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Paper

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August 2010

Acknowledgements: We would like to thank the participants of the 35th EARIE conference (Toulouse) for valuable comments on the draft paper.

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Keywords: access regulation, foreclosure, margin squeeze, telecommunications, fixed networks

JEL: L12, L41, L42, L50, L96

The views expressed are those of the authors entirely and do not represent those of RTR or Telekom-Control-Kommission (TKK). The usual caveat applies.

Abstract

This paper looks at the effects of different forms of wholesale and retail regulation on retail competition in fixed network telephony markets. We explicitly model two asymmetries between the incumbent operator and two entrants: (i) While the incumbent has zero marginal costs, the entrant has the wholesale access charge as (positive) marginal costs; (ii) While the incumbent is setting a two-part tariff at the retail level (fixed fee and calls price), the entrant can only set a linear price for calls. We model the product of the incumbent as horizontally differentiated from the products of the entrants who are homogenous and do not have any market power. Competition from other infrastructures such as mobile telephony or cable is modelled as an 'outside opportunity' for consumers. We find that entrants without market power might be subject to a margin squeeze if the wholesale access price is set at average costs and competitive pressure from other infrastructures increases. Product differentiation, however, prevents market foreclosure. We argue that a wholesale price regulation at average costs is not optimal in such a situation and discuss retail-minus and deregulation as potential alternatives.

1 Introduction

In the late 1990s, competition was introduced in European fixed network voice telephony markets by allowing entrants to get access to the incumbent's network. At the beginning of fixed network liberalization, the main concern of regulators was to bring down retail prices from their (perceived) excessive levels. As calls prices of the incumbent fell significantly after the introduction of wholesale access regulation, the focus of regulation shifted: Currently, a main concern of NRAs is that the incumbent might – absent regulation – set the price of call services so low that an equally efficient entrant in the downstream segment could not survive given the regulated wholesale access charge. Such price setting by the incumbent operator is called margin squeeze or price squeeze.

Retail services offered by alternative operators buying essential wholesale inputs (origination and termination) from the incumbent are still widely used today (see European Commission (2009), Annex 2, Figure 44a). The consumer subscribes to the incumbent's network and then can choose to make her calls via the incumbent or the entrant. This choice is due to ex ante carrier selection (CS) and carrier pre-selection (CPS) obligations imposed on the incumbent firm. In turn, direct access competition stemming from infrastructure-based cable or unbundling (ULL) operators ('intramodal') is rather limited to this day as the average European incumbent firm is holding by far the highest market share.[1] In contrast, competitive pressure from mobile telephony ('intermodal') has increased significantly over the past years.[2]

[1] According to European Commission (2009), Annex 2, Figure 45, 81,4% of EU subscribers were using the incumbent for direct access in July 2008.

[2] See European Commission (2009a), Annex 2, Figure 3, or Schäfer/Schöbel (2006), pp. 6-87, for international case studies.

Our paper examines in detail the incentives and equilibrium outcomes in a scenario where the potentially regulated incumbent faces such service-based (CS/CPS) competition. Given this focus, infrastructure-based competition – either intramodal from within the wireline sector or intermodal from wireless telephony – enters our model as an important outside opportunity for consumers. This provides a feasible way to take into account relevant competitive developments in this segment without having to deal simultaneously with complicated strategic interactions between a large number of potential players. We use this framework to examine i) the conditions under which entrants might be subject to a margin squeeze, and ii) the implications and effects of various regulatory options such as wholesale access regulation at cost oriented prices or retail-minus and retail regulation of the fixed fee.

We employ a differentiated product Bertrand oligopoly model, which distinguishes between the incumbent on one hand and several entrants supplying a homogeneous product on the other hand. With this specification the incumbent enjoys market power, but the entrants do not. We consider this as a rather realistic scenario on fixed voice telephony markets where incumbents (still) benefit from diverse incumbency advantages stemming from, e.g., brand or product loyalty, good reputation, consumer inertia or uncertainty about quality of new entrants. Price competition among CS and CPS providers on the other hand has become particularly intense[3] and has considerably reduced market power of the entrants. As a consequence, there is no role for double marginalization in the model. Furthermore, our model differs from previous models in two respects: First, we model a potential difference in (perceived) marginal cost between the incumbent and the entrant. While the incumbent is assumed to have zero marginal costs per minute, the entrant has the wholesale access charge as (potentially) positive and substantial marginal costs. We call this asymmetry between incumbent and entrant the 'vertical asymmetry'. Second, the incumbent can set a two-part

[3] See European Commission (2009b), chapter 3-6, for evidence on fixed voice telephony markets.

tariff at the retail level (a fixed fee and a price per minute), while the entrant can only set a linear price per minute.[4] We call this the 'horizontal asymmetry'. Both of these asymmetries appear important when dealing with the service-based type of competition we focus on.

This paper provides a generalized version of the much simpler and policy orientated presentation in Briglauer/Götz/Schwarz (2010) who solely focus on the homogenous product case. Apart from Briglauer/Götz/Schwarz (2010) – as far as we are aware – the horizontal and the vertical asymmetry have not yet been simultaneously applied in a single model. The seminal telecom-models of Armstrong (2002) and Laffont/Rey/Tirole (1998a and 1998b) (ALRT) either consider one-way access where the incumbent and the alternative operator are setting linear prices at the retail level or consider competition (and interconnection) between two operators which can both set one- or two-part tariffs at the retail level. Also in the literature on non-price discrimination ('sabotage', 'raising rival´s costs' see Economides (1998), Sibley/Weisman (1998), Beard/Kaserman/Mayo (2001), Weisman (2003), Mandy/Sappington (2007)) incumbent and entrant compete in linear prices at the retail level. We show that the extent to which the incumbent is able to extract consumer surplus via a fixed fee is decisive for retail per-minute prices and for the terms at which the incumbent is willing to provide access. Biglaiser and DeGraba (2001) also consider a model where the incumbent operator has wholesale costs of zero but is selling access at a positive price. Both firms can set two-part tariffs at the retail level, however. Gans and King (2005) investigate the

[4] Although CS/CPS operators could also set two-part tariffs in principle (where the user then pays a fixed fee in addition to the incumbent's fixed fee), empirical evidence shows that customers are reluctant to accept such an 'extra' fixed fee, see for instance WAR (2004). This comes along with an increase in consumers' demand for 'one-stop-shopping' solutions, see European Commission (2009), Volume 2, Annex 2, pp. 125-128, for the European or RTR (2008), pp. 20-21, for the Austrian market situation. In turn, the entrants' pricing scheme is comparatively realistically represented by simple linear tariffs. Only in a few European countries, an effective 'wholesale line rental' product exists (in addition to CS/CPS) which allows an alternative operator to offer access services to consumers without having own infrastructure in place (see Cullen International (2007)). Therefore, we focus on the case where only CS/CPS is available since this applies to the majority of countries.

'competitive neutrality' of access charges and model the 'vertical asymmetry'. They find that upstream prices that differ from marginal costs are not competitively neutral in the sense of placing integrated and non-integrated firms on an equal basis. They do not allow the incumbent to set two-part tariffs, however. Davis and Murphy (2001) analyse competition between a firm offering two complementary goods and a firm offering only one of the two goods, which is a setting close to the 'horizontal asymmetry' but without two-part tariffs. Peitz (2005) examines the effect of asymmetric access regulation on market entry and consumer surplus. Peitz formalizes a market where incumbent and infrastructure-based entrants compete in two-part tariffs with identical cost structures. Other (recent) related papers are Sarmento/Brandao (2007) and Kotakorpi (2006) which focus on effects of vertical integration and access regulation on foreclosure and investments. Both use linear pricing at the retail level.

The rest of the article is structured as follows: Section 2 presents the basic model. Section 3 contrasts the benchmark case of an unregulated incumbent with various regulatory options. We examine the most commonly employed instruments of retail-minus and cost-oriented regulation. We also consider the effects of increased competition from outside opportunities and from product differentiation. Section 4 summarizes and discusses the main conclusions.

2 The model

In this Section we present the model where a vertically integrated operator (the incumbent operator *I*) competes with two (or more) entrants (E_1 and E_2). Since the entrants basically resell the same service (provided by the incumbent), we assume that consumers do not view their products as differentiated. Since we assume Bertrand price-competition an immediate consequence is that the price of the entrants will always be equal to the access charge *t* since

we assume that all retail costs are zero. As entrants do not exert market power, double marginalization is not an issue in our model. Like in Armstrong (2002), our entrants can be called a competitive fringe. The entrants buy access at a price t from the incumbent operator. At the retail level, the incumbent operator is setting a two-part tariff with a fixed charge f and a per-minute charge of p_I. The entrants can only set a per-minute charge of $p_{E,1}$ and $p_{E,2}$, respectively. Consumers subscribe to the incumbent and pay the fixed charge f and then can decide whether they use the incumbent or the entrants for their calls.

We model the product of the incumbent as horizontally differentiated from the products the entrants offer. While the entrants do not enjoy market power due to selling the same product as the fellow entrant, the incumbent has market power and can set a price different from that of the entrant and nevertheless command a positive market share. Demand for entrant i is given by

$$(1) \qquad x_{E,i} = \begin{cases} 0, & \text{for } p_{E,i} > p_{E,j} \\ \frac{1}{2}\frac{a - p_{E,i} - as + p_I s}{1 - s^2}, & \text{for } p_{E,i} = p_{E,j}, \\ \frac{a - p_{E,i} - as + p_I s}{1 - s^2}, & \text{for } p_{E,i} < p_{E,j} \end{cases} \qquad i, j = 1, 2, i \neq j.$$

Here we assume that the entrants share demand equally if they charge the same price. The incumbent faces retail demand x_I for calls with

$$(2) \qquad x_I = \frac{a - p_I - as + p_E s}{1 - s^2},$$

where $p_E = \min\{p_{E,1}, p_{E,2}\}$. The differentiation parameter s is between 0 and 1 with 0 indicating independent demand and 1 indicating that consumers consider the entrants' products to be perfect substitutes for the product of the incumbent.

The above demand functions can be derived from the following quasi-linear utility function of a representative consumer:

$$(3) \qquad U = y + a(x_{E,1} + x_{E,2} + x_I) - \frac{x_{E,1} + x_{E,2}}{2}^2 - \frac{x_I^2}{2} - s \; x_{E,1} + x_{E,2} \; x_I ,$$

where *y* is the numeraire good. We assume that the number of consumers is of measure one, and that all consumers are actually identical. When introducing a fixed fee to extract consumer surplus, we will further discuss this assumption.

With the quasi-linear utility function, consumer surplus is given by (monetary) utility minus total expenses. Consumer surplus *CS* reads

$$(4) \qquad CS = U - Y = a(x_E + x_I) - \frac{x_E^2}{2} - \frac{x_I^2}{2} - s x_E x_I - p_E x_E - p_I x_I - f ,$$

where $x_E = x_{E,1} + x_{E,2}$ and total income *Y* is equal to total expenditure from the budget constraint and *f* is the fixed fee (line rental). In formal terms, the latter means that $Y = y + p_E x_E + p_I x_I + f$ respectively. Consumers will choose to buy access from the incumbent only if $CS > CS^O$, where CS^O is consumer surplus from the outside opportunity, which is defined analogously to *CS*.

As mentioned in the introduction, CS^O provides a simple way to account for infrastructure-based competition from either intramodal or intermodal services. Note that consumers choose either the outside good provided by the alternative suppliers, the incumbent's product or CS/CPS services provided by the service-based entrants. We will assume that the incumbent takes the utility provided by the outside opportunities as given. Therefore, we abstract from the potential strategic interactions between the different market segments (e.g. mobile vs. wireline).

The profit of the entrant *i* is

$$\Pi_{E,i} = x_{E,i}(p_{E,i} - t), \tag{5}$$

while the profit of the incumbent is

$$\Pi_I = f + x_I p_I + t x_E \tag{6}$$

with *t* being the access charge. For simplification, all other variable costs are assumed to be equal to zero. As regards fixed costs, we assume that service-based entry does not require fixed investments. Therefore, entrants do not face fixed costs on the retail or wholesale level. As we will see later, this implies that foreclose does not occur as long as demand increasing effects exists, i.e. as long as $s < 1$.

3 Equilibrium outcomes under various regulatory regimes

We now turn to the derivation of the equilibrium of the model. Due to the simple setup with two homogenous entrants, which do not have market power, the unregulated benchmark case as well as the cases with either regulation of only the wholesale access charge or with retail regulation of only the fixed fee is straightforward. We discuss these cases briefly and then turn to the practically most relevant case of the combination of retail and wholesale regulation.

3.1 Benchmark case

As noted above, introducing at least two entrants offering a homogeneous product leads to pricing at marginal costs for the entrants, i.e., for each entrant we have $p_E = t$. There is no double marginalization problem in this case, and the incumbent will simply set the access

charge equal to marginal costs, i.e. $t = 0$. This maximizes the consumer surplus, which the incumbent extracts via the fixed fee f^{UR}.

$$f^{UR} = \frac{a^2}{1+s} - CS^O$$

The fixed fee is decreasing in the product differentiation parameter *s*, the more homogenous products are, the lower is consumer surplus.

These results are an instance of the 'Chicago Critique' of foreclosure according to which there is only one profit which the incumbent can fully skim by the fixed fee. If potential entrants are equally efficient retail outlets and if they do not have market power, the incumbent is strictly better off to provide access as long as $s < 1$, i.e. if there is a 'love of variety' effect.[5]

The welfare properties of the equilibrium are straightforward. Since prices are equal to marginal costs, we are in a first-best solution. Total welfare is at a maximum and consumer surplus is equal to the consumer surplus provided by the outside opportunity.

As for the benchmark case, turning to the case of isolated regulation of the wholesale access charge *t*, the result is obvious. Since the unregulated access charge is equal to marginal cost, there is nothing to gain in terms of welfare or of consumer surplus with such a policy.

3.2 Retail regulation of the fixed fee f

So far, we considered cases where the incumbent charged retail prices rather close to marginal costs as he could extract consumer surplus directly by means of a fixed fee. In the next step, we examine the changes resulting from putting constraints on this instrument. In opposite to the outside opportunity such constraints render extraction of all consumer surplus (above CS^O)

[5] In the model, the incumbent would even 'subsidize' inefficient entrants or entrants facing fixed costs if consumers value variety. However, voluntary access or even subsidized access by an incumbent has, to our knowledge, never been observed in practice. We will discuss the assumption of 'love of variety' in section 4.

impossible. In most countries regulators set upper bounds on retail access charges, motivated by universal service considerations or firm specific market power.[6] Second, the ability to extract all consumer surplus is limited if consumers are heterogeneous.[7]

We consider the following three-stage game:

Stage 1: The regulator and/or the heterogeneity among consumers determines f^R,

Stage 2: The incumbent sets the access price t

Stage 3: Price competition between the firms

We have to distinguish three cases:

Case 1: f^R is so small that optimal linear prices are charged.

Case 2: f^R is in a medium range where it becomes binding with equality, such that a marginal change in the constraint has an effect on prices.

Case 3: f^R is large and no longer binding. This brings us back to the unregulated benchmark case (see above).

Case 1: Optimal linear prices

If f^R is sufficiently small, the incumbent maximizes profits by choosing the optimal linear price p_I. Taking into account that $p_E = t$, profit maximization with respect to p_I yields the reaction function, which is also the equilibrium price of the third stage.

$$(7) \qquad p_I = \frac{a\ 1-s}{2} + ts\,.$$

[6] Prior to liberalisation particular retail access fees were typically cross subsidised due to distributional concerns. Introducing liberalisation by forcing access to the incumbent's network was first achieved by basic forms of wholesale (interconnection) obligations (enabling CPS and CS services). Gradually, inefficient cross subsidies among retail tariffs were eliminated ('tariff rebalancing') during the first liberalisation phase.

[7] For an in-depth analysis see Tirole (1988), Chap. 3.

Substituting this result into the profit function and solving for the equilibrium of the second stage of the game, we obtain the access charge t determined by the incumbent as

$$(8) \qquad t = \frac{a}{2}.$$

The result is therefore simple and straightforward. Bertrand competition among two entrants leads to $p_E = t$ and the incumbent sets t as well as p_I equal to the monopoly price $a/2$. By setting t equal to this value, the monopolist is able to extract all profit possible with linear prices.

Note that the above reasoning applies only if either f^R or the utility from the outside good and therefore CS^O is rather low. It assumes that there is not much substitution away from fixed line telephony even if monopoly prices are charged for this service. Given that there are serious arguments for considering mobile telephony as increasingly better substitutes for wireline services, we expect that the incumbent is subject to stronger constraints. Note that the constraints from the outside good and the respective values of CS^O imply that Case 2 applies also for 'small' values of f^R. As soon as $CS^O + f^R$ is greater than the consumer surplus with optimum linear prices, f^R becomes binding with equality. Given the above arguments, we turn to the empirically probably more important case 2.

Case 2: f^R is binding with equality

In this case the incumbent sets his price and the access charge in a way such that ensuing consumer surplus is just equal to $f^R + CS^O$.

$$(9) \quad p_I = p_E = t = a - \sqrt{CS^O + f^R \quad 1+s}$$

$$\text{for } CS^O + f^R \in \left[\frac{a^2}{4\ 1+s}, \frac{a^2}{1+s} \right]$$

The boundary cases of the domain lead to the monopoly price and to price equal marginal cost, respectively. The explanation of this result is straightforward. The incumbent sets prices sufficiently low so that he can extract as much consumer surplus by means of the fixed fee as possible and that consumers still buy the product. Given the constraint to provide sufficient consumer surplus, the incumbent sets the prices as high as possible since we are in the range below the monopoly prices.

The result in equation (9) shows that there is no margin squeeze; the incumbent offers access at retail-minus. Furthermore, prices are decreasing if utility from the outside opportunity increases. Via this channel, intermodal competition has a direct effect on call prices. Furthermore, the relation between f^R and equilibrium prices and the access charge, respectively is an inverse one. If the incumbent is allowed to charge a higher fixed fee, he will decrease call prices.

3.3 Regulation of the fixed fee f and the access charge t

In current EU regulatory practice regulation of both the monthly fixed fee and the access charge is most common (see Cullen International (2008)). Again, we need to distinguish between different, i.e. binding and non-binding levels of f^R. The wholesale access charge t is exogenously fixed by the regulator at a cost-oriented level, t^{CO},[8] or determined by a 'retail-minus' rule, i.e., $t^{RM} = p_I$. In both cases, the entrants' price will be equal to the regulated access charge.

[8] Typically, cost oriented prices are based on average costs of the incumbent's network which are significantly above marginal costs. For a further discussion on this assumption see Briglauer/Götz/Schwarz (2010), p. 5.

First, we consider (exogenously determined) cost oriented access charges. For a low level of f^R (Case 1) we know that the optimum linear prices apply. The incumbent's price derives from the respective reaction function (Equation (7) applies). We obtain:

$$(10) \qquad p_I = \left(1-s\right)\frac{a}{2} + st^{CO}.$$

Note that p_I is always greater than t^{CO} as it is a weighted average of the monopoly price and the access charge t^{CO}. Therefore, the incumbent's price is greater than that of the entrants and there is no margin squeeze.

Next, we examine what happens for larger values of $f^R + CS^O$, i.e. in the case where f^R becomes binding with equality (Case 2). This applies when $f^R + CS^O$ is greater than consumer surplus evaluated at optimum linear prices, i.e, when

$$(11) \quad f^R + CS^O > CS\left(p_I = \left(1-s\right)\frac{a}{2} + st^{CO}, p_E = t^{CO}\right) = \frac{1}{8}\left(\frac{a^2\left(5+3s\right)}{1+s} - 8at^{CO} + 4\left(t^{CO}\right)^2\right).$$

If this condition applies, the incumbent will charge a (lower) price in order to guarantee f^R. As soon as

$$(12) \qquad f^R + CS^O > CS \quad \left(p_I = t^{CO}, p_E = t^{CO}\right) = \frac{\left(a - t^{CO}\right)^2}{1+s},$$

the incumbent charges a price lower than the price of the entrants and also lower than the access charge t^{CO}.

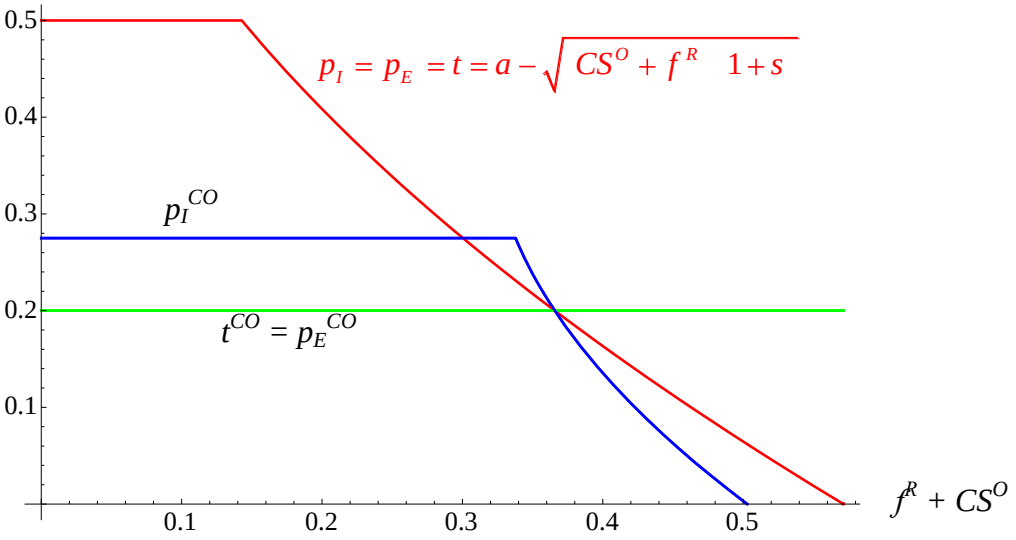

Figure 1: Equilibrium prices and access charge as a function of f^R and CS^O, including cases with and without cost-oriented regulation of wholesale access charge (a = 1, s = .75).

Figure 1 depicts both the case without regulation of the wholesale access charge and with a rate t^{CO} regulated at average cost. The figure allows for a 'dynamic' interpretation of a development with increasing intermodal competition. Just fix f^R at some small values (e.g. .1) and assume that CS^O is 0 so that optimal linear prices apply (in the case without regulation of the wholesale access charge). Without wholesale regulation the incumbent's retail and wholesale price is equal to the (linear) monopoly price of .5. Increasing intermodal competition leading to larger values of CS^O eventually leads to a gradual decrease of the wholesale and retail prices to prices which can be as low as the marginal costs (which are de facto zero on a per minute basis). Finally, we may arrive at flat rates for fixed-line telephony.

If we introduce cost-oriented wholesale regulation of the access charge at t^{CO} = .2, prices are lower for low values of CS^O than without wholesale regulation. Furthermore, there is no margin squeeze and the incumbent charges a higher retail price than the entrant ($p_I^{CO} > p_E^{CO}$). However, as intermodal competition increases to lead to values of $f^R + CS^O$ greater than about .34, the incumbent reduces his retail price. Tougher intermodal competition eventually

leads to a margin squeeze. This is an important result since it is a potential explanation for the observed shift of regulation from preventing excessive calls prices to preventing 'too low' calls prices which may squeeze the entrants out of the market. This shift has happened within the last years when competition from other (in particular mobile) networks also increased significantly and the fixed fee also increased. Three results deserve further mentioning: First, in the region of the margin squeeze the incumbent charges a lower price than without wholesale regulation. The low p_I serves to allow full extraction of f^R. Second, even though the entrants charge a higher price than the incumbent, they get positive demand due to product differentiation and therefore are not foreclosed. Third, the incumbent would even have an incentive to voluntarily reduce access charge below t^{CO} in order to extract additional consumer surplus.

Turning to regulation according to the retail-minus rule, the access charges are determined from the incumbent's optimization problem. A comparison with section 3.2 shows that a retail-minus regulation simply replicates the case without wholesale regulation, i.e., the incumbent would voluntarily set the access price according to the retail-minus rule. Increases in either f^R or CS^O lead to a reduction of the access charge t^{RM}. With retail-minus regulation such increases would eventually lead to lower access charges than the values obtained under cost-oriented regulation.

4 Summary and conclusions

We presented a model where two (or more) entrants buy an input from a vertically integrated incumbent and compete with the incumbent in prices at the retail level. The model allowed us to investigate if or under which conditions the entrants are subject to a margin squeeze and/or will be foreclosed by the incumbent. The entrants have the wholesale access price as positive

marginal costs while the incumbent has zero marginal costs. In addition, the incumbent can set a two-part tariff while the entrants can only set a linear price. Such we were capturing the main features of CS/CPS competition in fixed network voice telephony markets where entrants typically enjoy no market power vis a vis the incumbent. In turn, the incumbent still has market power which is due to diverse "incumbency advantages". Furthermore, we considered the effects from infrastructure based competition (e.g. from mobile or cable networks or from ULL operators) by introducing an 'outside opportunity' for the consumer.

Since the homogenous entrants do not have market power, there is no double marginalization and no margin squeeze in the unregulated case. A margin squeeze may still arise, however, if the access charge is regulated at (positive) average costs and the retail fixed fee is unregulated or regulated and sufficiently large. But, there is no foreclosure as the entrants are differentiated from the incumbent. If the fixed fee is regulated and sufficiently small, the margin squeeze disappears. With the introduction of an outside opportunity, a dynamic interpretation of the model is possible: In a situation where the access price is regulated at average costs and the fixed fee is also regulated (and sufficiently small), an increase in the utility provided by the outside opportunity or an increase in the fixed fee will lower the retail calls price of the incumbent below the access charge. Increased competition from outside opportunities may such lead to a margin squeeze. This is an important result since this might have happened in many countries over the past years. As pressure from other infrastructures – most notably, mobile telephony – became stronger and stronger, the focus of regulation in fixed network markets shifted from preventing excessive calls prices to preventing a margin squeeze. Our model provides a reasonable explanation for this and shows that the margin squeeze might well be the result of increasing (intermodal) competition rather than of anticompetitive behaviour. In the model the incumbent would in a certain range voluntarily set an access charge below an average cost-oriented price. In such a situation a retail-minus

access price would – at least in theory – lead to lower retail prices than a cost-oriented access price. Indeed, regulators seem to increasingly consider retail-minus regulation as kind of regulatory safeguard,[9] which guarantees that there is no margin squeeze and that the regulated incumbent firm gets necessary downward pricing flexibility in intermodal competition.

Strong pressure from outside opportunities of course puts into question the need for regulation in calls markets (including wholesale regulation and the CS/CPS business case) itself. Regulators therefore will have to closely examine whether (and for which markets) competitive pressure from mobile telephony or other networks is strong enough so that the regulation of fixed network voice telephony markets would no longer be necessary at all or could be at least partially reduced. Currently, it seems that (European) policy makers and regulators do not consider intermodal competition sufficiently established to warrant full deregulation of access and retail markets as an option in the medium term.

A second main result of our models refers to the impact product differentiation has on margin squeeze and foreclosure on part of the entrants. As we model consumers' demand as exhibiting 'love of variety' the entrants are – despite being exposed to a margin squeeze in some situations – never foreclosed. Since they bring additional demand, they are valuable for the incumbent who can appropriate the additional surplus. The service-based entrants might ensure that customers stay on the incumbent's platform rather than switching to intermodal

[9] The retail-minus approach has received increasing regulatory attention in recent years. See for instance, the discussion within the Independent Regulators Group (IRG), which published principles of implementation and best practice regarding the use of retail-minus pricing (IRG (2005)). Since then retail-minus has been applied by NRAs for diverse narrowband ("Wholesale Line Rental") and broadband ("bitstream", "naked-DSL") access products. As regards academic literature see for instance Goncalves (2007) discussing the adequacy of retail-minus as an alternative to cost orientation in determining bitstream access charges or Sarmento/Brandao (2007) who show that retail-minus regulation avoids foreclosure and leads to better results than cost-based regulation in terms of investment level and consumer surplus.

competitors. Additionally, many effects extend also to the limiting case where the entrant is not differentiated from the incumbent (see Briglauer/Götz/Schwarz (2010)) although the entrant is then always foreclosed if there is a margin squeeze in this setting.

As regards a critical evaluation of our framework, we first need to mention that there exist other explanations for the occurrence of a margin squeeze.[10] However, we consider those arguments not very relevant for the situation of service-based competition we described. Second, we assumed that the incumbent takes the utility provided by the outside opportunities as given. Therefore, we abstract from the potential strategic interactions between the different market segments (e.g. mobile vs. wireline). While one could model these interactions in a framework building on ALRT or Biglaiser and DeGraba (2001), this task was also beyond the scope of our present paper.

[10] See for example the discussion and literature review on dynamic leveraging in Crocioni (2007).

Appendix: Regulatory background

The EU regulatory framework for electronic communications markets[11] requires NRAs to periodically analyse the state of competition on a certain number of markets and impose appropriate *ex ante* remedies in case that an operator is found to have significant market power (SMP).[12] To promote harmonization among Member States, the European Commission also published a list of markets which have to be considered by each NRA, the 'Recommendation on Relevant Markets' (see European Commission (2003)). This Recommendation originally included the following fixed network voice telephony markets, which are the issue of this article (the number of the market corresponds to the number in the Recommendation):

Retail level:

1. Access to the public telephone network at a fixed location for residential customers.
2. Access to the public telephone network at a fixed location for non-residential customers.
3. Publicly available local and/or national telephone services provided at a fixed location for residential customers.
4. Publicly available international telephone services provided at a fixed location for residential customers.
5. Publicly available local and/or national telephone services provided at a fixed location for non-residential customers.
6. Publicly available international telephone services provided at a fixed location for non-residential customers.

[11] See Directives 2002/19/EC, 2002/20/EC, 2002/21/EC and 2002/22/EC, OJ L108, 24.4.2002.

[12] The concept of SMP is based on the concept of dominance in general competition law (see European Commission (2002).

Wholesale level:

8. Call origination on the public telephone network provided at a fixed location.
9. Call termination on individual public telephone networks provided at a fixed location.
10. Transit services in the fixed public telephone network.

While all NRAs found SMP on the retail access markets (markets 1 and 2) and on the wholesale markets for origination and termination, a majority also found SMP on some or all of the 'calls' markets (markets 3-6). In many cases, therefore, not only the access to wholesale services, but also the prices of the incumbent's retail services have been regulated up to now.

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