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REGULATION AND INTERNET ACCESS IN GERMANY

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Abstract

We explain the recent events in the German market for online access using a model of a regulated monopoly renting phone lines to retailers. Retailers offer either a linear or a flat tariff to consumers. Consumer heterogeneity leads to adverse selectiion. We show why market entry for flatrate firms is difficult under a linear wholesale tariff. With both a linear and a flat wholesale tariff the consumer market shows a mixture of tariffs as well. When marginal costs are zero it is optimal to have a wholesale flatrate only. However, marginal moves towards this equilibrium are not always welfare improving.

JEL Classification: D4.

Keywords: Internet, flatrate, adverse selection.

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1 Introduction

In comparison to other countries, like the U.S. for example, it was difficult to find internet providers offering a flatrate[1] for internet connection via the phone line to private households in Germany in the past. In March 2001 the online information service www.flatrate.de listed a total of six internet service providers (ISPs) offering a flatrate for 24 hour access. Five of the firms charged more than €70 per month for this service and, additionally, a similar processing fee. It is unlikely that these offers attract a lot of customers. According to a survey of the German periodical PC-Welt from November 2000 only 1% of their readers would be willing to pay more than €50 per month for a flatrate. This leaves the €40 flatrate of AOL as the only offer which is likely to have a substantial market share.[2] On the other hand, a lot of firms entered the market with low prices, but they had to withdraw their flatrate offers later on. According to www.flatrate.de nine firms entered and left the market between in 1999 and 2000.

We believe that the reason for this fact lies in the pricing policy of the former state monopoly Deutsche Telekom, which offers other competitors a wholesale price of about 0.75 cents per minute for using its phone lines. On 16th November 2000 RegTP, the German government authority regulating the Deutsche Telekom, decided that as of February 2001 Deutsche Telekom has to offer a wholesale flatrate additional to its linear pricing scheme to competitors. Deutsche Telekom strongly opposed this decision and took the issue to the courts. On 16th March 2001 the administrative appeals court of North Rhine-Westphalia excused Deutsche Telekom from offering a wholesale flatrate to its competitors until all the legal issues in the ruling have been cleared up in court. It was influenced by the decision of t-online, the subsidiary of Deutsche

[1] With a flatrate the consumer pays a fixed amount for unlimited online access in a certain period, generally a month. In a linear price tariff, by contrast, he pays a sum proportional to the time he is online.

[2] AOL is well known for its aggressive pricing policy. It is therefore an open question whether this offer is covering costs or is a form of predatory pricing to gain market share. This could be a profitable strategy if customers have switching costs and AOL is able to exploit these switching costs later on. For a survey of the literature on switching costs, see Klemperer (1995).

Telekom offering internet access, to abandon its own flatrate a few weeks earlier. Currently RegTP is not pushing the issue anymore and the prospects for an affordable internet access flatrate for the majority of German households in the near future are dim. This contrasts with recent developments in other countries in the European Union. The British regulation authority Oftel successfully forced British Telecom to offer a wholesale flatrate. Since the introduction of FRIACO (Flatrate Internet Access Call Origination) the number of British ISPs offering modestly priced flatrate internet access has soared. In Spain flat-rate Internet access via the fixed telephony network was introduced by the Decree-law 2000/7 of 23 June 2000. France Telecom announced the introduction of a flatrate for 1 September 2001. The tariff was negotiated with the French regulation authority ART, which estimates that this will allow ISP's to offer flatrate access for €28.[1]

The problem is that there is no alternative to Deutsche Telekom for ISPs that intend to serve the national market. In fact, the situation in the ISP market is to a large extend a result of the lack of competition in the market for local phone calls. While competition seems to work well in the market for medium and long distance calls,[2] Deutsche Telekom still had a market share for the last mile of about 98% in 2000. Although it has to sell local loop lines to competitors if households want to switch, the regulated price is too high to foster competition in this market segment. Even after the decision of RegTP on 30th March 2001 to reduce the price by 5% this is still substantially above the price Deutsche Telekom charges its customers. So far there is no alternative to Deutsche Telekom for most households. Only in the big cities there is limited competition by so called City Carriers that offer local loop lines to businesses and to some extend for private households. Interestingly, there are quite a number of low price flatrate offers of ISPs that cooperate with City Carriers. Moreover, City Carriers offer free local phone

[1] For recent information about the French market see http://www.art-telecom.fr.

[2] According to RegTP the market share of all competitors of Deutsche Telekom in this market exceeded 40% in 2000. Also prices have decreased substantially. The price for a long distance call inside Germany during daytime, for example, is only a tenth of the price before the deregulation. See www.regtp.de for the latest numbers.

calls for calls that originate and terminate inside their own net. For these calls they do not have to pay interconnection fees to Deutsche Telekom which would be on a price per minute basis. If these are competitive prices this suggests that true marginal costs are zero, an issue that will be of relevance in the discussion of social welfare later on.

In this paper we present a model that tries to explain why market entry of ISPs offering a flatrate is difficult under the linear wholesale tariff of Deutsche Telekom. Why they cannot make profits in a market where other providers use linear prices, despite a preference of consumers for flatrates that we build into the model.[1] An important feature of our model is consumer heterogeneity, which plays a crucial role for providers offering a flatrate. The business model announced by flatrate firms that entered the German market in the past is generally built on the idea of cross-subsidizing the high usage customers with revenues from low usage customers. The firm intends to make a profit only on the average customer, not on every customer. We model this heterogeneity buy assuming a distribution of utility functions implying different usage rates for a given flatrate.[2] As expected, it turns out that a problem of flatrate firms in this model is adverse selection, they attract exactly those customers causing the highest costs. We show that the business model described above does not work when lines have to be rented under a linear wholesale tariff. The optimal flatrate when entering a competitive market is so high, that the firm makes profit on every customer. It is unlikely, however, that customer preferences for the flatrate are so high as to allow the firm to gain any market share. Things are different when there is an additional wholesale flatrate. It is possible to show that a low enough wholesale flatrate will lead to a different market structure, with both flatrate and linear price tariff having a certain market share. We argue that Deutsche Telekom resisted the flatrate,

[1] Such a preference is often invoked as one possible explanation for customers choosing a flatrate although their ex-post expenditures would have been lower under a linear tariff. See the discussion in Mitchell and Vogelsang (1991), p.191, for the market for phone calls.

[2] This distinguishes our model from the usual Hotelling type setup that is often used for telecommunication networks. See Laffont et al. (1998a) and Laffont et al. (1998b) for a discussion. We believe that consumer preferences for a certain network, as assumed in this framework, are not important in the provider market.

because a flatrate that gains substantial market share would lower its profits. Although it is necessary that Deutsche Telekom has revenues to pay for the maintenance costs of its network, it would be the best if this money were raised with a flatrate fee only, because true marginal costs are zero.[1] However, only a discrete step to a flatrate only equilibrium is unambiguously welfare improving in our model.

While our discussion is motivated by the situation in the market for internet access, the results of our analysis are of a general nature and have other applications as well. The market for local telephone calls, for example, has similar characteristics. If a competitor does not have his own local loop lines, however, each call originates and terminates in the grid of Deutsche Telekom. In contrast to internet service providing there is no possibility for a firm to add value, it can only act as a reseller. Maybe because it is more obvious in this case that reselling with a flatrate is not profitable we haven't seen attempts to enter this market with such an offer. Clearly, from a welfare perspective the lessons drawn above apply here as well and a complete switch to a system like in the U.S. with flatrate tariffs for local calls would be preferable.

The remainder of the paper is organized as follows. In Section 2 we introduce a model with consumer heterogeneity and derive the market structure. Section 3 discusses optimal policies in that market for flatrate firms. In Section 4 we show how new regulation is about to change the industry and why Deutsche Telekom resisted this step of RegTP. Finally, we show in Section 5 that a discrete jump to a flatrate only equilibrium would improve welfare, while marginal measures have ambiguous welfare effects. Section 6 concludes.

[1] Marginal costs are only zero in the absence of congestion, of course. In internet pricing congestion plays a prominent role. See Mackie-Mason and Varian (1997) for an interesting suggestion for pricing internet traffic. In the local telephone network, by contrast, congestion is generally not a problem.

2 The Model

In our model we concentrate on two pricing systems, a linear price tariff with price p and a flatrate f. We define these prices to be equal to the price for permanent online access for a certain period. In the linear tariff the consumer pays a fraction of the price p according to the time he was online, while the time online does not affect his expenditures for a flatrate, implying a zero marginal price. We neglect the possibility of a two part tariff and other nonlinear pricing systems, which only play an important role when the package offered by the ISP includes other services like an e-mail account, a personal web-page etc. A simple explanation for this fact might be fixed costs for the usage of the instruments p and f. Costs add up when using both and make this possibility too costly. Consumers often prefer flatrate offers, because they do not have to worry about the many technical possibilities to work offline and thereby minimize cost. On the other hand, flatrate offers generally imply a sort of contract with the supplier which reduces flexibility for consumers. We denote these costs s_p and s_f respectively. A consumer buying from a flatrate supplier therefore saves an amount $s = s_p - s_f$ which can be positive or negative. Thus, we can interpret s as a preference of the consumer for the flatrate.

We assume that the utility from having online access at all $\bar{u}$ is large enough to ensure that all consumers buy from at least one of the suppliers in the market. Following the standard practice in the literature[1] we also abstract from income effects. More precisely, the utility of a consumer is $U + \bar{u} - s_p$ and U is given by:

$$U = u(h - \bar{h}) - I_f(f - s) - I_p ph, \tag{1}$$

where u is a subutility function depending on the fraction of the period online h and a satiation level $\bar{h}$.[2] The consumer buys either from the flatrate supplier ($I_f = 1, I_p = 0$) with flatrate f

[1]See, for example, Mitchell and Vogelsang (1991), p.28.

[2]We therefore do not assume the existence of network effects. See Economides (1996) for an overview of the

which yields utility $u(h-\bar{h})-f-s_f+\bar{u}$. Or she buys from the other supplier ($I_f=0, I_p=1$), who charges a price per period p which yields $u(h-\bar{h})-ph-s_p+\bar{u}$. The subutility is assumed to be twice continuously differentiable and has the properties: $u(0)=0$, $u'(\cdot)>0$, $u''(\cdot)<0$ and $u'(0)=0$, the last of which establishes the interpretation of $\bar{h}$ as a bliss point.[1]

As discussed in the introduction, consumer heterogeneity plays a crucial role in the ISP market. We take account of this fact by allowing the bliss points to differ between consumers.[2] More precisely, we assume that consumers are distributed uniformly over the unit interval and have bliss points according to the following linear function:[3]

$$\bar{h}(x)=h_0+h_1x,\ \forall x\in[0,1] \tag{2}$$

with $h_0, h_1>0$ and $h_0+h_1\leq 1$. Each consumer maximizes utility for both types and then chooses the supplier yielding the higher utility. First, we solve the maximization problem for a buy from the flatrate supplier:

$$h_f=\underset{h}{\operatorname{argmax}}\, u(h-\bar{h})-f+s \tag{3}$$

which has the following solution

$$u'(h_f-\bar{h})=0 \Leftrightarrow h_f=\bar{h} \tag{4}$$

Obviously, the consumer facing a marginal cost of zero will consume up to his bliss point. The

literature on networks. We believe that network effect are not crucial for the choice of an ISP. Generally, neither for the access to or exchange of information nor for communication is it necessary to have the same provider.

[1] A widely used example would be $u=-0.5(\bar{h}-h)^2$. See Mason (2000) for an application of this functional form to internet pricing.

[2] The model is therefore an example of a single-parameter disaggregated model. For a general discussion of this type of model, see Wilson (1993), p.125ff.

[3] This restriction reduces the complexity of the analysis substantially. Linearity is also a common assumption in the literature using Hotelling type "transportation costs" to model consumer heterogeneity. See Laffont et al. (1998a) and Laffont et al. (1998b), for example.

maximization problem of the consumer buying from the supplier with linear price delivers the demand function for this scheme:

$$
\begin{aligned}
h_p &= \underset{h}{\operatorname{argmax}}\, u(h-\bar{h}) - ph \quad \Rightarrow && (5)\\
u'(h_p - \bar{h}) &= p \quad \Leftrightarrow && (6)\\
h_p &= \bar{h} + v(p) && (7)
\end{aligned}
$$

where $v(p), v'(\cdot) < 0$, is defined as $v(\cdot) = u'(\cdot)^{-1}$.

Since consumers differ in their bliss points it is likely that different consumers opt for different suppliers. To analyze this in more detail we first take a look at the indifferent consumer x_i who has identical maximum utilities for both suppliers, $U_f = U_p$. We can easily identify the position of this consumer on the unit interval:

$$
\begin{aligned}
U_f &= U_p \Leftrightarrow \\
u(\bar{h}-\bar{h}) - f + s &= u(\bar{h} + v(p) - \bar{h}) - p(\bar{h} + v(p)) \Leftrightarrow \\
-f + s &= u(v(p)) - p(h_0 + h_1 x_i + v(p)) \Leftrightarrow \\
x_i &= \frac{1}{p h_1}\left[u(v(p)) - p v(p) + f - s\right] - \frac{h_0}{h_1} && (8)
\end{aligned}
$$

Let's for the moment assume that equation (8) leads to an interior solution. If this is the case then it seems natural to assume that consumers to the left of the indifferent consumer choose one of the suppliers and consumers to the right choose the other. In fact, it is easy to prove the following proposition.

Proposition 1

If the indifferent customer is an interior customer, then all customers to the left, with lower bliss points, choose the supplier who charges a linear price and all customers to the right, with higher bliss points, choose the flatrate supplier.

Proof: See Appendix.

It should be noted that this proposition, despite being very intuitive, is not as obvious as it may seem. Actually, as discussed together with the proof in the Appendix, it is not possible to extend the proof to arbitrary classes of continuous utility functions. The intuition for this is as follows. To ensure that the proposition holds the maximum utility when choosing the flatrate has to increase by more than the the maximum utility when choosing the linear price when the bliss point rises. This is an assumption how utilities differ between consumers and the theoretical restrictions on modelling are very weak.

As a result of proposition 1 we can interpret x_i as the market share of the supplier charging a linear price and $1 - x_i$ as the market share of the flatrate supplier. From equation (8) it is straightforward to derive the following comparative statics for these market shares:

$$\begin{aligned}
\frac{\partial x_i}{\partial f} &= \frac{1}{ph_1} > 0, \; \frac{\partial x_i}{\partial s} = -\frac{1}{ph_1} < 0 \\
\frac{\partial x_i}{\partial p} &= -\frac{1}{p}\left(x_i + \frac{h_0}{h_1}\right) - \frac{v(p)}{ph_1} < 0 \\
\frac{\partial x_i}{\partial h_0} &= -\frac{1}{h_1} < 0, \; \frac{\partial x_i}{\partial h_1} = -\frac{1}{h_1} x_i < 0
\end{aligned}$$

all of which conform to intuition and need no further explanation. Market share of the flatrate firm increases when it reduces its rate, when consumer preference for the flatrate increases, when the other supplier increases his price and when the bliss point function has either a steeper slope or a higher overall level.

The last two effects deliver a good explanation of the double surprise that many flatrate ISPs faced after market entry. They had both a lot more customers than they expected and much higher usage than expected. This coincidence can be explained by a too low expectation of h_0 or h_1 or both.

3 The Optimal Flatrate

Now we take a look at the profit maximizing strategy of the flatrate firm. For a given price of the other firm and given market share profit for the flatrate firm is:

$$\pi_f = \int_{x_i}^{1} (f - \bar{h}(s)c)ds \tag{9}$$

where c is marginal cost. In the Appendix we proof the following lemma.

Lemma 1

If $p > c/2$ the profit maximizing rate for the flatrate firm fulfills:

$$f = ph_1(1 - x_i + \frac{c}{p}x_i) + h_0c \tag{10}$$

Proof: See Appendix

Since the provider market in Germany is highly competitive with fierce price competition, we assume in the following $p = c$. In this case the optimal flatrate is:

$$f = (h_0 + h_1)c \tag{11}$$

and we can state the following proposition without further proof.

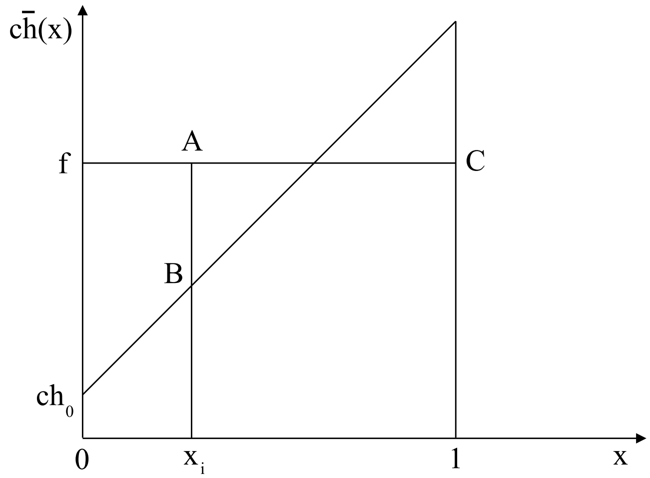

Figure 1: The Optimal Flatrate

Proposition 2

If a flatrate firm enters a competitive market it sets a flatrate such that it breaks even on the consumer with the highest bliss point and therefore usage rate.

This is interesting, because it makes clear that there is no room for cross subsidization of high usage customers with revenues from low usage customers. The intuition for this result can be demonstrated by a graphical argument. In figure 1 we plot the bliss point function times marginal cost which represents cost per customer for the flatrate firm. To facilitate the discussion we set the slope of this function equal to one. This implies that the derivative of the equilibrium market share with respect to the flatrate is also equal to one. We further assume that the firm considers a flatrate f below the optimal flatrate derived above and that the firm captures a market share x_i.

It is not important whether the firm makes any profit at this market share. In any case, if the firm increases the flatrate f by one euro this increases revenues from its existing customers by $\overline{AC}$ euros. On the other hand the firm will loose customers and thereby revenues of $\overline{AB}$ euros. It is easy to verify that whatever the market share, the net gain of an increase in the flatrate is positive, as long as the flatrate is below the maximum of the cost per customer function.[1]

Another implication of this proposition is that the pricing decision is completely independent of the preference for flatrates. The preference parameter s is only important to determine the actual market share of the entering firm, but not the optimal flatrate.[2] In the end the optimal price is easy to calculate, when taking into account that the customer with the highest bliss point is likely to surf all day long. In this case $h_0 + h_1 = 1$ and the optimal price is simply $f = c$. If the preference of consumers is high enough, then the entering firm can gain market share and since it breaks even with the customer with highest usage it makes profits on the other customers. However, it is unlikely that the preference parameter is so high as to allow the flatrate firm to gain any market share.

From equation (8) we can deduce the following condition on the preference parameter:

$$\begin{aligned} x_i &= \frac{1}{ph_1}\left[u(v(p)) - pv(p) + f - s\right] - \frac{h_0}{h_1} < 1 \quad \Leftrightarrow \\ s &> u(v(p)) - pv(p) - p(h_0 + h_1) + f \end{aligned} \tag{12}$$

Using $p = c$ and $f = (h_0 + h_1)c$ from above we get

$$s > u(v(c)) - cv(c) \tag{13}$$

The right hand side is equal to the net gain of the customer with highest bliss point from consuming less than the bliss point at price c. This implies that this customer is willing to pay a price for a flatrate offer that is as high as the price he would pay if he consumes up to the bliss point from a supplier with linear price. For customers in the interior it even implies that

[1] If the slope of this function is different from one then the graphical argument has to be augmented, because the effect of f on the market share is different. It might seem that a very steep function would lead to a different result. However, if the function is very steep then an increase in f has only a weak impact on the market share.

[2] This holds only for interior solutions of course. If the flatrate firm serves the whole market the preference parameter matters.

they pay more than they would pay when consuming up to their bliss points at price c. If a costumer can allow himself to forget about any marginal costs and stay online up to his bliss point in the linear tariff, why should he pay even more for a flatrate that would imply exactly the same consumption profile. It is hard to imagine that s is that high.

4 New Regulation

It is still possible that the Deutsche Telekom will be obliged to offer a wholesale flatrate in the future. The result would be two wholesale tariffs, a linear tariff and a flatrate. In this case the ISP has to decide how to allocate customer traffic, which can be caused by both customers using the flatrate and customers using the linear price, on the two types of lines. In this section we derive the new market equilibrium.

Assume that there are at least two firms offering a flatrate and a linear tariff and there is price competition in both segments of the market. The crucial question is whether it is profitable to use rented flatrate lines for customers using the linear tariff or the other way round. In the appendix we show that this is not the case. Then, because of price competition, the price p for the linear tariff will be equal to marginal cost c and the flatrate f has to be equal to the wholesale flatrate per customer d.[1] We can therefore prove the following proposition.

[1]We assume for simplicity in the following discussion that a firm offering the flatrate does not incur any other fixed costs.

Proposition 3

When there are two wholesale tariffs, a flatrate and a price tariff, a market structure where firms use linear tariff lines and charge marginal costs for customers paying a linear price, and use flatrate lines for flatrate customers charging them the wholesale flatrate is the unique Nash equilibrium when customers do not have a very strong preference for either the flatrate or the linear tariff.

Proof: See Appendix

The intuition here is that the indifferent customer is certainly willing to pay more for a flatrate line than what he spends in a linear tariff. Therefore it is not worthwhile for a firm to use a flatrate line for him when he is charged a linear tariff. However, because of decreasing marginal utility, this will generally not be as much as his usage times marginal cost will rise when he switches to a flatrate tariff. As a consequence, he would cause costs above the flatrate tariff when he is charged a flatrate and the firm uses a linear tariff line for him.

To better understand what the preferences of Deutsche Telekom regarding the future wholesale flatrate are we have to derive their profit maximizing choice of the wholesale price d, for a given price c. To do that we have to make assumptions about the cost structure. Since Deutsche Telekom is using to a very large extent existing infrastructure it seems reasonable to assume that it has mainly fixed maintenance costs and that marginal costs are zero when a customer uses a line. Even in the case of congestion this would be appropriate, since the costs of congestion are generally borne by the consumers. This means that gross profits are simply revenues given by:

$$\pi = d(1 - x_i) + \int_0^{x_i} c(\bar{h}(s) + v(c))ds \tag{14}$$

For this definition of profit we can derive the following result.

Proposition 4

For the regulated monopoly it would be optimal if the wholesale flatrate would be equal to the expenditure of the consumer with the highest bliss point in a linear tariff with current wholesale price c.

Proof: See Appendix

It is possible to use Figure 1 again to explain this result. The only difference is that we have to substitute the $c\bar{h}(x)$ line with the $c(\bar{h}(x) + v(c))$ line indicating revenues for Deutsche Telekom from selling linear price lines to ISPs. Then, for any flatrate below the maximum of this line, Deutsche Telekom could increase revenues from selling flatrate lines to ISPs by $\overline{AC}$ euros if it increases the flatrate by one euro. And it would loose the difference between the flatrate and the revenues from selling a linear tariff line, which amounts to $\overline{AB}$ euros. As before, there is a positive net gain from increasing the flatrate.

It is possible that this optimal wholesale flatrate does not capture a large market share. For the consumer with the highest bliss point it is certainly worthwhile to switch to the flatrate because he can expand usage and still pay the same overall price. For other users, however, this flatrate implies higher costs which has to be weighed against the possibility of unlimited access. Currently marginal costs are already quite low which suggests that the willingness to pay for unlimited access is not too high. If actual consumption of high usage customers is far above the usage of average consumers, i.e. if the bliss point function is steep, than most costumers will choose to remain in the linear tariff. As a consequence, profits for the optimal flatrate would be close to profits without such a tariff. In such a situation it seems natural that Deutsche Telekom resists the introduction of a wholesale flatrate, because the regulation authority will not administer a tariff that does not gain market share. It is likely that RegTP targets not the marginal, but the average customer and then profits for Deutsche Telekom are likely to fall.

Admittedly, this is inconsistent with the cost based model used by RegTP to calculate wholesale prices.[1] If RegTP follows this approach then it fixes prices such that gross profits are just sufficient for Deutsche Telekom to break even. We actually use this assumption in the following chapter. In reality, however, there is a lot of discretion involved in the process of price fixing. If RegTP should be successful in forcing Deutsche Telekom to introduce a wholesale flatrate then it is rather questionable whether there will be an immediate offsetting increase in the linear wholesale price. At least it will not be easy for Deutsche Telekom to prove that this is necessary.

5 Welfare

In this section we assume that the goal of RegTP when making its decision about the wholesale tariff structure of Deutsche Telekom is maximization of social welfare w under the restriction of a certain minimum profit $\hat{\pi}$. Because of consumer heterogeneity the welfare function is not unique. We follow the usual practice in the theory of non-linear pricing[2] and assume a utilitarian specification with equal weights for each consumer. This implies the following optimization problem:

$$\begin{aligned} \max_{c,d} w &= (1-x_i)s + x_i u(v(c)) \\ \text{s.t.} \quad \hat{\pi} &= d(1-x_i) + \int_0^{x_i} c(\bar{h}(s) + v(c))ds \end{aligned} \tag{15}$$

[1] The Telecommunications Act of 1996, Art.24(1), prescribes that wholesale prices have to equal to the costs of efficient service provision. RegTP calculates these costs using an analytical cost model. For detail see www.regtp.de.

[2] See Wilson (1993) for an extensive discussion.

Proposition 5

If marginal costs are zero and regulation has to assure a given level of profits then welfare is maximized by using only a flatrate when the preference for the linear tariff is not very high. If the market share of the linear tariff is positive a policy of increasing the linear tariff and decreasing the flatrate keeping profits constant is welfare improving only if the change in consumption of consumers in the linear tariff is below a certain threshold.

Proof: See Appendix

The first part of the proposition is obvious. Clearly, if we consider a discrete jump from any market structure to an equilibrium with a flatrate only, this would be welfare improving for reasonable values of s, i.e. $s > u(v(c))$. However, marginal measures put at least part of the consumers at a disadvantage. For a given market share welfare would go down, because $u(v(c))$ would decline, while the reallocation of costs from flatrate customers to price tariff customers is welfare neutral. The change in the market share, however, tends to increase welfare, because more customers use the flatrate tariff and reach their bliss points. The trade off involved here requires a comparison of the gain in utility of the marginal customer with the reduction in utility of all customers still using the linear tariff. Without additional assumptions about the form of the utility this is not possible.

6 Conclusions

We have shown that consumer heterogeneity makes it difficult for internet providers to offer a flatrate tariff when they face the same marginal costs as suppliers with linear tariff. Cross-subsidization does not work and the firm would have to make a profit on the customer with the highest usage rate. It is unlikely that customer preference for a flatrate is so high as to make this possible. As a consequence, market entry was rare in Germany in the past. This will only change if the regulation authority RegTP forces Deutsche Telekom to offer a wholesale flatrate to ISP's. If the flatrate is not too high, this will allow firms to make flatrate offers that actually gain market share. Deutsche Telekom will continue to resist low flatrates that run counter to profit maximization given the regulated linear price.

If true marginal costs are zero it would be welfare improving if RegTP would force Deutsche Telekom to abandon the linear wholesale tariff and rely on a wholesale flatrate only. This is also important for other countries, like the UK, France, or Spain, that have already introduced a wholesale flatrate. As long as there is an additional linear tariff that has a certain market share there is room for improvement. In fact, it is not clear whether the introduction of a wholesale flatrate is welfare improving if this leads to an upward adjustment of the linear tariff. The reason is that the customers in the linear tariff loose from this policy and this has to be weighed against the gains for customers that switch to the flatrate. If the demand of customers in the linear tariff is very price sensitive then welfare decreases. Even if there is no immediate offsetting increase in linear tariffs after the introduction of wholesale flatrates, a resulting decline in gross profits for the regulated monopoly clearly reduces the possibilities for rate reductions in the future. Rate reductions are actually quite common, mostly due to technological progress. In this case the loss for customers in the linear tariff is more subtle, but it is still an important part of the equation.

Appendix

Proof of Proposition 1:

What we need to show is that

$$\frac{\partial U_f}{\partial x} > \frac{\partial U_p}{\partial x}, \forall x. \tag{16}$$

Let's consider this problem for a general subutility $u(h, \bar{h})$:

$$\frac{\partial u(\bar{h}, \bar{h})}{\partial \bar{h}} > u'(h, \bar{h})\frac{\partial h}{\partial \bar{h}} + \frac{\partial u(h, \bar{h})}{\partial \bar{h}} - p\frac{\partial h}{\partial \bar{h}}, \tag{17}$$

which, because of $u' = p$ is equal to

$$\frac{\partial u(\bar{h}, \bar{h})}{\partial \bar{h}} > \frac{\partial u(h, \bar{h})}{\partial \bar{h}}. \tag{18}$$

For the class of utilities $u(h - \bar{h})$ this is clearly true:

$$0 > -u'(h - \bar{h}), \forall h < \bar{h}. \tag{19}$$

For other classes of utilities this need not be the case however. Consider for example $u(h, \bar{h}) = -g(\bar{h})(\bar{h} - h)^t$ with $g(\cdot) > 0$, $g'(\cdot) < 0$, $1 < t < \infty$. Here the condition is:

$$0 > -g'(\bar{h})(\bar{h} - h)^t - g(\bar{h})(\bar{h} - h)^{t-1}. \tag{20}$$

For $g'(\bar{h}) \rightarrow -\infty$ it is certainly not fulfilled. Q.e.d.

Proof of Lemma 1:

The first order condition for a profit maximum is given by:

$$\frac{\partial \pi_f}{\partial f} = 1 - x_i - \frac{\partial x_i}{\partial f}(f - \bar{h}(x_i)c) \quad = \quad 0 \quad \Leftrightarrow \tag{21}$$

$$1 - x_i - \frac{1}{ph_1}(f - (h_0 + h_1 x_i)c) \quad = \quad 0 \tag{22}$$

which can be solved for equation (10) in the text. The second order condition is:

$$\frac{\partial^2 \pi_f}{\partial f^2} = -\frac{\partial x_i}{\partial f} - \left[\frac{\partial x_i}{\partial f}\left(1 - \frac{\partial h}{\partial x_i}\frac{\partial x_i}{\partial f}c\right) + \frac{\partial^2 x_i}{\partial f^2}(f - h(x_i)c)\right] < 0 \tag{23}$$

which is equivalent to

$$-\frac{1}{h_1 p} - \frac{1}{h_1 p}\left(1 - \frac{h_1}{h_1 p}c\right) < 0 \tag{24}$$

and can be easily solved for $p > c/2$. Q.e.d.

Proof of Proposition 3:

Assume that the linear tariff and the flatrate lead to an interior indifferent customer at x_i. If the customer buys a flatrate he has consumption $\bar{h}(x_i)$. If the firm uses a linear price line it pays $\bar{h}(x_i)c$, if it uses a flatrate line it pays d. The flatrate line is cheaper if:

$$\begin{aligned} \bar{h}(x_i)c \quad &> \quad d \quad \Leftrightarrow \\ \left(h_0 + \frac{1}{c}[u(v(c)) - cv(c) + d - s] - h_0\right)c \quad &> \quad d \quad \Leftrightarrow \\ u(v(c)) - cv(c) \quad &> \quad s \end{aligned} \tag{25}$$

We already know from the discussion following the opposite condition in equation (13) that this is very likely to be fulfilled.

If the indifferent customer buys a linear price line, he consumes $h(c) = \bar{h}(x_i) + v(c)$. If the firm uses a linear price line it pays $(\bar{h}(x_i)+v(c))c$, if it uses a flatrate line it pays d. The linear price line is cheaper if:

$$\begin{aligned}(\bar{h}(x_i)+v(c))c &< d \quad \Leftrightarrow \\ u(v(c)) &< s \end{aligned} \tag{26}$$

which means that the preference for the linear price system $(-s)$ has to be smaller than $u(0) - u(v(c)) = -u(v(c))$, which is the difference between the bliss point and the utility in a price tariff at price c. A higher preference would imply that if a firm offers a consumer using a linear tariff a flatrate that is equal to his current expenditures, then the consumer would prefer to stay in the linear tariff. That's not impossible but unlikely.

If it does not pay to serve the indifferent customer with a flatrate line when he uses a linear tariff, then it certainly does not pay to use such a line for customers left of the indifferent customer. These customers all have a lower consumption and therefore cause lower costs on the linear price line. A similar argument can be made for the other case. It is straightforward that in a corner solution the incentives not to deviate are even stronger.

Finally, when firms compete with prices, prices different from marginal cost are not an equilibrium. This is a standard result in the literature. It should be noted that the wholesale price d is not a fixed cost in the sense that it is independent of production. It is only fixed with respect to usage not with respect to the number of customers. Q.e.d.

Proof of Proposition 4:

The first order condition for a profit maximum is given by:

$$\begin{aligned}\frac{\partial \pi}{\partial d} = (1-x_i) - d\frac{\partial x_i}{\partial d} + \frac{\partial x_i}{\partial d}c(\bar{h}(x_i)+v(c)) &= 0 \quad \Leftrightarrow \\ (1-x_i) + \frac{1}{ch_1}(ch_0 + ch_1 x_i + cv(c) - d) &= 0 \quad \Leftrightarrow \\ c(h_0 + h_1 + v(c)) &= d \end{aligned} \tag{27}$$

The second order condition is

$$\frac{\partial^2 \pi}{\partial d^2} = -\frac{1}{ch_1} < 0 \tag{28}$$

which completes the proof. Q.e.d.

Proof of Proposition 5:

The first part is straightforward. For the second part we use the following first order condition for a welfare improvement from lowering the flatrate:

$$\frac{\partial w}{\partial d} + \frac{\partial w}{\partial c}\frac{\partial c}{\partial d} < 0 \quad \Leftrightarrow \quad w_d - w_c\frac{\pi_d}{\pi_c} < 0 \tag{29}$$

where the last term follows from the implicit function rule and constant profits. We additionally make the following assumptions: $w_d, w_c < 0$, $\pi_d, \pi_c > 0$ and $s = 0$. The first assumption about welfare is always fulfilled, we discuss the second one below. The assumptions about profit have to be fulfilled in any sensible equilibrium if the first assumptions hold or the policy maker would have a free lunch. The last assumption keeps the exposition simple without changing the qualitative result.

Using these assumptions and the fact that $u' = c$, $v' = \partial h/\partial c$ and $u(v(c)) = ch(x_i) - d$ we can rewrite the condition to:

$$
\begin{aligned}
\frac{w_d}{\pi_d} &< \frac{w_c}{\pi_c} \quad \Leftrightarrow \\
\frac{\frac{\partial x_i}{\partial d}(ch(x_i)-d)}{\frac{\partial x_i}{\partial d}(ch(x_i)-d)+1-x_i} &< \frac{cx_i\frac{\partial h}{\partial c}+\frac{\partial x_i}{\partial c}(ch(x_i)-d)}{cx_i\frac{\partial h}{\partial c}+\frac{\partial x_i}{\partial c}(ch(x_i)-d)+\int_0^{x_i}h(s)ds}
\end{aligned}
\tag{30}
$$

Both sides are negative, because the numerators are negative and the denominators are positive. If w_c would be positive, which is possible, the condition would trivially be fulfilled. If $-\partial h/\partial c$, the derivative of demand, is large enough then $w_c < 0$. The derivative only shows up once in the numerator and the denominator on the left hand side. Because of the sign restrictions we know that

$$
\frac{\partial x_i}{\partial c}(ch(x_i)-d) < -cx_i\frac{\partial h}{\partial c} < \frac{\partial x_i}{\partial c}(ch(x_i)-d) + \int_0^{x_i} h(s)ds \tag{31}
$$

If the derivative is comparatively large, we are close the upper bound and marginal profits are close to zero. In this case the condition is not fulfilled and welfare goes down when the flatrate is reduced, because the constant profits restriction requires a very strong increase in the linear tariff. If the derivative is close to the lower bound, marginal welfare is close to zero and welfare is improving when the flatrate is reduced. Q.e.d.

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