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# **W. E. P.**

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## **Würzburg Economic Papers**

Nr. 27

### **Profitable Cannibalization**

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## **Profitable Cannibalization**

**Norbert Schulz**

Why do firms establish new firms supplying the same market? For instance, in Germany the regional supplier of electricity ENBW set up another company called Yello which serves among others the traditional customers of ENBW. It is therefore conceivable that ENBW lost some market share in her home market. Hence, ENBW did cannibalize to some extent her own market. This happened when the German market for electricity was opened up for competition. In such circumstances incumbent firms may rationally expect entry to occur, especially if they realize that new firms would have cost advantages while it is not possible to decrease own costs sufficiently. To prevent this entry to happen, it can be better to start a new firm which can also profit from cost advantages. Setting up new firms can therefore have the aim to preempt the market or to predate new entrants. This argument is well known in the literature (e.g. Bolton et al. (1999)).

Note however, that this argument is purely defensive. It suggests that the only incentive to set up a new firm is to prevent entry by an independent new firm. In short: starting a new firm which cannibalizes among the traditional customers is detrimental to profits but it would be even more detrimental if an independent firm would enter. Among others things this paper shows that under certain conditions one incumbent firm has an incentive to set up a new firm even if entry is extremely difficult for an independent firm and therefore not likely. The conditions for profitable setting up of a new firm turn out to be quite mild. It may also be profitable if incumbent firms own the new entrant jointly. This latter possibility will not be considered here, because it would meet resistance from antitrust authorities under traditional competition law.

To this end we start with two symmetric incumbent firms. Each of these firms has a natural home market. This may be due to customer loyalty or the like, as is the case to an high degree in electricity markets. The degree of loyalty is not uniform among customers however. There are always some customers willing to switch if they receive an offer of a lower price. Competition among the incumbents will focus on these customers. Such competition will decrease prices. What will happen, if a new firm enters such a market? Obviously it must try to attract less loyal customers of the incumbent. To this end it must offer lower prices than the incumbents. In a first round this implies lower prices and a decreased market share of the incumbents. However, it is natural to assume that customer loyalty is stronger vis a vis a completely new firm than vis a vis established firms. This effect may mitigate the intensity of competition. After all it means that it is harder for a new entrant to attract a customer than it is for an established rival. A reduction in prices will thus attract less customers for a new firm. This partial effect speaks for higher prices. Of course, this partial effect has to be confronted with the incentive of incumbent firms to lower prices in order to limit their loss of market share. Stated otherwise: With the entry of a new firm, the battle for price sensitive customers is not between the established rivals but between an established firm and the new firm. As the new firm has disadvantages in attracting such customers, the intensity of competition may decrease,

although more firms are active in the same market. As will be shown in the paper this effect can be sufficiently large to increase the prices of incumbent firms. Even if this is not the case, this effect provides an incentive for an established firm to set up a new firm under circumstances where it would not be profitable without it.

The paper is organized as follows: Section 1 sets up the model and describes the status quo, where the two incumbent firms are not threatened by entry of any sort. Section 2 establishes the announced results and section 3 concludes by commenting on the relationship to the literature and on the relationship to competition policy.

## 1. The model and the status quo

Two firms produce a physically homogenous commodity with constant marginal cost  $c$  without relevant limits of capacity. We start in a situation, where both firms have long standing relationships with customers which renders them loyal to a certain extent to "their" respective firm. Loyalty of a customer is modeled by switching costs  $s$ . The mass of customers of each firm is normalized to be 1. Among these customers switching costs  $s$  vary between 0 and 1. Each customer is characterized by her value of  $s$ . We assume that the customers are uniformly distributed with respect to  $s$ . Customers demand one unit of the commodity or none. They have a common reservation price of  $r$  which is assumed large enough so that each customer will demand one unit in any equilibrium situation which we will encounter in what follows.

Suppose now that firm 1 sets price  $p_1$  and firm 2 sets price  $p_2$ . Then a customer of firm 1 will remain loyal to firm 1, if

$$p_1 \leq p_2 + s \Leftrightarrow p_1 - p_2 \leq s.$$

Given the uniform distribution of  $s$  this gives the demand of loyal customers of firm 1:

$$D_{11}(p_1, p_2) = 1 - (p_1 - p_2)^+$$

Firm 1 attracts also customers of firm 2, if

$$p_1 + s \leq p_2 \Leftrightarrow s \leq p_2 - p_1.$$

Therefore the demand arising from customers of firm 2 for firm 1 is thus:

$$D_{12}(p_1, p_2) = (p_2 - p_1)^+$$

This implies that demand for firm 1 is summarized by

$$D_1(p_1, p_2) = 1 - (p_1 - p_2).$$

For analogous reasons the demand for firm 2 is:

$$D_2(p_1, p_2) = 1 - (p_2 - p_1)$$

As profits of firm  $i$  are therefore  $\pi_i = (p_i - c)D_i(p_1, p_2)$ , it is obvious that a Nash-equilibrium in prices exists. The first order conditions characterizing such an equilibrium are:

$$1 + c - 2p_i + p_j = 0$$

From this it is immediate to calculate the common equilibrium price for both firms:

$$p_1^* = p_2^* = 1 + c$$

Therefore both firms have profits of 1 each. Note that firms are able to pass on any common changes of costs to customers. As long as both firms have access to the same technology it does not pay to adopt a cost reducing technology as the rival firm can then also adopt such a technology and profits are unchanged in equilibrium although changing technology usually has some costs. As a matter of fact we assume that it is prohibitively costly to adopt another technology. This feature of the model is not important for the main result but it eases the analysis.

## 2. Entry of a third firm

In this section we introduce the entry of a third firm. For the time being it is not important whether this firm is owned partially, completely or not at all by one of the incumbents. We assume here that the third firm has full discretion over pricing decisions. Thus even if we will interpret later on the third firm as a subsidiary of an incumbent, the pricing decisions will not be controlled by the incumbent owner. If this were not the case, the pricing decision of the third firm would become a form of price discrimination of the incumbent owner. As price discrimination is not the issue of this note we will abstract from this possibility.

The third firm is characterized by two potential differences vis à vis established firms. First, switching costs for customers of each incumbent firm are generally higher when a switch to the new firm is considered than when a switch to another established rival firm is considered. We model this by switching costs  $sA$  relating to a switch to the new firm, where  $A \geq 1$ . Second, new firms may have access to less costly production possibilities. We will assume for notational simplicity that the costs of the third firm are normalized to zero. This assumption is chosen because of arguments saying that new firms find it easier to tap the international electricity markets than established firms do. Hence, the assumption reasonably captures some aspects of the German electricity market, but it is certainly also a valid description of other markets. For instance, markets where a new technology is available, while established firms find it difficult to change to this new technology, may be another candidate fitting the framework of the model suggested here.

The following analysis has not the purpose to examine all possible equilibria under all possible parameter values of the model. Instead we shall focus on parameter combinations which lend itself to easily establish the claim of the paper. It is for this reason that we impose the following assumption.

**Assumption A:** Let  $k := c/A$ .  $A$  and  $k$  satisfy the following condition

$$(A(2 - k) + 5 - 4k)^2 < 4(A + 2)(2 - k)^2$$

This assumption will help to select among two local maxima of the profit function of firm 1 or firm 2. At this point it is sufficient to point out that this condition can be satisfied by combinations of  $A \geq 1$  and  $k \leq 2$ .

**Proposition 1** If assumption A is satisfied,  $p_1 = p_2 = 2(A + c)/3$  and  $p_3 = (A + c)/3$  is a Nash-equilibrium of the price-setting game.

Proof: Consider firm 1 first. Note that  $p_3 < p_2$ . For  $p_1 < p_3 = 1/3(A + c)$  firm 1 will not loose any customers. Hence, for such prices demand from "own" customers is  $D_{11} = 1$ .

For  $p_3 = 1/3(A + c) < p_1 < p_2 = 2/3(A + c)$  firm 1 cannot loose any customers to firm 2 but to firm 3. A customer will not switch to firm 3, if

$$p_1 \leq p_3 + sA \Leftrightarrow \frac{p_1 - p_3}{A} \leq s.$$

Thus for such prices the demand from "own" customers is  $D_{11} = 1/A (A - p_1 + p_3)$ .

For  $p_1 > p_2 = 2/3(A + c)$  customers satisfying

$$p_1 \geq p_2 + s \Leftrightarrow s \leq p_1 - p_2$$

prefer to switch to firm 2. Likewise customers satisfying

$$p_1 \geq p_3 + sA \Leftrightarrow s \leq \frac{p_1 - p_3}{A}$$

prefer to switch to firm 3. Hence, demand from "own" customers for such prices is

$$D_{11} = 1 - \max\left(p_1 - p_2, \frac{p_1 - p_3}{A}\right).$$

Note that

$$\max\left(p_1 - p_2, \frac{p_1 - p_3}{A}\right) = p_1 - p_2 \Leftrightarrow \frac{Ap_2 - p_3}{A - 1} = \frac{2}{3}(A + c) + \frac{1}{3} \frac{A + c}{A - 1} < p_1.$$

This implies that  $D_{11}$  is concave in  $p_1$ .

Firm 1 can in principle also attract customers of firm 1. As long as  $p_1 < p_3 = 1/3(A + c)$ , a customer of firm 2 will switch to firm 1 if

$$p_1 + s < p_2 \Leftrightarrow s < p_2 - p_1.$$

Demand from other customers will therefore be  $D_{12} = p_2 - p_1$ .

For  $p_1 > p_3 = 1/3(A + c)$ , some customers of firm 1 will switch to firm 3 and some will switch to firm 1: Customers of firm 2 prefer to go firm 1 rather than stay with firm 2, if

$$s < p_2 - p_1.$$

They prefer to go to switch to firm 1 rather than to firm 3 if

$$p_1 + s < p_3 + sA \Leftrightarrow s > \frac{p_1 - p_3}{A - 1}.$$

Therefore the demand from other customers is

$$D_{12} = \left( p_2 - p_1 - \frac{p_1 - p_3}{A - 1} \right)^+.$$

Note that  $D_{12} = 0$  for  $p_1 \geq p_2 - \frac{p_2 - p_3}{A} = \frac{2}{3}(A + c) - \frac{A + c}{3A}$ .

This implies for the demand of firm 1:

$$D_1 = \begin{cases} 1 - p_1 + \frac{2}{3}(A + c) & \text{for } p_1 < \frac{A + c}{3} & (1) \\ 1 - \frac{A + 2}{A} p_1 + \frac{2}{3}(A + c) + \frac{2}{3A}(A + c) & \text{for } \frac{A + c}{3} < p_1 < \frac{(A + c)(2A - 1)}{3A} & (2) \\ 1 - \frac{1}{A} p_1 + \frac{1}{3A}(A + c) & \text{for } \frac{(A + c)(2A - 1)}{3A} < p_1 < \frac{(A + c)(2A - 1)}{3(A - 1)} & (3) \\ 1 - p_1 + \frac{2}{3}(A + c) & \text{for } \frac{(A + c)(2A - 1)}{3(A - 1)} < p_1 & (4) \end{cases} \quad \text{No}$$

te that  $D_1$  is concave in the joint domain of (1) and (2) and also in the joint domain of (3) and (4). However,  $D_1$  is not concave on the complete domain (1) to (4). In general the profit function turns out to have two local maxima, one in (2) and one in (3). Solving the first order conditions gives for (2)

$$p_1 = \frac{A + \frac{2}{3}(A + c)(A + 1) + c(A + 2)}{2(A + 2)}$$

and for (3) we have

$$p_1 = \frac{2(A + c)}{3}.$$

Calculating the profits at these two values of  $p_1$  reveals that under assumption A  $p_1$  in (3) is the global maximum of the profit function of firm 1.

This implies that the values of  $p_1$  given in the statement of the proposition is indeed the best response of firm 1 given the values of the two other firms. As firm 2 is exactly symmetric to firm 1 the same is true for firm 1. As for firm 3 the analysis is very easy:

Firm 3 can only attract customers from firm 1, if she charges a lower price. A customer of firm 1 will switch to firm 3, if

$$p_3 + sA < p_1 \Leftrightarrow s < \frac{p_1 - p_3}{A}.$$

Clearly, demand from former customers of firm 1 is therefore  $D_{31} = \frac{1}{A} \left( \frac{2(A + c)}{3} - p_3 \right)$ . By the same argument the demand from former customers of firm 2 has the same value. Hence, the demand facing firm 3 is  $D_3 = 2 D_{31}$ . From this it is immediate to derive that the profit maximizing price is  $(A + c)/3$  as claimed in the statement of the proposition. This completes the proof of proposition 1.

Proposition 1 provides the basis for the argument that the entry of a third firm does not necessarily decrease prices of incumbent firms and that the profits of incumbent can increase, if it sets up a subsidiary firm which takes away some of its former customers. Let us start with the first argument.

**Proposition 2** If assumption A is satisfied, prices will increase with the entry of a third firm– measured from the status quo – iff  $A(2 - k) > 3$ .

Proof: Preentry prices are  $1 + c = 1 + kA$ . Hence incumbents prices increase iff

$$\frac{2A(1 + k)}{3} > 1 + kA \Leftrightarrow A(2 - k) > 3.$$

Note that this inequality is compatible with assumption A:  $k = 5/4$  and  $A = 5$  satisfy both the inequality and assumption A.

At first sight, the result contained in proposition 2 is surprising. Intuitively, the new firm has a cost advantage which should make her a fiercer competitor. One might also be inclined to think that the new firm has to fight harder because it is more difficult for her to attract customers. This again favors lower prices. Finally before entry, the established firms have to balance their wish to attract customers from their rival with their wish to exploit their particularly loyal customers. This should speak for higher prices without entry– one might think. Thus all these arguments suggest decreasing prices following entry. Indeed these arguments are compatible with the model (if the above inequality is reversed). But as pointed out in the



introduction there is another effect which may dominate all of these: With the third firm in the market an incumbent firm may not be in direct competition with the rival incumbent (which is implied by assumption A). In such a situation an increase of the incumbent's price yield higher marginal profits if the competitor is the new firm, which finds it more difficult to attract customers from the incumbent than her rival: Suppose the incumbent firm and the other incumbent set prices as in the status quo equilibrium. This implies that marginal profits derived from a price increase are zero:

$$1 + c - 2p_1 + p_c = 0$$

Here  $p_c$  denotes the price of the competitor. If this price is set by the third firm, the incentive to increase prices is proportional to

$$A + c - 2p_1 + p_c$$

which is positive if  $A > 1$ . Hence the incumbent firm has an incentive to increase prices, if the new firm charges the same prices as the rival incumbent before entry. Of course, the new firm will set different prices and therefore prices may decrease, but as proposition 2 shows this effect may be strong enough to dominate the outcome.

Given that prices of incumbents may increase following entry by a new firm, it would seem possible in principle that even profits of incumbents increase. If cost disadvantages of incumbents are not that large and if switching costs for the new firm are high enough, the effect driving proposition 2 might expected to be strong enough to outweigh any countervailing forces. Indeed, the profit of an incumbent firm is

$$A \frac{(2 - k)^2}{9}$$

at the equilibrium according to proposition 1. This profit would be larger than the profit before entry (see section 1) if  $A(2 - k)^2 > 9$ . This condition exactly mirrors a low cost disadvantage of incumbents and a switching cost disadvantage of the new firm. Unfortunately this condition is incompatible with assumption A. It can be shown that there is no combination of  $A$  and  $k$  which satisfies this condition and assumption A. At the current stage of this work it is not known what an equilibrium looks like, if assumption A is not satisfied. Preliminary analysis suggests that in such cases there is either an asymmetric equilibrium or no equilibrium in pure strategies. Hence, it is possible that entry can be profit-increasing for other equilibria than those reported in proposition 1. But even if it should turn out that without assumption A such a result cannot be obtained within the specification of the model, it seems to be an artifact of the piecewise linear structure of demand used here for simplicity. This point should be subject to further research.

It is however true that an incumbent firm can improve her profit by setting up a new firm. The profit of the third firm is

$$A \frac{2(1+k)^2}{9}.$$

This implies that the profit of an incumbent firm plus the profit of the new firm is therefore

$$A \frac{2+k^2}{3}.$$

**Proposition 3** If assumption A is satisfied and if  $A(2+k^2) > 3$  an incumbent firm has an incentive to setup a third firm.

Proof: trivial as the profit of an incumbent is 1 without a third firm.

It is obvious to verify that assumption A and the condition contained in proposition 3 are compatible. The example given for proposition 2 is sufficient to establish this claim.

This result does not come as a surprise after knowing proposition 2. As the condition in proposition 3 is much weaker than the condition contained in proposition 2 one could wonder whether a decreased level of prices of all firms (if the condition of proposition 2 is not satisfied) can be counterbalanced by gains in market shares. After all, all prices are lower. Therefore gains in market share are obtained with considerable costs due to price reductions. As the proposition 3 makes clear, profits of an incumbent cum new firm can indeed increase her profit even if prices decrease moderately enough. In this case setting up a new firm indeed cannibalizes the incumbent firm but this cannibalization increases profits of the incumbent together with her subsidiary. In this sense setting up a cannibalizing new firm is not purely defensive. Even if it would be clear that new firms established by outsiders do not have a chance to enter the market, there is a clear-cut incentive for an incumbent to start up such a firm, if the condition of proposition 3 is satisfied. In German electricity markets it is obvious that outsiders (international candidates of entry) can be easily deterred as the major suppliers of electricity also control the net needed to deliver electricity of the consumer. It is particularly easy to inhibit such attempts of entry as long as the access of the net is conditioned on the fact that the entrant should supply electricity from liberalized markets. What the results of this note suggest is that under such circumstances it pays incumbent firms to set up new firms which focus on price sensitive consumers. this may imply that consumers with high switching costs do not benefit from entry of a new firm at all. To the contrary they might end up paying higher prices (if the condition of proposition 2 is satisfied).

Finally, it should be noted that entry by many new firms cannot be expected. If another new firm enters the market, she will have to attract new customers from the customer base of established firms as the (only) third firm had to. If other firms have to overcome the same switching costs as the third firm in this section, it will not pay to enter as prices will be driven down to marginal costs in a Bertrand fashion. Hence, whenever there is some temporal advantage of a first entrant, this entrant can be expected to be safe from further entry. In this sense the results above are robust with respect to the number of potential entrants.

### 3. Discussion and concluding remarks

Consequences of switching costs have been investigated in several papers. Klemperer (1995) provides a survey. This literature employs most of the time a discrete typology of customers (low switching costs, high switching costs). This leads in general to the necessity to use mixed strategy equilibria. In this respect the modeling approach of the present paper is obviously different. Apart from these technical issues, the question of entry has not been analyzed in a similar way to the best of my knowledge.

The literature on product differentiation (see Anderson et al. (1992) for a survey) is related to the approach taken here. Indeed the functional forms of demand in the present paper are very much reminiscent of those found in the product differentiation literature, especially in its horizontal modeling type à la Hotelling or à la Salop. However, in these models entry usually leads to lower prices for all active firms, in contrast to the results derived here. In these models such a result is to be expected. If entry occurs, all firms together offer almost always closer substitutes than before entry. This depresses equilibrium prices. Although the mathematics of demand looks similar in these models and in the model presented here, it does so only at first sight. Note that here the new firm has been modeled as confronted with higher switching costs. This is an aspect which cannot be accommodated in any sensible way in models of product differentiation and it is an essential modeling input for the results derived here.

It is clear that brand loyalty together with the resulting switching costs is conceptually different from issues treated in the product differentiation literature. In this literature loyalty to a firm is also possible. But it is grounded on the fact that this firm offers a variant of the product which is closer to a customer's most favored variant. The disutility of consuming a variant which is very distant from this most favored variant is in some respect similar to switching costs. But as the differing results derived from these models and the one presented here illustrate, this similarity does not carry far. In short: the conceptual differences prevent the use of exactly the same analytical framework. This makes genuine models with switching costs necessary.

It seems worthwhile to relate the results of this note to competition policy. As efficiency is usually considered the foremost aim of competition policy, one should note first that the entry of the third firm unambiguously enhances efficiency. The total supply does not change in the context of the model and it is provided at lower costs by the third firm. Hence, the entry of the third firm increases social surplus by reducing production costs. Changes in prices reflect here distribution effects. It is true that prices may increase for particularly loyal customers of incumbent firms. But as we have assumed that the reservation price of all customers is the same and high enough to never matter, this increase has no demand depressing effect and thus no efficiency reducing effect. It is of course conceivable that this changes if customers differ in reservation prices and if the higher prices lead some customers to refrain from buying the commodity. In such a context, the balance between cost reduction via the new firm and efficiency losses due to excluded customers is less clear. To assess this balance the analysis would have to be adapted for differing reservation prices.

It has been observed by many scholars that the praxis of competition policy is more often than not more concerned with issues of consumer surplus than with social surplus. Neven and Röller (2001) have argued that such an aim for competition agencies may enhance efficiency more than the direct aim of efficiency. Their main argument for such an assessment rests on the lobbying process which is important in many cases and usually favors firms as opposed to consumers. As a rule the latter group is not present in hearings of antitrust cases. It is therefore also interesting to look at the consequences of our results for consumer surplus.

Within the context of our model total revenues can serve as an indicator of consumer surplus. If total revenues increase with the new firm consumer surplus decreases. It is easy to verify that revenues will increase if  $A(5 - k^2) > 9$ . This condition is again compatible with assumption A. Hence, consumer surplus may indeed be reduced by the entry of a new firm..

As long as we stay in the strict domain of the model above the efficiency aim obviously leads us to welcome the third firm. Even if an antitrust agency would indeed be obliged to a consumer surplus standard, it would (fortunately) find it very difficult to judge a priori whether consumer surplus can be harmed by the new firm.

If the new firm is independent of the incumbent firms such entry would of course not be the subject of an antitrust case under traditional competition policy anyway. It may, however, become a case, if the new firm is a (partial) subsidiary of one incumbent. It may then be a case of merger control, because it can be a joint venture between one incumbent and another firm. Again the efficiency aim would call for no objection by the antitrust agency. And the agency might find the fact that the pricing decision is taken by the third firm without interference of the incumbent firm as conducive to no objection.

Finally, a remark on price discrimination seems appropriate. Bans on price discrimination towards consumers have been criticized by many scholars. In the context of the present work it should be pointed out that a firm can circumvent such a ban by setting up a subsidiary. Even if the pricing decision is not coordinated between the subsidiary and the established firm such a move can improve profits as we have seen. It is interesting that in the situation modeled in this note firms would refrain to price discriminate directly (Schulz (2000)). There it is shown that a firm does have an incentive to use price discrimination only if she has a major advantage over the rival which is not the case here. Hence, in situations where customer loyalty plays an important setting up a new firm which is active in the same market seems to be the better alternative to direct price discrimination.

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