Coexistence of Strategic Vertical Separation and Integration

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Abstract

This paper gives conditions under which vertical separation is chosen by some upstream firms, while vertical integration is chosen by others in the equilibrium of a symmetric model. A vertically separating firm trades off fixed contracting costs against the strategic benefit of writing a (two-part tariff, exclusive dealing) contract with its retailer. Coexistence emerges when more than two vertical Cournot oligopolists supply close substitutes. When vertical integration and separation coexist, welfare could be improved by reducing the number of vertically separating firms. The scope for coexistence diminishes when assumptions on contract observability and commitment are relaxed.

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1 Introduction

The strategic advantages of delegation are well-known. Examples of strategic delegation can be found in papers on delegation within the firm (e.g. see Fershtman, 1985, Sklivas, 1987, and Vickers, 1985), vertical structure of distribution channels (e.g. see Bonanno and Vickers, 1988, Coughlan and Wernerfelt, 1989, and Gal-Or, 1990), and bargaining (e.g. see Jones, 1989).[1] Delegation does not only offer strategic advantages, it comes at a cost. The existence of information asymmetries, transaction costs, and opportunism between principal and agent makes delegation costly, as Williamson (1975) observes. A delegation decision therefore trades off the strategic advantages of delegation against its costs.

Most literature on strategic contracts within distribution channels focuses on vertical duopolies, and on symmetric vertical market structures resulting from symmetric models. All of the aforementioned strategic delegation papers obtain symmetric market structures. And, with the exception of Vickers (1985) and Gal-Or (1990), all these papers focus on duopolistic settings.

In practice, however, vertically integrated and separated distribution channels often coexist. For example, Slade (1998a) observes coexistence in the UK beer industry before antitrust intervention. In 1985 the market share of vertically integrated brewers was 22.5%, while delegating brewers had a market share of 52.5%. A second documented example of coexistence is in the Vancouver retail gasoline market in 1991, where about 51% of the stations were vertically integrated, while 25% of the stations remained separated from their oil companies (see Slade, 1998b).[2]

In this paper we give conditions under which asymmetric equilibrium market struc-

[1] For recent surveys on strategic delegation, see e.g. Caillaud and Rey (1994), or Gal-Or (1997).

[2] The remaining market shares were served by independent retailers that signed either non-exclusive dealing or linear pricing contracts with manufacturers. In the UK beer market the vast majority of brewers with non-exclusive dealers were either foreign firms or micro-brewers.

tures result from a symmetric model. In other words, we answer the following question: *Under what conditions do strategic vertical integration and separation coexist in equilibrium?* In particular, these conditions are on the nature of downstream market competition, and the observability of retailing contracts.

Gal-Or (1990) analyzes this problem with Bertrand competition in the final goods market. To countervail the strategic advantage of vertical separation, Gal-Or introduces a fixed cost for a vertically separating upstream firm of writing a contract. Despite the cost of vertical separation, the analysis of Gal-Or does not result in an equilibrium where vertical separation and integration coexist. The aim of this paper is to show that in a symmetric model with Cournot competition in the final goods market such coexistence can occur.

We focus our attention on strategic incentives to vertically separate or integrate. To obtain a clear trade-off of strategic incentives and contract costs, we abstract completely from vertical externalities among vertically separated firms. If vertical externalities were present, then the incentive to internalize them would bias the results towards vertical integration. In general, vertical integration internalizes at least two vertical externalities among firms. First, there is the well-known vertical externality of double-marginalization with linear pricing contracts between upstream and downstream firms. Second, the vertical externality of foreclosure is due to intra-brand competition among two retailers that supply a final good from the same upstream firm. We eliminate these vertical externalities by imposing two vertical restraints on the relationship between upstream and downstream firms. First, we allow for non-linear pricing between upstream and downstream firms. A two-part tariff contract, consisting of a per-unit wholesale price and fixed franchise fee, internalizes the double-marginalization externality among vertically separated firms. Second, we assume that firms write exclusive dealing contracts to eliminate the foreclosure externality. Exclusive dealing contracts assign one unique upstream supplier to each downstream firm.

We assume, furthermore, that each upstream firm supplies only to one downstream firm. The implementation of exclusive territories avoids intra-brand competition, and keeps the analysis tractable.

Although these vertical restraints are exogenous to our model, the literature suggests that such restraints are chosen in equilibrium. For example, Gal-Or (1991) shows that if final goods are sufficiently differentiated, firms prefer two-part tariffs over linear prices and resale price maintenance in equilibrium. Salinger (1988) shows that, with final good Cournot competition, a vertically integrated firm prefers not to supply to a second downstream firm. Furthermore, Lin (1990) shows that, in the absence of intra-brand competition, exclusive dealing is chosen by firms in equilibrium for both linear and two-part tariff pricing contracts.

Besides theoretical support, there is also some empirical support for these vertical restraints. In the UK beer industry and the Vancouver gasoline industry most of the vertically separated retailers were actually working under exclusive dealing, two-part tariff contracts, as Slade (1998a-b) shows. Empirical support for exclusive territories in these studies is weaker. Retailers that produce for the same manufacturer do not operate in independent markets, but they have at least considerable market power. This is the case in the UK beer industry, since "beers sold in two different pubs of a single brewer are imperfect substitutes, due to locational factors, personalities of the publicans, and other distinguishing features" (Slade 1998a, p. 579, footnote 22). Moreover, the fact that "service stations are remarkably evenly distributed within the [Vancouver] city boundaries" (Slade 1998b, p. 96) combined with consumers' transportation costs suggests that service stations have market power as well.

The paper is organized as follows. In section 2 we describe the model. Section 3 analyzes the equilibrium vertical structures with observable strategic contracts between upstream and downstream firms. In section 4 we analyze the welfare that result from the equilibrium vertical structures. The assumptions concerning observability of contracts are discussed in section 5. Finally section 6 concludes the paper. The proofs of propositions are relegated to the appendix.

2 The Model

The only difference between our model and that in Gal-Or (1990) is the nature of product market competition. Whereas Gal-Or studies a model with final good Bertrand competition, we assume that retailers set quantities in the final goods market.

We consider an industry with N (where $N \geq 2$) upstream firms, $U_1, .., U_N$, and many potential downstream firms with reservation payoff 0. Because there are many potential downstream firms, the upstream firms have all the bargaining power, and make take-it-or-leave-it offers to downstream firms. That is, we focus our attention on forward vertical integration. We assume that the industry is organized as N independent distribution channels. The downstream firms transform one unit of the upstream firms' intermediate good into one unit of the final good at zero cost.

The game has three stages. In the first stage upstream firms simultaneously choose whether to vertically integrate or separate. We make the following assumptions on vertical integration. One upstream firm can be vertically integrated with only one downstream firm. An integrated firm neither offers nor accepts contracts from other channels. Vertical integration resolves all conflicts of interest within the distribution channel.

Without loss of generality we assume that only the first m upstream firms chose to separate vertically, i.e. firms $U_1, .., U_m$ separate while firms $U_{m+1}, .., U_N$ integrate vertically, with $m \in \{0, 1, .., N\}$. In stage 2 of the game each vertically separating upstream firm U_i offers an exclusive dealing contract to downstream firm D_i, with $i = 1, .., m$. The upstream firm bears a fixed cost $F > 0$ for offering the contract to the downstream firm.[3] Firm U_i's contract specifies a per-unit wholesale price, w_i, and

[3] This revenue loss, which could be due to e.g. inefficient bargaining or information asymmetries,

fixed franchise fee, f_i, for $i = 1, .., m$. Let us denote $(w^m, f^m) = ((w_1, f_1), .., (w_m, f_m))$. We assume that all contracts are observable, and are not secretly renegotiable. The intermediate goods are supplied to the downstream firms at no cost at the end of stage 2.

In the third stage of the game downstream firms simultaneously choose the quantities of final goods that they supply to the consumers. We assume that final goods are symmetrically differentiated, where consumers' inverse demand is linear in quantities. Inverse demand for final good i, given quantities $\mathbf{q} = (q_1, .., q_N)$, is as follows:

$$P_i(\mathbf{q}) = \alpha - q_i - \delta Q_{-i}, \tag{1}$$

with $\alpha > 0$, $\delta \in [0, 1]$, and $Q_{-i} = \sum_{j \neq i} q_j$. We interpret parameter δ as the degree of product differentiation between final products. For $\delta = 1$ downstream firms supply homogeneous goods, while for $\delta = 0$ downstream firms supply to independent markets.

Finally payoffs are realized. Given contract (w_i, f_i), vertically separated upstream and downstream firms receive the following profits, respectively:

$$\begin{aligned} \pi_{U_i}(\mathbf{q}) &= w_i q_i + f_i - F, \text{ and} \qquad (2) \\ \pi_{D_i}(\mathbf{q}) &= (P_i(\mathbf{q}) - w_i)\, q_i - f_i, \text{ for } i = 1, .., m. \qquad (3) \end{aligned}$$

A vertically integrated firm receives the following profits:

$$\pi_i(\mathbf{q}) = P_i(\mathbf{q}) q_i, \text{ for } i = m + 1, .., N. \tag{4}$$

We solve the game for pure-strategy subgame perfect equilibria (SPEs).

can be interpreted as the cost difference between vertical separation and integration. Naturally if vertical integration is more costly than vertical separation, i.e. $F < 0$, no interesting trade-off remains. In that case vertical separation gives both a strategic advantage and saves contract costs, and consequently all firms separate vertically.

3 Equilibrium Choices

In this section we give conditions under which our symmetric model results in coexistence of strategic vertical separation and integration in SPE. The first subsection describes the SPEs of the final two stages of the game, by deriving equilibrium final good quantities and contracts. The second subsection describes the SPE in the first stage and gives conditions for coexistence of vertical integration and separation in SPE.

3.1 Equilibrium in Retailing and Contracting

In stage 3 of the game firms set final good quantities. Suppose that m distribution channels are vertically separated with contracts (w^m, f^m), while $N-m$ channels are vertically integrated, with $m = 0, 1, .., N$. We define the function $v(w^m, m)$ as follows:

$$v(w^m, m) = \frac{(2-\delta)\alpha + \delta \sum_{k=1}^{m} w_k}{(2-\delta)[2+(N-1)\delta]}. \tag{5}$$

The equilibrium final good quantities, prices and profits are summarized in the following lemma.

Lemma 1 *Given $m = 0, 1, .., N$ and contracts (w^m, f^m), the final good market equilibrium is as follows.*
(VS) For $i = 1, .., m$:

$$q_i^*(w^m, m) = P_i^*(w^m, m) - w_i = v(w^m, m) - \frac{w_i}{2-\delta}, \tag{6}$$

$$\pi_{U_i}^*(.) = w_i q_i^*(.) + f_i - F, \text{ and } \pi_{D_i}^*(.) = (P_i^*(.) - w_i)\, q_i^*(.) - f_i. \tag{7}$$

(VI) For $i = m+1, .., N$:

$$q_i^*(w^m, m) = P_i^*(w^m, m) = v(w^m, m), \text{ and } \pi_i^*(w^m, m) = v(w^m, m)^2. \tag{8}$$

Each downstream firm's reaction function is downward sloping in the total quantity of the firm's competitors. An increase in a distribution channel's wholesale price is similar to an increase of its downstream firm's marginal cost. Therefore, the vertically separated downstream firm's reaction function shifts inward, which makes it a less aggressive Cournot competitor. Hence, each firm's equilibrium final good quantity is increasing in its competitors' wholesale prices. Each vertically separated firm's equilibrium quantity is decreasing in its own wholesale price. The equilibrium final good prices are increasing in wholesale prices. Hence, each distribution channel's equilibrium profit is increasing in its competitor's wholesale price. The effect of an increase in wholesale price on the distribution channel's own profit depends on the trade-off between the price increase and the channel's quantity decrease. For a wholesale price greater or equal to the intermediate good's marginal cost (i.e. $w_i \geq 0$) the channel's profit decreases in its own wholesale price.

In stage 2 of the game each vertically separated upstream firm U_i chooses its contract (w_i, f_i), with $i = 1, .., m$. It is obvious that the franchise fee is set such that it fully extracts the distribution channel's anticipated equilibrium profits. Since, for non-negative wholesale prices, each distribution channel's equilibrium profit is decreasing in the channel's wholesale price, the upstream firms decrease their wholesale prices below marginal cost (i.e. below zero). The equilibrium wholesale price trades off the marginal benefit of the final good price increase against the marginal cost of the firm's final good quantity decrease. Lemma 2 summarizes the second stage SPE.

Lemma 2 *Given $m = 0, 1, .., N$, and $i = 1, .., m$, firm U_i's SPE contract (w_i^*, f_i^*) is such that: $f_i^*(m) = (P_i^*(w^*, m) - w_i^*)\, q_i^*(w^*, m)$, and*

$$w_i^*(m) = \frac{-\delta^2(2-\delta)(N-1)\alpha}{2[2+(N-2)\delta][2-\delta+(N-1)\delta(1-\delta)]+\delta^3(N-1)(m-1)} \leq 0. \quad (9)$$

Note that the equilibrium wholesale price is indeed non-positive, and symmetric due to the symmetry of our model. This is commonly observed in the literature on strategic delegation with strategic substitutes.

3.2 Coexistence

In stage 1 of the game upstream firms choose whether to vertically integrate or separate. In other words, the SPE m is determined. When we substitute the SPE contract in the upstream firms' revenue functions, we obtain the following revenues of vertical integration and separation, respectively:

$$\pi^{VI}(m) = v(w^*, m)^2, \text{ and} \tag{10}$$

$$\pi^{VS}(m) = \left(v(w^*, m) + \frac{1-\delta}{2-\delta}w^*\right)\left(v(w^*, m) - \frac{1}{2-\delta}w^*\right). \tag{11}$$

We define the following function:

$$H(m) \equiv \pi^{VS}(m+1) - \pi^{VI}(m). \tag{12}$$

For simplicity, we introduce the tie-breaking rule that makes a firm choose vertical integration whenever it is indifferent between vertical integration and separation.

Equilibrium conditions for symmetric vertical structures with all firms vertically integrated or separated are, respectively:

$$m^* = 0, \text{ if } \pi^{VI}(0) \geq \pi^{VS}(1) - F, \text{ or } H(0) \leq F \text{ and} \tag{13}$$

$$m^* = N, \text{ if } \pi^{VS}(N) - F > \pi^{VI}(N-1), \text{ or } H(N-1) > F. \tag{14}$$

It is straightforward that there are always contract costs F such that we obtain a symmetric vertical industry structure in SPE. If contracts are costless, i.e. $F = 0$, all firms will separate vertically in SPE, since this gives firms a strategic advantage at zero cost. Since $H(0)$ is finite, we can always find a contract cost F that exceeds it. Such a high contract cost outweighs the precommitment benefits of writing contracts, and, consequently, all firms integrate vertically in SPE.

The condition for obtaining an asymmetric vertical structure in SPE, with m^* vertically separating firms and $N - m^*$ vertically integrating firms is:

$$m^* \in \{1, .., N-1\}, \text{ if } H(m^*) \leq F < H(m^* - 1). \tag{15}$$

Note that if $H(m)$ is decreasing in m, there are contract costs such that this condition is met. Clearly, if $H(m)$ increases in m, condition (15) can never be satisfied. This is stated in the following proposition.

Proposition 1 *For all contract costs lower than* $H(N-1)$ *(resp. higher than* $H(0)$*) there exists a SPE with full vertical separation (resp. integration). Moreover, if* $H(.)$ *increases monotonically in* m*, then coexistence of vertical integration and separation cannot occur in SPE. If* $H(.)$ *decreases monotonically in* m*, then the SPE* m^* *is unique, and coexistence of vertical integration and separation* $(1 \leq m^* \leq N-1)$ *occurs in SPE iff* $H(N-1) \leq F < H(0)$.

The literature often focuses on strategic delegation effects in a duopolistic setting. The following proposition confirms that the literature's focus on symmetric vertical structures is consistent with our results.

Proposition 2 ***(Duopoly)*** *For a vertical duopoly,* $N = 2$*,* $H(.)$ *increases in* m*, i.e. there is no contract cost such that vertical separation and integration coexist in SPE.*

When we combine propositions 1 and 2, we obtain the following for vertical duopolies. If contracting costs are low, i.e. $F < H(0)$, all firms separate vertically in a unique SPE, i.e. $m^* = N$. Intermediate contracting costs, $H(0) \leq F < H(1)$, result in a duplicity of SPEs, with full vertical integration in one, and full vertical separation in the other equilibrium. For high contracting cost, i.e. $F \geq H(1)$, both upstream firms choose to integrate vertically in a unique SPE, i.e. $m^* = 0$.

In the remainder of this section we show that this symmetric equilibrium market structure need no longer emerge in an oligopoly with more than two distribution channels. Concretely, we prove the following proposition.

Proposition 3 ***(Oligopoly)*** *For a vertical oligopoly, with* $N \geq 3$*, the degrees of differentiation* $\underline{\delta}(N)$ *and* $\overline{\delta}(N)$ *exist with* $0 < \underline{\delta}(N) \leq \overline{\delta}(N) < 1$*, such that:*
(i) for all $\delta \geq \overline{\delta}(N)$*:* $H(.)$ *decreases in* m*, i.e. for* $H(N-1) \leq F < H(0)$ *vertical integration and separation coexist in SPE, and the SPE number of vertically separated distribution channels* m^* *is unique and decreasing in* F*;*
(ii) for all $\delta \leq \underline{\delta}(N)$ *and any* F*: all firms are vertically integrated in the unique SPE.*

If final goods are homogeneous, equilibrium profits are decreasing and convex in m, since more delegation creates fiercer competition in retailing. Moreover the equilibrium profits of vertically separated firms decrease more steeply than the profits of vertically integrated firms, i.e. $d\pi^{VS}/dm < d\pi^{VI}/dm < 0$. Figure 1 below illustrates the emergence of coexistence. Curve ABC (resp. DEG) represents the profit of verti-

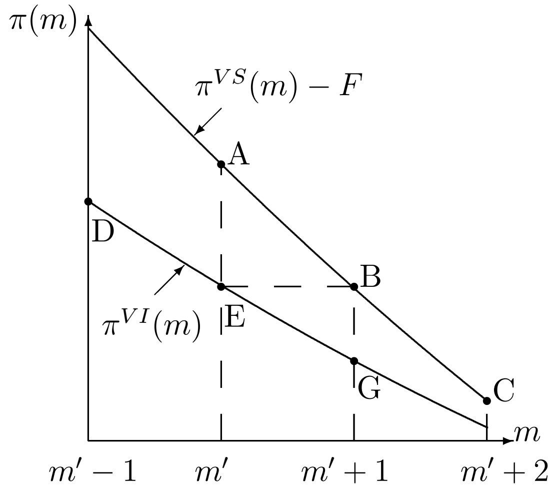

Figure 1: Cournot Competition

cal separation, $\pi^{VS}(m) - F$ (resp. integration, $\pi^{VI}(m)$), as a function of the number of separated distribution channels. Given m' vertically separated distribution channels, an integrated firm is indifferent between remaining integrated and separating unilaterally. A separated channel would be worse off by integrating vertically, since it would drop from A to D in figure 1. Hence, the SPE number of vertically separated firms is m'. A marginal increase of contract cost F shifts curve ABC slightly downward, and creates a strict preference for the vertically integrated channel not to deviate unilaterally. A marginal decrease in contract cost F, i.e. a marginal upward shift of curve ABC, changes the equilibrium number of separating firms from m' into $m' + 1$. A vertically integrated firm does not want to separate, since it would drop from G to a point near C in figure 1. Similarly, a vertically separated firm would be worse off by integrating, since it would jump from a point slightly above B down to point E in figure 1. This explains proposition 3 (i).

This result implies that the symmetry result for vertical duopolies does not carry over to vertical oligopolies. Coexistence in a vertical duopoly is impossible since the profit curve of vertically separated firms is only marginally steeper than the profit curve of the vertically integrated firm. In that case the convexity of the profit curves destroys the possibility of coexistence.

A similar intuition also explains part (ii) of proposition 3. With highly differentiated final goods both profit curves $\pi^{VS}(m) - F$ and $\pi^{VI}(m)$ are almost flat. Since the retailers supply to approximately independent markets, vertical separation loses its strategic impact on competing distribution channels. The fixed cost F of writing such a nonstrategic contract discourages upstream firms from vertical separation, and all firms remain vertically integrated in SPE.

The proposition shows that the negative result of Gal-Or (1990) for strategic complements does not carry over to a model with strategic substitutes. When retailers compete in prices, the equilibrium profits are increasing and convex in the number of vertically separated firms, since delegation makes retailers less “aggressive”. Furthermore, the equilibrium profits of vertically separated distribution channels increase steeper in m than the profits of integrated channels, i.e. $d\pi^{VS}/dm > d\pi^{VI}/dm > 0$. Figure 2 below illustrates this case. Curve HIJ (resp. KLM) represents the profit

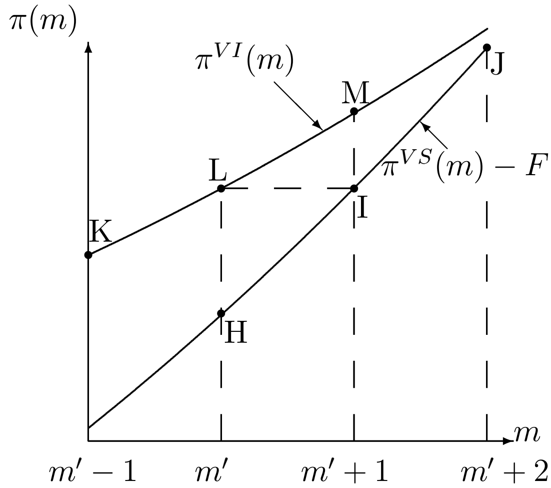

Figure 2: Bertrand Competition

of vertical separation, $\pi^{VS}(m) - F$ (resp. integration, $\pi^{VI}(m)$), as a function of m. Given m' vertically separated distribution channels, it is profitable for an individual separated channel to integrate vertically, since it will move from H to K in figure 2. Alternatively, given $m' + 1$ vertically separated channels, a vertically integrated firm prefers to unilaterally separate, and move from M to J in figure 2. Notice that neither an increase nor a decrease in the contract cost, i.e. a downward or upward shift of curve HIJ respectively, can eliminate unilateral incentives to deviate from an interior m.

4 Welfare Analysis

This section analyzes the welfare that results from the asymmetric vertical structures of the previous section for homogeneous final goods. We perform the welfare analysis for a given number of separated firms, m, given SPE contracts and quantities.

Social welfare is the sum of net consumers' surplus and total industry's profits. Net consumers' surplus and total industry profits, given SPE contracts and final good quantities, equal:

$$CS^*(m) = \alpha \sum_{i=1}^{N} q_i^*(w^*, m) - \frac{1}{2}\left(\sum_{i=1}^{N} q_i^*(w^*, m)\right)^2 - \sum_{i=1}^{N} P_i^*(w^*, m) q_i^*(w^*, m) \quad (16)$$

$$\Pi^*(m) = \sum_{i=1}^{N} P_i^*(w^*, m) q_i^*(w^*, m) - mF, \text{ respectively.} \quad (17)$$

Since final good competition is fiercer with more delegation, the net consumers' surplus increases in m: $dCS^*/dm > 0$. Due to fiercer retail competition and duplication of contract costs the industry's total profits decrease in the number of vertically separating firms: $d\Pi^*/dm < 0$.

Welfare, $W^*(m)$, which is the sum of expressions (16) and (17), equals:

$$W^*(m) = \alpha \sum_{i=1}^{N} q_i^*(w^*, m) - \frac{1}{2}\left(\sum_{i=1}^{N} q_i^*(w^*, m)\right)^2 - mF. \quad (18)$$

The overall welfare effect of an increase in the number of vertically separating firms is not obvious, since consumers' surplus increases while industry's profits decrease in m. This overall effect is summarized in the following expression:

$$\frac{dW^*(m)}{dm} = \frac{\alpha^2(N-1)}{[N+1+m(N-1)]^3} - F. \quad (19)$$

The benefit of more delegation is the improvement in allocative efficiency, which is represented by the first term of expression (19). The welfare loss of more delegation is due to the duplication of contract costs, as is summarized by the second term of (19). The trade-off between the welfare benefit and loss determines the welfare-maximizing amount of delegation $\widehat{m}$.

A comparison between the welfare-maximizing amount of delegation, $\widehat{m}$, and the SPE amount, m^*, gives the following. The marginal private and social cost of vertical separation are identical. However, the marginal private benefit of strategic precommitment exceeds the marginal social benefit of improving allocative efficiency. This results in excessive vertical separation in SPE. In particular, for sufficiently low or high contract costs the SPE number of vertically separated firms is welfare-maximizing, i.e. $m^* = \widehat{m}$ with $m^* \in \{0, N\}$. For intermediate contract costs strictly more than $\widehat{m}$ firms choose for vertical separation in SPE, i.e. $m^* > \widehat{m}$ with $m^* \in \{1, .., N\}$. We summarize this finding in the proposition below.

Proposition 4 ***(Welfare)*** *For $N \geq 3$ and $\delta = 1$ there is excessive vertical separation in SPE: $m^* \geq \widehat{m}$. In particular, there is a contract cost $\underline{F} \in (0, H(N-1))$, such that for all $\underline{F} \leq F \leq H(0)$ more than $\widehat{m}$ firms separate vertically in SPE: $m^* > \widehat{m}$. For all other contract costs the SPE number of vertically separated firms is welfare-maximizing: $m^* = \widehat{m}$.*

This proposition suggests that an antitrust authority should discourage vertical separation in industries where strategic vertical integration and separation coexist. It could implement such a policy by adopting more lenient merger rules for vertical integration.

5 Discussion

Recently the importance of contract observability and secret contract renegotiation on the precommitment effect of delegation received considerable attention in the literature. In this section we discuss the effects of relaxing our assumptions on the observability and renegotiability of firms' contracts.

An influential paper on the precommitment effects of unobservable contracts is Katz (1991). The paper shows that the strategic effect of vertical separation vanishes in the "rational-agent equilibrium" of our delegation game when contracts are unobservable. Recently, Fershtman and Kalai (1997) show that this negative conclusion need not hold, if the more conventional refinement of trembling-hand perfect equilibrium is used. Furthermore, Katz's negative results need not be robust to the introduction of a small probability that contracts become observable, or to repeating the delegation game several times. These results restore the trade-off between the strategic advantage and the transaction cost of vertical separation. Finding the conditions under which this trade-off results in equilibrium coexistence awaits future research.

Even if contracts are observable, but can be secretly renegotiated, the precommitment effect of retail contracts disappears, as Caillaud *et al.* (1995) show. Upstream firms will therefore integrate vertically in equilibrium to avoid the contract costs. This strong negative result need, however, not hold after we slightly change the model. Caillaud *et al.* (1995) claim that if upstream and downstream firms are asymmetrically informed about marginal final good production costs and compete in quantities, renegotiable contracts create a precommitment effect. This restores the trade-off between the precommitment effect and the costs of writing a contract. Whether coexistence of vertical separation and integration result from this trade-off, needs to be explored in future research. A positive side effect of performing such an exercise is that it endogenizes the costs of writing a contract. After the introduction of asymmetric information, the contracting cost is simply the expected informational rent that a separating upstream firm leaves the downstream firm to make the contract incentive compatible.

6 Conclusion

In this paper we showed that the existence of asymmetric vertical industry structures in equilibrium depends on the interaction of retailers in the final good market. When oligopoly retailers supply closely substitutable final good quantities, equilibrium coexistence of vertical separation and integration is possible. However, when the retailers are Cournot duopolists or when final goods are supplied to independent markets, vertical separation and integration do not coexist in equilibrium. Gal-Or (1990) shows that with Bertrand competition in the final goods market equilibrium coexistence never occurs.

An excessive number of firms chooses vertical separation when vertical integration and separation coexist in equilibrium. This suggests that a welfare-maximizing antitrust authority should encourage vertical integration in asymmetric vertical oligopolies.

Although the scope for coexistence diminishes when contracts are unobservable or secretly renegotiable, the literature suggests that the trade-off between precommitment effects and contract costs remains after the introduction of asymmetric information between upstream and downstream firms. Whether coexistence actually occurs in equilibrium after these changes to the model, needs to be addressed in future research.

The insights of the literature on franchising could be helpful in performing such an analysis.[4] The franchising literature studies the incentive effects of vertical integration when there is moral hazard in the relationship between upstream and downstream firms. For a recent survey on theoretical and empirical contributions to this literature, see e.g. Lafontaine and Slade (1997). Work in this area on the incentive effects of asset ownership in the presence of incomplete contracts suggests that coexistence of vertical integration and separation, or "dual distribution", may result from symmetric models. Important ingredients for obtaining coexistence in such models are double-sided moral hazard, e.g. see Mathewson and Winter (1994) and Lutz (1995), or an informed principal, e.g. see Gallini and Lutz (1992). In Gallini and Lutz an informed principal signals high demand for its product by vertically integrating with some of its retailers, since vertical integration is one way of taking an observable stake in the product's profitability.

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Appendix

This appendix contains the proofs of the paper's lemmas and propositions.

Proof of Lemma 1: We characterize the final goods supply equilibrium, given $N-m$ vertically integrated firms, and m vertically separated firms with wholesale prices $w^m = (w_1, .., w_m)$. Suppose these wholesale prices are sufficiently low such that firms supply positive quantities. The first-order conditions for profit-maximization give the reaction functions for the vertically integrated and separated firms are, respectively:

$$\widetilde{q}_i(Q_{-i}; w^m, m) = \begin{cases} \frac{1}{2}\left(\alpha - \delta Q_{-i} - w_i\right), \text{ for } i = 1, .., m, \text{ and} \\ \frac{1}{2}\left(\alpha - \delta Q_{-i}\right), \text{ for } i = m+1, .., N, \end{cases} \tag{20}$$

It is easy to show that the second-order conditions for profit-maximization are satisfied. Summing over $i = 1, .., N$ gives the following:

$$Q^* = \sum_{i=1}^{N} \widetilde{q}_i(Q_{-i}; w^m, m) = \frac{1}{2}\left(N\alpha - (N-1)\delta Q^* - \sum_{i=1}^{m} w_i\right), \tag{21}$$

or

$$Q^* = \frac{N\alpha - \sum_{i=1}^{m} w_i}{2 + (N-1)\delta}. \tag{22}$$

After substituting this expression in the firms' reaction functions, we obtain the equilibrium final good quantities, prices, and profits of lemma 1. □

Proof of Lemma 2: In stage 2 the vertically separating firm U_i chooses its two-part tariff contract such that it maximizes its profit, given downstream firm D_i's participation constraint, and contracts chosen by others, for $i = 1, .., m$. If we focus on interior solutions, firm U_i's contracting problem is as follows:

$$\max_{(w_i, f_i)} \{w_i q_i^*(w^m; m) + f_i - F\} \tag{23}$$

$$\text{s.t. } (P_i^*(w^m, m) - w_i)\, q_i^*(w^m, m) - f_i \geq 0. \tag{24}$$

It is obvious that the franchise fee is optimally set such that all the downstream firm's profit is extracted:

$$f_i^* = (P_i^*(w^m, m) - w_i)\, q_i^*(w^m, m), \tag{25}$$

which reduces the upstream firm U_i's optimization problem to ($i = 1, .., m$):

$$\max_{w_i} \{P_i^*(w^m, m) q_i^*(w^m, m) - F\}, \text{ or} \tag{26}$$

$$\max_{w_i} \quad \left\{\left(v(w^m, m) + \frac{1-\delta}{2-\delta} w_i\right)\left(v(w^m, m) - \frac{1}{2-\delta} w_i\right) - F\right\}. \tag{27}$$

Firm U_i's first-order condition gives the following reaction function for wholesale price w_i:

$$\widetilde{w}_i(w_{-i}; m) = \frac{-\delta^2(N-1)\left((2-\delta)\alpha + \delta \sum_{k \neq i} w_k\right)}{2[2 + (N-2)\delta][2 - \delta + (N-1)\delta(1-\delta)]}, \text{ for } m = 1, .., N. \tag{28}$$

It is straightforward to show that each firm's profit is concave in its own wholesale price. After recognizing that the symmetry of the model gives symmetric SPE wholesale prices, this immediately gives the equilibrium wholesale price of lemma 2. Notice that the equilibrium wholesale prices are, indeed, low enough to guarantee third-stage equilibria with positive equilibrium quantities. □

Proof of Proposition 1: To obtain full vertical separation, choose contract cost $F = 0$, such that $F < H(N-1)$ is satisfied, since $H(N-1)$ obviously exceeds zero. Clearly $H(0)$ is finite. Hence, we obtain full vertical integration for contract cost $F \geq H(0)$. If $H(.)$ is increasing in m, then $H(0) < H(N-1)$ holds. Therefore, inequalities $F < H(N-1)$ and $F \geq H(0)$ are satisfied for the same F, iff $H(0) \leq F < H(N-1)$, and both full vertical separation and integration are SPE strategies. If $H(.)$ is decreasing in m, then $H(0) > H(N-1)$ holds. Therefore, inequalities $F < H(N-1)$ and $F \geq H(0)$ cannot be satisfied for the same F, and for $H(N-1) \leq F < H(0)$ no symmetric vertical oligopoly exists in SPE. Monotonicity of $H(.)$ implies that intervals $[0, H(N-1)), [H(N-1), H(N-2)), .., [H(1), H(0)), [H(0), \infty)$ do not overlap, which implies uniqueness of the SPE m. This proves proposition 1. □

Proof of Proposition 2 (Duopoly): For a duopolistic industry vertical separation and integration do not coexist in equilibrium, since for $N = 2$:

$$H(1) - H(0) = \frac{\alpha^2\delta^6 \left(32 + 16\delta - 24\delta^2 - 12\delta^3 + \delta^4\right)}{16(2+\delta)^2(2-\delta)^2(4-2\delta-\delta^2)^2} \geq 0, \forall \alpha, \delta. \tag{29}$$

This proves proposition 2. □

Proof of Proposition 3 (Oligopoly):

(i) Homogeneous final goods: For an oligopolistic industry ($N \geq 3$) with homogeneous final goods ($\delta = 1$), coexistence of vertical separation and integration is possible in equilibrium, since for $\delta = 1$:

$$\begin{aligned} &H(m+1) - H(m) = \\ &\frac{-\alpha^2(N-1)^2 K}{[(m+1)(N-1)+2]^2[(m+2)(N-1)+2]^2[(m+3)(N-1)+2]^2}, \end{aligned} \tag{30}$$

with

$$K \equiv 2m^3(N-1)^3 + 3m^2(N-1)^2(3N-1) + 12mN(N-1)^2 + 5N^3 - 13N^2 - N + 1. \tag{31}$$

Note that $5N^3 - 13N^2 - N + 1 > 0$ for $N \geq 3$, which implies that:

$$H(m+1) - H(m) < 0 \text{ for all } m, \text{ if } \delta = 1 \text{ and } N \geq 3. \tag{32}$$

Since the inequality is strict and $H(m+1) - H(m)$ is continuous in δ, we conclude that there is a critical value $\overline{\delta}(N) < 1$ such that for all $\delta \geq \overline{\delta}(N)$ the inequality holds for all m. This proves proposition 3 (i).

(ii) Independent final goods markets: For $\delta = 0$ a separating firm's SPE wholesale price equals zero, $w_i^*(m) = 0$ for all m. SPE revenues of vertically integrating and separating firms therefore equal, and since $F > 0$, the unique SPE is one in which all firms remain vertically integrated, $m^* = 0$. The existence of a positive critical value $\underline{\delta}(N)$ follows directly from continuity of the upstream firms' profit function and strict positivity of F. This completes the proof of proposition 3. □

Proof of Proposition 4 (Welfare):

Consider an oligopolistic industry ($N \geq 3$) with homogeneous final goods ($\delta = 1$). The welfare with m vertically separated firms equals:

$$W^*(m) = \frac{1}{2}\alpha^2 \left(1 - \frac{1}{[N+1+m(N-1)]^2}\right) - mF. \tag{33}$$

Since welfare is concave in m (i.e. $d^2W^*/dm^2 < 0$ for all m), $\widehat{m} < m^*$ iff $W^*(m^*) < W^*(m^* - 1)$. We should therefore evaluate the sign of welfare difference:

$$\Delta W^*(m; F) \equiv W^*(m) - W^*(m-1) \tag{34}$$

for $m \in \{1, .., N\}$. Distinguish the following three cases.

(a) For $0 \leq F < H(N-1)$ all distribution channels are vertically separated in SPE, i.e. $m^* = N$. For $F = 0$ we obviously obtain that $W^*(N) > W^*(N-1)$, or $m^* = \widehat{m} = N$. For F approaching $H(N-1)$ we obtain the following:

$$\Delta W^*(N; H(N-1)) = \frac{-\frac{1}{2}\alpha^2(N-1)[2N^4 - 4N^3 + 4N^2 - 5N - 1]}{(N^2 - N + 2)^2(N^2+1)^2} < 0. \tag{35}$$

Since $\Delta W^*(N; F)$ decreases monotonically in contract cost F, there exists a contract cost $\underline{F} \in (0, H(N-1))$ such that: (i) for all $F < \underline{F}$, $W^*(N) > W^*(N-1)$ or $m^* = \widehat{m} = N$, and (ii) for all $\underline{F} < F < H(N-1)$, $W^*(N) < W^*(N-1)$ or

$m^* = N > \widehat{m}$.

(b) For each $m^* \in \{1, .., N-1\}$ and for $H(m^*) \leq F < H(m^*-1)$ we obtain coexistence with m^* vertically separated distribution channels in SPE. The welfare difference then equals:

$$\Delta W^*(m^*; F) \leq \Delta W^*(m^*; H(m^*)) = \frac{-\frac{1}{2}\alpha^2(N-1)L(m^*)}{\prod_{k=m^*-1}^{m^*+1}[N+1+k(N-1)]^2}, \text{ with} \tag{36}$$

$$\begin{aligned} L(m) \equiv\ & 2(N-1)^4m^4 + 2(N-1)^3(2N+3)m^3 + (N-1)^2(2N^2+5N+5)m^2 \\ & -4N[(N^2-1)m + (N^2+N+2)]. \end{aligned} \tag{37}$$

Since

$$L'(m) = 2(N-1)[N+1+m(N-1)][(N-1)m(4(N-1)m+5) + 2N((N-1)m-1)] \tag{38}$$

is greater than zero for all $m \geq 1$ and $N \geq 3$, we obtain:

$$L(m) \geq L(1) = 8N^4 - 21N^3 - N^2 - 3N + 1 > 0, \text{ for all } N \geq 3. \tag{39}$$

Hence, for each $m^* \in \{1, .., N-1\}$ and for $H(m^*) \leq F < H(m^*-1)$ we obtain: $\Delta W^*(m^*; F) < 0$, or $m^* > \widehat{m}$.

(c) Finally for $F \geq H(0)$ all distribution channels are vertically integrated in SPE, i.e. $m^* = 0$. It is also welfare-maximizing not to delegate, since:

$$\begin{aligned} W^*(0) - W^*(1) &= -\Delta W^*(1; F) \geq -\Delta W^*(1; H(0)) \\ &= \frac{\frac{1}{2}\alpha^2(N-1)[2N^2-5N-1]}{4N^2(N^2+1)^2} > 0, \text{ for all } N \geq 3, \end{aligned} \tag{40}$$

and since $W^*(m)$ is concave in m. Hence, $m^* = \widehat{m} = 0$. This completes the proof. □

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