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VERTICAL SEPARATION*

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A simple duopoly model is used to show the advantage to a manufacturer of selling his product through an independent retailer (vertical separation) rather than directly to consumers (vertical integration). Vertical separation is profitable insofar as it induces more friendly behaviour from the rival manufacturer. We consider the case where franchise fees can be used to extract retailers' surplus. We show that vertical separation is in the collective, as well as individual, interest of manufacturers, and hence facilitates some collusion in the simple setting that we examine.

I. INTRODUCTION

THE THEME of much work on vertical integration is that "integration harmonizes interests" (Williamson [1971, p. 117]). For example, if a manufacturer acts as retailer of his own products, he does not have to bother with arrangements to deal with the conflicting incentives that an independent retailer (or retailers) would have. However, in an oligopolistic market, the disharmony of interests between manufacturer and retailer entailed by vertical *separation* (as opposed to integration) may be turned to the manufacturer's advantage. In this paper we examine the strategic motive for vertical separation.[1]

In the model below there are two single-product firms manufacturing differentiated goods. Each firm decides whether to be the retailer of its own product (vertical integration) or to sell through an independent retailer (vertical separation). In the latter event, the manufacturer chooses the wholesale price at which he will supply his retailer. Retailers achieve Nash equilibrium in prices. We consider the case where the manufacturer can charge a franchise fee to the retailer (which in principle could be negative). With perfect competition between potential retailers, this fee transfers all the retailer's surplus to the manufacturer. In these circumstances we show that it is always in the individual interest of a manufacturer to choose vertical separation and to set a wholesale price which is higher than unit manufacturing costs (assumed to be constant). Moreover, we show that vertical separation is in the collective interest of the manufacturers inasmuch as their profits at equilibrium with vertical separation exceed their profits at equilibrium with vertical integration. Thus there is a sense in which vertical

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[1] See Vickers [1985, especially page 146].

separation facilitates some collusion, though it does not permit perfect collusion. Our results generalise to n-firm oligopoly, but we confine attention to duopoly for the sake of simplicity and to use illustrative diagrams.

It must be noted that our analysis applies only to cases where a retailer sells the product of just one manufacturer. It is of course essential to many retailing operations that the products of a wide variety of manufacturers are sold (see Stahl [1982], Bliss [1986]), but there are important instances of our assumption, including cars and hamburgers. Our analysis is also confined to the case where each manufacturer uses just one retailer. By contrast, the recent literature on vertical restraints (see Mathewson and Winter [1984] and Rey and Tirole [1986a, 1986b]) looks at the problem facing a single manufacturer who uses several retailers. Among other things, that literature explores externalities between the manufacturer's several retailers, which we ignore, since our purpose is to look at strategic interaction between manufacturers and the resulting benefits of vertical separation.

In the next section we describe the model and prove our results, while section III contains some concluding remarks.

II. VERTICAL SEPARATION WITH FRANCHISE FEES

As said in the Introduction, we shall confine attention to the case of duopoly, in order to make use of simple geometric arguments. We consider the case in which each manufacturer can charge a franchise fee to his retailer so as fully to extract the retailer's surplus. In that event, each manufacturer is concerned to maximise the final price of his product (net of production costs) multiplied by the quantity sold.

Let p^i be the price of good i ($i = 1, 2$), net of unit cost of supply, which we assume to be constant. Let $p = (p^1, p^2)$. The demand function for good i is denoted by $D^i(p)$. While superscripts are used to distinguish between goods, subscripts will be used to denote partial derivatives with respect to prices. Thus, for example, $D^2_{12} = \partial D^2/\partial p_1 \partial p_2$. We make standard (mild) assumptions about the demand functions:

Assumption 1. Demand for good i is decreasing and concave in the price of good i:

$$D^i_i(p) < 0 \quad \text{and} \quad D^i_{ii}(p) \leqslant 0, \qquad \text{for all } p \text{ and } i = 1, 2 \tag{1}$$

Assumption 2. Goods are substitutes[2]:

$$D^i_j(p) > 0, \qquad \text{for all } p \text{ and } i, j = 1, 2 \tag{2}$$

Let

$$\Pi^i(p) = p^i D^i(p) \tag{3}$$

[2] If the goods are independent, because of the double marginalisation problem (Spengler [1950]) vertical integration (weakly) dominates vertical separation for both manufacturers (the two are equivalent if and only if there is a fully extracting franchise fee).

Then if each manufacturer is vertically integrated, $\Pi^i(p)$ will be manufacturer i's payoff function. We take Nash equilibrium in prices as our solution concept.[3] That is to say, each firm chooses its price optimally, given the price chosen by its rival. The Nash equilibrium (which under additional very mild assumptions exists and is unique)[4] will be given by the solution to $\Pi_i^i(p) = 0$ $(i = 1, 2)$. Let it be denoted by

$$(4) \qquad p^* = (p^{*1}, p^{*2})$$

On the other hand, if manufacturers are *not* vertically integrated, final product prices will depend on the arrangements that they have with their retailers. We shall suppose that manufacturers set wholesale prices, and that retailers can buy as much as they want at those prices, which effectively become the retailers' unit costs.[5] Let w^i be the wholesale price set by manufacturer i to his own retailer and let $w = (w^1, w^2)$. Then the payoff function of retailer i will be given by

$$(5) \qquad R^i(p; w^i) = (p^i - w^i)D^i(p)$$

By our assumptions, for each w there will be a unique Nash equilibrium of the game between retailers (with payoff functions given by (5)).[6] Let it be denoted by

$$(6) \qquad p(w) = (p^1(w), p^2(w))$$

It is worth noting that $R^i(p; 0) \equiv \Pi^i(p)$ and therefore $p(0) = p^*$. We assume that for each w the Nash equilibrium between retailers is stable:

Assumption 3 (stability). For all w and for each $i = 1, 2$

$$(7) \qquad R_{ii}^i(p(w); w^i) + R_{ji}^i(p(w); w^i) < 0$$

Finally, we assume that the variables in the game between retailers are strategic complements[7]:

Assumption 4. Retailers' prices are strategic complements:

$$(8) \qquad R_{ji}^i(p; w^i) \equiv D_j^i(p) + (p^i - w^i)D_{ji}^i(p) > 0$$

for all p with $p^i \geqslant w^i$.

[3] See the remarks concerning Cournot competition in section III.

[4] Assumptions 1 and 2 are sufficient to ensure existence and uniqueness if we add the following very mild assumptions: $D^i(0) > 0$ and, for each p^j, D^i becomes zero (and has a negative slope) at some finite price p^i which depends continuously on p^j and is bounded away from infinity. These two assumptions guarantee the existence of a positive price vector p such that $\Pi_i^i(p) = 0$ for each $i = 1, 2$ (see Bonanno and Zeeman [1985]). Strict concavity of Π^i implied by assumption 1 then ensures that such a p is unique and is a Nash equilibrium.

[5] Since we have defined the prices p^1 and p^2 net of unit supply costs, we have already taken other retailing expenses (which are part of supply costs) into account.

[6] As in footnote 4, existence and uniqueness of an equilibrium with retail prices in excess of wholesale prices are guaranteed for all w such that $D^i(w) > 0$ $(i = 1, 2)$.

[7] See Bulow *et al.* [1985]. In view of assumption 2, a sufficient (but not necessary) condition for this is that $D_{ji}^i(p) \geqslant 0$ for all p.

Assumptions 3 and 4 imply that in (p^1, p^2)-space the slope of the reaction curve of retailer 1 (with respect to the p^1-axis) is positive and greater than the positive slope of the reaction curve of retailer 2. This means that if retailer 2 increased his price by Δp, then retailer 1 would find it optimal to increase his price in response, although not by as much as Δp. Furthermore, assumptions 3 and 4 together imply that $\partial p^2/\partial w^1 > 0$ and therefore if manufacturer 1 increases his wholesale price, *both* retailers' prices will go up. These facts are used in the proof of proposition 1, which establishes the individual incentive for vertical separation.

Let $\pi^i(w)$ be the profit of manufacturer i at the Nash equilibrium between retailers, when franchise fees can be used to extract retailers' profits. That is,

$$\pi^i(w) = \Pi^i(p(w)) \tag{9}$$

Proposition 1. If franchise fees can be used to extract the retailers' profits, it is in the individual interest of each manufacturer to choose vertical separation and charge his retailer a wholesale price in excess of unit production cost, no matter whether the other manufacturer is vertically integrated or separated.

Proof. Let $\hat{w}^2$ be the wholesale price charged by manufacturer 2 to his own retailer (if $\hat{w}^2 = 0$, manufacturer 2 is vertically integrated; note that we do not rule out the possibility that $\hat{w}^2$ is negative). We shall first show that $w^1 = 0$ (that is, vertical integration) is not manufacturer 1's optimal response to $\hat{w}^2$. By the implicit function theorem applied to $R_i^i = 0$ $(i = 1, 2)$ at the Nash equilibrium corresponding to $w^1 = 0$ and $w^2 = \hat{w}^2$, we have

$$\frac{\partial p^2(0, \hat{w}^2)}{\partial w^1} = \frac{R_{12}^2(p(0, \hat{w}^2); \hat{w}^2)}{\Omega} \frac{\partial R_1^1(p(0, \hat{w}^2); 0)}{\partial w^1} \tag{10}$$

where $\Omega = R_{11}^1 R_{22}^2 - R_{21}^1 R_{12}^2$ (with all partial derivatives evaluated at the point (p, w) given by $p = p(0, \hat{w}^2)$ and $w = (0, \hat{w}^2)$), which is positive by assumptions 1, 3 and 4. Thus $\partial p^2/\partial w^1 > 0$. Now, differentiating (9) with respect to w^1 we obtain

$$\begin{aligned} \frac{\partial \pi^1(0, \hat{w}^2)}{\partial w^1} &= \Pi_1^1(p(0, \hat{w}^2)) \frac{\partial p^1(0, \hat{w}^2)}{\partial w^1} + \Pi_2^1(p(0, \hat{w}^2)) \frac{\partial p^2(0, \hat{w}^2)}{\partial w^1} \\ &= \Pi_2^1(p(0, \hat{w}^2)) \frac{\partial p^2(0, \hat{w}^2)}{\partial w^1} > 0 \end{aligned} \tag{11}$$

since $\Pi_1^1(p(0, \hat{w}^2)) = R_1^1(p(0, \hat{w}^2); 0) = 0$, because $p(0, \hat{w}^2)$ is the Nash equilibrium corresponding to $w^1 = 0$ and $w^2 = \hat{w}^2$ (and $\Pi_2^1 > 0$ by assumption 2). We now show that the best response to $\hat{w}^2$ is a *positive* w^1. Suppose not, and let $\hat{w}^1 < 0$ be the best response. At the Nash equilibrium corresponding to $(\hat{w}^1, \hat{w}^2)$ we have $R_1^1 = \Pi_1^1 - \hat{w}^1 D_1^1 = 0$ and therefore $\Pi_1^1 > 0$ (since $\hat{w}^1 < 0$, by our supposition, and $D_1^1 < 0$). Thus

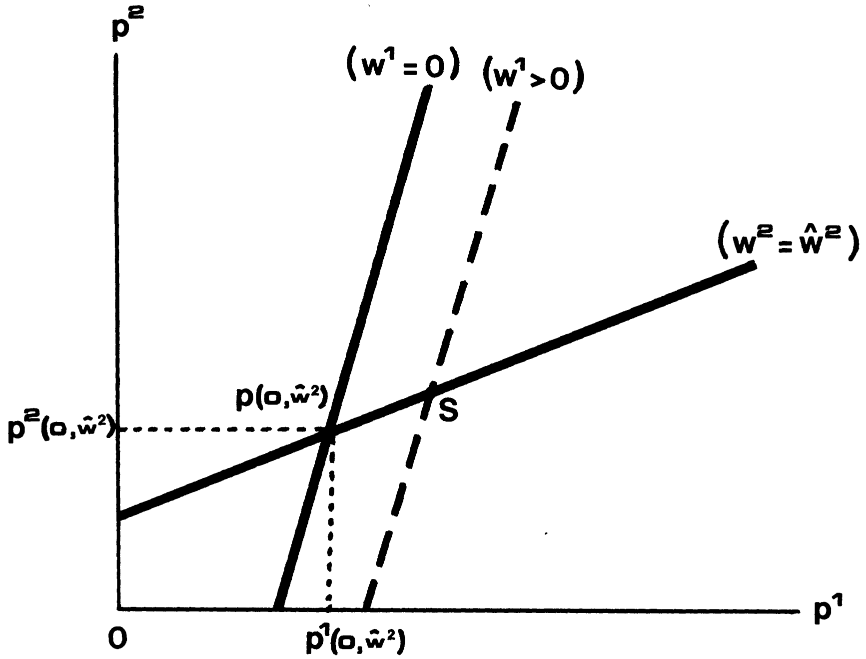

Figure 1

$\partial\pi^1/\partial w^1 = \Pi_1^1(\partial p^1/\partial w^1)+\Pi_2^1(\partial p^2/\partial w^1) > 0$, since—by the implicit function theorem and assumptions 1–4—also the remaining terms are positive. Q.E.D.

Proposition 1 becomes obvious if one looks at Figure 1.

The steeper of the two continuous lines represents the reaction curve of the vertically integrated manufacturer 1, while the other continuous line represents the reaction curve of retailer 2 given the wholesale price $\hat{w}^2$ (or the reaction curve of the vertically integrated manufacturer 2 if $\hat{w}^2 = 0$). The dashed line represents the reaction curve of *retailer* 1 when manufacturer 1 chooses vertical separation and charges a positive wholesale price $w^1 > 0$. If manufacturer 1 chooses vertical integration, the Nash equilibrium is given by $p(0, \hat{w}^2)$. On the other hand, given the relative slopes of the reaction curves, if manufacturer 1 chooses vertical separation, the Nash equilibrium (between retailer 1 and retailer 2) will be along retailer 2's reaction curve at a point where both final prices have gone up (point S). Since at $p(0, \hat{w}^2)$, Π^1 is at a maximum with respect to p^1 (the point $p(0, \hat{w}^2)$ lies on the reaction curve given by $\Pi_1^1 = 0$), the first-order effect on Π^1 of the increase in p^1 is zero, while the first-order effect of the increase in p^2 is positive. Thus it pays manufacturer 1 to choose vertical separation and charge a wholesale price in excess of production cost. In other words, by increasing w^1, manufacturer 1

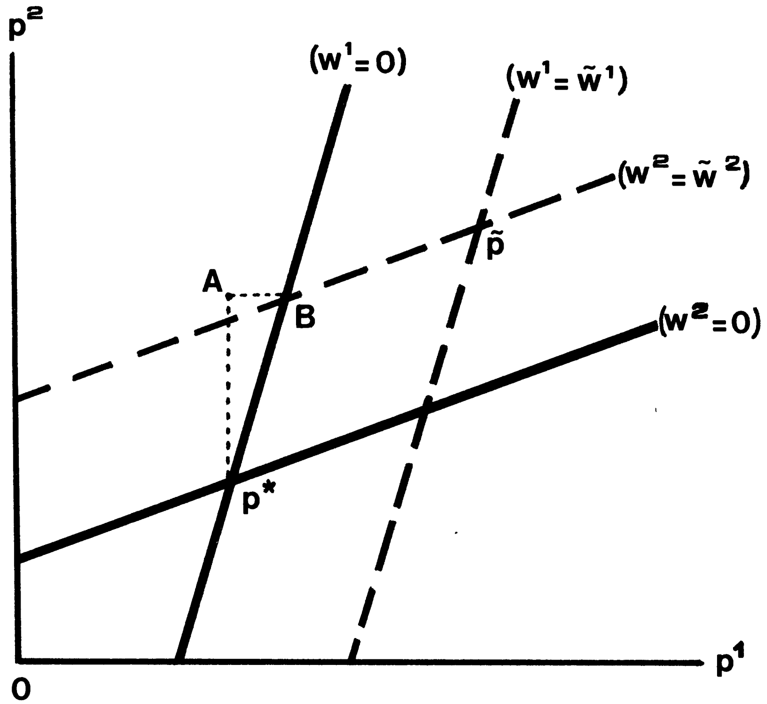

Figure 2

shifts his retailer's reaction curve outwards and can choose the best point on retailer 2's reaction curve.

It is not only in the *individual* interest of a manufacturer to separate vertically. Next we show that both manufacturers will be better off if they both choose vertical separation and charge wholesale prices in excess of production costs (and can collect their retailer's profits by means of a franchise fee) than if they remain integrated. Let

(12) $\tilde{w} = (\tilde{w}^1, \tilde{w}^2)$

be the Nash equilibrium of the game between manufacturers where the payoff functions are given by (9), and let

(13) $\tilde{p} = (p^1(\tilde{w}), p^2(\tilde{w}))$

be the corresponding equilibrium retail prices. (In other words, $(\tilde{w}, \tilde{p})$ is the perfect equilibrium of the two-stage game in which first manufacturers choose wholesale prices and then retailers compete in retail prices.)

Proposition 2. For each $i = 1, 2$,

(14) $\pi^i(\tilde{w}) > \pi^i(0) \equiv \Pi^i(p^*)$

We shall give a simple geometric proof of the above proposition by referring to Figure 2.

First of all, by proposition 1 we have that $\tilde{w}^i > 0$ for each $i = 1, 2$. In Figure 2 the continuous lines represent the reaction curves of the vertically integrated manufacturers and the dashed lines the reaction curves of the retailers given $w^1 = \tilde{w}^1$ and $w^2 = \tilde{w}^2$. Consider manufacturer 1. At point A we have that

$$\Pi^1(A) > \Pi^1(p^*) \tag{15}$$

by assumption 2, since at A, p^1 has remained constant, while p^2 has increased. Furthermore,

$$\Pi^1(B) \geqslant \Pi^1(A) \tag{16}$$

by definition of reaction curve (in the movement from A to B, p^2 remains constant). Finally, it must be that

$$\pi^1(\tilde{w}) \equiv \Pi^1(\tilde{p}) \geqslant \Pi^1(B) \tag{17}$$

by definition of $\tilde{w}$. In fact, given $\tilde{w}^2$, manufacturer 1 could choose $w^1 = 0$ (i.e. vertical integration) and the corresponding equilibrium would be point B. The same argument obviously applies to manufacturer 2. Q.E.D.

Propositions 1 and 2 imply that the two-stage game in which first manufacturers choose wholesale prices (a zero wholesale price being interpreted as the decision to be vertically integrated) and then retailers compete in retail prices, has a unique perfect equilibrium at which both manufacturers choose vertical separation and charge wholesale prices in excess of production costs, provided franchise fees can be used to extract retailers' surplus.

III. CONCLUDING REMARKS

Vertical separation with wholesale prices in excess of production costs is profitable when there are fully extracting franchise fees for the following reason. By raising his wholesale price, manufacturer 1 causes the price charged by retailer 1 to rise. Given our (rather mild) assumptions on demand, the reaction function of seller 2 in price space is upward sloping and, therefore, the price of retailer 2 rises too, which benefits manufacturer 1. Starting from a position where wholesale price equals production cost, the effect upon profits of a small increase in wholesale price due to the change in p^1 is negligible, whereas that due to the induced change in p^2 is distinctly positive. Hence the overall effect is beneficial. Vertical separation permits the increase in wholesale price, whereas in-house retailing effectively constrains the whole price to equal production cost.

Reaction functions slope up when the variables in the game between retailers are strategic complements (see Bulow *et al.* [1985]), but if those variables are strategic substitutes—as is often the case if quantities are the strategic variables—very different results hold. In the Cournot example in Vickers [1985], vertical separation is in the individual (but not the collective) interest of manufacturers, and it involves a wholesale price *less* than unit production cost, accompanied by a negative franchise fee, i.e. a fee paid *to* the retailer. Although the strategic advantage of vertical separation remains, its nature is therefore quite different when the strategic variables in the game between retailers are altered.

In this paper we have looked at the case of two manufacturers each of whom has one retailer. Let this be called the (2, 1) case. The extension of the analysis to the $(m, 1)$ case is straightforward, though somewhat tedious. In section I we noted that other authors have investigated the $(1, n)$ case (i.e. one manufacturer with several retailing agents), which involves problems of *intra*-brand competition quite distinct from the questions of *inter*-brand competition examined here. Perhaps the next step is to attempt to combine both issues in a study of the general (m, n) case.

We have shown that vertical separation, in conjunction with an appropriate contract between manufacturer and retailer, can be a profitable strategic move, which works by inducing the rival firm to act in a more friendly manner. The well-known literature on strategic commitment examines several other ways of seeking to achieve the same end (including, for example, strategic investment in capacity or R & D to alter costs), and an important question for future research concerns the relative merits of these various instruments. In reality, vertical separation does not operate costlessly (as we assumed for the purposes of our simple model). There may be costs of information and coordination, and franchise fees cannot always be used to extract retailers' profits fully. However, vertical separation has some advantages as a method of commitment. Compared with internal incentives and organisation designed to achieve the same strategic goals, separation makes the commitment more observable and harder to reverse. Compared with strategic investment to alter costs, separation does not distort factor choice and worsen internal efficiency. We therefore believe that vertical separation—and vertical arrangements between manufacturers and retailers more generally—deserve some consideration from a strategic viewpoint.

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