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ODD RUNE STRAUME

## MANAGERIAL DELEGATION AND MERGER INCENTIVES



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# Managerial delegation and merger incentives\*

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## Abstract

We analyse how the internal organisation of firms affects the correspondence between private and social incentives for horizontal merger. Applying a model of endogenous merger formation in a three-firm asymmetric Cournot industry, we contrast the cases of entrepreneurial and managerial firms. The use of strategic delegation increases both the probability that a merger takes place and the likelihood that the ‘wrong’ type of merger is undertaken, from a viewpoint of social welfare. This suggests that managerial delegation increases the scope for antitrust policy.

*Keywords:* Managerial delegation; Endogenous mergers; Cost asymmetry; Antitrust policy.

*JEL Classification:* D21, D43, L11, L21, L41

## 1 Introduction

In this paper we discuss how the internal organisation of firms - more specifically the use of managerial delegation - affects incentives for horizontal merger in asymmetric industries, where firms differ in cost efficiency. Such mergers do not only reduce competition; they also generate efficiency gains.<sup>1</sup> Particular attention is thus directed towards the correspondence between private and social merger incentives. By using a

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<sup>1</sup>The trade-off between reduced competition and the realisation of efficiency gains in a social evaluation of mergers was identified and formalised by Williamson (1968), and has since been elaborated on in great detail by e.g. Farrell and Shapiro (1990), Levin (1990) and McAfee and Williams (1992).

model of endogenous merger formation, our aim is to provide a better understanding of how potential discrepancies between private and social merger incentives - and thus the scope for antitrust policy - are related to the use of managerial delegation.

The separation of ownership and management in large corporations challenges the validity of the traditional assumption of a firm as a single profit-maximising agent. The idea that firms strive towards other goals than profit maximisation, which has a long tradition in the so-called behavioural theory of the firm,<sup>2</sup> has been reconsidered in the literature on strategic delegation, which was pioneered by Vickers (1985), Fershtman (1985), Fershtman and Judd (1987) and Sklivas (1987). In general, imperfect product market competition is a sufficient condition for owners to provide their managers with incentives which deviate from profit maximisation.

The idea of strategic delegation has obviously important implications for the understanding of industrial organisation in general. However, the amount of theoretical work on the role of delegation in merger processes is surprisingly scant. Two related papers are González-Maestre and López-Cuñat (2001) and Ziss (2001), who consider how managerial delegation affects the profitability of horizontal mergers in a symmetric Cournot oligopoly, and find that merger profitability is generally increased.<sup>3</sup> There are, however, no efficiency gains from a merger in these studies, so the relationship between private and social incentives for merger is not an issue.

In the present paper we consider a three-firm Cournot industry in which mergers are formed through bargaining between owners at the outset of the game. The effects of managerial delegation on merger incentives are assessed by comparing the cases of *entrepreneurial* and *managerial* firms. In order to make the distinction between social and private merger incentives an interesting one, we assume that a merger always entails an efficiency gain. The literature on horizontal mergers suggests several potential sources for efficiency-enhancing mergers. The most commonly indicated source of efficiency gains is the presence of cost asymmetries.<sup>4</sup> If the firms in a certain industry produce at different marginal costs, mergers can yield rationalisation gains through

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<sup>2</sup>See e.g. Baumol (1958), Simon (1964) and Williamson (1964).

<sup>3</sup>Faulí-Oller and Motta (1996) also study the effect of delegation on merger profitability. However, this is done under the assumption that managers also make takeover decisions. In the present paper, as well as in the other related studies, the merger process is controlled by owners.

<sup>4</sup>For some recent studies of horizontal merger in asymmetric industries, see Barros (1998), Smythe et al. (2000), Kabiraj and Lee (2000), Stennek (2001), Faulí-Oller (2002).

re-allocation of production from high-cost to low-cost plants.<sup>5</sup> We also adopt this idea by assuming that the firms have constant, but different, marginal costs of production.

Ruling out the possibility of merger to monopoly by assumption, we find that the correspondence between private and social incentives for merger is highly dependent on whether or not owners use strategic delegation. In the case of entrepreneurial firms, the merger process produces the socially most preferred ownership structure if the degree of cost asymmetry is either sufficiently low, or sufficiently high. In the delegation regime, on the other hand, there is always a conflict between private and social merger incentives, and the merger process will actually produce the socially *least* preferred ownership structure if the cost structure is sufficiently asymmetric.

These results are due to the fact that delegation changes the merger incentives in two different ways. Firstly, a merger is always profitable in the delegation regime, even if there are no efficiency gains. Secondly, the merger process is to a larger extent motivated by the quest for market power, relative to cost-saving motivations. This means that the use of delegation not only increases the probability that a merger will take place, but it also increases the likelihood that the ‘wrong’ type of merger will be undertaken. Our results therefore suggest that the use of strategic delegation increases the scope for antitrust policy. This is the main message of the paper.

The rest of the paper is organised in the following way. In the next section we present the basic ingredients of the model. In section 3 we explain the assumptions of the endogenous merger process, which is based on Horn and Persson (2001), whereas section 4 is devoted to the analysis of the relationship between market structures and delegation incentives. In section 5 we solve the model and derive the equilibrium ownership structure for the cases of entrepreneurial and managerial firms, respectively. The equilibrium outcome of the game is then related to the social ranking of ownership structures in section 6. Finally, some concluding remarks are offered in section 7.

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<sup>5</sup>A merger may also be an instrument to obtain transmission of cost-reducing technology (see e.g. Faulí-Oller and Sandonis, 2002). It is also possible that a merger creates additional synergies. For instance, Perry and Porter (1985) introduce a specific asset that reduces marginal costs through mergers. In another line of reasoning, Lommerud et. al (2002) suggest that a downstream merger may create variable cost synergies through an improved bargaining position vis-à-vis upstream input suppliers.

## 2 The model

Consider an industry with three initial owners of firms producing a homogeneous good, which is sold at the market clearing price, given by the inverse demand function

$$p(Q) = a - Q, \quad (1)$$

where  $Q = \sum_{i=1}^3 q_i$  is the total output of the firms in the industry. The mode of competition is Cournot, and we also assume that entry to the industry is restricted, due to some firm-specific ownership advantages of the incumbents.

The production technologies of the firms are represented by constant marginal costs of production,  $c_i$ , and the firms differ in efficiency, so that  $c_1 < c_2 < c_3$ . To simplify the analysis we make the differences in efficiency symmetrically distributed by assuming that the marginal production cost of firm  $i$  is given by

$$c_i = (i - 1)c, \quad i = 1, 2, 3. \quad (2)$$

The parameter  $c$  is then a direct measure of cost asymmetry in the industry.<sup>6</sup> In order to make sure that the least efficient firm is always active in any possible ownership structure, we assume that  $c$  is below a critical value  $\bar{c}$ .<sup>7</sup>

We want to distinguish between the cases of *entrepreneurial* and *managerial* firms. If firms are entrepreneurial, each owner makes the output decision herself. On the other hand, if firms are managerial, each owner delegates the output decision to a manager. In either case, owners are assumed to be profit-maximisers.

In the delegation regime, each manager chooses the firm's output to maximise his personal payoff, given by an individual contract provided by the owner of the firm. Owners receive the resulting profits, whereas managers are rewarded according to their contracts. Owners are able to assess the performance of their managers according to two readily observable indicators: profits ( $\pi$ ) and sales ( $q$ ). The incentive contracts are specified so that manager  $i$  has an incentive to maximise a function  $\phi_i(\pi_i, q_i)$ . Following the established practice in the literature on managerial delegation, we specify  $\phi_i$  to be a linear combination of its arguments, and given by

$$\phi_i(\pi_i, q_i) = \theta_i \pi_i + (1 - \theta_i) q_i. \quad (3)$$

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<sup>6</sup>This particular specification of cost asymmetry is a simplification of Barros (1998).

<sup>7</sup>The subsequent analysis demonstrates that  $\bar{c} = \frac{a}{11}$ .

Manager  $i$  can maximise his payoff by choosing the value of  $q_i$  which maximises  $\phi_i(\cdot)$ , so owner  $i$  can determine her manager's incentives by choosing  $\theta_i$ .<sup>8</sup>

For delegation contracts to be effective as commitment devices, they must be public information<sup>9</sup> and irreversible.<sup>10</sup> However, as observed by González-Maestre and López-Cuñat (2001), the commitment problem can be overcome by interpreting the model as one where an owner chooses her manager's *type*, rather than contract. With this interpretation, a manager's type is represented by the parameter  $\theta_i$ , where a low value of  $\theta$  means that the manager is an 'aggressive' type with strong preferences for sales.

The game is characterised by the following sequence of play:

Stage 1: The equilibrium ownership structure of the industry is determined through bargaining between the owners.

Stage 2: In the case of *entrepreneurial* firms, the owners set quantities and the game ends. In the case of *managerial* firms, the owners choose incentive contracts for their managers.

Stage 3: Managers set quantities.

### 3 Endogenous merger formation

When making predictions about the equilibrium ownership structure in this industry we exclude the possibility of merger to monopoly. Besides being a less interesting industry structure, it is also reasonable to assume that complete monopolisation would not gain permission from antitrust authorities.

To introduce some notation, let an ownership structure  $\mathcal{M}_i$  be a partition of the set  $\{1, 2, 3\}$  of owners into coalitions. When we exclude complete monopolisation, we are left with the following possible ownership structures:  $\mathcal{M}_0 = \{1, 2, 3\}$ ,  $\mathcal{M}_A = \{\{1, 2\}, 3\}$ ,  $\mathcal{M}_B = \{\{1, 3\}, 2\}$  and  $\mathcal{M}_C = \{1, \{2, 3\}\}$ .

In order to make some predictions about which ownership structure will emerge as an equilibrium outcome of the game, we will make use of an approach developed by Horn and Persson (2001), which treats the merger process as a cooperative game of coalition-formation, where the players are free to communicate and write binding contracts.

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<sup>8</sup>With this specification, manager  $i$ 's actual payoff could be given by  $\alpha_i + \beta_i\phi_i$ , where  $\alpha_i$  and  $\beta_i$  are some constants with  $\beta_i > 0$ .

<sup>9</sup>Fershtman and Judd (1987) argue that incentive contracts are more costly to change than prices or production, so they will be unaltered for a substantial amount of time and are therefore likely to be observed by rivals.

<sup>10</sup>Katz (1991) shows that the commitment value of delegation is present even under private information and renegotiation, provided that delegation is imperfect and renegotiation occurs under incomplete information.

Without going into details about the theoretical foundations, the approach involves a comparison of any two possible ownership structures  $\mathcal{M}_i$  and  $\mathcal{M}_j$ , where  $\mathcal{M}_i$  is said to *dominate*  $\mathcal{M}_j$  ( $\mathcal{M}_i \text{ dom } \mathcal{M}_j$ ) if the combined profits of the *decisive group* of owners are larger in  $\mathcal{M}_i$  than in  $\mathcal{M}_j$ . The *decisive group* of owners are the owners that are expected to be able to influence whether  $\mathcal{M}_i$  will be formed instead of  $\mathcal{M}_j$ , and vice versa. We do not allow payments between coalition, so owners belonging to *identical coalitions* in the two structures cannot affect whether  $\mathcal{M}_j$  will be formed instead of  $\mathcal{M}_i$ , but all remaining owners can influence this choice and are thus *decisive*.<sup>11</sup>

Consider the ownership structures  $\mathcal{M}_0$  and  $\mathcal{M}_A$ . In this case owner 3 stands alone in both structures, so the decisive owners are the merger participants in  $\mathcal{M}_A$ , i.e. owners 1 and 2. Now consider instead  $\mathcal{M}_A$  and  $\mathcal{M}_B$ . For  $\mathcal{M}_A$  to dominate  $\mathcal{M}_B$  it is not enough that owners 1 and 2 prefer  $\mathcal{M}_A$  over  $\mathcal{M}_B$ . If owner 3 is adversely affected by the formation of  $\mathcal{M}_A$ , this owner may want to persuade owner 1 to form  $\mathcal{M}_B$  instead, by offering a large share of the surplus in this structure. Thus, all three owners are decisive, and the dominance relation is determined by a comparison of total industry profits in the two ownership structures.

Finally, the solution concept is the *core*. Those structures that are in the core (i.e. the structures that are *undominated*) are defined as *Equilibrium Ownership Structures (EOS)*.

## 4 Market structures and managerial incentives

With asymmetric production costs, a merger between firms  $i$  and  $j$  implies that the merged entity can produce at marginal costs equal to  $\min\{c_i, c_j\}$ . Thus, a merger always entails a rationalisation gain since production can be re-allocated from a high-cost to a low-cost plant.<sup>12</sup> Consequently, there are two different motivations for merger in this model, namely increased market power and a rationalisation of production. Note also that  $\mathcal{M}_B$  and  $\mathcal{M}_C$  are equivalent in terms of *market structure*, since both ownership structures are characterised by a duopoly with a cost difference between the firms equal to  $c$ . We can thus identify three different possible market structures: the decentralised structure ( $\mathcal{M}_0$ ), a duopoly with 'small' cost differences ( $\mathcal{M}_B$  or  $\mathcal{M}_C$ ) and a duopoly with 'large' cost differences ( $\mathcal{M}_A$ ).

In order to characterise the equilibrium outcome of the different possible ownership structures, we introduce the following notation: sub-

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<sup>11</sup>See Horn and Persson (2001) for a formal definition of *decisive owners*.

<sup>12</sup>If cost differences are due to the existence of superior technologies that can be fully transferred through a merger, the merged firm can also be viewed as a multiplant firm, operating the two former firms as plants.

script  $i + j$  refers to the merged entity in case of a merger between firms  $i$  and  $j$ , whereas superscripts  $e$  and  $m$  refer to the cases of entrepreneurial firms and managerial firms, respectively.

As usual, the equilibrium outcome in each ownership structure is found by using a backwards induction argument. Let us first define the relevant profit functions. The profit of a single owner  $i$  is given by<sup>13</sup>

$$\pi_i = [p(Q) - (i - 1)c] q_i, \quad (4)$$

whereas if owners  $i$  and  $j$  decide to merge, they earn a combined profit of

$$\pi_{i+j} = [p(Q) - \min\{(i - 1)c, (j - 1)c\}] q_{i+j}. \quad (5)$$

Production is determined at the last stage of the game. In the delegation regime, equilibrium output of firm  $i$  is partly determined by managerial incentives (or preferences), and given by a function  $q_i^m(\theta_i, \theta_{-i}, a, c)$ . In the case of entrepreneurial firms, equilibrium output of firm  $i$  is solely determined by market size and the degree of cost asymmetry in the industry, and given by  $q_i^e(a, c)$ . Note that  $q_i^m = q_i^e$  for  $\theta_i = \theta_{-i} = 1$ .

If firms are managerial, the optimal incentive contracts are determined by profit maximisation at the second stage of the game. Inserting  $q_i^m(\theta_i, \theta_{-i}, a, c)$  into the profit functions, the simultaneous profit maximisation problem yields an optimal incentive contract for firm  $i$  which is characterised by a function  $\theta_i(a, c)$ .

The effects of merger in a simple homogeneous goods Cournot oligopoly with entrepreneurial firms are reasonably well known. In this section we will therefore concentrate on how equilibrium managerial incentives are affected by the market structure of the industry.<sup>14</sup>

Different ownership structures yield different incentives for strategic delegation, so a merger is always accompanied by new incentive contracts for managers in all firms.<sup>15</sup> Let  $\theta_i(\mathcal{M}_j)$  denote the optimal contract of owner  $i$  in ownership structure  $\mathcal{M}_j$ . The equilibrium outcomes in the different ownership structures are then characterised by

$$\theta_i(\mathcal{M}_0) = \frac{5}{5 + a + (19 - 10i)c}, \quad i = 1, 2, 3, \quad (6)$$

$$\theta_{1+2}(\mathcal{M}_A) = \frac{5}{5 + a + 4c}, \quad (7)$$

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<sup>13</sup>For simplicity, the payoff to managers is suppressed in the profit expressions.

<sup>14</sup>The explicit expressions for the equilibrium outcome in each ownership structure, in terms of output and profits, are given in Appendix A.

<sup>15</sup>With the alternative interpretation of strategic delegation, an industrial restructuring causes each owner to fire the previous manager and hire a new one of a different type.

$$\theta_3(\mathcal{M}_A) = \frac{5}{5 + a - 6c}, \quad (8)$$

$$\theta_{1+3}(\mathcal{M}_B) = \theta_1(\mathcal{M}_C) = \frac{5}{5 + a + 2c}, \quad (9)$$

$$\theta_2(\mathcal{M}_B) = \theta_{2+3}(\mathcal{M}_C) = \frac{5}{5 + a - 3c}. \quad (10)$$

We observe that  $\theta_i(\mathcal{M}_j) \in (0, 1)$  for all  $i$  and  $j$ . Strategic delegation under Cournot competition implies that managers' payoffs depend positively on sales in equilibrium. This further implies that the use of managerial contracts makes the equilibrium within each ownership structure more competitive, compared with the non-delegation game.

More important for the present analysis, though, is the relationship between relative production costs and managerial incentives. From (6)-(10) we see that  $\theta_i < \theta_j$  within each ownership structure if  $c_i < c_j$ . Thus, the owners of more cost-efficient firms will provide their managers with higher relative sales incentives, compared with less cost-efficient firms. This effect is increasing in the degree of asymmetry,  $c$ . In other words, lower relative costs imply more 'aggressive' managers. This means that the use of managerial contracts *reinforces* the asymmetry which is initially caused by different marginal production costs.<sup>16</sup>

The incentive for strategic delegation arises because it can be used as a device for an owner to commit her manager to a higher level of output, which then serves to deter output from rival firms. The benefits of output deterrence are twofold. Firstly, market shares are captured from rival firms, and this effect is positively related to the marginal production costs of these firms. Secondly, the output contraction of rival firms also leads to a price increase, which raises the firm's revenues in proportion to the level of output produced by the firm. Consequently, the incentives for strategic delegation are stronger for a low-cost firm, which initially enjoys a larger share of the market.

## 5 The equilibrium ownership structure

In order to assess how the use of managerial delegation affects private incentives for horizontal merger, we use the case of entrepreneurial firms as the benchmark.

**Proposition 1** *In the case of entrepreneurial firms, the EOS is*

- (i)  $\mathcal{M}_0$  if  $c \leq \frac{a}{29}$ ,
- (ii)  $\mathcal{M}_B$  if  $c \in \left[\frac{a}{29}, \frac{a}{17}\right]$ ,
- (iii)  $\mathcal{M}_B$  or  $\mathcal{M}_C$  if  $c \in \left[\frac{a}{17}, \bar{c}\right)$ .

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<sup>16</sup>This result is found in Ferstman and Judd (1987), and is also indicated by Das (1997) in a different setting.

The proof is given in Appendix B.

In the absence of delegation, the merger process results in either no merger, or a merger involving the least cost-efficient firm, depending on the degree of cost asymmetry in the industry.

>From the existing literature on horizontal merger we know that in a model of Cournot competition in homogeneous goods with linear demand, a sufficient degree of cost-saving is necessary to make a two-firm merger profitable. If  $c = 0$  we have a completely symmetric industry structure. In this case a merger is never privately profitable, as first shown by Salant et al. (1983).<sup>17</sup> In order for the rationalisation gain from a merger to be large enough to compensate for the aggressive response by the outside firm, and thus make a merger profitable, the degree of cost asymmetry must be sufficiently high. Consequently, for a low degree of cost asymmetry,  $c < \frac{a}{29}$ , the decentralised structure, with no merger, is the unique equilibrium.

For  $c \geq \frac{a}{29}$ , at least one type of merger is profitable for the participants. Within the relevant range ( $c < \bar{c}$ ), the potential cost saving from a merger, due to a more efficient allocation of production, is increasing in the degree of cost asymmetry. The cost-saving potential can partly be realised through any type of merger, but the efficiency gain is larger in a merger with the least efficient firm. Thus, when several types of merger are profitable, the equilibrium ownership structure is determined by total industry profits, which are higher in the market structure which yields the more efficient allocation of production.

If firms engage in strategic delegation, the private incentives for merger change quite dramatically, as illustrated by the following Proposition:

**Proposition 2** *In the case of managerial firms, the EOS is*

- (i)  $\mathcal{M}_B$  or  $\mathcal{M}_C$  if  $c \leq \frac{2a}{39}$ ,
- (ii)  $\mathcal{M}_A$  if  $c \in [\frac{2a}{39}, \bar{c})$ .

The proof is given in Appendix C.

A corollary of Proposition 2 is that a merger is always profitable in the delegation regime. This mirrors the results in González-Maestre and López-Cuñat (2001) and Ziss (2001), who find that the use of managerial delegation will generally increase the profitability of horizontal mergers in symmetric Cournot industries.

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<sup>17</sup>When products are homogeneous, the aggressive response from the outside firm is too strong to make a two-firm merger profitable. Such a merger could be profitable, however, if products are sufficiently differentiated, as shown by Lommerud and Sørgaard (1997).

A useful intuition for this result, which is by no means straightforward, is provided by Ziss (2001): a merger induces an output contraction by the merging parties. By reducing output by  $x$  units the merger participants lose profits on those  $x$  units, but obtain higher prices, and thus a higher profit margin, on the remaining units. In the delegation regime, pre-merger profit margins are lower due to a more aggressive behaviour in the production sub-game. This improves the profitability of a merger, compared with the case of entrepreneurial firms, since it lowers the lost profits on the  $x$  units that are no longer produced by the merging parties.

Obviously, with asymmetric firms the profitability of a merger is further increased, due to the rationalisation effect. In fact, any type of merger is always profitable when firms use strategic delegation. Furthermore, Proposition 2 indicates that, contrary to the case of entrepreneurial firms, a merger between the two most cost-efficient firms is the equilibrium outcome of the merger process if the degree of cost asymmetry is sufficiently high.

The intuition can be traced to the effect of cost asymmetry on the optimal delegation contracts. We have seen that managerial delegation reinforces the initial cost asymmetry, implying that the two most cost-efficient firms have a larger share of the market in the pre-merger, and are thus stronger competitors, compared with the entrepreneurial case. If the degree of cost asymmetry is sufficiently high, this implies further that a merger between the two strongest firms allows the merged entity to enjoy a near-monopoly position in the market, which yields higher industry profits than a situation with two more equal competitors post-merger. Consequently, strategic delegation strengthens the anti-competitive incentive for merger, relative to the cost-saving incentive.

## 6 Social versus private incentives for merger

When a merger results in a more efficient allocation of production, such a merger may also increase social welfare. It is thus interesting to compare the equilibrium ownership structure with the socially most preferred ownership structure, in order to establish the correspondence between social and private incentives for merger.

Let  $W(\mathcal{M}_i)$  denote social welfare, measured as the sum of producers' and consumers' surplus, in ownership structure  $\mathcal{M}_i$ . If  $W(\mathcal{M}_i) > W(\mathcal{M}_j)$  we say that  $\mathcal{M}_i$  is socially preferred to  $\mathcal{M}_j$ , expressed as  $\mathcal{M}_i \succ \mathcal{M}_j$ . Since  $W(\mathcal{M}_B) = W(\mathcal{M}_C)$  we will refer to this particular market structure as  $\mathcal{M}_B$ . Once more, we use the case of entrepreneurial firms as a benchmark. In this case, a simple comparison of welfare in the

different ownership structures yields the following result:<sup>18</sup>

**Proposition 3** *In the case of entrepreneurial firms, the social ranking of market structures is given by*

- (i)  $\mathcal{M}_0 \succ \mathcal{M}_B \succ \mathcal{M}_A$  if  $c < \frac{7a}{107}$ ,
- (ii)  $\mathcal{M}_B \succ \mathcal{M}_0 \succ \mathcal{M}_A$  if  $c \in \left(\frac{7a}{107}, \bar{c}\right)$ .

A merger has two contrasting effects on social welfare. A higher market concentration implies higher prices and thus increased market distortion. On the other hand, a more efficient allocation of production will have a positive cost-reducing effect. For the second effect to dominate, the degree of cost asymmetry must be sufficiently high. In this case a merger involving the least cost-efficient firm, i.e.  $\mathcal{M}_B$ , is the socially preferred ownership structure.

A merger between the two most cost-efficient firms, however, does not increase social welfare, even if the cost structure is relatively asymmetric. The reason is twofold: if  $c$  is relatively low, the rationalisation gain from the merger is not sufficiently large. On the other hand, if  $c$  is relatively high,  $\mathcal{M}_A$  is a highly concentrated market structure, due to the large cost difference between the firms. Consequently, the price increase more than outweighs the cost-savings, from a viewpoint of social welfare. In fact, Proposition 3 confirms that  $\mathcal{M}_A$  is the socially *least* preferred market structure for all  $c < \bar{c}$ .

If owners use strategic delegation, a similar comparison of welfare in the different ownership structures reveal a slightly different social ranking.

**Proposition 4** *In the case of managerial firms, the social ranking of market structures is given by  $\mathcal{M}_0 \succ \mathcal{M}_B \succ \mathcal{M}_A$  for all  $c < \bar{c}$ .*

We see that a merger between the two most cost-efficient firms is always the socially least preferred ownership structure, whether or not the owners use strategic delegation, and the intuition is similar for both cases. The only difference between the two regimes in terms of social ranking of ownership structures, is that the decentralised structure is always preferred under managerial delegation, even for high degrees of cost asymmetry. This is mainly due to the fact that the low-cost firms' shares of total industry output are greater when owners use strategic delegation, which means that production is more efficiently allocated in this case. Consequently, the scope for efficiency-enhancing merger is lower.

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<sup>18</sup>See Appendix A for an explicit derivation of welfare in the different ownership structures.

Having established the social ranking of ownership structures, we can now use the results from the previous section to examine the relationship between private and social incentives for horizontal merger.

**Proposition 5** *In the case of entrepreneurial firms, the equilibrium ownership structure coincides with the socially most preferred ownership structure if  $c \leq \frac{a}{29}$  or  $c \in [\frac{7a}{107}, \bar{c})$ . If firms are managerial, the equilibrium ownership structure never coincides with the socially most preferred ownership structure.*

The proof follows from Propositions 1-4.

The degree of correspondence between private and social incentives for merger is highly dependent on whether or not owners use strategic delegation. In the absence of delegation, the equilibrium outcome of the merger process coincides with the socially most preferred outcome if the industry is characterised by either a relative low or a relative high degree of cost asymmetry. In the first case, a merger will not be undertaken because it is not profitable, whereas in the second case, the rationalisation gain from the merger that arises in equilibrium is sufficiently large for this ownership structure to dominate the others, from a viewpoint of social welfare.

In the delegation regime, on the other hand, the merger process always fails to produce the socially most preferred outcome. Furthermore, unless the degree of cost asymmetry is very low, a comparison of Propositions 2 and 4 reveals that the equilibrium outcome under delegation is the least preferred ownership structure, namely a merger between the two most cost-efficient firms.

There are two aspects of strategic delegation which contribute to the large discrepancy between private and social incentives for merger. Firstly, the use of delegation generally increases the profitability of merger. A merger is profitable under delegation even if it entails no cost-savings. Secondly, the use of delegation also increases the probability that the ‘wrong’ type of merger is formed. This is due to the fact that delegation reinforces the cost-based asymmetry in the industry, which reduces the potential rationalisation gain from a merger and means that the merger process to a larger extent is motivated by a quest for increased market power.

## 7 Concluding remarks

Because of potential discrepancies between private and social incentives for merger, the market can generally not be relied upon to produce the socially most preferred market structure. This provides a rationale for

antitrust policy, and illustrates the importance of understanding the relationship between private and social merger incentives. In this paper we have concentrated attention towards the internal organisation of firms as a key factor in this relationship.

Comparing the cases of entrepreneurial and managerial firms, we have shown that the use of strategic delegation significantly distorts the incentives for horizontal merger: firstly, by increasing the probability that a merger will take place, and, secondly, by also increasing the probability that the merger process leads to the wrong type of merger, from a viewpoint of social welfare.

There are at least two ways to interpret our results in relation to antitrust policy. In this paper we have contrasted two alternative models of the firm: the *entrepreneurial* and the *managerial* model. Without committing to any particular stance regarding the relevance of either model, our results suggest that if the managerial model is the more appropriate description of actual firm behaviour, then the scope for antitrust policy is considerably larger than what is suggested by the established literature on horizontal merger, which is predominantly based on the entrepreneurial model.

Alternatively, we can view the two models not as competing models, but as models with different applicability to different types of industries. Our results then suggest that antitrust authorities should pay particular attention to this aspect in the evaluation of the social desirability of a proposed merger.

In characterising the correspondence between private and social incentives for horizontal merger, generality is hard to obtain. Firstly, there is a number of potential sources of efficiency gains that can be realised through a merger. Secondly, a prediction of the outcome of an endogenous merger process is required, which necessitates a fair amount of structure to be imposed on the analysis. Consequently, the scope of any such analysis must necessarily be restricted by a certain degree of particularity in the assumptions. The present paper is certainly no exception in this respect. Nevertheless, our main results are driven by a mechanism that we believe to be fairly general: in Cournot industries, cost-based asymmetries between firms are reinforced by the use of strategic delegation, which strengthens anti-competitive incentives for merger. Thus, we believe that the main message of the paper generalises beyond the rather stylised structure of our model.

## A Equilibrium outcomes in the different ownership structures

Solving the game by backwards induction, we derive the following expressions for output and profits:

### Entrepreneurial firms

$$q_i^e(\mathcal{M}_0) = \frac{1}{4} [a + (7 - 4i)c], \quad i = 1, 2, 3, \quad (\text{A.1})$$

$$\pi_i^e(\mathcal{M}_0) = \frac{1}{16} [a + (7 - 4i)c]^2, \quad i = 1, 2, 3, \quad (\text{A.2})$$

$$q_{1+2}^e(\mathcal{M}_A) = \frac{1}{3} (a + 2c), \quad q_3^e(\mathcal{M}_A) = \frac{1}{3} (a - 4c) \quad (\text{A.3})$$

$$\pi_{1+2}^e(\mathcal{M}_A) = \frac{1}{9} (a + 2c)^2, \quad \pi_3^e(\mathcal{M}_A) = \frac{1}{9} (a - 4c)^2 \quad (\text{A.4})$$

$$q_{1+3}^e(\mathcal{M}_B) = q_1^e(\mathcal{M}_C) = \frac{1}{3} (a + c) \quad (\text{A.5})$$

$$q_2^e(\mathcal{M}_B) = q_{2+3}^e(\mathcal{M}_C) = \frac{1}{3} (a - 2c) \quad (\text{A.6})$$

$$\pi_{1+3}^e(\mathcal{M}_B) = \pi_1^e(\mathcal{M}_C) = \frac{1}{9} (a + c)^2 \quad (\text{A.7})$$

$$\pi_2^e(\mathcal{M}_B) = \pi_{2+3}^e(\mathcal{M}_C) = \frac{1}{9} (a - 2c)^2 \quad (\text{A.8})$$

### Managerial firms

$$q_i^m(\mathcal{M}_0) = \frac{1}{10} [3a + (57 - 30i)c], \quad i = 1, 2, 3, \quad (\text{A.9})$$

$$\pi_i^m(\mathcal{M}_0) = \frac{3}{100} [a + (19 - 10i)c]^2, \quad i = 1, 2, 3, \quad (\text{A.10})$$

$$q_{1+2}^m(\mathcal{M}_A) = \frac{2}{5} (a + 4c), \quad q_3^m(\mathcal{M}_A) = \frac{2}{5} (a - 6c) \quad (\text{A.11})$$

$$\pi_{1+2}^m(\mathcal{M}_A) = \frac{2}{25} (a + 4c)^2, \quad \pi_3^m(\mathcal{M}_A) = \frac{2}{25} (a - 6c)^2 \quad (\text{A.12})$$

$$q_{1+3}^m(\mathcal{M}_B) = q_1^m(\mathcal{M}_C) = \frac{2}{5} (a + 2c) \quad (\text{A.13})$$

$$q_2^m(\mathcal{M}_B) = q_{2+3}^m(\mathcal{M}_C) = \frac{2}{5} (a - 3c) \quad (\text{A.14})$$

$$\pi_{1+3}^m(\mathcal{M}_B) = \pi_1^m(\mathcal{M}_C) = \frac{2}{25} (a + 2c)^2 \quad (\text{A.15})$$

$$\pi_2^m(\mathcal{M}_B) = \pi_{2+3}^m(\mathcal{M}_C) = \frac{2}{25} (a - 3c)^2 \quad (\text{A.16})$$

## A.1 Social welfare

Defining social welfare as the sum of consumers' and producers' surplus, the welfare function is given by

$$W = \sum_i \pi_i + \frac{1}{2}Q^2. \quad (\text{A.17})$$

Using (A.1)-(A.16), social welfare in the different ownership structures is given by the following expressions:

### Entrepreneurial firms

$$W^e(\mathcal{M}_0) = \frac{1}{32}(15a^2 - 30ac + 79c^2) \quad (\text{A.18})$$

$$W^e(\mathcal{M}_A) = \frac{1}{9}(4a^2 - 8ac + 22c^2) \quad (\text{A.19})$$

$$W^e(\mathcal{M}_B) = W^e(\mathcal{M}_C) = \frac{1}{18}(8a^2 - 8ac + 11c^2) \quad (\text{A.20})$$

### Managerial firms

$$W^m(\mathcal{M}_0) = \frac{1}{200}(99a^2 - 198ac + 1299c^2) \quad (\text{A.21})$$

$$W^m(\mathcal{M}_A) = \frac{1}{25}(12a^2 - 24ac + 112c^2) \quad (\text{A.22})$$

$$W^m(\mathcal{M}_B) = W^m(\mathcal{M}_C) = \frac{1}{25}(12a^2 - 12ac + 28c^2) \quad (\text{A.23})$$

## B Proof of Proposition 1

Comparing any type of merger with the decentralised ownership structure, the decisive group of owners consists of the merger participants. From (A.2) and (A.4), we find that  $\pi_{1+2}^e(\mathcal{M}_A) > [\pi_1^e(\mathcal{M}_0) + \pi_2^e(\mathcal{M}_0)]$ , implying  $\mathcal{M}_A \text{ dom } \mathcal{M}_0$ , if  $c > \frac{a}{13}$ . From (A.2) and (A.7) we find that  $\pi_{1+3}^e(\mathcal{M}_B) > [\pi_1^e(\mathcal{M}_0) + \pi_3^e(\mathcal{M}_0)]$ , implying  $\mathcal{M}_B \text{ dom } \mathcal{M}_0$ , if  $c > \frac{a}{29}$ . From (A.2) and (A.8) we find that  $\pi_{2+3}^e(\mathcal{M}_C) > [\pi_2^e(\mathcal{M}_0) + \pi_3^e(\mathcal{M}_0)]$ , implying  $\mathcal{M}_C \text{ dom } \mathcal{M}_0$ , if  $c > \frac{a}{17}$ . For values of  $c$  below the critical levels, the dominance relations are reversed. When comparing two different types of merger, all owners are decisive. In this case the dominance relation is determined by a comparison of total industry profits in the different ownership structures. From (A.4), (A.7) and (A.8) we have that  $\sum \pi^e(\mathcal{M}_B) = \sum \pi^e(\mathcal{M}_C) > \sum \pi^e(\mathcal{M}_A)$  for all  $c < \bar{c}$ . Thus,  $\mathcal{M}_B$  and  $\mathcal{M}_C$ , which are identical market structures, always dominate  $\mathcal{M}_A$ .

The pairwise comparison of ownership structures show that  $\mathcal{M}_0$  is undominated for  $c < \frac{a}{29}$ ,  $\mathcal{M}_B$  is undominated for  $c \in (\frac{a}{29}, \frac{a}{17})$ , while  $\mathcal{M}_B$  and  $\mathcal{M}_C$  are undominated for  $c \in (\frac{a}{17}, \bar{c})$  ■

## C Proof of Proposition 2

Comparing any type of merger with the decentralised ownership structure, the decisive group of owners consists of the merger participants. From (A.10), (A.12), (A.15) and (A.16), we find that  $\pi_{1+2}^m(\mathcal{M}_A) > [\pi_1^m(\mathcal{M}_0) + \pi_2^m(\mathcal{M}_0)]$  for all  $c < \bar{c}$ ,  $\pi_{1+3}^m(\mathcal{M}_B) > [\pi_1^m(\mathcal{M}_0) + \pi_3^m(\mathcal{M}_0)]$  for all  $c < \bar{c}$  and  $\pi_{2+3}^m(\mathcal{M}_C) > [\pi_2^m(\mathcal{M}_0) + \pi_3^m(\mathcal{M}_0)]$  for all  $c < \bar{c}$ . Thus,  $\mathcal{M}_0$  is always dominated by any other ownership structure. When comparing two different types of merger, all owners are decisive. In this case the dominance relation is determined by a comparison of total industry profits in the different ownership structures. From (A.15) and (A.16) we have that  $\sum \pi^m(\mathcal{M}_B) = \sum \pi^m(\mathcal{M}_C)$  for all  $c < \bar{c}$ . Furthermore, from (A.12), (A.15) and (A.16) we find that  $\sum \pi^m(\mathcal{M}_A) > \sum \pi^m(\mathcal{M}_B) = \sum \pi^m(\mathcal{M}_C)$  if  $c > \frac{2a}{39}$ . If  $c < \frac{2a}{39}$ , the dominance relation is reversed. Consequently,  $\mathcal{M}_A$  dominates  $\mathcal{M}_B$  and  $\mathcal{M}_C$ , which are identical market structures, if  $c > \frac{2a}{39}$ . The pairwise comparison of ownership structures show that  $\mathcal{M}_B$  and  $\mathcal{M}_C$  are undominated for  $c < \frac{2a}{39}$ , while  $\mathcal{M}_A$  is undominated if  $c \in (\frac{2}{39}a, \bar{c})$  ■

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