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Strategic and welfare implications of bundling

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Abstract

A standard oligopoly model of bundling shows that bundling by a firm with a monopoly over one product has a strategic effect because it changes the substitution relationships between the goods among which consumers choose. Bundling in appropriate proportions is privately profitable, reduces rivals' profits and overall welfare, and may drive rivals from the market.

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1. Introduction

The economic and legal literatures on bundling, like the much larger related literatures on tying, emphasize consequences of the practice that are efficiency-enhancing in the sense that they may allow a firm that possesses a given degree of market power to extract more consumers' surplus, but they do not decrease net social welfare.[1]

This efficiency view of bundling is apparently so prevalent that (at least some) commentators feel justified in denying that there is a basis for policy concern with the practice (DeLong, 1998):

> Microsoft is also attacked for 'tying' because it wants to bundle its Internet browser into its operating system. But except under unusual conditions of monopoly power, scholars and courts no longer view tying as a serious antitrust concern; there hasn't been a major tying case in the U.S. in at least 20 years.

Grimes (1994) puts forward a number of reservations about the validity of such an efficiency presumption when market imperfections are taken into account. The point of this note is that an

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[1] Adams and Yellen (1976) emphasize the role of bundling as a vehicle for price discrimination; see also Schmalensee (1984). Bowman (1957); Burstein (1960a), (1960b) are seminal presentations of the efficiency interpretation of tying.

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efficiency presumption is unjustified even without allowing for market imperfections.[2] Bundling has a strategic effect because it changes the substitution relationships between the goods among which consumers choose. Bundling in appropriate proportions is privately profitable, reduces rivals' profits and overall welfare, and may drive rivals from the market.

2. Demand

We work with a simple and standard model of consumer behavior.[3] Let market demand for two goods 1 and 2 be derived from a social welfare function of the form

$$U = m + a(Q_1 + Q_2) - \tfrac{1}{2}(Q_1^2 + 2\theta Q_1 Q_2 + Q_2^2), \tag{2.1}$$

where m represents 'all other goods'.

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

Inverse demand curves for the two products are

$$p_1 = a - (Q_1 + \theta Q_2) \tag{2.2}$$

and

$$p_2 = a - (\theta Q_1 + Q_2)\,. \tag{2.3}$$

The normalization that makes the slopes of the inverse demand curves equal to -1 is without loss of generality.

We assume there are two firms, A and B. Firm A is a monopolist of product 1,

$$Q_1 = q_{A1}\,. \tag{2.4}$$

Both firms produce product 2:

$$Q_2 = q_{A2} + q_{B2} \tag{2.5}$$

3. Bundling and demand

Suppose firm A sells its products only in the proportion k_A of good 1 to one unit of good 2; that is, firm A offers b_A bundles

[2] There is a sense in which the present note is dual to Burstein (1960a). Using a model of one monopolized product and a number of other products produced under competitive conditions, he shows that there can be no presumption that tying is used to extend monopoly power from one market to another. Using a model of one monopoly and one duopoly market, and taking strategic and welfare consequences explicitly into account, I show that there can be no presumption that bundling does not have such effects.

[3] The earliest uses of which I am aware of this model are Spence (1976); Dixit (1979).

$$(k_A, 1)\,. \tag{3.1}$$

Firm *B*, which does not produce product 1, sells a 'bundle' that consists only of one unit of good 2,

$$(0,1)\,. \tag{3.2}$$

The relationships between the bundles and the underlying variables are

$$Q_1 = k_A b_A \tag{3.3}$$

and

$$Q_2 = b_A + b_B\,, \tag{3.4}$$

respectively, where b_A is the number of bundles sold by firm 1 and b_B is the number of bundles sold by firm 2.

Substitute Eqs. (3.3) and (3.4) into Eq. (2.1) and rewrite the welfare function in terms of bundles as

$$U = m + a[(k_A + 1)b_A + b_B] - \tfrac{1}{2}[(1 + 2\theta k_A + k_A^2)b_A^2 + 2(1 + \theta k_A)b_A b_B + b_B^2] \tag{3.5}$$

The implied inverse demand curves for bundles are

$$P_A = (k_A + 1)a - [(1 + 2\theta k_A + k_A^2)b_A + (1 + \theta k_A)b_B] \tag{3.6}$$

$$P_B = a - [(1 + \theta k_A)b_A + b_B] \tag{3.7}$$

Bundling has a strategic effect because it alters—indeed, may even create—substitutability relationships. If $\theta = 0$, so that there is no demand relationship between goods 1 and 2, the bundled goods are nonetheless demand substitutes.

4. Bundling and payoffs

Henceforth, for simplicity, let $\theta = 0$, so the two goods are independent in demand. This is not essential to the qualitative nature of the results that follow.[4]

Assume also that marginal cost is constant, c per unit, for both goods.[5] For the moment, leave the nature of fixed costs unspecified.

Finally, assume that the firms act as Cournot quantity-setting oligopolists.

[4] As a simplifying assumption, it does follow much of the literature on tying and bundling (see, for example, Burstein (1960a)).

[5] Unit cost can be made to differ for the two goods with some complication in the algebra, but this does not change in the nature of the results.

4.1. Without bundling

Noncooperative equilibrium outputs if firm 1 does not bundle are

$$q_{A1} = \tfrac{1}{2}(a - c) \tag{4.1}$$

$$q_{A2} = q_{B2} = \tfrac{1}{3}(a - c). \tag{4.2}$$

q_{A1} is monopoly output for good 1. q_{A2} and q_{B2} are Cournot duopoly outputs for good 2. Equilibrium payoffs, before allowing for fixed costs, are

$$\pi_A = \left(\tfrac{1}{4} + \tfrac{1}{9}\right)(a - c)^2 = \tfrac{13}{36}(a - c)^2 \tag{4.3}$$

$$\pi_B = q_{B2}^2 = \tfrac{1}{9}(a - c)^2 . \tag{4.4}$$

Noncooperative equilibrium consumers' surplus plus economic profit is

$$\tfrac{59}{72}(a - c)^2 \tag{4.5}$$

4.2. With bundling

Let $k_A = 1$. This is sufficient to bring out the strategic and welfare effects of bundling.[6] Noncooperative equilibrium outputs of bundles are

$$b_A = \tfrac{3}{7}(a - c) \tag{4.6}$$

$$b_B = \tfrac{2}{7}(a - c) \tag{4.7}$$

These translate into output levels

$$Q_1^b = \tfrac{3}{7}(a - c) < \tfrac{1}{2}(a - c) \tag{4.8}$$

and

$$Q_2^b = \tfrac{5}{7}(a - c) > \tfrac{2}{3}(a - c) . \tag{4.9}$$

of the underlying goods.

Bundling reduces the output of good 1 and increases the output of good 2. Firm A produces $\frac{3}{7}(a - c)$ units of good 2, more than without bundling. Firm B produces $\frac{2}{7}(a - c)$ units of good 2, less than without bundling. This reflects the fact that bundles are strategic as well as demand substitutes.

The increase in output of good 2 means that the price of firm B's 'bundle' is less than the equilibrium price of good 2 without bundling. Bundling by firm A means that firm 2 sells less and at a

[6] In many markets, the units in which goods are measured are essentially arbitrary. In others (operating systems, web browsers) this may not be the case.

lower price, compared with a situation in which A does not bundle. Bundling therefore lowers firm 2's profit.

Indeed, direct calculation shows

$$\Pi_A = \tfrac{18}{49}(a-c)^2 > \tfrac{13}{36}(a-c)^2 = \pi_A \tag{4.10}$$

$$\Pi_B = \tfrac{4}{49}(a-c)^2 < \tfrac{1}{9}(a-c)^2 = \pi_B\,. \tag{4.11}$$

These expressions are for payoffs gross of fixed costs. If B's fixed costs fall in the appropriate range, it will be profitable for B to operate if A does not bundle, and become unprofitable for B to operate if A does bundle. In such cases, bundling will allow A to extend a (possibly legal) monopoly over product 1 to product 2.

5. Bundling and welfare

In the model as specified to this point, net welfare with bundling is

$$\tfrac{39}{49}(a-c)^2 < \tfrac{59}{72}(a-c)^2. \tag{5.1}$$

Firm A's bundling therefore reduces social welfare, compared with the case in which firm A does not bundle. This establishes that an efficiency presumption for bundling is unwarranted.

6. Policy implications

Burstein (1960a) (p. 68) wrote to show ''that tying arrangements can be viewed in a context apart from the extension of monopoly or exclusion of entry.'' The force of the present contribution is that the efficiency interpretation of multiproduct marketing arrangements is possible but not necessary. The effects of bundling in the standard oligopoly model examined here are those ascribed to bundling by the leverage theory. Bundling *can* allow a firm with a monopoly in one market to exercise greater market power in other markets, to strategically disadvantage rivals in those markets, and to reduce net social welfare.

This does not establish that the effect of bundling is necessarily to reduce net social welfare. Cases may occur in which bundling increases quality;[7] cases may occur in which bundling reduces marginal or fixed cost. The net welfare impact of bundling in such cases will involve the kind of welfare tradeoffs raised by Williamson (1968) in another context. But it cannot be presumed that bundling does not worsen market performance.

[7] This would occur in the present model if the price-axis intercept of A's bundle exceeds $(k_A+1)a$.

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