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Bundling and Foreclosure

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September 29, 2006

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We examine a two-sector model characterized by monopoly provision in market 1 and perfect competition in market 2. We follow the set up in Martin (1999), but we consider the case where goods 1 and 2 can be either substitutes or complements. With this framework, we analyse the profit sacrifice required if the monopolist offers a bundle consisting of one unit of good 1 and k units of good 2 to foreclose the competitive sector. Our results show that foreclosing rivals via bundling is less costly when products are complements rather than substitutes.

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1 Introduction

A firm that has market power may undertake a number of actions designed to make it difficult for rivals to compete profitably. These actions, which include for example the foreclosure of a market to rivals, can be characterised under the rubric of exclusionary conduct.[1]

In this paper we examine the relationship between profit sacrifice associated with foreclosure via bundling and the degree of substitutability between the products. The conduct that we examine is similar to what Nalebuff (2005) referred to as 'exclusionary bundling': A firm with market power in good 1 and facing actual (or potential) competition in good 2 prices a bundle in a way that makes it impossible for equally-efficient one-good rivals in market 2 to compete. Unlike traditional predatory pricing, the exclusionary behavior need not be costly

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[1] For a survey and literature review of exclusionary conduct, see Fallon and Menezes (2006).

to the firm. In this spirit, we consider how a monopolist can use bundling to minimise the profit sacrifice, if any, required to foreclose a competitive market.

Our paper is close to Martin (1999). In his two-goods model, there is a monopolist in one sector and the other sector is characterised by duopolists competing by setting quantities. Although the demand for the two goods is assumed to be independent, Martin shows that by offering a bundle consisting of one unit of good 1 and 1 unit of good 2, the monopolist can create substitution relationships between the two goods.

We utilise the same set up but instead consider the case where goods 1 and 2 can be either substitutes or complements. We then analyse the incentives for the monopolist to offer a bundle consisting of one unit of good 1 (the monopoly good) and k units of good 2 (the competitive good) to foreclose the competitive sector. We show that the choice of k is crucial for minimising the profit sacrifice required for foreclosure. When foreclosure is accomplished by offering (as part of the bundle) a larger quantity of good 2, vis-à-vis the quantity that is offered absent the conduct, without affecting the supply of good 1 in the market, the conduct does not require profit sacrifice.

Our main result is that foreclosing rivals via bundling is less costly when products are complements rather than substitutes. When the two goods are substitutes the monopolist could foreclose the competitive sector by supplying a large quantity of good 1 – this would not require bundling. With bundling, this strategy is even more effective. By including good 2 in the bundle, the bundle is a closer substitute to good 2 than good 1 alone. Increasing the supply of the bundle, or decreasing the price of the bundle, puts more pressure on the demand for good 2 compared with increasing the supply of good 1 only. However, producing more of good 1 and good 2 results in a reduction in the price of good 1 since the two goods are substitutes. In this sense, foreclosure by producing more good 2 is costly for the monopolist.

When two goods are complements, it is not possible to foreclose the competitive sector without bundling. However, by including good 2 in the bundle, the monopolist can choose k to create a bundled good which is a substitute to good 2. Foreclosure is thus feasible by increasing the supply of this bundled good. Furthermore, increasing the supply of good 2 for foreclosure purposes helps to maintain the price for good 1 since the two goods are complements. Therefore, the foreclosure strategy is less costly for the monopolist when the two goods are complements.

A full analysis of foreclosure would necessitate an analysis of the prospective market structure to determine whether recoupment is possible when foreclosure requires profit sacrifice. There are two questions one can ask: the first is what profit sacrifice would be required to

foreclose the second market; the second is what would the motivations be for the monopolist to foreclose the second market. In this paper, we focus only on the first question. The second question will be the subject of future research.

2   The Model

We consider a two-sector model where the market for good 1 is characterised by a monopoly provider and the market for good 2 is characterised by perfect competition. Firm 1 is the monopolist in the market for good 1 but also supplies into competitive market for good 2. We follow Martin (1999) in that the demand for goods 1 and 2 can be derived from a social welfare function of the form

$$U = m + a\left(Q_1 + Q_2\right) - \frac{1}{2}\left(Q_1^2 + 2\theta Q_1 Q_2 + Q_2^2\right),$$ (1)

where m represents all other goods in the economy.

The corresponding inverse demand curves for the two goods are

$$p_1 = a - \left(Q_1 + \theta Q_2\right)$$ (2)

and

$$p_2 = a - \left(\theta Q_1 + Q_2\right).$$ (3)

The parameter θ lies strictly between -1 and $+1$. If $\theta = 0$, the demand for the two goods are independent. If $\theta > 0$, the two goods are substitutes, and they are complements if $\theta < 0$.

The marginal cost of production in markets 1 and 2 are equal to c_1 and c_2, respectively, and there are no fixed costs. Under the assumed market structures, we have $Q_1 = q_1^1$ and $Q_2 = \sum_{n=1}^{N} q_2^n$, where all N firms are price takers.

3   The Benchmark Equilibrium

We first compute equilibrium profits under the benchmark, defined as the equilibrium in the absence of exclusionary behaviour. In particular, Firm 1 can choose among two pricing schemes: independent pricing and pure bundling (selling goods 1 and 2 as a bundle). When the monopolist prices the two products independently, it acts as a price taker in market 2 and sets $p_2 = c_2$. The monopolist then maximises its profit by choosing its supply in market 1. When the monopolist chooses to sell by pure bundling, it sells a bundle consisting of 1 unit of good 1 and k units of good 2. This bundle is represented by $(1, k)$, with $k \geq 0$.

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All remaining firms in market 2 sell the bundle consisting of $(0, 1)$. The monopolist chooses both its supply of the bundled good and k to maximise its profits with the restriction that the actual price of good 2 – that is, the price of the bundle $(0,1)$ – is set equal to its marginal cost.

Proposition 1 *Absent exclusionary behaviour, independent pricing and pure bundling generate the same equilibrium profit level for the monopolist.*

Given that the price of good 2 is effectively set at marginal cost, the quantity of good 2 supplied in the market remains the same under independent pricing and pure bundling. Therefore, the monopoly rent remains the same under the two schemes. This is analogous to the reasoning behind the Law of One Monopoly Rent.

We denote by b_M the monopolist's supply of the bundled good. Let b be the total supply from firms 2 to N in market 2. The quantity of the two goods are thus

$$Q_1 = b_M \tag{4}$$

and

$$Q_2 = kb_M + b. \tag{5}$$

With the bundled goods, the social welfare function can be expressed as

$$U = m + a\left((1+k)\,b_M + b\right) - \frac{1}{2}\left(b_M^2 + 2\theta b_M\left(kb_M + b\right) + \left(kb_M + b\right)^2\right). \tag{6}$$

The inverse demand functions for the bundled goods are

$$p_{b_M} = a\left(1 + k\right) - \left(2k\theta + k^2 + 1\right)b_M - \left(\theta + k\right)b \tag{7}$$

and

$$p_b = a - \left(\theta + k\right)b_M - b. \tag{8}$$

Under the price-taking and no predation assumptions, $p_b = c_2$. This then defines the quantity sold by competitors in market 2:

$$b = a - \left(\theta + k\right)b_M - c_2. \tag{9}$$

Substituting this quantity into Equation 7 gives:

$$p_{b_M} = \left(1 - \theta\right)a + \left(k + \theta\right)c_2 - \left(1 - \theta\right)\left(1 + \theta\right)b_M. \tag{10}$$

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Setting marginal revenue for the bundle equal to the marginal cost of the bundle yields:

$$b_M = \frac{(a - c_1) - \theta(a - c_2)}{2(1 - \theta^2)}. \tag{11}$$

The resulting profit in the benchmark equilibrium is

$$\Pi = (p_1 - c_1)Q_1 = \frac{((a - c_1) - \theta(a - c_2))^2}{4(1 - \theta^2)}. \tag{12}$$

4 Foreclosure

In this section, we determine what is the optimal pricing structure if Firm 1 is determined to foreclose the market for good 2. We assume that the monopolist can only foreclose the market by offering the bundle. In particular, we rule out the possibility that the monopolist can offer good 2 by itself below cost and drive out all other competitors. In addition to possible antitrust implications, doing so may require higher profit sacrifice than under pure bundling.

The inverse demand functions when b_M consists of the bundle $(1, k)$ and b consists of the 'bundle' $(0, 1)$ are given in Equations 7 and 8. Price-taking behaviour in market 2 implies that firms 2 to N set $p_b = c_2$. We now compute the quantity of b_M required to foreclose the market for good 2 by solving equations 7 and 8 for the b_M that would results in $b = 0$. This gives:

$$b_M = \frac{a - c_2}{(\theta + k)}. \tag{13}$$

This quantity implies a bundle price equal to:

$$\begin{aligned} p_{b_M} &= a(1 + k) - (1 + 2\theta k + k^2) b_M \\ &= \frac{a(k - 1)(1 - \theta) + (2k\theta + k^2 + 1) c_2}{k + \theta}, \end{aligned} \tag{14}$$

and the resulting profit level is

$$\begin{aligned} \Pi &= (p_{bM} - c_1 - kc_2) b_M \\ &= \frac{(a(k - 1)(1 - \theta) - (k + \theta) c_1 + (1 + k\theta) c_2)(a - c_2)}{(k + \theta)^2}. \end{aligned} \tag{15}$$

The monopolist then chooses k to maximise profit:

$$\max_k \Pi = \frac{(a(k - 1)(1 - \theta) - (k + \theta) c_1 + (1 + k\theta) c_2)(a - c_2)}{(k + \theta)^2}. \tag{16}$$

The first order condition yields

$$\frac{\left(2a - ak - a\theta - 2c_2 + ak\theta + kc_1 + \theta c_1 - k\theta c_2 - a\theta^2 + \theta^2 c_2\right)(a - c_2)}{(k + \theta)^3} = 0.$$

For $k \neq -\theta$, this holds for

$$k = \frac{-\theta(a - c_1) + \left(2 - \theta^2\right)(a - c_2)}{(a - c_1) - \theta(a - c_2)}. \tag{17}$$

When $k = -\theta$, the function attains the minimum as in this case the demand for b_M and b are independent. That is, Firm 1 would not be able to foreclose the competitive sector by offering b_M. The second order condition confirms that the solution in Equation 17 yields the maximum.

The proposition below establishes the optimal k for both the substitutes and complements cases.

Proposition 2 *The optimal k is that for $\theta > 0$, $k^* = \frac{-\theta(a-c_1)+\left(2-\theta^2\right)(a-c_2)}{(a-c_1)-\theta(a-c_2)}$ for $\frac{\theta a - \left(2 - \theta^2\right)(a-c_2)}{\theta} \leq$ $c_1 \leq a - \theta(a - c_2)$. Otherwise, $k^* = 0$. For $\theta < 0$, $k^* = \frac{-\theta(a-c_1)+\left(2-\theta^2\right)(a-c_2)}{(a-c_1)-\theta(a-c_2)}$. The resulting quantity and profits are*

$$b_M\big|_{k^* = \frac{-\theta(a-c_1)+\left(2-\theta^2\right)(a-c_2)}{(a-c_1)-\theta(a-c_2)}} = \frac{a - c_2}{(\theta + k)} = \frac{(a - c_1) - \theta(a - c_2)}{2\left(1 - \theta^2\right)}, \tag{18}$$

$$\Pi\big|_{k^* = \frac{-\theta(a-c_1)+\left(2-\theta^2\right)(a-c_2)}{(a-c_1)-\theta(a-c_2)}} = \frac{\left((a - c_1) - \theta(a - c_2)\right)^2}{4\left(1 - \theta^2\right)}, \tag{19}$$

$$b_M\big|_{k^* = 0} = \frac{a - c_2}{\theta}, \tag{20}$$

and

$$\Pi\big|_{k^* = 0} = \frac{\left(\theta(a - c_1) - (a - c_2)\right)(a - c_2)}{\theta^2}. \tag{21}$$

Proof. See the appendix. ∎

When the two goods are substitutes, for small c_1 ($c_1 \leq \frac{\theta a - \left(2-\theta^2\right)(a-c_2)}{\theta}$) and large c_1 ($c_1 \geq a - \theta(a - c_2)$), to foreclose the competitive market, the monopolist only offers bundles consisting of $(1, 0)$. For intermediate c_1, the monopolist chooses $k^* > 0$. When the two goods are complements, the monopolist always offers the bundle $(1, k)$, with $k > 0$.

When the monopolist offers the bundle with $k^* = \frac{-\theta(a-c_1)+\left(2-\theta^2\right)(a-c_2)}{(a-c_1)-\theta(a-c_2)}$, the quantity of b_M offered is the same as Q_1 in the benchmark case. Since b_M consists of $(1, k)$, the supply of Q_1 is the same under foreclosure and in the benchmark. Thus foreclosure does not distort the monopolist's quantity choice in market 1, and there is no profit sacrifice required.

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The lower bound of c_1 for $k^* \geq 0$ would be negative if c_2 is sufficiently small. Or if

$$c_2 \leq \frac{\left(2 - \theta^2 - \theta\right) a}{\left(2 - \theta^2\right)}. \tag{22}$$

When c_2 is large and c_1 is small, it is relatively costly to include good 2 in the bundle, and the monopolist offers the bundle $(1,0)$ to foreclose market 2. Therefore, foreclosure requires profit sacrifice in this parameter range.

So far in the paper, profit sacrifice refers to profit below the benchmark equilibrium profit level, not necessarily price below the marginal cost. Note that $\Pi|_{k^*=0} < 0$ if

$$\frac{c_2 - a\left(1 - \theta\right)}{\theta} \leq c_1. \tag{23}$$

Since $\frac{c_2 - a(1-\theta)}{\theta} < a - \theta\left(a - c_2\right)$ for $\theta > 0$, when $c_1 > a - \theta\left(a - c_2\right)$, the monopolist has to price below the marginal cost to foreclose the competitive sector, which would result in the below-cost pricing behaviour traditionally associated with exclusionary conduct. In fact, for $c_1 > a - \theta\left(a - c_2\right)$ and $c_2 < \left(1 - \theta\right) a$, it is not possible to foreclose the competitive market unless the monopolist is willing to pay the consumers to take away the bundle. It is also important to note that unlike the traditional predatory story, in our setting, profit sacrifice occurs in the market for good 1,while foreclosure takes place in the market for good 2.

5 Conclusion

In this paper, we analyse the profitability of an exclusionary bundling strategy. The key result is that it is less costly for the monopolist to foreclose the market when the two goods are complements rather than substitutes. A major policy implication is that bundling may raise more competitive concern when two goods are complements. This is in contrast to traditional emphasis of competition policy on mergers among firms who offer close substitutes than when they are complements. Furthermore, as in Nalebuff (2005)'s analysis of exclusionary bundling, foreclosure via bundling does not necessarily require profit sacrifice. Therefore, absence of profit sacrifice does not necessarily imply absence of exclusionary intention.

References

[1] Fallon, J. and F. M. Menezes (2006), 'Exclusionary Conduct: Theory, Tests and some relevant Australian Cases ', *Competition and Consumer Law Journal,* vol 13, pp. 197 - 240.

[2] Nalebuff, B. (2005), 'Exclusionary Bundling.' *Antitrust Bulletin*, vol. 50, no. 3, pp. 321 - 70.

[3] Stephen, M. (1999), 'Strategic and Welfare Implications of Bundling. ' *Economic Letters*, vol. 62, no. 3, pp. 371-76.

6   Appendix

Proof. of Proposition 2: The solution is interior (that is, k is non-negative) if

$$\frac{-\theta\left(a-c_1\right)+\left(2-\theta^2\right)\left(a-c_2\right)}{\left(a-c_1\right)-\theta\left(a-c_2\right)} \geq 0.$$

Note that $\left(a-c_1\right)-\theta\left(a-c_2\right) \geq 0$ if $c_1 \leq a-\theta\left(a-c_2\right)$.

For $c_1 \leq a-\theta\left(a-c_2\right)$, $k \geq 0$ if

$$\theta c_1 \geq \theta a - \left(2-\theta^2\right)\left(a-c_2\right).$$

Case (1) For $\theta > 0$, $k \geq 0$ if

$$c_1 \geq \frac{\theta a - \left(2-\theta^2\right)\left(a-c_2\right)}{\theta}.$$

Case (2) For $\theta \leq 0$, in order to create a bundle that is a substitute for good 2, we require $k+\theta \geq 0$ or

$$\frac{-\theta\left(a-c_1\right)+\left(2-\theta^2\right)\left(a-c_2\right)}{\left(a-c_1\right)-\theta\left(a-c_2\right)} \geq -\theta.$$

This holds if

$$\frac{a-c_1}{a-c_2} \geq \theta.$$

This is true for $\theta \leq 0$. ∎