Duopoly Competition with Competitor Partial Ownership

Duarte Brito*
Universidade Nova de Lisboa

Luís Cabral*
IESE Business School

Hélder Vasconcelos*
Universidade Católica Portuguesa and *CEPR*

July 2010

Abstract

Owning a share of a competitor's stock lessens the degree of oligopoly competition. In this paper, we explore this theme by considering different forms of ownership (voting and non-voting shares) as well as different divestiture options. Among other results, we show that turning voting shares into non-voting shares increases consumer surplus; and selling the voting shares to a large shareholder is better than selling it to small shareholders. Perhaps more surprisingly, we provide conditions such that a partial sale of voting shares is worse than turning those shares into non-voting shares.

*Brito is Assistant Professor at Universidade Nova de Lisboa and Research Fellow at CEFAGE, Universidade de Évora. Cabral is Professor of Economics, Academic Director (New York Center), and SP-SP Research Fellow, all at IESE Business School; and Research Fellow, CEPR; lcabral@iese.edu.Vasconcelos is Associate Professor at Universidade Católica Portuguesa, Research Fellow at CEGE, and Research Affiliate at CEPR. This paper was written while the authors were working as consultants to the Portuguese Competition Authority (PCA). Discussions with Gary Biglaiser (Visiting Scholar at the PCA) and António Gomes of the PCA are gratefully acknowledged. All errors are the authors' sole responsibility.

1 Introduction

In 2006, British Sky Broadcasting Group (BSkyB), a UK pay-TV broadcaster, announced the acquisition of 17.9 % of ITV, a UK free-to-air TV broadcaster. The UK Competition Commission concluded that such acquisition would lessen competition considerably, and ordered BSkyB to reduce its shareholding to below 7.5 per cent. In a related example, until November 2007 Portugal Telecom (PT) held a 58% share of PT Multimedia (PTM), a combination of voting and non-voting stock. The two firms operated in several markets as the two main "competitors" (sometimes the sole competitors). Responding to government pressure that PT divest its share in PT Multimedia, a sale took place whereby PT's share in PT Multimedia was sold to PT's shareholders.

These are just two of many examples where a firm owns a share in a competitor. This situation raises a series of competition policy questions, including: (a) To what extent does partial ownership lessen competition and decrease consumer surplus? (b) What difference does it make whether the partial ownership consists of voting shares, as opposed to preferred (non voting) stock? (c) If a divestiture of control rights is to take place, what is the best way to implement it: to sell the shares to a large shareholder, to sell the shares to small shareholders, or to turn the voting stock into preferred stock?

In this paper, we attempt to address the last of the above questions, and in the process shed some light on the first questions as well. We propose a basic framework whereby each shareholder maximizes his financial interest, whereas each firm maximizes the combined interests of its controlling shareholders, as measured by voting shares.

As a preliminary result, we show that, under general conditions, a sufficient statistic for consumer surplus under duopoly is given by the weights that each firm gives to its competitor's profits at the decision-making moment (pricing, in our model).

We then apply the above general result to examine the impact of alternative forms of divestiture. First, we show that turning a partial ownership from voting stock to preferred stock increases consumer welfare. In other words, while a financial interest in a competitor may lessen competition, a controlling share is even worse. As a related result, we show that a full divestiture by sale leads to higher consumer surplus than turning voting stock to preferred stock. (Admittedly, consumer surplus is not the sole consider-

ation. In particular, the transactions costs of a sale are likely to be much higher than those of removing voting rights.)

Next, we show that a sale to a large independent shareholder fares better than a sale to many small shareholders. Intuitively, a sale to a large shareholder increases the weight given to independent shareholders in the target firm; and this has the benefic "countervailing" effect of increasing weight given to the target firm to its own profit. Finally, we provide a possibility result whereby the partial sale of a partial ownership can actually have a negative effect on consumer surplus.

While our results are couched in terms of divestiture of partial competitor ownership, they also apply (with the appropriate sign change) to an increase in partial ownership. Overall, two robust ideas stand out from our results: (a) a participation that induces control is more damaging to consumer welfare than a passive participation, though both decrease consumer surplus; and (b) the concentration of control among independent shareholders in the target firm is beneficial from a consumer surplus point of view (the "countervailing" effect).

■ **Related literature.** A number of authors have consider the impact of partial competitor ownership on the nature of oligopoly competition. In one of the earliest contributions, Reynolds and Snapp (1986) consider the case of Cournot competition and assume that each firm's decisions are taken by an independent controller that maximizes the stream of profits the firm is entitled to. Hence, profits (but not control) are divided in proportion to the equity shares. They show that output is decreasing with partial ownership.

Bresnahan and Salop (1986) build on Reynolds and Snapp (1986) by introducing the distinction between financial interest and control. They consider the possibility that two competitors may create a joint-venture, i.e., an additional firm whose profits will be split in proportion to the partners financial interests. As for the joint venture objective function, several possibilities are considered, reflecting different control configurations. The objective functions analyzed include independent own profit, profit of the controlling partner or joint profit maximization. The competitive effects of the different types of control are discussed and it is established, among others, that independence of the joint venture is more competitive than any form of silent financial interest or limited joint control and that silent financial interest is more competitive than limited joint control, full ownership by one parent or

control by one parent.[1]

Flath (1992) contributes to this literature by considering both direct (as in Bresnahan and Salop (1986) and Reynolds and Snapp (1986)) and indirect financial shareholding. Firm A indirectly holds shares in firm C if it holds shares in firm B and, in turn, firm B holds shares in firm C. The anticompetitive effects are greater in this case than when only direct holdings are considered. Dietzenbacher et al (2000) extend these results to more than three firms and to Bertrand competition. They also provide an empirical application to the Dutch financial market.[2]

Although most of the literature focuses on unilateral effects of partial ownership, Gilo et al (2006) look at the possibility of coordinated effects. Specifically, they analyze whether passive financial investments in rivals facilitate or hinder tacit collusion. Despite the fact that larger crossholdings may limit the punishment after deviation from a collusive arrangement (Malueg, 1992), Gilo et al (2006) establish that an increase in financial ownership by a rival firm never hampers collusion.

Perhaps closest to our analysis, O'Brien and Salop (2000) point out that obtaining control of a rival firm with only partial ownership of its profits may be worse, in terms of welfare, than a complete merger between the two competitors.[3] Our results are consistent with O'Brien and Salop's. However, by providing a formal, analytical framework, we are able to uncover additional effects not present in their analysis. For example, we provide sufficient statistics for the effects of partial ownership (and divestiture of partial ownership) on consumer welfare; and we provide sufficient conditions such that a divestiture increases or decreases consumer welfare.

■ **Structure of the paper.** The remainder of the paper is structured as follows. In Section 2 we present our formal framework. Section 3 includes some preliminary results (lemmas) which we then use in Section 4, where we

1. Reitman (1994) considers the same ownership structure as Reynolds and Snapp (1986) in a conjectural variations model to discuss the incentives firms may have in participating in partial ownership arrangements. See also Alley (1997) for an application of a conjectural variations model with partial ownership arrangements and trade to the automobile industry.
2. In related recent research, Micola and Bunn (2008) conducted a series of simulations to analyse the effects of crossholdings on the outcome of sealed bid-offer auctions with capacity constraints.
3. In a recent contribution Foros et al (2010) consider the case when the partial ownership of one firm in the other is endogenously determined.

present our main results. In Section 5, we apply our analysis to the case of BSkyB's divestiture of ITV. Extensions to our basic framework are included in Section 6. Section 7 concludes the paper.

2 Formal approach

Consider an industry with two firms (A and B) and n shareholders. We explicitly consider the distinction between voting stock (i.e., shares with control rights) and preferred (non-voting) stock. Firm i's total stock ($i = A, B$) is composed of a percentage V_i of voting stock and a percentage $1 - V_i$ of preferred stock. Shareholder k holds a share v_{ik} of voting stock in firm i and a share s_{ik} of preferred stock in firm i. Hence, shareholder k holds a percentage $t_{ik} \equiv v_{ik} V_i + s_{ik} (1 - V_i)$ of firm i's total stock.

Each firm's profit is distributed among shareholders proportionally to their total stock, regardless of whether it be voting stock or preferred stock. Hence, shareholder k receives a profit stream corresponding to a percentage t_{ik} of firm i's aggregate profit, Π_i. It follows that shareholder k's payoff is given by $t_{ik} \Pi_i + t_{jk} \Pi_j$.

In addition to individual shareholders, we also consider the possibility that firm A owns a share t_{B0} in firm B.[4] It follows that, if π_i is firm i's operating profit ($i = A, B$), then firm A's aggregate profit (including cross-holdings) is given by $\Pi_A = \pi_A + t_{B0} \Pi_B$, whereas for firm B we have simply $\Pi_B = \pi_B$.

Each firm's objective function is a weighted sum of voting shareholders' payoffs, where weights are given by those shareholders' voting shares. Formally, firm i maximizes ω_i ($i = A, B$), which are given as follows:

$$\begin{aligned} \omega_A &= \sum_{k=1}^{n} v_{Ak} \left(t_{Ak} \Pi_A + t_{Bk} \Pi_B \right) \\ \omega_B &= \sum_{k=1}^{n} v_{Bk} \left(t_{Ak} \Pi_A + t_{Bk} \Pi_B \right) + v_{B0} \omega_A \end{aligned} \tag{1}$$

An alternative way to think about firm i's maximization problem is to consider that, ultimately, there are n shareholders with control rights (through

4. Strictly speaking, firm B has $n + 1$ shareholders, if we include the competing firm as a shareholder.

v_{ik}) and financial interests (through t_{ik}) in firms A and B, both direct and indirect interests:

$$\begin{aligned}\omega_A &= \sum_{k=1}^{n} v_{Ak}\left(t_{Ak}\,\pi_A + (t_{Bk} + t_{Ak}\,t_{B0})\,\pi_B\right)\\ \omega_B &= \sum_{k=1}^{n} (v_{Bk} + v_{B0}\,v_{Ak})\left(t_{Ak}\,\pi_A + (t_{Bk} + t_{Ak}\,t_{B0})\,\pi_B\right)\end{aligned} \tag{2}$$

Lemma 1 *The maximization of (1) is equivalent to the maximization of (2).*

Many of our results below are better expressed in terms of share correlation / concentration indexes. Specifically, we define

$$K_i \equiv \sum_{k=1}^{n} v_{ik}\,t_{ik} \tag{3}$$

$i = A, B$. In words, K_i measures the correlation between direct control and financial interest, as well as the concentration of such control/interest. In the limit, $K_i = 0$ either because the firm i's control is separated from its ownership or because there are many small shareholders. At the opposite extreme, $K_i = 1$ if there is a single shareholder who controls the firm.

Although our general notation allows for shareholders with holdings in both firms, for most of the paper we will assume that this is not the case except for the share firm A holds in firm B. Taking this into account and with the benefit of (3), we may rewrite (2) as follows:

$$\begin{aligned}\omega_A &= K_A\,\pi_A + t_{B0}\,K_A\,\pi_B\\ \omega_B &= v_{B0}\,K_A\,\pi_A + \left(K_B + v_{B0}\,t_{B0}\,K_A\right)\pi_B\end{aligned} \tag{4}$$

Without loss of generality, we can re-write the firms' maximization problems as

$$\begin{aligned}\omega_A &= \pi_A + \gamma_A\,\pi_B\\ \omega_B &= \pi_B + \gamma_B\,\pi_A\end{aligned}$$

where

$$\begin{aligned}\gamma_A &= t_{B0}\\ \gamma_B &= \frac{v_{B0}\,K_A}{K_B + v_{B0}\,t_{B0}\,K_A}\end{aligned} \tag{5}$$

3 Preliminary results

We are interested in understanding how changes in ownership affect consumer welfare. For this purpose, we assume that firms compete in prices and that prices are strategic complements: $\partial^2 \omega_i / \partial p_i \, \partial p_j > 0$. Moreover, we assume that an increase in firm i's price increases firm j's operating profit π_j and reduces consumer surplus. The following result then relates changes in γ_i to changes in consumer surplus.

Lemma 2 *Consumer surplus is decreasing in* $\gamma_i + \gamma_j$.

In words, Lemma 2 indicates that $\gamma_i + \gamma_j$ is a sufficient statistic for consumer welfare. In particular, an increase in $\gamma_i + \gamma_j$ leads to higher equilibrium prices and lower consumer surplus. Although we focus our attention on price competition, the negative relation between γ_i and consumer surplus extends to other modes of market competition (for example, Cournot competition with linear demands). The idea is fairly intuitive: to the extent that firm i takes firm j's profit into consideration when maximizing profits, we are closer to the perfect collusion extreme, which implies higher prices.

Although our focus is on changes in firm A's holdings of firm B, we first consider a series of comparative statics exercises with respect to infinitesimal changes in some key parameters.

Lemma 3 *γ_B is increasing in K_A and v_{B0}; and decreasing in K_B and t_{B0}. Moreover, γ_A is increasing in t_{B0} and independent of other parameter values.*

The result regarding γ_A follows from (5) and is fairly intuitive: firm A cares about firm B's profits to the (precise) extent that it has a financial interest in firm B. By contrast, the results regarding γ_B (the weight given by firm B to firm A's profits) are more complicated because of the indirect effects in place, as reflected in (5). Let us consider each of them in turn.

First, γ_B is increasing in K_A. Why would firm B care about firm A's profits? Because the shareholders who control firm A also control firm B (through v_{B0}) *and also have a financial interest in firm A*. The extent to which the shareholders who control firm A also have a financial interest in firm A is measured by K_A, thus γ_B is increasing in K_A. In the extreme when $K_A = 0$, the voting shareholders in firm A have control but no financial interest in that firm; and their influence in firm B's decision making will tend to give no weight to firm A's profits.

Second, γ_B is decreasing in K_B. Recall that the indexes K_i measure both correlation and concentration. In this case, it is best to think of K_B as a *concentration* index. In the limit when K_B is small, all firm B shareholders (except firm A) are of infinitesimal size. This implies that firm A's share in firm B, even if less than 1, effectively gives firm A complete control over firm B. To the extent that K_A is greater than zero, so that firm A's voting shareholders also have a financial interest in firm A, this implies that the controlling share v_{B0} will induce firm B to care a lot for firm A's profits. For this reason, an increase in K_B — a greater concentration of control by firm B's "independent" shareholders — "counterweights" the effect of v_{B0}. We will return to this "countervailing" effect later.

Third, γ_B is increasing in v_{B0}. In fact, greater control of firm B by firm A's shareholders leads firm B to place greater weight on firm A's profits. The channel through which this effect takes place is similar to that discussed above regarding the partial derivative $\partial \gamma_B / \partial K_A$. To the extent that $K_A > 0$, the voting shareholders who have partial indirect control over firm B also have a financial interest in firm A. Such control is used to influence firm B in terms of giving greater weight to firm A's profits. And the greater v_{B0} is, everything else constant, the greater the control of firm B by firm A, and the greater this effect is.

Fourth, γ_B is decreasing in t_{B0}. We are now considering firm A's financial interest in firm B, not its control over firm B. Everything else constant, the more firm A cares about firm B (as measured by t_{B0}), the more firm A will use its control over firm B to maximize firm B's profits, which in turn leads to a lower γ_B.

To conclude the discussion of Lemma 3, notice the contrast between the latter two derivatives: γ_B is increasing in v_{B0} but decreasing in t_{B0}. This shows that the nature of firm A's holdings in firm B matters a great deal: control and financial interest are related but different forms of shareholding. In fact, for a given level of financial interest, greater control leads firm B to place greater weight on firm A's profits; but for a given level of control, greater financial interest leads firm B to place a lower weight on firm A's profits. In the next section we will discuss the importance of this distinction when comparing various forms of divestiture.[5]

5. As we will see, the two form of shareholding are not independent: an increase in voting shares also leads to an increase in financial interest, except in the limit case when $V_i = 0$, so that voting shares correspond to no financial interest.

Discussing the effects of partial ownership, O'Brien and Salop (2000) also allude to the important distinction between active and passive ownership:

> In analyzing the competitive effects of partial ownership, it is necessary to distinguish between two aspects of partial ownership, financial interest and corporate control ... These two factors have separate and distinct impacts on the competitive incentives of the acquired and acquiring firm. Financial interest affects the incentives of the acquiring firm, while corporate control affects the incentives of the acquired firm. (p. 568)

While we agree with this characterization, we also think that it is incomplete. We agree that a higher t_{B0} leads to a higher γ_A ("financial interest affects the incentives of the acquiring firm") and that a higher v_{B0} leads to a higher γ_B ("corporate control affects the incentives of the acquired firm"). But to this we add that, to the extent that firm A has some control over firm B, financial interest also affects the incentives of the acquired firm (a higher t_{B0} leads to a lower γ_B, as stated in Lemma 3).

4 Main results

We now turn to the main results in the paper, where we consider the implications for consumer surplus of various alternative forms of divestiture of firm A's control holding in firm B. Specifically, using Lemmas 2, 3 and other results, we now characterize the effect of the following alternative options:

1. The shares are turned into preferred stock.
2. The shares are sold to infinitesimally small shareholders.
3. The shares are sold to a new large shareholder.

Option 1 directly addresses the issue of control. If the main concern is that firm A controls firm B, then the simplest way of addressing the issue is to remove such control by turning its voting shares into non-voting shares. Moreover, one advantage of this option is that it does not require an actual share sale (as Options 2 and 3 do), with the resulting complication of finding a "fair" sale price.

Option 2 is a natural benchmark. Just as the most competitive market structure corresponds to atom-sized firms, one may conjecture that atom-sized shareholders best correspond to the idea of a competitive structure. However, as we will later see, such shareholder structure does not necessarily maximize consumer surplus.

Option 3 is similar to Option 2 with the difference that the sale is made to one large shareholder.

Next we consider the various divestiture options listed above and determine their relative merit in terms of consumer surplus. First we consider the possibility of turning firm A's voting stock in firm B into preferred stock.

Proposition 1 *Turning voting stock v_{B0} into preferred stock (Option 1) leads to an increase in consumer surplus.*

Turning voting stock into preferred stock does not completely separate the firms: the financial interest is kept at the same level. However, as far as consumer surplus is concerned it represents a positive move. In fact, as Lemma 3 shows, keeping t_{B0} constant (as is the case in the operation at hand) leads per se to no change in γ_B. However, also as shown by Lemma 3, a decrease in v_{B0} leads to a decrease in γ_B; and this in turn leads to an increase in consumer surplus, as shown in Lemma 2.

Intuitively, the switch from voting stock to preferred stock has two effects on control: it weakens firm A's control of firm B (the direct effect) and it also strengthens control by firm B's independent shareholders. Both of these effects lead firm B to place a lower weight on firm A's profit.

Currently competition policy in the EU and the U.S. seems roughly consistent with Proposition 1's characterization of the effects of partial ownership. In the EU, any partial interest that enables the purchaser to exercise control over the target company is subject to a merger filing. The same is not true, however, if the acquisition does not change the degree of control. The U.S. guidelines also make a distinction between active and passive acquisitions, though they also recognize that even passive acquisitions may present competitive concerns (Hatton and Cardwell, 2010).

Proposition 2 *The sale of v_{B0} to a new large shareholder (Option 3) implies higher consumer surplus than the sale of v_{B0} to a series of small shareholders (Option 2).*

The intuition for this result is akin to part of Lemma 3, where we state that γ_B is decreasing in K_B: the greater the concentration of firm B's shareholdings, the less weight firm B places on firm A's profits. In the limit when $K_B = 0$, firm A's voting share in firm B grants firm A effective control over firm B, that is, firm B maximizes firm A's profits (assuming firm A voting shareholders also have a financial interest in firm A).

The difference between Option 3 and Option 2 is that the former leads to an increase in K_B, whereas K_B remains constant under the latter. And by the same argument as in Lemma 3 the former leads to a lower value of γ_B, and thus greater consumer surplus.

In other words, Proposition 2 corresponds to the *countervailing effect* of shareholder concentration: strong independent shareholders in firm B have the beneficial effect of counterweighting the negative effect (from a consumer surplus perspective) of firm A's partial ownership of firm B. There is an interesting analogy with the countervailing effect of buyer power in vertical relations (e.g., Dobson and Waterson, 1997). In general, market share concentration is bad for consumer welfare; but to the extent that there already is market power at one level of the value chain, an increase in concentration at a different level (e.g., downstream) may be welfare-enhancing.

While we show that a sale to one large shareholder is better than the sale to an infinite number of infinitesimal shareholders, these are not the only possibilities to consider. In fact, the highest consumer surplus (lowest $\gamma_A + \gamma_B$) corresponds to a sale pattern that maximizes the post-divestiture value of K_B. If there is a perfect correlation between control and financial interest in firm B, this would correspond to selling v_{B0} to the largest independent shareholder in firm B.

Proposition 3 *A complete divestiture of voting stock v_{B0} leads to greater consumer surplus if it takes place by sale (Options 2, 3) than if it takes place by a switch to preferred stock (Option 1).*

To understand the intuition for Proposition 3, it may help to think of a sale of v_{B0} to an infinite number of infinitesimal shareholders (Option 2) as a two-step process: first v_{B0} is turned into preferred stock (Option 1); and then this preferred stock is distributed to an infinite number of infinitesimal shareholders. Strictly speaking, the two steps lead to a different final arrangement than Option 2. However, to the extent that the stock is distributed to infinitesimal shareholders, it does not matter whether it is voting or preferred stock.

The crucial point is then to understand the impact of the second step above: transferring preferred stock from firm A to an infinite number of infinitesimal shareholders. From (5), a decrease in t_{B0} leads to a decrease in γ_A. This makes sense: to the extent that firm A reduces its financial interest in firm B, it will place a lower weight on firm B's profit. (See also the discussion after Lemma 3.) Having established that the transfer of t_{B0} leads to a lower γ_A, we must now add that it has zero effect on γ_B. This may appear as a contradiction with respect to Lemma 3, where we stated that a decrease in t_{B0} leads to an increase in γ_B; but in fact such result requires $v_{B0} > 0$. Since the first step above leads to $v_{B0} = 0$, the subsequent transfer of preferred stock has no effect on γ_B.

We conclude therefore that the second step leads to a further decrease in $\gamma_A + \gamma_B$, which by Lemma 2 corresponds to an increase in consumer surplus, and which finally proves that the sale of v_{B0} leads to a greater increase in consumer surplus than the switch from voting stock to preferred stock.

Although the consumer welfare effect of a complete divestiture is greater under the sale option, there are two important considerations that weigh against Proposition 3. First, the transactions costs of a sale are considerably greater than the transactions costs of a switch from voting stock to preferred stock. In particular, the latter does not require valuing firm B's stock. Second, Proposition 3 only applies for a *complete* divestiture. As we will see next, the effect on consumer surplus of a partial sale of voting stock may actually be negative.

Proposition 4 *If K_B is sufficiently small, then the divestiture of a small fraction of v_{B0} by means of a share sale leads to a decrease in consumer surplus.*

In order to understand the scope of Proposition 4, consider the following simple example: all shares are voting shares; there is only one shareholder in firm A; firm A owns 50% of firm B; and there are four other shareholders in firm B, each holding 12.5% of the stock.

Consider the divestiture of 1% of firm A's holdings in firm B by means of a sale to an infinite number of small shareholders. Note that the values of K_A and K_B remain constant throughout such sale. From (5), we conclude that the only effect in γ_A and γ_B is through v_{B0} and t_{B0} — or simply v_{B0}, since $t_{B0} = v_{B0}$ given our assumption that all shares are voting shares.

When v_{B0} (firm A's share of firm B) decreases by .01, so does the value of γ_A (the weight placed by firm A's management on firm B's profits). This

is fairly intuitive and reflects the first equation in (5): the weight given by firm A to firm B's profits is proportional to firm A's financial interest in firm B. (This is also part of Lemma 3.)

What is perhaps not as intuitive is that a reduction in v_{B0} leads to an *increase* in the weight given by firm B to firm A's profits. Consider the numerical example at hand. Computation yields $K_A = 1$ and $K_B = 4\,(12.5\%)^2 = .0625$. Plugging these values into (5), we conclude that a 1% reduction in v_{B0} leads to an increase in γ_B from 1.6 to 1.619.

In the limit, suppose that there is an infinite number of infinitesimal shareholders in firm B, except for firm A, which holds a strictly positive share. This means that firm A has effective control of firm B, that is, firm B's objective is effectively firm A's objective. If we now reduce firm A's holding in firm B to a low level, then firm A's financial interest in firm B is also reduced. In the limit as this value becomes close to zero, firm A's interest becomes identified with firm A's profits. Since firm A has effective control over firm B, it follows that firm B's management becomes more concerned with firm A's profits, a change that corresponds to an increase in γ_B.

The condition in Proposition 4 implies that the above increasing effect in γ_B is sufficiently strong to counteract the "natural" decreasing effect in γ_A. Specifically, the condition that K_B is sufficiently small implies that firm A's voting share in firm B, v_{B0}, effectively gives firm A control of firm B.

In the above numerical example, γ_A decreases by .01, whereas γ_B increases by .019. In the limit when $K_B = 0$, (5) implies $\gamma_A = v_{B0}$ and $\gamma_B = 1/v_{B0}$. Since $v_{B0} < 1$, the derivative of γ_B with respect to v_{B0} is greater (in absolute value) than the derivative of γ_A with respect to v_{B0}.

O'Brien and Salop's (2000) comments on the effects of partial ownership echo the possible effects described in Proposition 4:

> Partial investments can raise either larger or smaller concerns than complete mergers. This may seem surprising, since partial acquisition would appear to align the parties' interests less in all cases than would a complete merger. The competitive effects of partial ownership depend critically on two separate and distinct elements: financial interest and corporate control. This distinction is absent in merger analysis, which assumes that the acquiring firm (or person) automatically controls the acquired entity after the merger. With partially ownership interests, however, these elements are separable. They can occur in ways that result

> in greater or lower harm to competition than a complete merger. (p. 562)

In other words, starting from a full merger, the sale of some of firm B's stock owned by firm A may lead to a decrease in consumer surplus. In our framework, this corresponds to starting with the case $v_{B0} = t_{B0} = 1$ and $K_B = 0$ and considering a small reduction in t_{B0}. From (5) we can show that such reduction leads to an increase in $\gamma_A + \gamma_B$.[6]

How can one possibly go from full merger to something that is even worse than full merger? The idea is that when a firm has control over the prices of two substitutes, it has the incentive to increase one of them so as to increase the demand for the other one. In so doing, it will face a trade-off between higher profits in one of the firms and lower profits in the other one. To the extent that the controlling firm cares less for the profit of the target firm — because it does not completely own it — it has incentive to increase prices more than in the case of a complete merger.

5 Application: BSkyB and ITV

Some of our results in the previous section are fairly robust and general. However, Proposition 4 suggests that in some cases the results depend a great deal on particular parameter values. In this section, we look at a particular example with particular parameter values: BSkyB's participation on ITV.

In 2006, the British Sky Broadcasting Goup plc (BSkyB), UK's largest pay-TV broadcaster and retailer, announced that it had acquired 17.9% of ITV, UK's largest commercial free-to-air TV broadcaster. BSkyB's operation was referred to the UK's Competition Commission, which decided that BSkyB's participation would significantly lessen competition. Although BSkyB had no board representation, the Competition Commission argued that the 17.9% share allowed BSkyB to exercise material influence over ITV's strategic commercial policy. The reason is that, based on past experience, there is very low attendance at shareholder meetings, which in turn gives BSkyB the ability to block special resolutions proposed by ITV's management.

6. Notice however that we consider the case of two firms selling strategic complements. We conjecture our result extends to the case of strategic substitutes, though not necessarily to the case of more than two competitors.

Following the Competition Commission's assessment, the Secretary of State ordered BSkyB to reduce its stake in ITV to less than 7.5%. BSkyB appealed, but in January 2010 the English Court of Appeal confirmed the Competition Tribunal's rejection of BSkyB's appeal.

Figure 1 plots the values of $\Delta\Gamma$, that is, the variation of $\gamma_A + \gamma_B$, as a function of K_B and of the share in ITV divested by BSkyB. We denote the latter by β, as distinct from α, the fraction of firm A's share in B that is divested; that is, $\beta \equiv \alpha\, v_{B0}$. In these graphs we assume that $K_A = 1$ and that firm A's share in firm B is purchased by an infinite number of infinitesimal shareholders. Below we consider the case when the share is sold to a new large shareholder.

The top panel in Figure 1 suggests that the impact of a divestiture depends greatly on the current state of firm B's control. If K_B is very small, then the divestiture increases the value of $\gamma_A + \gamma_B$, that is, leads to a lower consumer surplus. By contrast, if K_B is high then the impact is positive. (Our choice of $K_B = (.179)^2$ is motivated by the observation that, according to the Competition Commission, BSkyB's share of .179 allows it to effectively control ITV.) Finally, for intermediate values of K_B, the impact on consumer surplus depends on whether there is a small divestiture (consumer welfare decrease) or a large one (consumer welfare increase).

In the lower panel on Figure 1, we consider the reverse order of variables: for each value of β we vary K_B from low to high values. As suggested by Proposition 4, greater concentration of independent control improves the effect of a divestiture: the greater K_B is, the more favorable the variation in Γ, our measure of change in market power. This panel also suggests that the impact of β is generally ambiguous: for low values of K_B, the greater β is the greater the increase in Γ following divestiture; for high values, by contrast, the greater the value of *beta* the lower the increase in Γ (or the lower the decrease in Γ).

Proposition 2 states that selling firm A's participation to a large new shareholder is better than selling it to a series of small shareholders. Figure 2 suggests that this theoretical consideration has considerable empirical bite. Again we plot the change in the $\Gamma \equiv \gamma_A + \gamma_B$ as a function of β, the amount to be divested. In this figure we consider an intermediate value of K_B, namely $.01 = (10\%)^2$. Consistently with Proposition 2, the curve corresponding to a sale to infinitesimal shareholders lies uniformly above the curve corresponding to a sale to a large new shareholder. Interestingly, for $\beta = 10.4\%$ — the actual share divested by BSkyB, which is marked by a dashed line — the variation

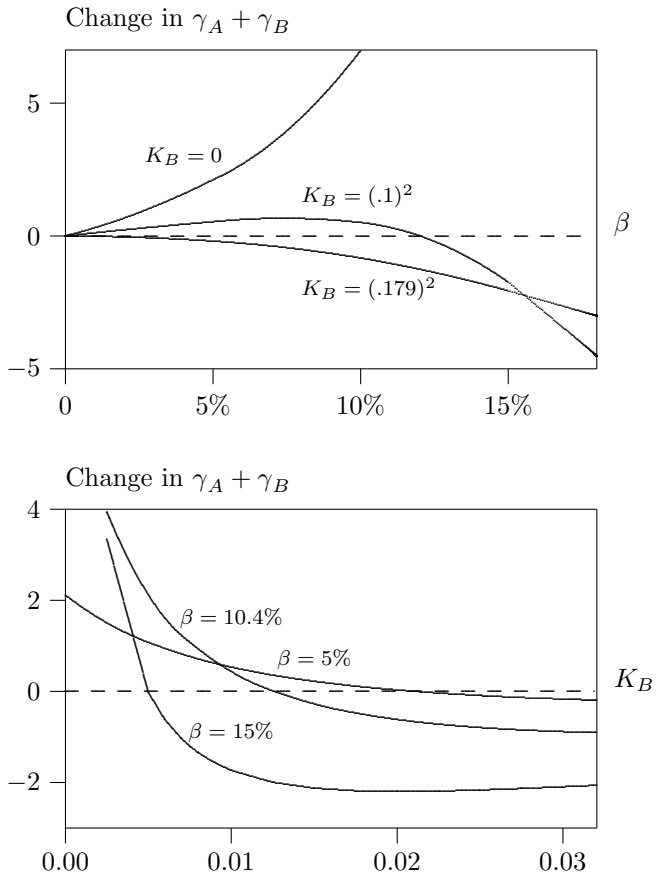

Figure 1: BSkyB's divestiture of its partial holding on ITV (by means of a sale to small shareholders). Effect on $\gamma_A + \gamma_B$ as a function of α for given values of K_B; and as a function of K_B for given values of α. Recall that $\gamma_A + \gamma_B$ is a sufficient statistic of consumer surplus: higher $\gamma_A + \gamma_B$ implies lower consumer surplus.

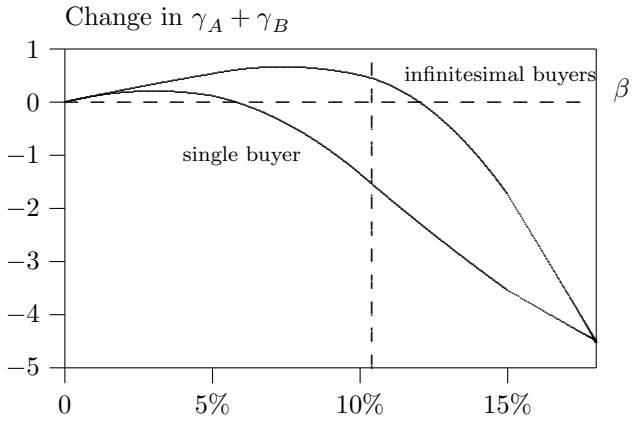

Figure 2: BSkyB's divestiture of its partial holding on ITV. Effect on $\gamma_A+\gamma_B$ as a function of α for $K_B = .01$ and assuming different types of buyers: one single large buyer and an infinite number of infinitesimal buyers.

is positive in one sale mode and negative in the other one.

In sum, while we lack precise information about the case at hand, simple calculations suggest that the result varies considerably not only in size but also in sign.

6 Discussion and extensions

Propositions 3 and 4 suggest a different ranking between divestiture by sale and divestiture by turning voting stock into preferred stock. The contradiction between the two results is only apparent: in fact, Proposition 3 refers to a complete divestiture, whereas Proposition 4 refers to the divestiture of a small fraction of firm A's holding in firm B. This suggests that the effect of a divestiture depends crucially on the fraction of the cross-holding that is sold. Our analysis shows this to be the case. We can show that, if K_B is sufficiently large, then all divestiture options lead to an increase in consumer welfare; moreover, Option 3 is better than Option 2 which in turn is better than Option 1. If however K_B is sufficiently small, then the welfare impact of a sale is negative for small values of α and positive for large values of α. Specifically, we can find thresholds α', α'' ($\alpha' < \alpha''$ such that a sale to a large shareholder (Option 3) is welfare increasing if and only if $\alpha > \alpha'$, whereas sale to a large number of small shareholders (Option 2) is welfare increasing

if and only if $\alpha > \alpha''$. Moreover, when K_B is sufficiently small, the ranking between the three options is as follows: (a) for a low range of values of α, Option 1 is better than 3 which in turn is better than Option 2; (b) for an intermediate range of values of α, Option 3 is better than Option 1 which in turn is better than Option 2; (c) for a high range of values of α, Option 3 is better than Option 2 which is better than Option 1.

We made a specific assumption regarding control, namely that it is proportional to voting share holdings. We could consider alternative mappings, for example a quadratic function of voting shareholdings. We conjecture that our main qualitative results would hold under such alternative specifications. We also considered a limited number of divestiture options. In a companion paper (Brito et al, 2010), we estimate the impact of alternative divestiture options. For example, when the Portuguese government ordered Portugal Telecom to divest of its share in PT Multimedia, it was agreed that PT would distribute its share by its shareholders in proportion to their PT holdings.

Finally, our analysis was based on the assumptions that no shareholder owns shares of both firms. In some cases (including the Portugal Telecom case described above) there are indeed common shareholders. How does this change the analysis? We show that most results remain qualitatively the same. However, the math becomes considerably more complex. The crucial summary statistics of the importance of common ownership are the indexes

$$K_{ij} \equiv \sum_{k=1}^{n} v_{ik}\, t_{jk} \quad (i, j = A, B)$$

In the preceding analysis we assumed that $K_{ij} = 0$. What happens when $K_{ij} > 0$? The general idea is that common shareholders lead to higher γs and thus to lower consumer welfare. Moreover, the various divestiture options considered before lead to changes in the values of K_{ij}, which in turn lead to effects on γ_A, γ_B in addition to the ones considered in Propositions 1–4.

Consider for example Option 1 (removing the voting rights associated with v_{B0}). Such operation increases the degree of control by firm B's shareholders. This in turn leads to an increase in K_{BA}, an effect not considered in our previous analysis (K_{AB} in turn remains constant, whereas K_B increases and K_A remains constant, as considered before). The effect on $\Gamma \equiv \gamma_A + \gamma_B$

of an infinitesimal divestiture of v_{B0} is given by:

$$\left.\frac{\partial \Gamma}{\partial \alpha}\right|_{\alpha=0} = \frac{-v_{B0}\left(K_A K_B - K_{BA} K_{AB}\right)}{(1-v_{B0})\left(K_B + K_{BA}\, t_{B0} + v_{B0}\left(K_{AB} + K_A\, t_{B0}\right)\right)^2}$$

To the extent that $K_A K_B > K_{BA} K_{AB}$, this is still negative as before. However, the effect is lower in absolute value.

Consider now Option 3, the sale of v_{B0} to a infinite number of infinitesimal shareholders. In this case the values of K_{ij} remain constant. However, the effect on $\Gamma \equiv \gamma_A + \gamma_B$ of an infinitesimal divestiture of v_{B0} depends on the values of K_{ij}:

$$\left.\frac{\partial \Gamma}{\partial \alpha}\right|_{\alpha=0} = -v_{B0}\left(\frac{\left(K_A K_B - K_{BA} K_{AB}\right) - \left(K_{BA} + v_{B0} K_A\right)^2 V_B}{\left(K_B + K_{BA}\, t_{B0} + v_{B0}\left(K_{AB} + K_B\, t_{B0}\right)\right)^2} + V_B\right)$$

If $K_{BA} = K_{BA} = 0$, as we considered in the previous sections, then $K_B = 0$ is a sufficient condition for the above to be positive, whereas a large K_B is a sufficient condition for the opposite sign. With joint ownership, however, this is no longer the case.

Notwithstanding all of the additional effects brought about by joint ownership, we can show that Lemma 3, which refers to the effects on γ_i of changes in K_i, K_j, t_{B0} and v_{B0}, is fairly robust to the possibility that $K_{ij} \neq 0$. In fact, as long as $K_A K_B - K_{AB} K_{BA} \geq 0$, all of the derivatives remain with the same sign. The only exception is $\partial \gamma_A / \partial K_A$, which is negative (not zero) when $K_{AB} > 0$.

7 Conclusion

In this paper we consider a duopoly competition setting where one of the firms owns a share of its competitor's stock. We discuss the role of control rights allocation and the competitive effects of different share allocations. While we have uncovered a number of different results, there are two which we consider reasonably robust: First, a participation that induces control is more damaging to consumer welfare than a passive participation, though both decrease consumer surplus. Second, the concentration of control among independent shareholders in the target firm is beneficial from a consumer surplus point of view (due to what we refer to as the "countervailing" effect).

In other respects, the results depend importantly on particular parameter values, including the concentration/correlation coefficients K_i and K_{ij}. For example, the partial divestiture of a partial ownership may lead to a *lower* level of consumer welfare. This possibility, first noted by O'Brien and Salop (2000), is made more formal (and complete) in our analysis.

In conclusion, notwithstanding some general results, much depend on the specific numbers of each specific example. In a companion paper (Brito et al, 2010), we examine the particular case of PT's divestiture of its share in PT Multimedia.

Appendix

Proof of Lemma 1: Substituting $\Pi_A = \pi_A + t_{B0}\,\Pi_B$ and $\Pi_B = \pi_B$ in the first equation in (1) we obtain the first equation in (2). Substituting the first equation in (1) for ω_B in the second equation in (1), and simplifying, we obtain the second equation in (2). ■

Proof of Lemma 2: Firm i's first-order condition is given by

$$f(p_i, p_j; \gamma_i, \gamma_j) \equiv \frac{\partial\,\pi_i}{\partial\,p_i} + \gamma_i\,\frac{\partial\,\pi_j}{\partial\,p_i} = 0$$

Since $\partial\,\pi_j\,/\,\partial\,p_i > 0$, it follows that $\partial\,f(p_i, p_j; \gamma_i, \gamma_j)\,/\,\partial\,\gamma_i > 0$. Since moreover $\partial^2\,\omega_i\,/\,\partial\,p_i\,\partial\,p_j > 0$, standard supermodularity results (e.g., Theorem 2.3 in Vives, 2000) imply that equilibrium prices are increasing in γ_i. Finally, since consumer surplus is decreasing in prices the result follows. ■

Proof of Lemma 3: Taking derivatives and simplifying, we get

$$\begin{aligned}
\frac{\partial\,\gamma_B}{\partial\,K_A} &= \frac{v_{B0}\,K_B}{\left(K_B + v_{B0}\,t_{B0}\,K_A\right)^2} > 0 \\
\frac{\partial\,\gamma_B}{\partial\,K_B} &= \frac{-v_{B0}\,K_A}{\left(K_B + v_{B0}\,t_{B0}\,K_A\right)^2} < 0 \\
\frac{\partial\,\gamma_B}{\partial\,v_{B0}} &= \frac{K_A\,K_B}{\left(K_B + v_{B0}\,t_{B0}\,K_A\right)^2} > 0 \\
\frac{\partial\,\gamma_B}{\partial\,t_{B0}} &= \frac{-\left(v_{B0}\,K_A\right)^2}{\left(K_B + v_{B0}\,t_{B0}\,K_A\right)^2} < 0
\end{aligned}$$

As to γ_A, (5) implies that $\partial\,\gamma_A\,/\,\partial\,t_{B0} = 1$ and that all other partial derivatives are zero. ■

Proof of Proposition 1: Assume that a percentage α of voting stock v_{B0} is turned into preferred stock. As a result of the switch from voting

to preferred stock, a shareholder k owning a percentage of voting shares v_{Bk} now owns a larger percentage, namely $v_{Bk}/(1-\alpha\, v_{B0})$. However, t_{Bk} remains unchanged. Hence, v_{B0} becomes $\frac{v_{B0}(1-\alpha)}{1-\alpha\, v_{B0}}$, K_B becomes $\frac{K_B}{1-\alpha\, v_{B0}}$, and V_B becomes $V_B\,(1-\alpha\, v_{B0})$ as a result of the switch from voting to preferred stock. Let $\Delta\Gamma$ be the change in $\gamma_A+\gamma_B$ resulting from the operation. We then have

$$\begin{aligned}\Delta\Gamma &= \left(t_{B0}+\frac{\frac{v_{B0}\,(1-\alpha)}{1-\alpha\, v_{B0}}\;K_A}{\frac{K_B}{1-\alpha\, v_{B0}}+\frac{v_{B0}\,(1-\alpha)}{1-\alpha\, v_{B0}}\;t_{B0}\,K_A}\right)-\left(t_{B0}+\frac{v_{B0}\,K_A}{K_B+v_{B0}\,t_{B0}\,K_A}\right)\\ &= -\frac{v_{B0}\,\alpha\,K_B\,K_A}{\left(K_B+t_{B0}\,v_{B0}\,K_A\right)\left(K_B+v_{B0}\,t_{B0}\,(1-\alpha)\,K_A\right)}<0\end{aligned}$$

Finally, Lemma 2 implies an increase in consumer surplus takes place. ■

Proof of Proposition 2: Assuming that a percentage α of voting stock v_{B0} is sold to a large shareholder, K_B increases by $(\alpha\, v_{B0})\,(\alpha\, v_{B0}\, V_B)$. However, in case of a sale to a series of small shareholders K_B is not affected. Other than this difference, the effects of Options 2 and 3 are the same. By Lemma 3, $\gamma_A+\gamma_B$ increases by more under a sale to a large shareholder, and by Lemma 2 this leads to greater consumer surplus. ■

Proof of Proposition 3: In all three options, complete divestiture of voting stock v_{B0} results in $v_{B0}=0$. From (5), this leads to $\gamma_B=0$ and $\gamma_A+\gamma_B=t_{B0}$. If the complete divestiture takes place by sale (Options 2, 3), t_{B0} decreases by $v_{B0}\,V_B$, while if there is a change to preferred stock (Option 1) t_{B0} remains constant. Lemma 2 implies that consumer surplus is greater under the sale option. ■

Proof of Proposition 4: Assume that a fraction α of voting stock v_{B0} is sold. Then

$$\Delta\Gamma=\left(\frac{V_B\,v_{B0}^2\,(1-\alpha)\,K_A\,K_A-K_BK_A}{\left(K_B+v_{B0}\,(1-\alpha)\,(t_{B0}-\alpha\, v_{B0}\,V_B)\,K_A\right)\left(K_B+t_{B0}\,v_{B0}\,K_A\right)}-V_B\right)\alpha\, v_{B0}$$

The right-hand side is positive if and only if the expression in large brackets

is positive. At $\alpha = 0$, $K_B = 0$, this reduces to

$$\frac{1}{t_{B0}} - 1 > 0$$

By continuity, $\Delta\Gamma$ is also positive for small values of α. Finally, Lemma 2 implies that the increase in Γ corresponds to a decrease in consumer surplus. ■

References

Alley, W. (1997), "Partial Ownership Arrangements and Collusion in the Automobile Industry," *The Journal of Industrial Economics* **45**, 191–205.

Bresnahan, Timothy, and Steven Salop (1986), "Quantifying the Competitive Effects of Production Joint Ventures," *International Journal of Industrial Organization* **4**, 155–175.

Brito, Duarte, Luís Cabral, and Hélder Vasconcelos (2010), "Portugal Telecom's Divestiture of PT Multimedia: An Economic Analysis," Working Paper.

Dietzenbacher, E., B. Smid, and B. Volkerink (2000), "Horizontal integration in the Dutch financial sector," *International Journal of Industrial Organization* **18**, 1223–1242.

Dobson, Paul W, and Michael Waterson (1997), "Countervailing Power and Consumer Prices," *Economic Journal* **107**, 418–430.

Flath, David (1992), "Horizontal Shareholding Interlocks," *Managerial and Decision Economics* **13**, 75–77.

Foros, Ø., H.J. Kind and G. Shaffer (2010), "Mergers and Partial Ownership," The Bradley Policy Research Center, Financial Research and Policy Working Paper No. FR 10-11.

Gilo, D., Y. Moshe and Y. Spiegel (2006), "Partial Cross Ownership and Tacit Collusion," *RAND Journal of Economics* **37**, 81–99.

Hatton, C., and D. Cardwell (2000), "Minority Acquisitions," *Competition Law Insigths*, 1 June, 5–6.

Malueg, D. (1992), "Collusive Behavior and Partial Ownership of Rivals," *International Journal of Industrial Organization* **10**, 27–34.

Micola, A.R. and D.W. Bunn (2008), "Crossholdings, concentration and information in capacity-constrained sealed bid-offer auctions," *Journal of Economic Behavior and Organization* **66**, 748–766.

Reitman, D. (1994), "Partial Ownership Arrangements and the Potential for Collusion," *The Journal of Industrial Economics* **42**, 313–322.

Reynolds, Robert J, and Bruce R Snapp (1986), "The Competitive Effects of Partial Equity Interests and Joint Ventures," *International Journal of Industrial Organization* **4**, 141–153.

Salop, Steven C., and Daniel P. O'Brien (2000), "Competitive Effects of Partial Ownership: Financial Interest and Corporate Control," *Antitrust Law Journal* **67**, 559–614.

Salop, Steven C., and Daniel P. O'Brien (2001), "The Competitive Effects of Passive Minority Equity Interests: Reply," *Antitrust Law Journal* **69**, 611–625.

Vives, Xavier (2000), *Oligopoly Pricing: Old Ideas and New Trends*, Cambridge, MA: MIT Press.