Exclusionary Pricing in Markets with Interdependent Demands

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Abstract

In this paper I use a simple model to study the competitive effects of exclusionary pricing involving two markets related by a positive demand externality. It is shown that below-cost pricing on one of these markets can allow an incumbent firm to exclude (from both markets) a more efficient rival which does not have a customer base yet. However, when exclusion occurs, it is always socially optimal. In addition, under some circumstances, there is inefficient entry: the entrant wins both markets while the social optimum would require the incumbent to win them.

JEL Classification: L13; L41.

Keywords: Exclusionary Pricing; Demand Externalities; Entry.

1 Introduction

This paper studies the competitive effects of exclusionary pricing involving two markets related by a positive demand externality. In particular, the paper considers a model of competition between an incumbent and an entrant when there are two market segments, market 2 with no demand externalities and market 1 where consumers derive a positive utility from the number of consumers buying the good in market 2. In addition, the two firms are assumed to price sequentially in the two markets, starting with market 2 (which generates externalities) and then in market 1.

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The proposed theoretical model captures the main features of a recent antitrust case in the UK involving Napp, a pharmaceutical company. In 2001 the Office of Fair Trading found that Napp had infringed the UK Competition Act 1998 through its behavior in the market for the supply and distribution of sustained release morphine in the UK. This infringement consisted of both predatory pricing in the hospital segment and excessive pricing in the community segment (Napp had a market share well in excess of 90% in both segments). Sustained release morphine is sold to two completely different groups of buyers. On one segment there are hospitals, which have a high demand elasticity (pharmaceuticals have to be paid out of their budget) and can count on the advice of specialist doctors for an assessment of the competing products. On the other segment, there is the so-called ‘community segment’, where general practitioners prescribe products for their patients (with the National Health System paying the bills), and who - not being experts - tend to choose those products which have already been chosen by hospitals.\footnote{In some cases, this is automatic: for patients who have been in hospitals, the general practitioners limit themselves to follow the hospital’s prescription.} This can then be seen as a situation wherein there are two market segments with interdependent demands: hospitals (market 2) care about prices only, not about demand by the other consumer group, while the demand of the community segment (market 1) strongly depends on the choices made by hospitals.

The analysis shows that exclusionary pricing may exist even when consumers perfectly coordinate their consumption choices, thereby providing a theoretical rationale for exclusionary pricing in markets with interdependent demands. However, it does not imply that below-cost pricing in such markets should be taken as anti-competitive conduct. Instead, I find that when exclusion occurs, it is always socially optimal. In addition, the proposed model always predicts the existence of an intermediate range of consumer basis for which it is optimal to let the incumbent serve the market, but the entrant manages to exclude the incumbent. This paper, therefore, does not find support for the idea that Napp breached competition laws.\footnote{Clearly, I am focusing here on a situation similar to the one that antitrust agencies and courts are facing if there was a monopolization (Section 2 of the US Sherman Act) or abuse of dominance (article 102 of the European Union Treaty) investigation. The market already exists and a firm enjoys an incumbency advantage.}

This paper then contributes to the literature which deals with exclusionary conduct. In the proposed model, the incumbent firm exploits demand externalities across buyers to exclude a rival, a mechanism that is in the spirit of anticompetitive exclusion in presence of contracting externalities, as stressed by Bernheim and Whinston (1998), but whose main insight was probably first applied to exclusionary conduct by Aghion and Bolton (1987). In particular, in my model it is as if the incumbent and one consumer group (the one which does not care about externalities) made a
coalition to the detriment of the other consumer group and the entrant. Apart from the literature on exclusive dealing (see e.g. Rasmusen et al. (1991), Segal and Whinston (2000)), a similar mechanism can be found in models of exclusionary pricing such as Karlinger and Motta (2007). The proposed model departs, however, from these three works in three important ways. First, sequential pricing is assumed. Second, in the present paper below-cost pricing and exclusion might still arise as an equilibrium solution without having to rely on miscoordination among buyers. Third, in my setting, below-cost pricing does not generate excessive exclusion.

2 The setup

Consider two firms selling exactly the same good to two different groups of consumers (say, to two market segments). One firm, firm $I$, is the dominant incumbent, and has already an installed base of $\beta^I = \beta \geq 0$ consumers on each market segment, and firm $E$ is a rival new firm which does not have any customer base, $\beta^E = 0$. Assume that the incumbent’s installed base of consumers results from the fact that the product at issue is a durable good and “old” consumers are locked-in to the firm they have bought from in the past and would not consider buying again.

On each market segment, there exists a second group of (“new”) consumers, of size $N > \beta$, that is on the market when the game starts. So, the two firms compete for “new” consumers and all the “new” consumers on a given market segment are homogeneous. Consumers on market segment 2 are assumed not to care about the number of consumers buying from the same firm on market segment 1 while consumers on market segment 1 obtain utility increasing in the number of (“old” and “new”) consumers of market segment 2 purchasing from the same firm. More formally, a “new” consumer from market segment 2 purchasing from firm $k$ ($k = I, E$) obtains utility

$$r - p^k_2,$$ (1)

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3 Karlinger and Motta (2012), for instance, consider an industry exhibiting network effects and show that an incumbent with an established customer base might charge a price below cost to some crucial group of consumers, thereby depriving the entrant from the scale it needs to operate profitably in the market. It turns out, however, that in their setting exclusionary equilibria crucially depend on some fragmentation of buyers: if buyers could coordinate their choices, exclusion of the more efficient entrant would no longer take place.

4 My motivating example, Napp, has features which resemble this assumption: hospitals buy at a procurement auction and continue to use their stock until a new auction is made.

5 This assumption is also in line with the case of Napp described in the introduction: hospitals are not influenced by purchase decisions of General Practitioners (GPs), but GPs’ demand increases with hospitals’ adoption of the pharmaceutical product.
whereas a “new” consumer from market segment 1 purchasing from firm $k$ ($k = I, E$) obtains utility

$$v(\beta^k + N_2^k) - p^k_1,$$

(2)

where $r \geq 0$ is the fixed benefit a consumer obtains from buying the good on market segment 2, $v(\cdot)$ is a function that represents the benefit a “new” consumer on market segment 1 derives from having consumers on the other market segment purchasing from the same firm, $N_2^k$ denotes the number of “new” consumers on market segment 2 that purchase from firm $k$, and $p^k_1 \geq 0$ is the price charged by firm $k$ to consumers on market segment $i$. The externality function is assumed to be twice-continuously differentiable, with $v(0) = 0$ and $v'(\cdot) > 0$.

Turning to the cost side, assume that the cost of serving a consumer does not depend on the market segment to which the consumer belongs. Let $c_I$ be the marginal cost for the incumbent and $c_E$ the marginal cost for the entrant. Assume $c_I > c_E \geq 0$. Let $\Delta c = c_I - c_E > 0$. Further, firm $E$ is assumed to face zero entry costs, to highlight that entry barriers come only from indirect network effects.

I also impose the following market viability conditions.

**Assumption 1** Assume that: (i) $r > c_I$; (ii) $v(\beta) \geq c_I$; and (iii) $v(N) \geq c_I > c_E$.

In this model, there is standard Bertrand competition on market segment 2. In addition, if the incumbent firm wins “new” consumers on market segment 2, then (irrespective of what $p^E_1 \geq 0$ is) all “new” consumers on market segment 1 will buy from the incumbent firm too, as long as the price does not exceed $v(N + \beta)$. It is then natural to consider the following sequential pricing game:

1. Each firm chooses its price on market segment 2 and consumers on market segment 2 make their purchasing decisions.

2. Each firm chooses its price on market segment 1 and consumers on market segment 1 make their purchasing decisions.

I further assume that consumers have self-fulfilling expectations.

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6 If $r = 0$, consumers on market segment 2 would never be willing to pay for the product.

7 In modelling the externality function, I follow closely Katz and Shapiro (1985): the utility a consumer derives from the purchased good depends upon the number of consumers who are in the same network. I further assume, however, that what consumers of one market segment (may) value is participation of consumers on the other market segment (i.e. cross-group externalities).

8 Recall that “old” buyers have already purchased the product and do not buy any longer.
3 Equilibrium solutions

In this section I look for the subgame perfect Nash equilibrium of this sequential pricing game.

3.1 Benchmark case: no installed base of consumers

Consider first the scenario in which \( \beta = 0 \). Then, as explained in what follows, only an entry equilibrium exists.

Suppose that at the end of stage 1, all “new” consumers on market segment 2 chose firm \( k \) (\( k = I, E \)). Then, firm \( k \) will also win stage 2 competition (for consumers on market segment 1) if and only if \( v(N) - c_k \geq 0 \), which is always true under Assumption 1.\(^9\) This implies that the winning firm \( k \) is monopoly with respect to group 1 consumers and extracts all surplus by charging those consumers the price \( v(N) \). This firm will then make a (second period) profit of \( N[v(N) - c_k] \).

Let us now examine competition in stage 1. Firms anticipate that buyers on market segment 1 will buy from the same firm that wins the competition for consumers on market segment 2. Hence, the lowest price that the incumbent and the entrant can charge in period 1 (the ones for which firms break-even) are respectively given by \( p^I_2 = 2c_I - v(N) \) and \( p^E_2 = 2c_E - v(N) \). But, since \( c_I > c_E \), \( p^E_2 < p^I_2 \), implying that the entrant firm will always win Bertrand competition on market segment 2 (by charging a price a shade below \( p^I_2 \)). One can thus state the following proposition.

**Proposition 1** Suppose there is no installed base of consumers. Then, in equilibrium, all consumers (on both market segments) buy from the entrant at prices \( p^E_1 = v(N) \) and \( p^E_2 = 2c_I - v(N) \).

Hence, if \( \beta = 0 \), the entrant will always win consumers from both groups.

3.2 Asymmetric installed bases of consumers

I now investigate the more general scenario in which \( \beta^I = \beta > 0 \) whereas \( \beta^E = 0 \).

Consider the second period. Two cases should be distinguished that I discuss in turn. Suppose first that at the end of stage 1 all “new” consumers on market segment 2 chose the incumbent. Then, in stage 2, one has an equilibrium in which \( p^I_1 = v(N + \beta) \) and all “new” consumers from market segment 1 buy from the incumbent. The incumbent is a monopolist with respect to consumers in market segment 1 and, therefore, extracts from them all possible surplus. The incumbent then makes

\(^9\)When firm \( k \) wins stage 1 competition for consumers on market segment 2, then market segment 1 consumers’ surplus from (also) buying from firm \( k \) is given by \( v(N) - p^I_1 \), whereas their surplus from buying from the rival firm would be non-positive.
a (second period) profit of \( \pi^I = N [v(\beta + N) - c_I] \) which is always positive due to Assumption 1.

Suppose now that at the end of stage 1 all “new” consumers on market segment 2 chose the entrant. Then, the entrant wins also stage 2 competition. When the entrant wins stage 1 competition for consumers on market segment 2, then market segment 1 consumers’ surplus from buying from the incumbent and from the entrant is respectively given by \( CS^I_1 (\beta, p^I_1) = v(\beta) - p^I_1 \) and \( CS^E (N, p^E_1) = v(N) - p^E_1 \). Now, since the best offer that the incumbent can make to consumers belonging to market segment 1 is \( p^I_1 = c_I \), one may conclude that by setting \( p^E_1 = c_I + v(N) - v(\beta) \), the entrant wins stage 2 competition and makes a (second period) profit of \( \pi^E = N [v(N) - v(\beta) + c_I - c_E] > 0 \).

Consider now competition in the first period for consumers in market segment 2. Firms anticipate that “new” buyers on market segment 1 will follow the choice of “new” buyers on market segment 2. Hence, the lowest prices that the incumbent and the entrant can charge in period 1 are respectively given by \( p^I_2 = 2c_I - v(\beta + N) \) and \( p^E_2 = 2c_I - [v(N) - v(\beta)] \). This in turn implies that the equilibrium first period price is equal to the max \( \{p^I_2, p^E_2\} \) (recall that there is Bertrand competition on market segment 2) and the incumbent wins if and only if \( p^E_2 > p^I_2 \) or, equivalently, if and only if:

\[
v(\beta + N) - [v(N) - v(\beta)] > 2\Delta c + c_I. \tag{3}
\]

So, the incumbent firm will only be able to exclude the entrant if its advantage from the installed base of consumers more than compensates for the entrant’s cost advantage. One can thus state the following proposition regarding the unique equilibrium of the proposed game.

**Proposition 2** Suppose \( \beta > 0 \). If condition (3) holds, then all “new” buyers buy from the incumbent at prices \( p^I_1 = v(N + \beta) \) and \( p^I_2 = 2c_I - v(\beta + N) \). If instead condition (3) fails to hold, then all “new” buyers buy from the entrant at prices \( p^E_1 = c_I + v(N) - v(\beta) \) and \( p^E_2 = 2c_I - v(\beta + N) \).

Anticipating that winning consumer group 2 allows a firm to win consumer group 1 as well, each firm wants to pledge its profit from consumer group 1 to compete more aggressively in the market for consumer group 2. This then implies that both firms are ready to charge a price below \( c_I \) on market segment 2.\(^{10,11}\) Hence, when the efficiency gap between the two firms is sufficiently small, there is an exclusionary equilibrium in which the incumbent firm engages in below-cost pricing on market segment 2.\(^{10,11}\)

\(^{10}\)Note that the prices indicated in Proposition 2 regarding consumers on market segment 2 can be rewritten as \( p^I_2 = c_E - [c_I - c_E + (v(N) - v(\beta))] < c_E < c_I \) and \( p^E_2 = c_I - [v(\beta + N) - c_I] < c_I \) (under Assumption 1).

\(^{11}\)This mechanism is similar to a standard (two-period) model of switching costs: firms enjoy ex-post market power after consumers make subscription choices. So, this induces firms to compete more aggressively ex-ante to attract consumers.
4 Welfare analysis

This section considers the impacts on total welfare. Two important preliminary remarks are in order at this point. First, recall that the utility of consumers on market segment $1$ increases continuously with the number of (“old” and “new”) consumers on the other market segment. Hence, the “old” generation of consumers on market segment $1$ cannot be ignored when studying welfare effects. Second, since I assume inelastic demands, when computing total welfare, prices can be ignored as they reduce consumers’ surplus by the same amount as they increase profits.

**Proposition 3** The exclusionary equilibrium will be socially optimal if and only if:

$$
(\beta + N)v(\beta + N) - Nv(N) - \beta v(\beta) > 2N\Delta c. \quad (4)
$$

**Proof.** Under exclusion, social welfare will be:

$$
SW^I = (\beta + N)[v(\beta + N) + r] - 2Nc_I. \quad (5)
$$

Social welfare when the entrant wins all “new” consumers is:

$$
SW^E = Nv(N) + \beta v(\beta) + (\beta + N)r - 2Nc_E. \quad (6)
$$

So, $SW^I > SW^E$ if and only if condition (4) holds.

Hence, there are two opposing forces at work: (i) indirect network externalities benefitting consumers on market segment 1 imply that society is better-off when consumers on both markets buy from the incumbent; and (ii) when it is the incumbent which serves both markets, there is a productive inefficiency, which is reflected in the r.h.s. of condition (4).

Now, if, for instance, $v(\cdot)$ is linear, one has that condition (3) boils down to $2\beta > 2\Delta c + c_I$, on the one hand, while from condition (4) one may conclude that $SW^I > SW^E \iff \beta > \Delta c$, on the other. So, for $\beta \in [\Delta c, \Delta c + c_I/2]$, the incumbent cannot win while the social optimum requires it to win. For other $\beta$, the market outcome coincides with the social optimum: for $\beta < \Delta c$ the two coincide and the entrant wins, while for $\beta > \Delta c + c_I/2$ the two coincide and the incumbent wins.$^{12}$

$^{12}$Even though in the proposed model indirect network effects give rise to demand complementarities in the context of a one-sided market, similar results could be obtained in a model of asymmetric two-sided markets (e.g. building
5 Extension: simultaneous pricing

In this section, I study what are the main implications of considering that firms address the two market segments simultaneously rather than sequentially.\textsuperscript{13}

I first look for the equilibrium in which the incumbent servers all buyers.

**Proposition 4** Suppose $\beta > 0$. If prices charged to consumers on different market segments are decided simultaneously, then there exists an equilibrium in which all “new” buyers buy from the incumbent if and only if

$$2N\Delta c \leq N[v(\beta + N) - v(N)].$$ \hspace{1cm} (7)

In the equilibrium, $p^I_1 = v(\beta + N)$ and $p^I_2 = 2c_E - v(N)$.

The proof of this and the next proposition may be found in the Supplementary materials file.

Notice that the existence condition (7) has a very intuitive economic interpretation. Imagine that “new” consumers from both market segments make a grand coalition such that the coalition chooses one of the two firms. Then, the incumbent firm will win the coalition if and only if the gain in terms of cross-group externalities benefiting (only) consumers on group 1 more than compensates for the cost disadvantage that the incumbent firm faces on both market segments.\textsuperscript{14}

I now turn to the entry equilibrium.

**Proposition 5** Suppose $\beta > 0$. If prices charged to consumers on different market segments are decided simultaneously, then there exists an equilibrium in which all “new” buyers buy from the entrant if and only if:

$$2N\Delta c \geq N[v(\beta + N) - v(N)] + N[v(\beta) - c_I].$$ \hspace{1cm} (8)

In the equilibrium, $p^E_1 = c_I + v(N) - v(\beta)$ and $p^E_2 = 2c_I - v(\beta + N)$.

Note that the existence condition (8) coincides with the one indicated in Proposition 2 for the existence of an entry equilibrium in a sequential pricing scenario. Basically, it can be obtained from Vasconcelos’ (2015) static framework). Using the words of Evans (2002), “[w]hat distinguishes two-sided markets from one-sided markets, and indirect from direct network effects, is whether one can identify distinct groups of users with different preferences. There is an argument that almost all network effects in reality are indirect effects and that almost all network markets are two-sided.” (p. 32).

\textsuperscript{13}This implies that the corresponding consumer groups are making their purchasing decisions simultaneously too.

\textsuperscript{14}Hence, under condition (7), if this grand coalition of “new” buyers were allowed to form, these buyers could not agree to collectively switch from the incumbent to the entrant.
by adding \( N [v(\beta) - c_I] \) to the r.h.s. and by changing the sign of the inequality. \( N [v(\beta) - c_I] \) (which is non-negative by Assumption 1) can be called the “incumbency advantage”: compared to the imaginary case of the grand coalition of all “new” consumers, it makes the existence of the entry equilibrium less likely by this term.

Now, as far as equilibrium prices are concerned, notice that if the entrant wins, the prices do not depend on whether the timing is sequential or simultaneous. The equilibrium price regarding customers on market segment 2 does differ, however, if the equilibrium involves exclusion. This is because in the simultaneous pricing scenario, if the entrant deviates by attracting consumers of group 2, it does not face any competition in the market for group 1 (given that the incumbent charges the monopoly price \( v(\beta + N) \)). In contrast, in the sequential pricing scenario, the incumbent will adjust its price to consumers in group 1 after losing group 2 consumers to the deviating entrant such that the entrant still faces some competition on market segment 1.

In concluding this section, let us investigate the welfare properties of this simultaneous pricing scenario. First, I ask when is exclusion socially desirable. Since the grand coalition internalizes fully the payoffs of all “new” consumers, inequality (7) captures perfectly the social welfare related to these “new” consumers. What is missing is then the change in the payoff of the “old” consumers belonging to group 1. They obtain \( \beta v(\beta + N) \) under exclusion and \( \beta v(\beta) \) under entry. So, exclusion is socially optimal if

\[
2N\Delta c < N [v(\beta + N) - v(N)] + X
\]  

(9)

holds, where \( X = \beta v(\beta + N) - \beta v(\beta) > 0 \) represents the externality (resulting from exclusion). Hence, by making use of eqs. (7) and (9), one may conclude that, similarly to what happened in the baseline model with sequential pricing, there is suboptimal exclusion: when exclusion occurs, exclusion is socially optimal, but some socially optimal exclusion may not occur because the incumbent firm does not internalize the positive externalities on the locked-in consumers belonging to group 1. Second, in order to see whether entry is socially excessive or not, one must contrast eqs. (8) and (9). Put it other way, we should compare the incumbency advantage \( N [v(\beta) - c_I] \) with the externality \( X \). If the latter is larger than the former, we have excessive entry (otherwise, entry is suboptimal). Now, if, for instance, \( v(\cdot) \) is linear, it is always the case that \( X > N [v(\beta) - c_I] \); so there always exist cases in which entry occurs in equilibrium, but it is socially inefficient (i.e. there is excessive entry, as in the baseline model).
6 Conclusion

I have presented in this paper a very simple model which studies the competitive effects of exclusionary pricing in industries where there is a clear asymmetry between two groups of consumers: there is a positive demand externality from one group to the other, but not vice versa.

I have showed that, in such a context, an incumbent firm may resort to below-cost pricing on one market segment in order to exclude a more efficient rival from the whole industry.

Interestingly, I find, however, that when exclusion occurs, it is always socially optimal. In addition, the proposed model always predicts the existence of inefficient entry: there always exist cases in which the social optimum requires the incumbent to win “new” consumers on both market segments but it is the entrant that wins them.

References


