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Entry in Telecommunication: Customer Loyalty, Price Sensitivity and Access Prices

by

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*Customer Loyalty, Price Sensitivity and Access Prices**

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Abstract:
Telecommunications is an industry characterised by heavy investments in infrastructure. Historically, one firm has typically been granted a national monopoly. Recently, competition has been opened up. Entrants have been allowed to use the existing network infrastructure at a regulated access price. We study the rivalry between incumbents and entrants under two distinct types of entry: Newcomer entry and reciprocal entry. The latter refers to the situation where two neighbouring "old monopolies" enter each other's markets. A question that is given special attention is when we would expect market sharing type collusion in the latter case.

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1. INTRODUCTION

Telecommunication firms have historically held dominant market positions in most countries. One important reason is the economies of scale in the industry. Since entry of new firms has been regarded as a cost-inefficient solution, one provider has historically often been granted a legal monopoly. To minimise exploitation of market power, this dominant service provider has often faced a restrictive regulatory regime. Lately, though, the industrial structure in telecom has changed dramatically. The industry has been deregulated. Most importantly, new firms have been permitted access to the dominant firm's network. The purpose of this paper is to discuss how such deregulation may change the nature of competition in the telecommunication industry. In particular, we study two different kinds of entry triggered by deregulation: the entrant may be a newcomer to the industry (newcomer entry), but we might also have that incumbent firms in neighbouring markets enter each other's market (reciprocal entry).

There are some idiosyncratic characteristics of this particular industry that should be taken into account when we model the effect of entry. Telecommunication services, such as telephone usage, are to a large extent a homogenous product. Despite this, it is not plausible to assume that all the consumers use the firm with the lowest price. We wish to model the fact that some customers might harbour brand loyalty towards the old monopolist. More precisely, we assume that some customers do not take price differences into account when choosing supplier -- and that a majority of these will choose the incumbent rather than the entrant. We further assume the larger the price difference between the firms' products, the larger the number of consumers that switches to the low price producer. To capture these demand characteristics, we extend a model first introduced in Allen and Thisse (1992), as we will return to shortly.

Second, there are asymmetries on the cost side. The old monopolist has typically invested in infrastructure. We focus on the case where duplication of the infrastructure is prohibitively expensive, so the entrant needs access to this infrastructure to be able to serve consumers. The cost asymmetry between the two firms arises because the entrant is charged an access price, which typically exceeds the marginal costs faced by the incumbent. We assume that this access price is set by some regulatory agency.

As mentioned, we will distinguish between two different entry scenarios. The entrant may be a newcomer to the industry, but also a previous monopolist in some neighbouring market. The interesting distinction is that when the entrant is a neighbour monopolist, the monopolist under attack can retaliate by entering the entrant's home market. Collusion under multimarket contact then becomes an issue.

In the first, classical entry game, we find that the entrant might set a higher price than the incumbent even if he has a cost disadvantage. This is true if a sufficiently large fraction of the consumers are loyal to the incumbent when the two firms set identical prices. The incumbent's best choice is then to set a high price and serve its loyal consumers rather than set a lower price and fight for the price sensitive consumers. Moreover, we find that advertising by the incumbent has an ambiguous effect on the entrant's decision to enter or not. A larger fraction of the total consumers that are loyal to the incumbent tends to deter entry, while less price rivalry due to more loyal consumers in general tends to attract entry. Finally, we find – as one intuitively expects – that higher price sensitivity leads to tougher price competition that may deter entry.

In the second entry game, where potential entry is reciprocal, results are distinctly different in many respects. The reason is that in this setting it is not simply a question whether a firm enters a market or not, but whether the firm enters the neighbouring market and then triggers reciprocal entry. A key question becomes under what circumstances multimarket collusion -- of the form that each firm stays in its original home market -- can be sustained. Higher price sensitivity (simultaneously in both markets) may deter entry and thus promote collusion. The opposite is true if price sensitivity goes up only in one market. Moreover, we find that advertising that affects the fraction of the consumers that are loyal to the incumbent promotes collusion if both firms undertake it and may trigger reciprocal entry if only one of the firms undertakes it.

Our basic model shares some similarities with switching cost models. Consumers are initially allocated to either the incumbent or the entrant, and for identical prices the entrant's market share is either equal to or lower than the incumbent's share. The larger the price difference, the larger the number of consumers that prefers being served by the low price firm. Since not all the consumers switch to the low price firm, we may interpret this as if the consumers incur switching costs. In that respect our model is closely related to Wang and Wen (1998), a switching cost model tailor-made to the characteristics in the telecommunication industry.[1] However, our model is distinctly different from theirs in many other respects. First, they assume two kinds of consumers and that either none or all the consumers in each group switch to the low price firm. In contrast, we assume one group of consumers and let the number of consumers that switches

[1]Their model is closely related to Klemperer (1987). For an explanation of the differences between those two models, see Wang and Wen (1998). Although the referred study is the one most closely related to ours, there are also numerous others. For a survey of the literature, see Klemperer (1995).

depend upon the price difference between the two firms. Second, they assume sequential price setting while we assume simultaneous price setting. Third, they – as well as other switching cost models – investigate only what we have labelled the classical entry game. Here the classical entry game is partially a prerequisite to study the potential for reciprocal entry and multimarket collusion.

The version of our model with potential for reciprocal entry is closely related to some models on collusion. In particular, our model shares many similarities with Lommerud and Sørgard (2000). In that particular model we analysed a multimarket homogenous goods duopoly with either Cournot or Bertrand competition. In contrast, in this model the starting point is the model first presented in Allen and Thisse (1992), a price setting model where not all consumers switches to the low price firm. It turns out that lacking price sensitivity and customer loyalty towards the incumbent crucially matter for results about when multimarket collusion can be sustained.

The article is organised as follows. In the next section we present the model structure. In section 3 we analyse the effects of entry given that the incumbent and the entrant compete non-cooperatively in the post-entry game. In section 4 we examine a certain kind of collusion, where entry in a neighbouring market triggers reciprocal entry in one's own market from the firm that experiences intrusion in his home market. In section 5 we summarise our results, and we hint at some implications for public policy.

2. THE MODEL

Consider an industry where one firm at present is a monopolist and a second firm considers to enter. We assume the following rectangular demand function:

(1) $Q = 1$ if $P \leq \overline{P}$ and $Q = 0$ if $P > \overline{P}$.

Then, obviously, an unthreatened monopolist sets $P = \overline{P}$ and earns a gross profit $\pi = \overline{P}$.

If both firms are active, we apply the demand system introduced in Allen and Thisse (1992). The firms are price setters. If the firms set an identical price, consumers buy either from the incumbent or the entrant. A fraction (1 – *s*) of the consumers chooses the services of the incumbent firm, a fraction *s* is served by the entrant. Allen and Thisse (1992) set *s* equal to ½, implying that with identical prices, consumers are split evenly between the firms. We think that in many contexts it is natural to assume that the incumbent has built up some brand name loyalty, so that when prices are identical, customers overproportionally choose the incumbent. We consequently assume that $0 < s \leq$ ½. The case where $s \rightarrow 0$ is the one where (almost) all the consumers are served by the incumbent when the two firms' prices are identical.

When prices differ, a fraction of the consumers would rather being served by the low price firm than the high price firm. If, for example, the entrant is the high price firm, it would then sell less than a fraction *s* of the total sale. The larger the price difference, the larger the fraction of consumers that would prefer being served by the low price firm. Let the parameter α ("price sensitivity") denote the tendency for consumers to notice price differences and thereby to choose being served by the low price firm. A high α implies that the fraction of the consumers that are price-concerned is large. We let superscripts *I* and *E* denote the incumbent and the entrant, respectively. The incumbent's demand system is the following:

$$
(2) \qquad \begin{bmatrix} Q_I = 1 & if \quad P_I \le P_E - \dfrac{s\overline{P}}{\alpha} \\ Q_I = 1 - s + \alpha\left(\dfrac{P_E - P_I}{\overline{P}}\right) & if \quad P_E - \dfrac{s\overline{P}}{\alpha} \le P_I \le P_E + \dfrac{s\overline{P}}{\alpha} \\ Q_I = 0 & if \quad P_E + \dfrac{s\overline{P}}{\alpha} \le P_I \end{bmatrix}
$$

The entrant's demand system can be formulated analogously. In words, the incumbent has a "base demand" (*1-s*) that can be taken as a measure of customer loyalty. If the incumbent states a lower price than the entrant this will imply that the incumbent steals away some customers from the entrant's base demand. In line with an example in Allen and Thisse (1992), we assume that the gain in demand is proportional to the relative price difference, with α as the factor of proportionality. In the end, the price difference is so large that the incumbent has captured the whole market. If the incumbent states the higher price, it will *lose* customers from its base demand, again at a rate proportional to the price difference, still with α as the factor of proportionality. Naturally, at some point the whole base demand is lost, so that the incumbent is left with zero demand.

Each firm produces with a constant returns to scale technology, so average cost equals marginal cost, and this cost is normalised to zero. The incumbent operates a network. The entrant cannot serve the consumers without access to the incumbent's network. The incumbent's marginal cost in the network is normalised to zero, while the entrant's per unit (politically determined) access price is denoted *t*. We assume that $0 < t < \overline{P}$. If $t > \overline{P}$, the access cost is prohibitively high in the sense that the per unit access cost exceeds the monopoly price. Furthermore, let *F* denote the entrant's fixed entry cost.

Consider the Nash equilibrium following entry. The incumbent has the choice between a *deterrence* and an *accomodation* strategy. We examine the two possibilities separately.

The incumbent, the low cost producer, can always capture the whole market by setting a sufficient low price. From (2) we see that by setting $\breve{P}_I = t - \frac{s\overline{P}}{\alpha}$, the entrant has zero sales when it sets its price equal to its marginal cost (t). The incumbent would then under deterrence earn $\breve{\pi}_I = t - \frac{s\overline{P}}{\alpha}$.

Alternatively, the incumbent can set a higher price and allow the entrant to sell a positive quantity. We have the following maximisation problems for the two firms, given that the entrant's entry cost F is sunk cost, and taking into account that both deterrence and accommodation are possibilities:

(3) $$\pi_I = max\left[\breve{\pi}_I, \max_{P_I} \; P_I\left(1 - s + \alpha\left(\frac{P_E - P_I}{\overline{P}}\right)\right)\right] \text{ for } 0 \le P_I \le \overline{P} \text{ and } t \le P_E \le \overline{P}$$

(4) $$\pi_E = max\left[0, \max_{P_E} \; (P_E - t)\left(s + \alpha\left(\frac{P_I - P_E}{\overline{P}}\right)\right)\right] \text{ for } 0 \le P_I \le \overline{P},\; t \le P_E \le \overline{P}$$

First, let us consider an interior solution where both firms sell positive quantities. From the two firms' first order conditions we have the following interior solution:

(5) $$\hat{P}_I = min\left[\overline{P}, \frac{(2 - s)\overline{P} + \alpha t}{3\alpha}\right]$$

(6) $$\hat{P}_E = min\left[\overline{P}, \frac{(1 + s)\overline{P} + 2\alpha t}{3\alpha}\right]$$

From (5) and (6) it can be found that $\hat{P}_i < \overline{P}$, where i=I,E, if:

(7) $$\alpha > max\left[\frac{(2 - s)\overline{P}}{3\overline{P} - t}, \frac{(1 + s)\overline{P}}{3\overline{P} - 2t}\right] \equiv \alpha^L .$$

The first expression inside the bracket is from (5), while the second is from (6). We focus on the case where entry results in lower prices. In line with this we assume that $\alpha > \alpha^L$.

If the prices expressed in (5) and (6) are set, we have the following individual firm gross profit for each of the firms:

(8) $$\hat{\pi}_I = \frac{\left[(2-s)\overline{P} + \alpha t\right]^2}{9\alpha\overline{P}}$$

(9) $$\hat{\pi}_E = \frac{\left[(1+s)\overline{P} - \alpha t\right]^2}{9\alpha\overline{P}}$$

From (6) it can be seen that the entrant will set earn positive gross profits ($P_E > t$) if:

(10) $$\alpha < \frac{(1+s)\overline{P}}{t} \equiv \alpha^H$$

Second, let us consider a solution where the incumbent continues to serve the total market even after entry. It would set $P_I = \breve{P}_I$ if $\breve{\pi}_I > \hat{\pi}_I$. Solving with respect to α, we have that $\breve{\pi}_I > \hat{\pi}_I$ if:

(11) $$\alpha^C \equiv \frac{(1+s)\overline{P}}{t} < \alpha < \frac{(4+s)\overline{P}}{t} \equiv \alpha^D,$$

By comparing (10) and (11), we see that $\alpha^C = \alpha^H$. This implies that as long as $\alpha < \alpha^H$ the incumbent decides not to serve the entire market after entry. Then the equilibrium prices are the one given by (5) and (6). In what follows we assume that $\alpha^L < \alpha < \alpha^H$. Then $P_i = \hat{P}_i < \overline{P}$ and $Q_i > 0$ in the post entry equilibrium game, where $i=I,E$.

3. NEWCOMER ENTRY

Let us consider the potential for entry by an entrant that is a newcomer to the industry. This might be of interest in itself, but also serves as a stepping stone for the analysis of the more complicated entry game where the entrant is an incumbent monopolist in some neighbouring market. First, consider the market equilibrium that will emerge if the entrant has sunk the entry costs *F*.

Proposition 1: Post-entry equilibrium prices

(i) *If* $s < \frac{\overline{P} - \alpha t}{2\overline{P}} \equiv s^*$, *where* $s^* \in [0, ½]$, *then* $\hat{P}_I > \hat{P}_E$.

(ii) $\frac{\partial \hat{P}_i}{\partial \alpha} < 0$, *where i=I,E, and*

(iii) $\frac{\partial \hat{P}_I}{\partial s} < 0$ *and* $\frac{\partial \hat{P}_E}{\partial s} > 0$.

Proof: Concerning (*i*), it can easily be seen from (5) and (6) that $\hat{P}_E > \hat{P}_I$ when $s = ½$ and $\hat{P}_E < \hat{P}_I$ when $s \to 0$. By comparison, we have that $\hat{P}_E > \hat{P}_I$ if the condition shown in the Proposition is met.

Concerning (*ii*) and (*iii*), it follows immediately from differentiation of (5) and (6). *QED*.

We see from part (*i*) of the Proposition that if *s* is sufficiently low, the incumbent sets a *higher* price than the entrant. This happens despite the fact that the incumbent is the low-cost firm. Obviously, the characteristics on the demand side explain the outcome. Low *s* implies that the incumbent has a high base demand of loyal customers. By lowering its price to capture price concerned consumers, the incumbent would lose revenue on its loyal consumers. This result is analogous to the result found in Wang and Wen (1998). Even though our model is quite different from that of Wang and Wen, we expect that the result that customer loyalty, modelled in some way or another, can bring a the low cost producer to set the highest price, will shine through in many model formats.

Note from part (*ii*) of the Proposition that prices are decreasing in α. This is quite obvious. A higher α means that consumers are becoming more price sensitive. It is well known that in a non-collusive setting this triggers more rivalry on prices.

Finally, note that a change in *s* influences the price setting of the two firms in opposite directions. A reduction in *s* implies that the incumbent's base of loyal customers goes up. The incumbent responds to this by increasing its price. The entrant's base demand decreases with *s* so the entrant is encouraged to lower its price to fight more fiercely over the price-concerned consumers. If the entrant starts out with the highest price, a higher *s* means that the price dispersion between the firms increases in *s*. If the incumbent initially sets the lower price, the situation is reversed.

Proposition 2: Post-entry profits

(i) $\frac{\partial \pi_i}{\partial \alpha} < 0$, *where i=I,E,*

(ii) $\frac{\partial \pi_E}{\partial s} > 0$, *and*

(iii) $\frac{\partial \pi_I}{\partial s} < 0$.

Proof: It can easily be verified for $\alpha^L < \alpha < \alpha^H$ from differentiation of (8) and (9). *QED*.

Part (*i*) in the Proposition is straightforward. An increase in α intensifies the price rivalry between the firms, and both firms lose.

Note from part (*ii*) of the Proposition that an increase in the incumbent's number of loyal consumers reduces the entrant's profit. Obviously, a reshuffling of consumers from the entrant to the incumbent would tend to reduce the entrant's profit. This is a direct effect of a reduction in s. There is, however, an induced effect that runs contrary to this. A larger number of loyal consumers encourages the incumbent to set a higher price. This dampens the shift of consumers from the entrant to the incumbent. Proposition 2 shows that the direct effect dominates: The entrant earns a lower profit as a result of a reduction in s.

Part (*iii*) of the Proposition tells us that the incumbent gains from having more loyal consumers. This is true even if the entrant, as we can see from Proposition 1, responds to lower s by setting a lower price. It implies again that the direct effect (a larger number of loyal consumers) outweighs the induced effect (more aggressive rival).

So far we have focused on the case where entry is a given fact. Since the incumbent by definition is present in the market before the potential entrant decides to enter or not, it is interesting to study how choices made by the incumbent prior to the potential entrant's entry decision can influence the later outcome. Such prior choices can influence later outcomes both in the deterrence case and in the accommodation case. Here we focus on the incumbent's possibility to investment in building brand name loyalty (through "advertising"). Advertising is taken to increase the incumbent's loyal customer base, that is, to reduce s. For any given price difference, the number of consumers served by the incumbent then increases with advertising. Another possible effect of advertising could be that consumers focus more on non-price issues. This is in our model captured by a reduction in α.[2] As long as the majority of consumers that do not act on price differences buy from the incumbent, this could also be profitable for the incumbent.

We assume advertising is costless. We also assume that only the incumbent can influence the demand structure through advertising, simply because this firm initially is the only one present in the market. If an entrant also could use advertising, we would expect such advertising to *reduce* customer loyalty to the incumbent. As regards price sensitivity, though, we expect entrant advertising to have the same effect as incumbent advertising.

Proposition 3 follows straightforwardly from Proposition 2:

Proposition 3: The incumbent's advertising strategy

(i) *If advertising by the incumbent reduces s, then overinvestment in advertising is the optimal strategy both under accommodation and deterrence.*

(ii) *If advertising by the incumbent reduces α, then overinvestment is the optimal accommodation strategy and underinvestment is the optimal deterrence strategy.*

(iii) *If advertising by the incumbent reduces α and s, then the incumbent overinvests if accommodation is the chosen strategy and either over- or underinvest if the deterrence strategy has been chosen.*

In the case of accommodation, the incumbent's strategy is obvious. It should invest in advertising to (i) increase the number of loyal consumers and/or (ii) to make the

[2]Note that advertising could also result in tougher price rivalry. The reason is that advertising would make consumers aware of more products, and the firms would then compete more fiercely on prices to attract consumers. For example, Grossman and Shapiro (1984) presents a model where advertising result in lower prices.

consumers less price sensitive which, in turn, encourages the firms to set a higher price than what they else would have done.

If the incumbent anticipate that it will decide to deter entry, though, this strategy may not be the right one. Advertising that results in less price sensitive consumers (lower α) implies a friendly welcome in the market for the entrant. To deter entry, the incumbent may then in stead underinvest in this type of advertising. Given that α is low, it would be rational to respond to entry by setting a low price, which would help deter entry.

However, if advertising basically gets you more loyal customers (lowers s), this reduces the entrant's sale at a given price. This points towards overinvestment to deter entry. Fudenberg and Tirole (1984) have famously studied how investment decisions influence rivals' actions. In their terminology, the result above that an entry deterring incumbent should underinvest in that type of advertising that reduces price sensitivity, is an example of a lean-and-hungry-look strategy.[3] The result that overinvestment deters entry if advertising basically influences customer loyalty, is an example of a top-dog strategy.

Some remarks about the politically set access price. From (5) and (6) it can be seen immediately that a lower access price tends to reduce the prices of both firms, but the price of the entrant falls the most. The entrant has a direct cost saving, and the rivalry between the firms increases. If the incumbent sets a higher price than the entrant, as we have shown can happen, a lower access price can in principle widen the price gap between the two firms. Notice from (8) and (9) that a lower access price reshuffles profit from the incumbent towards the entrant, as one would intuitively

[3]A similar result is found in Schmalensee (1983).

expect. This could be a potential problem if the incumbent's incentives to maintain the infrastructure is reduced.

4. RECIPROCAL ENTRY AND COLLUSION

We now consider the case where the potential entrant is an incumbent in some other market. This means that any incumbent that experiences entry into its market can retaliate by going into the entrant's own home market. We are especially interested in studying market-sharing type collusion. In particular we will assume that collusion between two previous national monopolists takes the form of each staying put in its own domestic market. Collusion might be an issue also with newcomer entry, but this type of multimarket contact is clearly only relevant in those situation where reciprocal entry is a possibility.

Under collusion, each firm charges the monopoly price for a single market. We assume that one firm, firm 1, is based in country *A*, and a second firm, firm 2, is based in country *B*. *M* refers to the case where collusion is sustained, so that each firm is monopolist in its own home market. *D* refers to the deviation phase. This is the period where one firm starts to export, while the other firm not yet has reacted to this behaviour. *N* stands for the punishment phase, which means a situation with noncooperative oligopolistic behaviour. We assume that punishment takes the form of "trigger strategies", meaning that a deviation from collusion triggers reversion to static Nash equilibrium for all future periods after the deviation period.[4]

With sustained collusion, each firm sells only in its home market. The per-period profit is then $\pi^M = \overline{P}$. Let us consider the case where firm i deviates by

[4] We apply a setting that is identical to the setting presented in Lommerud and Sørgard (2000). In that setting we assume identical products, and we investigate both Bertrand and Cournot competition and both trigger strategies and optimal punishment paths.

exporting. The maximisation problem in the export market in the period of deviation is (subscripts *i* and *j* denotes country (or the firm in country) *i* and *j*, respectively):

$$(12) \qquad \underset{P_i}{Max} \ \pi_i^D = \left(P_i - t_j\right)\left[s_j + \alpha_j\left(\frac{\overline{P} - P_i}{\overline{P}}\right)\right]$$

Solving this maximization problem, we have that:

$$(13) \qquad \widetilde{P}_i = \frac{s_j\overline{P} + \alpha_j\left(\overline{P} + t_j\right)}{2\alpha_j}$$

Since the deviating firm will never set $P_i > \overline{P}$, we have the following optimal price in the period of deviation:

$$(14) \qquad P_i^D = min(\overline{P}, \widetilde{P}_i)$$

Then it can easily be seen that if

$$(15) \qquad \alpha_j > \frac{s_j\overline{P}}{\overline{P} - t_j} \equiv \widetilde{\alpha}_j,$$

the deviator's price under deviation is lower than the domestic monopoly price. In most models of multimarket collusion it would simply not make sense for an entrant to deviate from collusion and attack the neighbouring market, only to charge the same price as the monopolist under attack. Here, however, the entrant would under these circumstances capture some "base demand", and (15) can be seen as an assumption that this temptation is not too high. We concentrate on the case where the entrant in the attack phase actually sets a price lower than the monopoly price, meaning that $\alpha > \widetilde{\alpha}$. The per-period profit for the deviating firm is then:

$$(16) \qquad \pi_i^D = \overline{P} + \frac{\left[s_j\overline{P} + \alpha_j\left(\overline{P} - t_j\right)\right]^2}{4\alpha_j\overline{P}}$$

After deviation both firms revert to static Nash equilibrium behaviour for ever. The equilibrium outcome in each of the two markets would then be as described in the previous section. Each firm would be the low cost producer in its home market and the high cost producer in the export market. We have the following per period profits after deviation:

$$(17)\qquad \pi_i^N = \frac{\left[(2-s_i)\overline{P}+\alpha_i t_i\right]^2}{9\alpha_i \overline{P}} + \frac{\left[(1+s_j)\overline{P}-\alpha_j t_j\right]^2}{9\alpha_j \overline{P}}$$

The first term inside the bracket represents the profits in the home market, while the second term is the profits in the export market.

The following condition determines if firms have incentives to sustain collusion, with δ denoting the discount factor, common for both parties:

$$(18)\qquad \frac{\pi^M}{1-\delta} \geq \pi^D + \frac{\delta}{1-\delta}\pi^N$$

If countries and firms are symmetric ($\alpha_i = \alpha_j = \alpha, t_i = t_j = t, s_i = s_j = s$), we have the following critical discount factor:

(19)

$$\delta \geq \frac{9\left|s^2\overline{P}^2 + 2s\alpha\overline{P}^2 - 2s\alpha\overline{P}t + \alpha^2 t^2 - 2\alpha^2\overline{P}t\right|}{\overline{P}^2\left(36\alpha + s^2 + 18s\alpha + 9\alpha^2 - 20 + 8S\right) - 2s\alpha\overline{P}t - 18\alpha^2\overline{P}t + \alpha^2 t^2 - 8\alpha t\overline{P}} \equiv \delta^*$$

We see that three key parameters determine the critical discount factor, customer loyalty, consumers' price sensitivity and access price. To make the analysis tractable, we evaluate the comparative statics at α=1. It can easily be shown that α=1 is in the relevant range of α we have specified previously. Even though we assume that we start from a symmetric situation, we open up for the possibility that the price sensitivity of consumers (α) can change for one country in isolation. Our results are as follows:

Proposition 4: Consumer price sensitivity (α)

(i) $$\frac{\partial \delta^*}{\partial \alpha} < 0.$$

(ii) $$\frac{\partial \delta_i^*}{\partial \alpha_i} < 0; \ \frac{\partial \delta_i^*}{\partial \alpha_j} > 0 \ \text{if } t < \left(\sqrt{4 - 8s + s^2} - 1\right)\overline{P}.$$

Proof: (*i*) We set $t_i = t_j = t$ in (29). Differentiating with respect to α, and then setting $\alpha = 1$, we obtain the following expression:

(20) $$\frac{\partial \delta^*}{\partial \alpha} = -36\frac{\overline{P}\left(4s\overline{P} + \overline{P} + 2t\right)}{\left[s\overline{P} + 25\overline{P} - t\right]^2}$$

Concerning part (*ii*), we let α_i denote the price sensitivity parameter in country *i*, and α_j the price sensitivity parameter in the neighbouring country. Then we have the following effect on home firm's discount factor by a change in the price sensitivity in home market, evaluated at $\alpha_j = \alpha_i = 1$:

(21) $$\frac{\partial \delta_i^*}{\partial \alpha_i} = 36\frac{\left(t + 2\overline{P} - s\overline{P}\right)\left(t - 2\overline{P} + s\overline{P}\right)}{\left[s\overline{P} + 25\overline{P} - t\right]^2} < 0$$

A change in the price sensitivity in the neighbouring country has the following effect, evaluated at $\alpha_j = \alpha_i = 1$:

(22) $$\frac{\partial \delta_i^*}{\partial \alpha_j} = -36\frac{t^2 + 2\overline{P}t + 8s\overline{P}^2 - 3\overline{P}^2 - s^2\overline{P}^2}{\left[s\overline{P} + 25\overline{P} - t\right]^2}.$$

Then the condition in the Proposition can easily be verified. *QED*.

In theory, there are two opposing effects of more price sensitive consumers in both markets. On the one hand, the firm that deviates earns more in the deviation phase. On the other hand, more price sensitive consumers trigger more intense rivalry after deviation and thereby a profit loss in the periods after deviation. This trade off is analysed in Nilsson (1999) in an analogous setting, and he concludes that improving price sensitivity has an ambiguous effect on the potential for collusion.[5] We see from part (*i*) in the Proposition that in our model more price sensitive consumers in both markets leads to a reduction in the critical discount factor. More price sensitive consumers result in a *larger* potential for collusion. In this case the loss of profits after deviation outweighs the short term gain in the deviation phase.

Alternatively, we may have a one-country change in price sensitivity. Obviously, more price sensitive consumers in one country weakens the incentive to deviate for the firm located in that country. There is no change in the short term gain, but a reduction in the future profits following a deviation. For the firm in the other country, though, there are two opposing forces. Its short term gain would increase, while its future profits would fall due to more intense rivalry in its export market. As we see from the Proposition, the net effect is ambiguous and depends crucially on the access price. A low access price implies that a one-country increase in price sensitivity reduces the scope for collusion, the opposite of what holds true for a both-countries increase in price sensitivity.

Consider now the relationship between collusion and access price. We stay with the symmetric case with identical access prices in the two countries (t). Comparative statics on t then can be interpreted as if the two countries jointly reduce (or increase) their access price. However, we also open up for the possibility that the access price can change unilaterally in one country (but from a common level).

[5]Note that the setting in Nilsson (1999) is distinctly different from our setting. In particular, firms are active in the same market also in the collusive outcome, while in our model firms are active only in its home market when collusion prevails. See also Møllgaard and Overgaard (2000). Like Nilsson (1999), they use a model that is distinctly different from ours. They show that the conclusion depends crucially on the number of firms in the industry and the punishment path. Our finding is identical to their findings when they assume duopoly and trigger strategies, as we do.

Proposition 5: Access prices (t)

(i) $\frac{\partial \delta^*}{\partial t} < 0$.

(ii) $\frac{\partial \delta_i^*}{\partial t_i} > 0; \frac{\partial \delta_i^*}{\partial t_j} < 0$

Proof: (*i*) A joint reduction in access prices has the following effect on the critical discount factor, evaluated at α=1:

(23) $$\frac{\partial \delta^*}{\partial t} = -216 \frac{\overline{P}}{\left[s\overline{P} + 25\overline{P} - t\right]^2}$$

(*ii*) If country *i* unilaterally lowers its access price, then it would affect only the home market profits after deviation for the firm located in country *i*. Obviously, then, $\frac{\partial \delta_i^*}{\partial t_i} > 0$.

The effect of the firm located in the neighbouring country of a change in home country's access price is:

(24) $$\frac{\partial \delta_i^*}{\partial t_j} = \frac{72\left(s\overline{P} + \overline{P} - t_j\right)\left(s\overline{P} + \overline{P} - t_i\right)\left(s\overline{P} - 5\overline{P} - t_i\right)}{\left[\overline{P}^2\left(25 + 26s + s^2\right) - 4t_i^2 + 5t_j^2 - 10s\overline{P}t_j - 10\overline{P}t_j - 16\overline{P}t_i + 8s\overline{P}t_i\right]^2} < 0$$

QED.

There are two opposing forces of a joint reduction in *t*. On the one hand, it would increase the short term profits following from a deviation. On the other hand, it would result in more intense rivalry after deviation and therefore reduce the future profits. As we see from the Proposition, the first effect dominates: Lower access prices would limit the potential for sustaining a collusive outcome. It is of interest to note that Lommerud and Sørgard (2000) in a setting with homogenous products found that lower access prices would *promote* collusion in a setting with Bertrand competition and *destabilise* a collusive outcome if Cournot competition prevails.

We find it worthwhile to explain the difference between our earlier and the present result. Bertrand competition with homogenous goods is a very harsh form of competition, and in such a setting the access price is normally the only shield against being hold down to zero profit. The profit level can be shown to depend very strongly on the access price. This in turn implies that the punishment after deviation, namely the return to noncooperative Bertrand, becomes much harsher with a lower access price. Even though a lower access price also will increase the temptation to deviate, the "harsher punishment" effect will dominate, so collusion is easier to sustain with a lower access price. In the present context, though, the access price is not the only reason why the firms can preserve some profit even under homogenous goods Bertrand competition. Customer loyalty points in the same direction. This means that a lower access price has a much less potential to harm profit under noncooperation. In the end we get a result contrary to our earlier one: Even in a Bertand situation, lower access prices destabilises collusion.

If we have a unilateral change in access price in one country, it has distinctly different effects on the two firms in question. The home firm would then have stronger incentives to sustain collusion, since competition would now lead to more intense rivalry in its home market. The other firm would now earn more in the neighbouring market, both during unilateral deviation and in the competitive outcome that follows. Therefore, it would have stronger incentives to deviate. Due to this, a unilateral reduction in access price may trigger a deviation and then a shift from collusion to competition.

Proposition 6: Customer loyalty (s)

(i) $\frac{\partial \delta^*}{\partial s} > 0$.

(ii) $\frac{\partial \delta_i^*}{\partial s_i} < 0; \frac{\partial \delta_i^*}{\partial s_j} > 0$.

Proof: (*i*) Differentiating (29) with respect to *s*, evaluated at α=1, gives the following expression:

$$\frac{\partial \delta^*}{\partial s} = 216 \frac{\overline{P}^2}{\left(s\overline{P} + 25\overline{P} - t\right)^2} > 0$$

(*ii*) We see from (16) and (17) that a change in s_i would only affect profits in own market after deviation. Hence, $\frac{\partial \delta_i^*}{\partial s_i} < 0$. Then it follows straightforward from the fact that $\frac{\partial \delta^*}{\partial s} > 0$ and $\frac{\partial \delta_i^*}{\partial s_i} < 0$ that $\frac{\partial \delta_i^*}{\partial s_j} > 0$. QED.

We see that an increase in the number of consumers loyal to the incumbent in each of the two markets (lower *s*) tends to reduce the critical discount factor; it promotes collusion. Again, there are two opposing forces. On the one hand, if many consumers are loyal to the incumbent then the short term gain from entry in the neighbouring market is limited. On the other hand, many loyal consumers implies that the long term loss in its own market following a deviation is limited. The reason is that the incumbent's loss from competition in its home market is now more limited.

A unilateral change in *s* may destabilise the collusive outcome. By increasing its own advertising and thereby the number of own loyal consumers, a firm reduces the scope for collusion. It may deviate, because it anticipates a higher future profits following a deviation. If we interpret *s* as advertising (see Proposition 3), then we see that the firms may face a coordination problem. The firms can be jointly better off if both advertise, because that would promote collusion. However, unilateral advertising would encourage the firm that advertises to deviate.

5. SOME CONCLUDING REMARKS

We have studied the interaction among some salient features in many telecom markets; customer loyalty towards the incumbent, imperfect price sensitivity, large investments in infrastructure that can only be used by an entrant at an access fee. The focus of attention has been on the rivalry between an incumbent and an entrant, both when the entrant is a start-up in the industry and when the entrant is a dominant incumbent in a neighbouring market. In the latter case collusion under multimarket contact becomes a relevant issue. We here review some of our central findings.

In the newcomer entry model we saw how the best strategy of the incumbent could be to set a *higher price* than the entrant, even though the access price to infrastructure gives the entrant a marginal cost disadvantage. It may simply pay for the incumbent to profit from the loyalty of some of the consumers than chasing very high market shares by lowering prices. Customer loyalty might lead the incumbent to follow an accommodation strategy as regards entry that allows the entrant a non-negligible market share. We think this description might capture reality in many telecom markets.

If an incumbent could advertise to install customer loyalty, it would be optimal to do so. However, advertising by the incumbent prior to a battle with an entrant could also be seen to reduce the price sensitivity of consumers, as non-price issues come more to the forefront. High investments are then only optimal when the incumbent decides to accommodate the entrant, but not when deterrence is chosen.

Turning to the case of reciprocal entry by "old monopolists" into each other's markets, the sustainability of market sharing collusion is of key interest. In much collusion analysis, one gets "paradoxical" results that what seemingly sharpens competition in effect increases the scope for collusion. If some cartel member deviates from a collusive agreement, the end result will be that collusion breaks down, and the more scaring noncooperative competition appears, the more eager the parties become to sustain the original collusion. For example, absent customer loyalty and imperfect price sensitivity, the model set-up here would imply that a lower access price would increase the scope for collusion -- and not necessarily be good for competition. However, this paradox does not arise here. Not only the access price, but also customer loyalty and lacking price sensitivity can shield firms against competition, should collusion collapse. A lower access price then will not to the same effect discipline colluding firms to stick together, and we get the end result that lower access prices can destabilize collusion. Lower access prices implies more competition both with and without collusion, so a policy maker will not have to think about what sort of entry situation is the relevant one. We also find that higher loyalty towards the incumbent promotes collusion, and the same applies for more price sensitive consumers.

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