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It Takes Two to Tango: Interlockings and Partial Equity Ownership

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Abstract

This paper investigates the role of interlocking directorates as a pre-deal mechanism in minority equity acquisitions between firms competing in the same product market. The potential gain from such transactions depends on the target firm's private intrinsic value, which the acquiring firm must assess under conditions of adverse selection. As an alternative, the acquirer may propose that one of its executives join the target's board to facilitate information disclosure. For this arrangement to succeed, however, the target must consent to the proposal. To analyze this mechanism, we develop a novel theoretical framework that identifies the conditions under which interlocking directorates arise and determines the equilibrium terms of the minority equity acquisition. The findings have important antitrust policy implications. An interlocking directorate is not necessarily part of a collusive arrangement, yet it may represent an initial step toward minority equity participation among competing firms in the same market.

Keywords: interlocking directorates, partial equity ownership, information, oligopoly

1. Introduction

Board interlocks—whereby directors simultaneously serve on multiple corporate boards—have resurged dramatically after their decline in the early 2000s. Today, over 10% firms, rising to 19% 2011 (Heemskerk, 2013). This resurgence raises a fundamental question: why do firms deliberately create these network ties?

The dominant theoretical perspectives emphasize ex-post benefits. Resource dependency theory views interlocks as channels for accessing capital, expertise, and information (Schoorman et al., 1981; Zona et al., 2018), while agency theory focuses on their role in monitoring management and extracting private benefits of control (Jensen & Meckling, 1976; Dyck & Zingales, 2004). Yet these frameworks largely overlook a critical strategic dimension: interlocks may serve as ex-ante mechanisms to reduce information asymmetries in the market for corporate control.

We propose that interlocking directorates function strategically as information-gathering devices during the pre-deal phase of partial acquisitions. When a potential acquirer faces uncertainty about a target's true efficiency—for instance, when marginal costs are private information—placing a director on the target's board before launching a bid can reveal crucial insider knowledge. This information advantage translates into measurable economic benefits: Cai and Seviril (2012) document that connected acquirers earn 0.12% non-connected transactions, with significantly lower takeover premiums when the interlocking director originates from the acquiring firm.

This paper analyzes interlocks and partial equity acquisitions as two complementary instruments serving a unified strategic objective. We focus specifically on minority stake acquisitions—where targets retain strategic control— a structure that has attracted renewed regulatory attention across jurisdictions (Fletcher et al., 2022). Notable examples include Gillette's acquisition of Wilkinson Sword's non-voting stock (1989), Microsoft's 7% stake in Apple (1997), and Ryanair's minority holdings in Aer Lingus (2006, 2008). These transactions soften product market competition by partially internalizing competitive externalities (Nain & Wang, 2018), yet their viability hinges on the acquirer's ability to identify valuable targets and avoid overpayment.

We formalize this intuition through a three-stage game with adverse selection. In the first stage, firms decide whether to establish an interlock; in the second, the acquirer proposes a minority stake acquisition; in the third, firms compete à la Cournot. Our central result demonstrates that the mere proposal of an interlock serves as an imperfect screening mechanism in the corporate control market. Efficient targets may accept interlocks to credibly signal their type and secure favorable acquisition terms, while inefficient targets decline to preserve informational rents. Consequently, interlocking emerges not merely as a governance arrangement but as a strategic preliminary step in corporate transactions.

Our analysis contributes to the literature in three ways. First, we shift the focus from ex-post benefits to the ex-ante strategic role of interlocks in reducing acquisition costs under asymmetric information. Second, we endogenize interlock formation as an equilibrium outcome of strategic interaction between potential transaction partners, rather than treating it as exogenous. Third, we highlight implications for antitrust policy: interlocks may distort not only product market competition—a well-recognized concern—but also the efficiency of the market for corporate control itself, a dimension largely overlooked in current regulatory frameworks.

The remainder of the paper proceeds as follows. In Section 2 we position our contribution within the relevant literature. Section 3 presents the theoretical model to set our analysis. In Section 4, we develop the analysis for product market competition, while in Section 5, we develop the analysis for corporate control. Finally, in Section 6, we derive the main results of our analysis. Section 7 concludes with policy implications.

2. Literature

Despite the abundant literature in the areas of management and sociology on the occurrence of interlocks and their impact in terms of resource-seeking, monitoring, reducing market uncertainty, internalizing potential conflicts, and assessing human capital (see e.g. Mizruchi, 1996; Loderer & Peyer, 2002; Ozmel et al., 2013; Lamb & Roundy, 2016; Mazzola et al., 2016), very little attention has been devoted to the strategic reasons leading to interlocking networks. The only exception we are aware of is Battaggion and Cerasi (2020), where interlock is the result of a strategic choice between horizontal competitors. Following up on this intuition, we address a further reason why interlock between competing companies might arise: interlocking directors (ID) could be the result of a non-cooperative strategy within an acquisition deal when there is asymmetric information in the market for corporate control.

Our model is similar to oligopoly models with partial equity ownership (PEO) (see, for instance, Reynolds and Snapp (1986) and Flath (1991) for quantity competition, while Shalegia and Spiegel (2012) for price competition). They all show that PEO softens competition in equilibrium. Ezrachi and Gilo (2006) and Gilo et al. (2006) analyze the relation between PEO and the incentive to collude, while Jovanovic and Wey (2014) consider PEO as a first step towards a full merger. In our model, we need a reason why rival companies share ownership, that is, because they gain profits when internalizing the externalities of quantity competition. We combine this motive with asymmetric information between the two rivals similarly to Liu et al. (2018), where firms competing à la Cournot face adverse selection due to private information about their marginal costs. They show that both firms at equilibrium prefer to share information. In our paper, the bidding company is willing to acquire a stake in the rival company due to the benefits of PEO, but does not know the intrinsic value of the target company.

We suggest that ID could be used as a strategic device to overcome asymmetric information in the acquisition deal.

Typically, in the literature on takeovers, the bidding company directly addresses the target company’s shareholders in a contest among bidders. We simplify the analysis of the market for corporate control by ruling out other bidders interested in participating in the acquisition, similarly to Schnitzer (1996), who studies the conditions by which a raider may decide to launch a friendly takeover when the value of the target is private information.

However, for the ID to succeed, the target company must agree to host the director of the rival company on the board: this is why we consider a strategic framework where the bidder and target choose their actions without cooperation.

We find empirical support for our idea in the empirical evidence on the acquisition of companies (see, e.g., Renneboog & Zhao, 2014; Stuart & Yim, 2010; Chikh & Filbien, 2011; Cai & Seviril, 2012) where ID are often associated with deals in the market for corporate control. Also, the empirical contributions on cross-border acquisitions among emerging markets identify board interlocks as a pre-deal mechanism in unstable and information-deficient markets (see, e.g. Khanna & Thomas, 2009; Connelly et al., 2011; Ashan et al., 2023). This empirical literature provides the ground on which we measure our theoretical predictions.

3. Methodology

In the product market, two firms selling a homogeneous good face the following inverse demand:

$$P(q_1, q_2) = 1 - q_1 - q_2. \quad (1)$$

The marginal cost of producing the good can take either of the two values $c^L = 0$ or $c^H = c \in (0,1]$. Since L is associated with the efficient company and H with the inefficient one, where c measures the inefficiency.

As for the informational set, we assume that, while it is publicly known that company *1* is efficient, i.e., $c_1^L = 0$, the efficiency level of company *2* is private information. Company *1* forms expectations about the level of efficiency of the rival, that is $\mu \triangleq Pr\{c_2^L = 0\} \epsilon [0,1]$ being the probability that the rival is efficient.

In the market for corporate control, company *1* (the "bidder") might acquire an equity stake σ in company *2* (the "target"). We assume that the regulator sets an upper bound to this equity stake, that is $\sigma \epsilon \left[0, \frac{1}{2}\right]$ (Note 1). Given the minority equity holding by company *1*, company *2* still controls its quantity. Thus, company *1* chooses quantity q_1 to maximize its consolidated profit, that is, individual profit plus the value of its share of profits in company *2*. Still, having an equity stake in the rival makes competition softer, so both companies enjoy greater profits. Therefore, company *2* might also be willing to tender a share of its equity to company *1* as it enjoys larger profits than in the Cournot case. To acquire an equity stake in company *2*, company *1* has to make an offer (bid); we assume that company *1* has full bargaining power. Since company 1 does not observe the marginal cost of company *2*, it might end up paying an excessive price for this minority equity stake.

One possible way to circumvent the asymmetry in information is for the bidder to propose an interlocking directorate to the target. If the target agrees to host an executive of the bidder on its board, the bidder will gain full disclosure of the marginal cost of the rival. However, for this agreement to take place, the target company has to accept the proposal in the first place, i.e., "*it takes two to tango*".

The timing of the game is as follows:

- at t=0, Nature selects the type of company *2*, either $c_2^L = 0 \; or \; c_2^H = c$; the type remains private information;
- at t=1, company *1* may propose an interlocking;
- at t=2, once the proposal is public, company *2* decides whether to accept it and, in case of acceptance, opens the board to an executive of company *1*;
- at t=3, company *1* (bidder) offers a bid B to acquire a minority equity stake σ in company *2* (target);
- at t=4, the two companies compete in the product market.

The game is solved by backward induction, using the concept of Bayesian Perfect Equilibrium.

4. Product Market

We begin by solving the game at the last stage (t=4), where the two companies compete in quantities. There are two possible cases:

- Competition with the interlock: company *1* interlocks with company *2* and, as a consequence, the type of company *2* becomes known to company *1* (all equilibrium variables are denoted by "*ID*");
- Competition without the interlock: without interlocking company *1* does not observe the type of company *2* (all equilibrium variables are denoted by "*N*")

For a given equity stake σ, the consolidated profits of the two companies are given by:

$$V_1(\sigma, q_1, q_2) \triangleq \pi_1(q_1, q_2) + \sigma\pi_2(q_1, q_2) \quad (2)$$

$$V_2(\sigma, q_1, q_2) \triangleq (1 - \sigma)\pi_2(q_1, q_2) \quad (3)$$

where π_1 and π_2 are the non-consolidated individual profits of the two companies.

In the case of interlocking, company *1* chooses quantity q_1 to maximize its consolidated profit in (2) observing the marginal cost of the rival; company *2* chooses quantity q_2 to maximize its consolidated profit in (3). In this case, the two companies are rivals in the product market with symmetric information. Solving for the Nash equilibrium, we derive the quantities (see Appendix A) and the individual profits:

$$\pi_1^{ID}(\sigma|c_2) \triangleq \frac{(1+c_2(1-\sigma))(1-\sigma+c_2(1+\sigma))}{(3-\sigma)^2} \quad (4)$$

$$\pi_2^{ID}(\sigma|c_2) \triangleq \left(\frac{1-2c_2}{3-\sigma}\right)^2 = \left(q_2^{ID}(\sigma|c_2)\right)^2 \tag{5}$$

For a given σ, the non-consolidated individual profit of company *1* in (4) is affected by the efficiency of company *2*. The more efficient company *2* is, the smaller the company's market share of 1. Similarly to the case of a company producing with two plants with different levels of efficiency, when leaving the efficient rival to produce a greater quantity, company *1* compensates the losses in its profit with the gains derived from the value of the equity stake of the efficient rival. At the equilibrium, the consolidated profits earned by each of the two companies are derived by substituting equations (4) and (5) into (2) and (3).

Without interlocking, we assume that company *1* sets its quantity without observing the quantity set by company *2*. Solving for the Nash equilibrium, we obtain the equilibrium quantities (see the Appendix) and the individual equilibrium profits:

$$\pi_1^N(\sigma|c_2) \triangleq \frac{(c(1+\sigma)(1-\mu)-\sigma+1)(c_2(3-\sigma)-(1+\sigma)(1-\mu)+2)}{2(3-\sigma)^2}, \tag{6}$$

$$\pi_2^N(\sigma|c_2) \triangleq \left(q_2^N(\sigma|c_2)\right)^2 \tag{7}$$

Quantities, prices and profits are affected by the belief μ held by company *1* that company *2* is efficient. As expected, the non-consolidated individual profit of company *2* is decreasing in c_2, while the profit of company *1* increases in the target's inefficiency level.

Notice that, at the equilibrium, the consolidated profits earned by each of the two companies are derived by substituting equations (6) and (7) into (2) and (3).

5. Market for Corporate Control

Now, we turn to the market for corporate control. Company *1* (the bidder) offers a bid *B* to acquire a minority equity stake in company *2* (the target). In exchange for the price of the acquisition, the target relinquishes a share $\sigma \leq 0.5$ of its profits to the bidder. As before, two possible cases depend on the acquirer's ability to interlock with the target.

Acquisition with the interlock. When the executive sits on the rival's board, the bidder can observe the target's marginal cost. The deal takes place with symmetric information; hence, it will offer a contract, $B_{c_2}^{ID}$, conditional on the observed type of the target by solving the following program:

$$\begin{cases} max\left[V_1^{ID}(\sigma|c_2) - B_{c_2}^{ID}\right] \\ s.t.(IR_2)\ V_2^{ID}(\sigma|c_2) + B_{c_2}^{ID} \geq V_2^{ID}(0|c_2) \\ 0 \leq \sigma^{ID} \leq 0.5 \end{cases}$$

given that company *1* has full bargaining power, the participation constraint IR_2 is binding at the equilibrium.

Proposition 1 When the bidder (company *1*) interlocks with the target (company *2*), the deal at the equilibrium depends upon the type of the target:

- if the target is efficient $(c_2 = 0)$, company *1* acquires the largest possible stake, conditional on being a minority stake that is $\sigma^{ID} = 0.5$ and pays the price $B_0^{ID} = \frac{7}{225}$.
- if the target is inefficient $\left(c_2 = c,\ with\ c \leq \frac{1}{5} = 0.2\right)$, company *1* acquires the stake $\sigma_c^{ID} = \frac{5c-1}{3c-1}$ and pays the price $B_c^{ID} = \frac{35}{18}c^2 - \frac{17}{18}c + \frac{1}{9}$.

Proof: see Appendix B.

The bidder acquires an equity stake conditional on the target type, which is observable. The stake increases in the target's efficiency level. However, the maximum acquisition is capped at $\sigma = 0.5$. Conversely, the bidder makes no offer if the target is inefficient, $c > 0{,}2$.

Acquisition without the interlock. Assume that now, the bidder does not observe the marginal cost of the target. Given the information asymmetry, the bidder faces the risk of attracting the inefficient target. At the same time, the inefficient target will pretend to be efficient since the bid offered to the efficient company is higher compared to the inefficient target. Hence, the bidder has to prevent the inefficient target from mimicking the efficient one;

that is, the incentive compatibility constraint of the inefficient type (IC_{2H}) must be binding.

$$(IC_{2H}):\quad V_2^N(\sigma_c|c) + B^N(\sigma_c|c) = V_2^N(\sigma_0|c) + B^N(\sigma_0|c) \tag{8}$$

It is less immediate to determine which constraint is binding since the target's participation constraint is type-dependent, given that the outside opportunity of the target in the status quo (not selling the equity stake) depends on its type.

Notice that we can rewrite the outside option for the efficient target as:

$$V_2^N(0|0) = V_2^N(0|c) + \Delta(c) \tag{9}$$

where $\Delta(c) = \frac{1}{2}c\left(\frac{1}{3}c\mu - \frac{5}{6}c + \frac{2}{3}\right)$ is positive in the interval $0 < c \leq 0.2$ and increasing in the degree of inefficiency, c. This implies that the greater the efficiency gap between the two types (higher c), the lower the incentive for the efficient target to tender a stake.

We can rewrite the participation constraint for each type as follows (Note 2):

$$(IR_{2L}):\; V_2^N(\sigma_0|0) + B^N(\sigma_0|0) - V_2^N(0|c) \geq \Delta(c)$$
$$(IR_{2H}):\; V_2^N(\sigma_c|c) + B^N(\sigma_c|c) - V_2^N(0|c) \geq 0$$

The efficient target is left at its reservation value, as in the interlocking case (although the reservation value now involves an expected term given by the bidder's belief about the target type, μ). Whenever the efficient target's participation constraint is binding, then the inefficient type's participation constraint is also fulfilled.

Solving the constrained problem of company *1*, we obtain the following results.

Proposition 2 Without interlocking, with $c \in (0, \frac{1}{5}]$, the bidder offers the following optimal contracts to induce self-selection by each type of the target:

$$\left\{\sigma_0^N = 0.5,\; B_0^N = \frac{1}{9} - \frac{1}{2}\left[\frac{3}{10}c(\mu - 1) + \frac{2}{5}\right]^2\right\}$$

and

$$\left\{\sigma_c^N = \frac{5c + c\mu - 1}{3c - c\mu - 1},\; B_c^N = \frac{1}{9} - \frac{1}{2}\left[\frac{3}{10}c(\mu - 1) + \frac{2}{5}\right]^2 + \frac{(3c\mu - 8c + 4)^2}{200} - \frac{c(\mu + 1)(3c - 1)^2}{2c\mu - 6c + 2}\right\}$$

Proof: see Appendix C.

Similarly to the interlocking case, the stake increases with the target's efficiency level. However, to induce truth-telling at the equilibrium, the bidder has to forgo a rent to the inefficient type to compensate him for the loss incurred when tendering σ_c^N instead of σ_0^N.

The following result gives the behaviour of this informational rent:

Corollary 3 *The rent is decreasing in the initial belief μ and in c.*

Proof: see Appendix D.

The more likely it is to meet an efficient target (larger μ), the smaller the rent to convince the inefficient target to give up the contract offered to the other type. The more distant are the two types in terms of efficiency (larger *c*), the smaller the rent.

6. The Equilibrium

Recalling the timing of the game, first, we solve for stage t=2, where the target has to decide whether to accept or reject the proposal to interlock (to host an executive on the board) by the bidder. If the target accepts the proposal, the interlock takes place. Then, we move back to stage t=1, analyzing whether the bidder will launch the proposal to interlock.

At stage t=2, a target of type $c_2 = \{0, c\}$ accepts the interlock whenever,

$$V_2^{ID}(\sigma^{ID}|c) + B_{c_2}^{ID} \geq V_2^N(\sigma^N|c_2) + B_{c_2}^N \tag{10}$$

The following Proposition states our result.

Proposition 4 At stage t=2, once the interlocking proposal has been made:

- the efficient target $(c_2 = 0)$ is indifferent between accepting or rejecting the interlock (we assume he tosses a coin);
- the inefficient target $\left(c_2 = c,\ \ with\ c \leq \frac{1}{5} = 0.2\right)$ always refuses the interlock.

Proof: see Appendix E.

Proposition 4 shows that we only observe "acceptance" when the target is efficient.

Let us now turn to stage t=1, when the bidder decides whether to launch the proposal to the target. The bidder may gain information about the target by simply proposing the interlocking. If the target accepts the proposal (acceptance), the bidder learns that the target is efficient with certainty since, according to Proposition 4, the inefficient target will never accept the proposal. In this case, the bidder updates its initial belief μ to a posterior equal to 1. Conversely, when the target refuses the proposal (refusal), the bidder receives an imperfect signal about the target's type: it could be an efficient target who, being indifferent, rejects the proposal with probability 1/2, or an inefficient target who always refuses the proposal to avoid disclosing its type. The bidder updates its initial belief μ using Bayes' rule, conditional on the observed action. The posterior probabilities ν and γ are therefore:

- when observing "refusal": $\nu = prob(c_2 = 0|no) = \frac{\mu}{2-\mu}$
- when observing "acceptance": $\gamma = prob(c_2 = 0|yes) = 1$

The following Proposition states our result:

Proposition 5 Given $\mu\epsilon[0,1)$, there exists a value $\hat{c}$ such that for any $c\epsilon\left(\hat{c}, \frac{1}{5}\right)$ the bidder proposes the interlocking agreement.

Proof: see Appendix F.

Proposition 5 states that the bidder gains by launching a proposal when seeking to acquire a minority equity stake in a competing company. This benefit is significantly pronounced when the target company is inefficient and the bidder takes on a higher level of risk during the acquisition. Given the result in Proposition 5, we can now solve the game for the subgame perfect Bayesian equilibrium.

Corollary 6 For $\mu\epsilon[0,1)$, and $c\epsilon\left(\hat{c}, \frac{1}{5}\right)$, at the sub-game perfect Bayesian equilibrium, the bidder proposes the interlocking:

- if the target accepts the proposal, the bidder acquires an equity stake $\sigma_0^{ID} = 0.5$ and pays a bid $B(\sigma_0^{ID}|0)$;
- if the target rejects the proposal, the bidder acquires an equity stake $\sigma_{c_2}^{N}$ and pays a bid $B\left(\sigma_{c_2}^{N}\middle|c_2\right)$.

Proof: The proof follows from the results in Propositions 4 and 5.

The result in Corollary 6 shows the conditions under which an interlocking might occur at the equilibrium. However, this does not imply that we will always observe it at the equilibrium; actually, the range of parameters c and μ where interlocking directorates occur together with partial equity ownership is remarkably narrow.

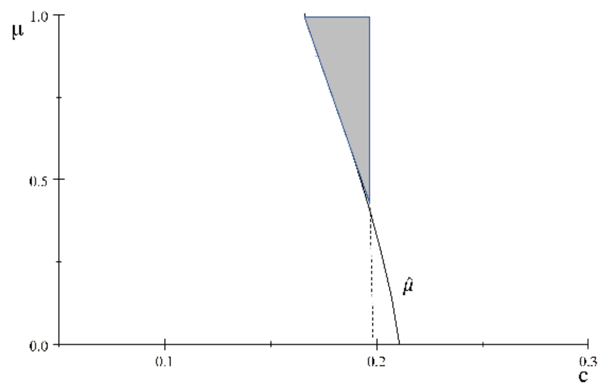

Figure 1. grey area with $c\epsilon\left(0, \frac{1}{5}\right)$

Our finding aligns with the empirical literature, which presents evidence that the two events together account for 10%. To clarify the implications of our model, we introduce a numerical example.

We set the model parameters to c = 0.15 and μ = 0.5, assuming the bidder has no prior bias about the target's type. The bidder always proposes an interlock. If the target accepts, it reveals itself as efficient, leading to an acquired stake of $\sigma_0^{ID} = 0.5$, at a bid price of $B(\sigma_0^{ID}|0)$ = 0.0311$. If the target rejects, no interlocking occurs: the bidder then offers to acquire a share of 50% to an efficient target ($\sigma_0^N = 0.5$) and only 28% to an inefficient one ($\sigma_c^N = 0.28$), with equilibrium prices satisfying:

$$B(\sigma_0^{ID}|0) = 0.0311 < B(\sigma_c^N|c) = 0.0312 < B(\sigma_0^N|0) = 0.0399$$

The bidder benefits from interlocking by paying the lowest price, while the inefficient target rejects the interlock to retain its informational rent. Overall, the example illustrates the way interlocking works as a screening device, allowing the bidder to identify the target's type and achieve a more favorable acquisition price.

7. Conclusions

Interlocking directorates might emerge as a strategic response to adverse selection in the corporate control market. Under asymmetric information, a potential acquirer may propose an interlock before an acquisition to obtain valuable insights into the efficiency of the target firm. We show that an efficient target has an incentive to accept such a proposal, thereby revealing its type and allowing interlocking to occur in equilibrium. In contrast, an inefficient target always rejects the interlock to preserve its informational rent, but this refusal also signals its inefficiency. Hence, interlocking arises as a strategic choice that shapes the terms and outcomes of the acquisition process. Through interlocking, the acquiring firm gains an informational advantage that directly affects the premium paid in acquisition deals.

Our findings contribute to the literature in two main ways. First, the proposed model provides a theoretical explanation for the empirical observation that interlocking and partial equity ownership often coexist but perform distinct functions. Second, the analysis offers new insights into the antitrust implications of interlocking in the corporate control market. While interlocking directorates and partial equity holdings are commonly viewed as complementary channels that may facilitate collusion, we argue that interlocking primarily operates as a cost-reducing mechanism in acquisitions. However, it may also reduce competition in the corporate control market by allowing bidders to access private information about potential targets. Future research could further explore these antitrust implications and the broader effects of strategic interlocking on market competition and corporate governance.

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Authors contributions

All authors contributed to the study conception and design. Material preparation and analysis were performed by both authors.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Notes

Note 1. Although the specific value of the equity stake matters (a larger share gives the bidder greater power to affect the decisions of the target), we limit the analysis to minority stakes where the bidder does not control the quantity of the target after the acquisition. Furthermore, in the model, we endogenously calculate this minority stake.

Note 2. The problem in this paper is a special case of the one where the two participation constraints rewrite as:

$$U^L(c=0)\geq U_0$$
$$U^H(c=c)\geq 0,$$

with $U_0 > 0$, while the inefficient constraint is normalized to *0* (see Laffont & Tirole, 1993).

Appendix A

Product Market: equilibrium values.

- Competition with the interlock.

$$q_1^{ID}(\sigma|c_2) = \frac{1-\sigma+(1+\sigma)c_2}{3-\sigma}$$

$$q_2^{ID}(\sigma|c_2) = \frac{1-2c_2}{3-\sigma}$$

and the equilibrium price

$$P^{ID}(\sigma|c_2) = \frac{1+c_2(1-\sigma)}{3-\sigma}.$$

Notice that for the quantity $q_2^{ID}(\sigma|c_2)$ to be positive, $c_2 \leq 0.5$.

- Competition without the interlock.

$$q_1^{N}(\sigma|c_2) = \frac{1-\sigma}{3-\sigma} + \frac{c(1+\sigma)(1-\mu)}{3-\sigma}$$

$$q_2^{N}(\sigma|c_2) = -\frac{c_2}{2} + \frac{-c(1+\sigma)(1-\mu)+2}{2(3-\sigma)}$$

and equilibrium price

$$P^{N}(\sigma|c_2) = \frac{c_2}{2} + \frac{-c(1-\mu)(1+\sigma)+2}{2(3-\sigma)},$$

Appendix B

Proof of Proposition 1

Given that company 1 has full bargaining power, the (IR_2) must be binding. From the maximization program with interlocking, we obtain the expression of the bid as a function of σ^{ID}:

$$B_{c_2}^{ID} = \pi_2^{ID}(0|c_2) - (1-\sigma^{ID})\pi_2^{ID}(\sigma^{ID}|c_2) =$$

$$\frac{(1-2c_2)^2}{9} - (1-\sigma^{ID})\left(\frac{1-2c_2}{3-\sigma^{ID}}\right)^2$$

We consider first the case of company 2 being inefficient, $c_2 = c$. Substituting the expression of the bid in the payoff, and taking the derivative w.r.t. σ_c^{ID} we obtain $\sigma_c^{ID} = \frac{5c-1}{3c-1}$ which is positive if $c \leq \frac{1}{5}$, therefore

$$\sigma^{ID}(c) = \min\left(\left(\max\frac{5c-1}{3c-1}, 0\right), \frac{1}{2}\right)$$

In the case company 2 is efficient, $c_2 = 0$ we substitute the expression of the bid in the payoff, and taking the derivative w.r.t. σ_0^{ID} we derive the equilibrium stake:

$$\sigma_0^{ID} = 1 \longrightarrow \overline{\sigma}_0^{ID} = \frac{1}{2}$$

Finally, we calculate the optimal bids in both cases, B_c^{ID} for the inefficient company 2 and B_0^{ID} for the efficient one:

$$B_c^{ID} = (1-2c)^2\left(\frac{1}{9} - \frac{(1-\sigma_c^{ID})}{(3-\sigma_c^{ID})^2}\right) =$$

$$\tfrac{35}{18}c^2 - \tfrac{17}{18}c + \tfrac{1}{9}$$

$$B_0^{ID} = \frac{1}{9} - \frac{(1-\sigma_0^{ID})}{(3-\sigma_0^{ID})^2} =$$

$$\frac{1}{9} - \frac{(1-\frac{1}{2})}{(3-\frac{1}{2})^2} = \tfrac{7}{225}$$

Q.E.D. □

Appendix C

Proof of Proposition 2

From the constrained maximization program for company 1, we derive the expression for the two bids:

$$B_0^N \triangleq B^N(\sigma_0|0) = V_2^N(0|0) - V_2^N(\sigma_0|0)$$

$$B_c^N \triangleq B^N(\sigma_c|c) = B^N(\sigma_0|0) + V_2^N(\sigma_0|c) - V_2^N(\sigma_c|c)$$

Substituting the two bids into the objective function, we derive the relaxed optimization problem:

$$\max_{\sigma_0^N,\sigma_c^N} EV_1^N(\mu) = \mu\left[V_1^N(\sigma_0|0) + V_2^N(\sigma_0|0)\right] + \\ +(1-\mu)\left[V_1^N(\sigma_0|c) + V_2^N(\sigma_0|0) - V_2^N(\sigma_0|c) + V_2^N(\sigma_c|c)\right] - V_2^N(0|0)$$

Plugging the bids into the relaxed program, we obtain:

$$EV_1^N(\mu) = \mu\left(\pi_1^N(\sigma_0|0) + \pi_2^N(\sigma_0|0)\right) + \\ (1-\mu)\left(\pi_1^N(\sigma_c|c) + \pi_2^N(\sigma_c|c) + (1-\sigma_0)\left(\pi_2^N(\sigma_0|0) - \pi_2^N(\sigma_0|c)\right)\right) - \pi_2^N(0|0)$$

The first order-condition with respect to σ_c is given by:

$$(FOC_{\sigma_c}): \quad (1-\mu)\frac{\partial}{\partial\sigma_c}\left(\pi_1^N(\sigma_c|c) + \pi_2^N(\sigma_c|c)\right) = 0.$$

Therefore, the optimal stake is:

$$\sigma_c^N = \frac{5c + c\mu - 1}{3c - c\mu - 1}$$

Analogously, the first-order condition with respect to σ_0 is given by:

$$(FOC_{\sigma_0}): \mu\tfrac{\partial}{\partial\sigma_0}\left(\left(\pi_1^N(\sigma_0|0;\mu) + \pi_2^N(\sigma_0|0;\mu)\right)\right) + \\ +(1-\mu)\tfrac{\partial}{\partial\sigma_0}\left((1-\sigma_0)\left(\pi_2^N(\sigma_0|0;\mu) - \pi_2^N(\sigma_0|c;\mu)\right)\right) = 0$$

The above expression does not provide a close solution for σ_0^N. However, we can show graphically (Figure 1) that the derivative is always positive for $\mu \in [0, 1]$ and $c \in [0, 0.5]$,

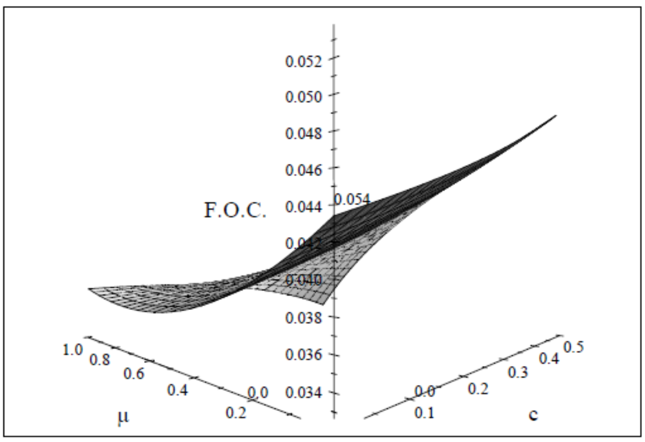

Figure 2: FOC_{σ_0}

Therefore, the bidder would like to acquire the largest share, $\sigma_0^N = 1$, but, given the constraint the optimal stake is $\sigma_0^N = \overline{\sigma} = \frac{1}{2}$.

Now we can compute the bids conditional on the two types:

$$B_c^N = B^N(\sigma_0^N|0) + V_2^N(\sigma_0^N|c) - V_2^N(\sigma_c^N|c) = \\ \left(\tfrac{1}{9} - \tfrac{1}{2}\left(\tfrac{3}{10}c(\mu-1) + \tfrac{2}{5}\right)^2\right) + \tfrac{1}{200}(3c\mu - 8c + 4)^2 - c(\mu+1)\frac{(3c-1)^2}{2c\mu - 6c + 2}$$

and

$$B_0^N = V_2^N(0|0) - V_2^N(\sigma_0^N|0) = \frac{1}{9} - \frac{1}{2}\left(\frac{3}{10}c(\mu-1) + \frac{2}{5}\right)^2$$

Appendix D

Proof of Corollary 3

From the incentive compatibility constraint, (IC_{2H}), we know that the cost of the distortion, which is the rent appropriated by the inefficient target is:

$$R_2 = V_2(\sigma_0^N|0) - V_2(\sigma_0^N|c) = \left(1 - \sigma_0^N\right)\left(\pi_2^N(\sigma_0^N|c) - \pi_2^N(\sigma_0^N|0)\right)$$

Substituting $\sigma_0^N(\mu)$ and rearranging, we obtain:

$$R_2 = \frac{1}{40}c\left(11c - 6c\mu - 8\right)$$

Taking the derivative with respect to μ, while keeping c constant, we have:

$$\frac{\partial R_2}{\partial \mu} = -\frac{3}{20}c^2 < 0.$$

Similarly, taking the derivative of with respect to c, in the relevant range $0 < c \leq 0.2$, for a given μ, we obtain:

$$\frac{\partial R_2}{\partial c} = \frac{11}{20}c - \frac{3}{10}c\mu - \frac{1}{5} < 0$$

Q.E.D.□

Appendix E

Proof of Proposition 4

We control whether the payoff for a given type of company 2 when accepting the interlocking is greater than without interlocking.

- When the *efficient* target accepts the interlock, his payoff is given by:

$$V_2^{ID}(\sigma^{ID}|0) + B_0^{ID} = \frac{1}{9}$$

while when he refuses the interlock, it is:

$$V_2^N(\sigma_0^N|0) + B_0^N = \left(1 - \sigma_0^N\right)\pi_2^N(\sigma_0^N|0) + B_0^N = \frac{1}{9}$$

Given that the two payoffs are equal, the efficient target is indifferent between accepting or refusing the interlocking proposal.

- When the *inefficient* target accepts the interlock, his payoff is given by:

$$V_2^{ID}(\sigma^{ID}|c) + B_c^{ID} = \frac{1}{9}\left(2c - 1\right)^2$$

while when he refuses the interlock, his payoff is:

$$\begin{aligned} V_2^N(\sigma_c^N|c) + B_c^N &= \left(1 - \sigma_c^N\right)\pi_2^N(\sigma_c^N|c) + B_c^N \\ &= \tfrac{11}{40}c^2 - \tfrac{3}{20}c^2\mu - \tfrac{1}{5}c + \tfrac{1}{9} \end{aligned}$$

The comparison between the two payoffs depends on the value of μ. We can prove that:

$$\lim_{\mu \to 1}\left(V_2^N(\sigma_c^N|c) + B_c^N\right) = \frac{1}{8}c^2 - \frac{1}{5}c + \frac{1}{9} > V_2^{ID}(\sigma^{ID}|c) + B_c^{ID} = \frac{1}{9}\left(2c - 1\right)^2 > 0$$

and

$$\lim_{\mu \to 0}\left(V_2^N(\sigma_c^N|c) + B_c^N\right) = \frac{11}{40}c^2 - \frac{1}{5}c + \frac{1}{9} > V_2^{ID}(\sigma^{ID}|c) + B_c^{ID} = \frac{1}{9}\left(2c - 1\right)^2 > 0$$

The R.H.S. is continuous in the interval and its derivative with respect to μ is negative, since

$$\frac{\partial}{\partial \mu}\left(\frac{11}{40}c^2 - \frac{3}{20}c^2\mu - \frac{1}{5}c + \frac{1}{9}\right) = -\frac{3}{20}c^2 < 0$$

Therefore $\forall\mu,\ V_2^N(\sigma_c^N|c) + B_c^N > V_2^{ID}(\sigma^{ID}|c) + B_c^{ID}$. We can conclude that the inefficient target always rejects the invitation. *Q.E.D.* □

Appendix F

Proof of Proposition 5

The bidder has to choose whether to propose the interlock.

- If the bidder does not propose the interlock, it does not elicit any new information about the type of the target, therefore its payoff is conditional on the prior μ.

  Substituting the values of (σ_0^N, σ_c^N), we obtain:

$$EV_1^N(\mu, c) = -\tfrac{27}{200}c^2\mu^3 + \tfrac{63}{200}c^2\mu^2 - \tfrac{7}{20}c^2\mu + \tfrac{17}{100}c^2 - \tfrac{3}{50}c\mu^2 - \tfrac{7}{100}c\mu + \tfrac{13}{100}c + \tfrac{7}{200}\mu + \tfrac{169}{1800}$$

- If the bidder proposes the interlock, we have two possible outcomes depending on whether the target accepts or refuses the proposal. According to Proposition 4, while the efficient target is indifferent between accepting or rejecting the proposal (we assume he tosses a coin), the inefficient one always refuses it. Therefore, the bidder should update her belief, given the observed actions. The posterior probabilities become:

$$\nu = prob(c_2 = 0\,|no) = \frac{prob(no\,|c_2 = 0)\,\mu}{prob(no\,|c_2 = 0)\,\mu + prob(no\,|c_2 = c)\,(1-\mu)} = \frac{\mu}{2-\mu}$$

and

$$1 - \nu = prob(c_2 = c\,|no) = \frac{2(1-\mu)}{2-\mu}$$

$$\gamma = prob(c_2 = 0\,|yes) = \frac{prob(yes\,|c_2 = 0)\,\mu}{prob(yes\,|c_2 = 0)\,\mu + prob(yes\,|c_2 = c)\,(1-\mu)} = \frac{\frac{1}{2}\mu}{\frac{1}{2}\mu} = 1$$

$$(1-\gamma) = prob(c_2 = c\,|yes) = 0$$

The bidder's payoff depends upon the choice of the target once she announces the proposal.

If the target accepts the proposal, the bidder learns with probability 1 that the target is efficient (updates her probability with posterior $\gamma = 1$), therefore the bidder's expected payoff is:

$$V_1^{ID}(\sigma^{ID}|0) - B_0^{ID} = \frac{29}{225}$$

in this case, the bidder compares the payoffs. The comparison depends on the value of μ. Let us define,

$$R_1(\mu) = EV_1^N(\mu, c) - \left(V_1^{ID}(\sigma^{ID}|0) - B_0^{ID}\right) = \left(-\tfrac{27}{200}c^2\mu^3 + \tfrac{63}{200}c^2\mu^2 - \tfrac{7}{20}c^2\mu + \tfrac{17}{100}c^2 - \tfrac{3}{50}c\mu^2 - \tfrac{7}{100}c\mu + \tfrac{13}{100}c + \tfrac{7}{200}\mu + \tfrac{169}{1800} - \tfrac{29}{225}\right)$$

Taking the limits of $R_1(\mu)$, we obtain:

$$\lim_{\mu\to 0} R_1(\mu) = \frac{17}{100}c^2 + \frac{13}{100}c - \frac{7}{200} < 0$$

Then, given that $R_1(\mu)$ is continuous in the interval and its derivative with respect to μ is positive,

$$\frac{\partial}{\partial \mu}R_1(\mu) = -\frac{81}{200}c^2\mu^2 + \frac{63}{100}c^2\mu - \frac{7}{20}c^2 - \frac{3}{25}c\mu - \frac{7}{100}c + \frac{7}{200} > 0$$

it is monotonically increasing. Therefore we conclude that $\forall\mu,\ EV_1^N(\mu, c) < V_1^{ID}(\sigma^{ID}|0) - B^{ID}(\sigma^{ID}|0)$. Hence, the bidder will propose the interlock.

If the target refuses the proposal, then the comparison reduces to: $V_1^N(\sigma^N|Ec|no) - B^N$ and $EV_1^N(\mu, c) - B^N$, where,

$$V_1^N(\sigma^N|Ec|no) = (\nu)\left(\pi_1(\sigma_0^N|0) + \pi_2(\sigma_0^N|0)\right) + (1-\nu)\left(\pi_1(\sigma_c^N|c) + \pi_2(\sigma_c^N|c) + \left(1-\sigma_0^N\right)\left(\pi_2(\sigma_0^N|0) - \pi_2(\sigma_0^N|c)\right)\right) - \pi_2(0|0)$$

and substituting the equilibrium values, we derive:

$$V_1^N(\sigma^N|Ec|no) = \frac{\left(162c^2\mu^3 - 405c^2\mu^2 + 549c^2\mu - 306c^2 + 162c\mu^2 + 72c\mu - 234c + 53\mu - 169\right)}{900(\mu-2)}$$

We can plot the difference $D_1(\mu, c) = V_1^N(\sigma^N|Ec|no) - EV_1^N(\mu, c)$.

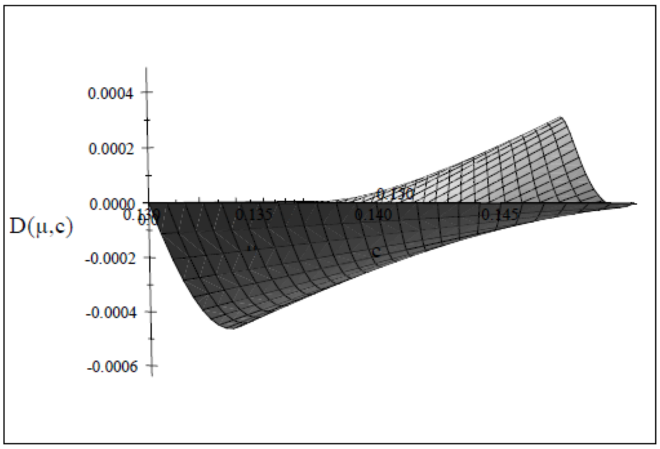

Figure 3: $D_1(\mu, c)$

We observe that $D_1(\mu, c)$ is positive for $c \geq \hat{c} = 0.14$. Therefore, for $c \in \left(\hat{c}, \frac{1}{5}\right)$, $V_1^N(\sigma^N|Ec|no) > EV_1^N(\mu, c)$ and again proposing the interlock is a dominant strategy for the bidder. *Q.E.D.* □