge as well the optimal price for content. If one of the two networks produce a higher network effect than the other then the respective price at this market will be relatively low in order to exploit the higher externality. Put differently, a, e.g., high network effect from content to Internet access leads to a high access price and a low price for advertising. The profit of the ISP is independent from network effects and equal to $\pi = 1$. Due to the fixed market enlargement effects caused by the network effects profits of an integrated ISP double in comparison to a usual multi-product monopolist serving two independent markets. Given the assumptions of our model, these results are identical with that of a typical two-sided platform.

2.3 Case II: Access of a Content Provider Offering Non-local Content

We now analyse the incentives of the vertical integrated ISP to grant a content provider access to the content market that seeks to offer perfectly differentiated content to (non-local) Internet users (see figure 2). The CP is also assumed to offer monopolistic contents. As the CP does not have an own network, it relies on the infrastructure of the vertical integrated ISP.

In order to give the CP access to the internet, the ISP charges an access charge t. In case that the content provider sells (non-local) content, i.e. that the access customers are not interested in CP's content and therefore no network effect from the amount of content provided by CP (approximated again by advertisement space) and the demand

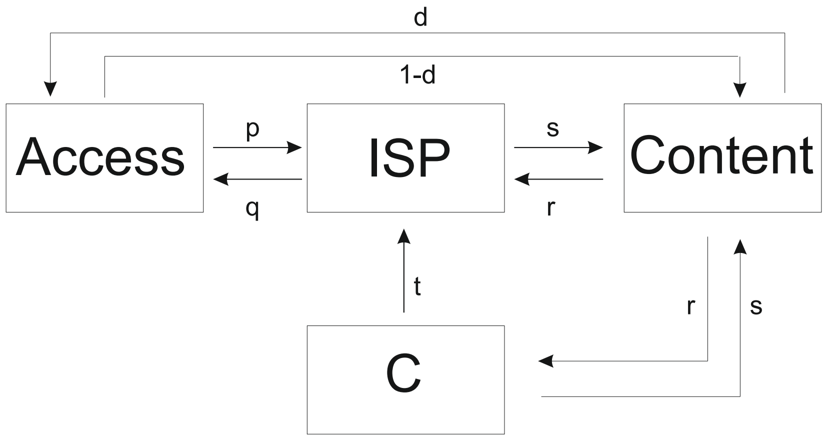

Figure 2: Case II

for internet access exists, and again that costs are negligible the profit functions of the ISP and CP are as follows:

$$\max_{q,s_I,t} \pi_I = \big(p = 1 - q + ds_I\big)q + \big(1 - s_I + (1-d)q\big)s_I + ts_C \tag{5}$$

and

$$\max_{s_C} \pi_C = \big(1 - s_C - t\big)s_C. \tag{6}$$

Assuming a two-stage game where the ISP initially sets q, s_I and t and then the content providers chooses its optimal s_C the following quantities can be observed by backward induction as $q = 1$, and $s_I = 1$. As neither the market for (Internet users') access nor the market for content/advertisement is affected by the content provider q as well as s_I are still equal to one. Of course, also the prices remain unchanged as $p = d$, $r_I = 1 - d$ The content provider's advertising rate is equal to $r_C = 3/4$ and advertising space is $s_C = 1/4$.

The ISP, furthermore, sets an monopolistic access charge (to the content provider) of $t = 1/2$. Thus the profits of ISP and CP are equal to $\pi_I = 9/8$ and $\pi_C = 1/16$.

In comparison to the benchmark case the ISP is, of course, able to gain higher profits (9/8 instead of 1) as it additionally sells access to a non-rival content provider at a monopolistic rate. Access, however, is granted and CP is able to gain positive and, given access costs of $t = 1/2$, also monopolistic profits.

2.4 Case III: Local consumers benefit from CP's content

As a next case we analyse a situation where the content provider offers a (to the content of the ISP) perfectly differentiated product which is, however, also demanded by local Internet users. For this reason, also the ISP benefits from CP's content at the access market, as users' willingness to pay for access increases with the amount of content provided by CP (again, measured by the amount of advertisement space offered). Assuming that the content provider offers local content the demand for access changes to $p = 1 - q + d(s_I + s_C)$, with $0 \leq d \leq 1$. While the profit function of the access provider remains unchanged the profit of the ISP is now maximized by:

$$\max_{q,s_I,t} \pi_I = \big(1 - q + d(s_I + s_C)\big)q + \big(1 - s_I + (1-d)q\big)s_I + ts_C. \tag{7}$$

Optimal quantity and price for Internet access in the end-user market are:

$$q = \frac{d+6}{6-d^2} \quad \text{and} \quad p = \frac{1}{2}\frac{d(d^2-2d-13)}{d^2-6}. \tag{8}$$

Both p and q increase with d ($\frac{\partial p}{\partial d} > 0$ and $\frac{\partial q}{\partial d} > 0$). If $d = 0$, that is, if end-users do not benefit from content offered by either the ISP and the content provider, then $p = 0$. In that case the ISP aims to attract as many end-users as possible and extracts all its profit from the advertisement market. The integrated ISP then gains profits only through its content and by granting access of the content provider. In case that $d > 0$ the integrated ISP charges end-users a positive access rate and also a lower advertising rate to advertising customers. The price p in this case is, not surprisingly, always higher than in either *Case I* or *Case II*.

The integrated ISP sets the quantity s_I and hence the price r_I on the advertisement market according to:

$$s_I = \frac{1}{2}\frac{d^2-d-12}{d^2-6} \quad \text{and} \quad r_I = \frac{1}{2}\frac{3d^2+11d-12}{d^2-6}. \tag{9}$$

The quantity s_I is at least equal to 1 (as in the cases before) but increases in d ($\frac{\partial s_I}{\partial d} > 0$). The ad rate of the ISP, r_I, decreases in d, becomes zero if $d = 0.88$ and turns negative for bigger d. With increasing d content becomes more and more important for end-users. However, as it does not seem plausible that advertising rates turn negative, it seems rather likely that $d < 0.88$. That is, advertising customers benefit more from access demand than access customers benefit from advertising and content.

Here also the access charge t depends on d as

$$t = \frac{d^2 + 3d - 3}{d^2 - 6} \tag{10}$$

and decreases in d: $\frac{\partial t}{\partial d} < 0$.The integrated ISP charges a positive price to the content provider as long as $d < 0.8$. If $d = 0.8$, i.e. if the demand for Internet access is strongly affected by the amount of content offered, then access is for free (see figure 3). For $d > 0.8$, the integrated ISP would even pay the content provider to access its network. This is profitable for the ISP because of the two-sidedness of the market, he can then charge higher prices for Internet access. Put differently, in case that the content provider offers an extremely important service which is highly appreciated by end-users, the ISP is willing to pay the content provider for the provision of the content over its network.

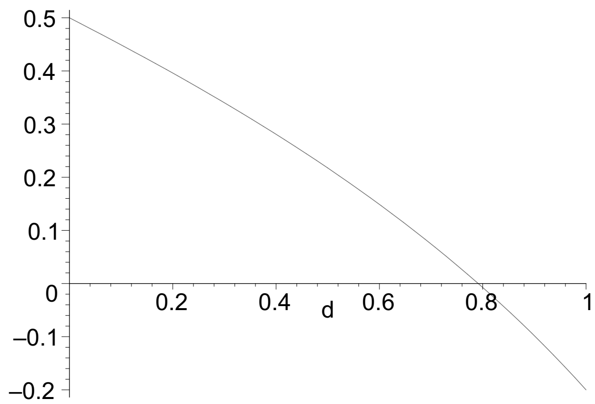

Figure 3: Access charge

Note that the access price t equals zero (and may be even negative) much earlier than the advertisement rate, r_I, of the integrated ISP. If $d = 0$, however, the integrated ISP charges the monopolistic access charge $t = 0.5$ as in *Case II.*

The quantity and the price of the CP also depend on the size of d:

$$s_C = \frac{3}{2}\frac{d+1}{6-d^2} \quad \text{and} \quad r_C = \frac{1}{2}\frac{2d^2 + 3d - 9}{d^2 - 6}. \tag{11}$$

s_C is always larger than zero and increases in d ($\frac{\partial s_C}{\partial d} > 0$). But is always smaller than the amount of the integrated ISP s_I. s_C, however, increases faster in d than s_I.

The content provider's ad rate $r_C = \frac{1}{2}\frac{2d^2+3d-9}{d^2-6}$ decreases in d ($\frac{\partial s_C}{\partial d} < 0$). For small d ($d < -4 + \sqrt{19}$=0.36) the ad rate of the content provider is lower than the rate of the integrated ISP. The latter, however, falls faster than r_C and r_C never becomes negative like r_I. The content provider does not directly take into account the indirect network effects in the Internet access market. The effect on this market are only incorporated indirectly over the content access fee t which decreases in d.

Without competition between the content provider and the integrated ISP in the advertisement market but with he existence of indirect network effects between Internet users and the content provider's amount of content, no exclusion takes places and the additional content increases with the size of the network effects.

2.5 Case IV: Access of a Content Provider that benefits from local users

Suppose that the content provider now also benefits from Internet access sold by the local ISP. That is, also the CP offers local content which leads to a positive network effect connected with advertising demand. We incorporate the indirect network effect from the Internet access market $(1-d)q$ in the inverse demand function of the content provider $r_c = 1 - s_c + (1-d)q$ such that the content providers profit function changes to

$$\max_{s_C} \pi_C = (1 - s_c + (1-d)q - t)s_C. \tag{12}$$

Again $0 \leq d \leq 1$ indicates the degree of dependence of the content market and the Internet access market. Put differently, d measures how much user value content. The higher d, the higher the users' valuation for content (again, measured by the amount of advertisement space sold).

Internet Access Market

Allowing for indirect network effects also to affect the content provider makes the model more symmetric. As a consequence, quantities in both markets do not depend on d

any more. In the Internet access market the quantity q and price p are given by:

$$q = \frac{7}{5} \quad \text{and} \quad p = \frac{9}{5}d - \frac{2}{5}. \tag{13}$$

q is higher than in the first two cases and equals q in *Case III* with $d = 1$. The price p is negative for small $d < \frac{2}{9}$. as it can be usally observed in two-sided markets, the market producing the higher network effect is subsidised by the other market. For $\frac{2}{9} \leq d \leq \frac{1}{2}$ p is smaller than in the first two cases and thereby also smaller than in *Case III*. For $\frac{1}{26}\sqrt{1609} - \frac{19}{26} \leq d \leq 1$ or $0.81 \leq d \leq 1$, p is marginally higher than in *Case III*. For $d = 1$ p in *Case III* and *IV* are equal. As now also the CP benefits from local customers and the ISP is able to extract part of the CP's profits it can (depending on d) be rational to reduce the access fee for end users.

A lower p is clearly induced by the two-sidedness of the market. If the ISP and the content provider benefit strongly from the amount of Internet access users, the integrated ISP subsidize Internet access and exploits the advertising market. Free hardware (router, etc.) or no fee for the first few month could be a feasible way to realize such negative prices in the Internet access market.[3]

Content/Advertisement Market

Quantity and price in the content and advertising market, respectively, are given by

$$s_I = \frac{6}{5} \quad \text{and} \quad r_I = \frac{6}{5} - \frac{7}{5}d. \tag{14}$$

Advertisement space s_I is because of the positive network effect always higher than in the first two cases and equals the quantity in *Case III* for $d = 1$. For all other d the quantity in *Case III* is monotonically increasing and lies between the first two cases and this case.[4]

The ad rate r_I is monotonically decreasing in d. For small $d < \frac{6}{7}$ r_I is positive.

[3]Similar results can be observed in content markets. Many services are provided at no cost as in this way platforms maximise network size of Internet users. Advertising customers are then charged a higher rate, respectively.

[4]For $d = 0$ the s_I is equal to the amount in the first two cases.

Access to the content provider

Access price t and the advertisement price of the content provider r_C also decrease in d. The content provider C has to pay the price t to the integrated ISP to be able to reach the local users:

$$t = \frac{6}{5} - \frac{7}{5}d. \tag{15}$$

C benefits from more local customers deciding for an Internet access, but local customers also benefit from a higher amount of content. Hence, the integrated ISP balances the price he charges for access to its network between the two groups. For $d = 0$ the content provider strongly benefits from a higher number of users, the price for access t reaches its maximum in this point. The integrated ISP uses this profit to subsidize the Internet access market. For $d = 0.5$ the content access price t equals that in the first two cases $t = \frac{1}{2}$. Both sides then benefit equally from each other, which offsets the indirect network effects.

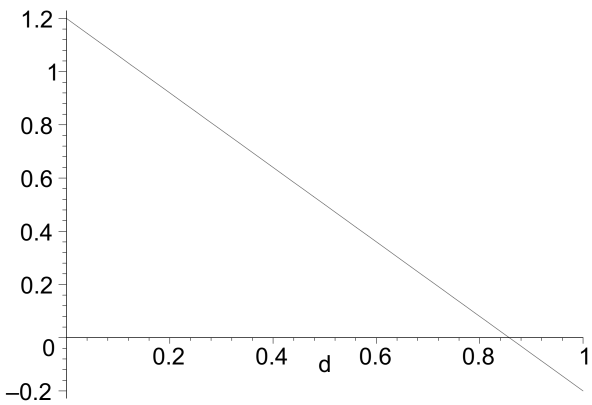

Figure 4: Access charge 2

For high d ($= \frac{6}{7} \approx 0.857$) the content provider does not have to pay to access the network of the integrated ISP. If users benefit strongly from the offered content ($d > \frac{6}{7}$), the integrated ISP has an incentive to pay the content provider to serve its local customers. The price for access turns negative in this area.

Regardless of the access price and regardles of the network effect, the content provider always sets the amount of $s_C = \frac{3}{5}$ Local user benefit through the indirect network effect d from the amount of content offered s_C. The integrated ISP therefore lowers the access price according to the strength of the indirect network effect

$$r_C = \frac{9}{5} - \frac{7}{5}d. \tag{16}$$

It is always higher than in *Case I* and equals the amount s_C in *Case III* for $d = 1$. The ad rate r_C also decreases in d but reaches its minimum in $r_C = \frac{2}{5}$for $d = 1$. This is equal to the minimum in *Case III.*

2.6 Case V: ISP and Content Provider offer Differentiated Products

The assumption that content is either perfectly homogeneous or perfectly differentiated is now lifted. As well as the assumption that Internet access consumers perceive content as totally differentiated in each case. We introduce the parameter θ (with $0 \leq \theta \leq 1$) indicating the degree of product differentiation, such that

$$r_I = 1 - s_I - \theta s_C + (1-d)q \quad \text{and} \quad r_C = 1 - s_c - \theta s_I + (1-d)q. \tag{17}$$

For $\theta = 1$ the products are perfectly homogeneous, for $\theta = 0$ they are perfectly differentiated. If the two products are perfectly homogeneous $\theta = 1$ then the Internet access customers only benefit from the content the ISP offers. The further the two contents are differentiated, the smaller θ, the more Internet access consumers benefit from the additional content offered.

Internet access consumers still value additional content according to the parameter d. But we now assume that they only appreciate additional content if the content is differentiated.[5] Two almost identical news websites, for example, do not benefit customer as much as two websites that provide different, i.e. differentiated, contents. The inverse demand for the access market is then given by

$$p = 1 - q + d(s_I + (1-\theta)s_C). \tag{18}$$

[5]As we assume free content, we again measure product differentiation from the perspective of advertisement customers. That is, if advertisement customers use the two content providers to reach different target groups, the member of the target groups also perceive the content as differentiated.

Profit functions are then given by:

$$\max_{q,s_I,t} \pi_I = (1-q+d(s_I+(1-\theta)s_C))q + (1-s_I-\theta s_C+(1-d)q)s_I + ts_C \tag{19}$$

and

$$\max_{s_C} \pi_C = (1-s_c-\theta s_I+(1-d)q-t)s_c. \tag{20}$$

Access Market

The ISP's optimal quantity of and price for access is:

$$q = -\frac{d\theta^2-\theta\,d-2\,\theta^2-2\,\theta+7}{d^2\theta^2+2\,d\theta^2-2\,\theta\,d+4\,\theta^2-2\,\theta-5} \quad \text{and} \tag{21}$$

$$p = \frac{1}{2}\,\frac{d^3\theta^2-3\,d^2\theta^2+2\,d^2\theta+12\,\theta\,d+4\,\theta^2-18\,d-8\,\theta+4}{d^2\theta^2+2\,d\theta^2-2\,\theta\,d+4\,\theta^2-2\,\theta-5}. \tag{22}$$

Due to the complementarity of access and content markets also q and p are affected by θ. That is, the lower the degree of product differentiation the lower the effects induced by network effect d.

Content/Advertisement Market

In the content/advertisement market optimal prices and quantities are given by:

$$s_I = \frac{1}{2}\,\frac{d^2\theta^2-2\,d\theta^2-\theta\,d+6\,\theta-12}{d^2\theta^2+2\,d\theta^2-2\,\theta\,d+4\,\theta^2-2\,\theta-5}, \tag{23}$$

$$r_I = \frac{1}{2}\,\frac{3\,d^2\theta^2-2\,d^2\theta-3\,d\theta^2-5\,\theta\,d+6\,\theta^2+14\,d-12}{d^2\theta^2+2\,d\theta^2-2\,\theta\,d+4\,\theta^2-2\,\theta-5}, \tag{24}$$

for the vertically integrated ISP and

$$s_C = \frac{3}{2}\,\frac{\theta\,d+2\,\theta-2}{d^2\theta^2+2\,d\theta^2-2\,\theta\,d+4\,\theta^2-2\,\theta-5} \quad \text{and} \tag{25}$$

$$r_C = -\frac{1}{2}\,\frac{d^2\theta^3-4\,d^2\theta^2-2\,d\theta^3+2\,d^2\theta+d\theta^2+9\,\theta\,d-6\,\theta^2-14\,d-6\,\theta+18}{d^2\theta^2+2\,d\theta^2-2\,\theta\,d+4\,\theta^2-2\,\theta-5} \tag{26}$$

for the content provider. Interestingly, s_C turns zero, i.e. exclusion takes place, when $d \geq \frac{2(1-\theta)}{\theta}$ or $\theta \geq \frac{2}{d+2}$, respectively (see figure 5 for exclusion areas).

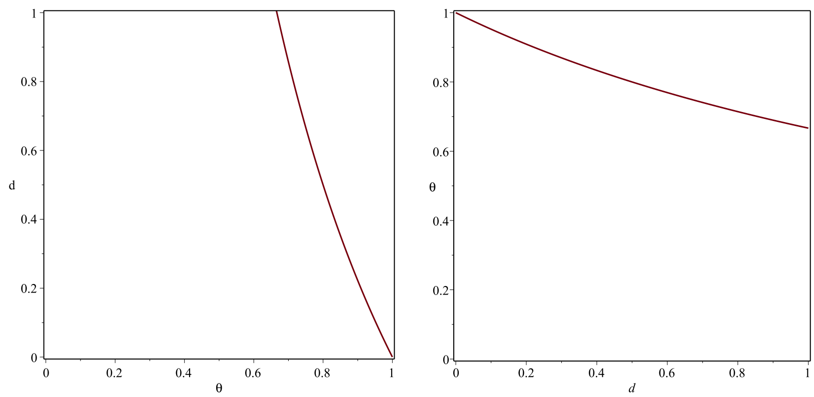

Figure 5: Exclusion areas for d and θ

The first condition $d \geq \frac{2(1-\theta)}{\theta}$ can only be satisfied for $\theta \geq \frac{2}{3}$ as $d \leq 1$. In the area $\frac{2}{3} \leq \theta \leq 1$ the function is monotonically decreasing in d. That is, for exclusion to take place the network effect d has to be strong when θ is low; namely for exclusion d needs to be 1, if the degree of differentiation $\theta = \frac{2}{3}$. Then Internet access user benefit maximally from content, but content provider do not benefit from the local Internet users. Put differently, the demand for advertisement does not depend on the access to the local Internet customers.

As the products getting more similar ($\theta \uparrow$) local Internet users benefit less from the additional content provider, their willingness to pay is decreasing when θ increases. Likewise, competition on the advertisement market between the two content provider is increasing in θ. There are two effects at work: the competition effect which decreases the profit of the integrated ISP. And the indirect network effect which increases the profit of the integrated ISP if he allows the content provider to serve its local customers. If $\theta \uparrow$ the competition increases and the indirect network effect decreases as consumers do not value duplication of the content. For small θ ($\theta < \frac{2}{3}$) no exclusion will take place, independent of the the size of the network effect parameter d.

Same holds true for the second condition $\theta = \frac{2}{d+2}$. Strong network effects do not lead to an exclusion. Only if products are nearly homogeneous the network effect enhances the incentives to exclude a competitor.

Access to the Content Market

The profit maximizing access fee which the ISP charges the content provider is:

$$t = -\frac{1}{2}\frac{d^2\theta^3 - 4\,d^2\theta^2 - 2\,d\theta^3 + 2\,d^2\theta + d\theta^2 + 12\,\theta\,d - 6\,\theta^2 - 14\,d + 12}{d^2\theta^2 + 2\,d\theta^2 - 2\,\theta\,d + 4\,\theta^2 - 2\,\theta - 5}. \qquad (27)$$

Perfect substitutes

In case $\theta = 1$ contents are considered perfect substitutes, the access charge simplifies to $t(\theta = 1) = \frac{1}{2}\frac{6-3d-d^2}{3-d^2}$. As can be seen from figure 6 this charge is always positive. In case that competition is most intense the vertical integrated ISP has no incentive to subsidize content offered by the CP.

Most interesting with contents being perfect substitutes it always holds that $t \geq r$. For $d = 0$ $t = r$ and the profits of CP would be zero. That is, the ISP would extract the entire profits of the content provider in case that no network effect from content to access exists. In case that $d > 0$ the end users' willingness to pay increases with more content. As the content of the content provider is a perfect substitute competition in the advertisement market leads to a loss of profits from the content market as well as (over the network effect) to a loss of profits in the access market as s_I is reduced by competition. t would then be always higher than r. In that case, however, the content provider makes losses and stays out of the market. Independently from the strength of a positive network effect the ISP always blocks entry of a competitor offering a perfectly homogeneous product. Nevertheless, such as clear cut result can only be derived when contents are perfectly substitutable.

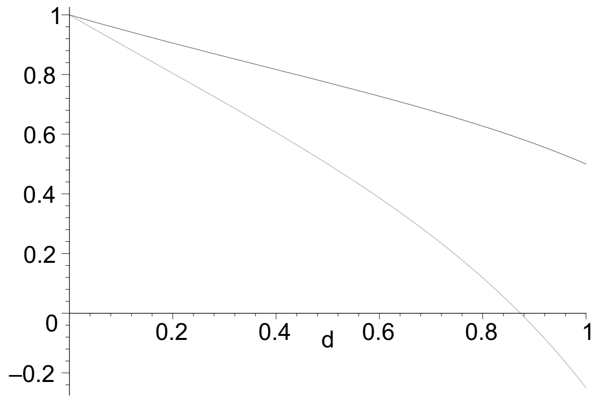

Figure 6: Access charge 3 (t, r)

3 Conclusion

Network neutrality has been fiercely debated in many economies such as, e.g., the United States or the European Union. One severe concern of the proponents of net neutrality is, inter alia, that vertically integrated Internet service provider could have incentives to exclude firms which act as competitors in downstream markets from their networks, i.e. the upstream markets.

To address this issue we use a simple model of a vertically integrated ISP which is able to grant access to a content provider to its access network. As a consequence, the ISP will face competition from the content provider over content and therefore in the advertisement market.

By these means, two effects exist: on the one hand, competition in advertising markets lead to lower firm specific quantities and therefore to lower profits. On the other hand, in case that end users benefit from additional contents, a positive network effect leads to a higher end users' willingness to pay and therefore to larger markets and higher profits as well. The latter effect reduces the incentives to exclude the rival content provider from the upstream market.

As exclusion is most likely to take place in monopolies, we assume that the ISP holds a monopoly over the local access market as well as over a specific content market. We then analyse different situations to determine the ISP's incentives to exclude its rival from the access network. This represents the most severe case where a non neutral

Internet could be used to exert market power.

Assuming, at first, totally differentiated products we find no incentives to block entry, independently whether end user in the local access market benefit from the additional content or not. This result is not surprising as the ISP is simply able to extract additional profits in the access market. However, in case that the ISP and the content provider offer imperfectly differentiated content blocking could possibly occur. This is especially likely if contents are sufficiently homogeneous or in case that network effects are relatively strong. That is, if the ISP losses are high due to either competition or not being able to exploit network effects under competition. In case that contents are considered perfect substitutes the ISP always blocks entry. In case that contents are not perfect substitutes but only slightly differentiated network effects have to be relatively, strong to prevent market entry of the content provider.

As European competition law prohibits the denial of network access when networks are monopolistic or characterized by strong market power, there is however now reason to regulate net neutrality in Europe. Monopolistic and oligopolistic access provider which are jointly dominant can always be forced to grant access to the upstream market in order to facilitate competition in downstream markets.

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