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**Endogenous Market Structures and  
Contract Theory**

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# Endogenous Market Structures and Strategic Contracts

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## Abstract

I study the role of unilateral strategic contracts for firms active in markets with price competition and endogenous entry. Traditional results change substantially when the market structure is endogenous rather than exogenous. They concern 1) contracts of managerial delegation to non-profit maximizers, 2) incentive contracts in the presence of moral hazard on cost reducing activities, 3) screening contracts in case of asymmetric information on the productivity of the managers, 4) vertical contracts of franchising in case of hold-up problems and 5) tying contracts by monopolists competing also in secondary markets. Firms use always these contracts to strengthen price competition and manage to obtain positive profits in spite of free entry.

*Key Words:* Strategic delegation, Incentive contracts, Screening contracts, Franchising, Tying, Endogenous market structures.

*JEL Classification:* L11, L13, L22, L43.

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# 1 Introduction

Consider a market with price competition where entry is free and occurs until profits are zero. Is there any contractual commitment that a firm can exploit to gain a competitive advantage and preserve positive profits? Contrary to what one may expect in a market where entry dissipates any profitable opportunities for the entrants, the answer is yes. More important, the kinds of contractual arrangements leading to these gains can be radically different from those emerging in traditional models with an exogenous number of competitors.

It is well known that in a price duopoly a profit-maximizing firm can increase profitability through a particular form of strategic delegation: this requires a commitment to adopt accommodating strategies which relax competition and increase prices and profits of both firms. The important works by Fershtman and Judd (1987) and Sklivas (1987) have emphasized the gains from delegating decisions on prices to managers with negative sale incentives. Raith (2003) has suggested that, in the presence of moral hazard of the managers, there are gains from incentive schemes (*à la* Holmstrom and Milgrom, 1991) with a low variable (output-related) compensation that generates low effort and softens competition. The same occurs in the presence of asymmetric information on the productivity of the managers faced with optimal screening contracts. Bonanno and Vickers (1988) and Rey and Stiglitz (1995) have emphasized the gains from vertical separation where the upstream firm charges the downstream firm with a franchise fee and a wholesale price above marginal cost to increase final prices. In the same spirit, Whinston (1990) has shown that, when a monopolist in a primary market is also active in a secondary duopolistic market, tying is never profitable (except for deterring entry) because it strengthens price competition. These results are a consequence of strategic complementarity between price choices (Fudenberg and Tirole, 1984; Bulow *et al.*, 1985): strategic contracts that induce the managers of the firm to increase the price, induce also the rival firm to increase its price and therefore they generate higher profits for both. Unfortunately, all these results are not robust to changes in the form of competition, and they break down when the two firms compete in quantities rather than in prices: this leaves the literature on strategic contracts with ambiguous results.

As suggested in Etro (2006), a limit of the literature on strategic commitments is that the number of competitors (two in most applications) is pre-determined and independent from the market outcome: this is in stark contrast with most real markets, where entry is attracted by the profitable opportunities left over by the active firms and by expectations

on future profitability. Even in concentrated markets where entry cannot be regarded as free (i.e. easy and immediate) because of the presence of large sunk costs, the number of active firms can be often seen in the medium-long run as endogenously determined by the profit conditions taking into account the exogenous (or endogenous) costs (Sutton, 1991). This paper shows that when a firm is active in a market whose structure is endogenous, that is where the number of competitors (two as above, or more) is endogenously determined, the cited contractual commitments can still play a role, but in a radically different way. Our results for markets with price competition and endogenous entry can be summarized as follows:

- operative strategies should be always delegated to managers whose objective function is a weighted average of profits and sales, and we characterize the optimal sale incentives;
- in the presence of moral hazard, managerial compensation should provide high-powered incentives with a larger variable compensation than the other firms, and we derive the optimal strategic incentive payments in a model *à la* Holmstrom-Milgrom;
- in the presence of asymmetric information, managerial payment schedules should induce higher effort than the other firms, and we derive the optimal screening contracts;
- vertical separation between an upstream producer and a downstream retailer should always entail wholesale prices below marginal costs for the downstream firm, and we determine the optimal franchising contracts (and verify the consequences of hold up problems on the same optimality of vertical separation);
- tying contracts can be effective devices to gain profits in a secondary market without fully deterring entry, and we determine the conditions for the optimality of tying.

The underlying reason of these results is that the strategic purpose of any contract changes when entry in the market is endogenous. Contractual arrangements that lead to a price increase are ineffective because they attract entry and reduce sales and profits. To the contrary, any contractual commitment to implement a price reducing strategy is effective because it limits the profitability of entry and increases the market share and the profits of the firm. This motivates positive sale incentives and managerial compensations that promote cost reducing activities. At the same time, the nature of the optimal franchising contracts radically changes when entry of downstream firms is free: low prices can only be forced through wholesale prices below the marginal cost. Finally, tying becomes a useful strategy because it strengthens competition, increases sales in the secondary market and can increase profits of the bundling firm even without inducing full entry deterrence.

The nature of these optimal strategic contracts matches what one would obtain if the same firm was engaged in quantity competition (with strategic substitutability) rather than price competition, dissolving the traditional ambiguity associated with the optimal strategic contracts.<sup>2</sup> The reason is that when the market structure is endogenous, under both price and quantity competition, it is always optimal to commit to an aggressive strategy with appropriate contracts with the managers or the customers.<sup>3</sup>

In this paper, I characterize the role of simple strategic contracts in a number of classic contexts, derive the optimal unilateral contracts (under our functional assumptions) and characterize the associated equilibrium market structure. The applications concern the cited models of contracts with managers (strategic delegation and incentive or screening contracts) or customers (franchising contracts and tying commitments), but elsewhere I have analyzed contracts with other stockholders, as the debt contracts (Etro, forthcoming, a). In most of the analysis, my focus is on unilateral contracts to emphasize the nature of the incentives that each single firm has, and how this changes in models with exogenous and endogenous market structures. Moreover, the analysis of unilateral commitments is the relevant one when we want to study the consequence of the behavior of a single dominant firm, as for the cases of vertical contracts and tying, which have crucial implications for antitrust policy. Nevertheless, the analysis of equilibria in which more or all firms can adopt the same contractual commitments can be developed along traditional lines:<sup>4</sup> in a Nash equilibrium the nature of the equilibrium contracts would be the same as that of the optimal unilateral contracts characterized here - for instance, see Etro (forthcoming, a) for the Nash equilibrium debt contracts adopted by multiple firms in a market with endogenous entry.

In conclusion, we show that in markets whose structure is endogenous there is always an incentive to bias the contractual arrangements between firm owners and other stakeholders.

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<sup>2</sup>A related message emerges in the model of Miller and Pazgal (2001), which shows that, when the set of incentive parameters available to the firms' owners is rich enough, the equilibrium prices, quantities and profits are the same regardless of whether the firms compete in prices or in quantities.

<sup>3</sup>Etro (2006) focuses on under- or over-investment in cost-reducing and demand enhancing activities. For some of the recent applications of the endogenous market structures approach to strategic commitments see Davidson and Mukherjee (2007), Tesoriere (2008), Ino and Matsumura (2008), Creane and Konishi (2009) and Kováč *et al.* (2009).

<sup>4</sup>The analysis of equilibria in which other firms adopt similar contractual commitments is immediate when a fringe of non-strategic firms enters and more complex when all the active firms can adopt their optimal contracts - see also Etro (forthcoming, b) for the case of equilibrium strategic trade policy)

Contrary to traditional results, the bias is always in the same direction, that of expanding production and reducing prices. Hopefully, this preliminary investigation can promote interest on the interaction between the theory of contracts within firms and market interactions between firms.

The paper is organized as follows. Section 2 introduces the basic framework for all the subsequent applications. Section 3 presents the simplest one, concerning profit-maximizing delegation to managers that do not maximize profits. Section 4 develops the topic of managerial compensation through a basic principal-agent model of moral hazard. Section 5 extends the analysis to the case of adverse selection. Section 6 applies our idea to franchising contracts between vertically separated firms. Section 7 analyzes bundling of goods as a strategic device for a monopolist producing also for a secondary market. Section 8 concludes.

## 2 Bertrand competition with endogenous entry

We consider  $n$  firms producing differentiated goods and competing in prices *à la* Bertrand. Direct demand for firm  $i$  is  $D(p_i, P_{-i})$  where  $p_i$  is the price of firm  $i$  and the price aggregator  $P_{-i} = \sum_{j=1, j \neq i}^n g(p_j)$  depends on all the other prices, with  $D_1 < 0$ ,  $D_2 < 0$ ,  $g(p) > 0$  and  $g'(p) < 0$ . Substitutability between goods is guaranteed by the fact that the cross derivative  $\partial D_i / \partial p_j \equiv \Delta_{ij}$  is always positive:  $\Delta_{ij} = D_2 g'(p_j) > 0$  for any  $i$  and  $j$ . All these properties are satisfied by common demand functions, as the isoelastic demand function *à la* Dixit-Stiglitz, any other demand derived from additively separable preferences,<sup>5</sup> the Logit demand function and others.

All goods are produced at the constant marginal cost  $c$  (but our results extend to general cost functions). Without any strategic contracts, net profits for firm  $i$  are:

$$\pi_i = (p_i - c)D(p_i, P_{-i}) - F \tag{1}$$

where  $F$  is a fixed cost of production. Strategic complementarity holds, that is  $\partial^2 \pi_i / \partial p_i \partial p_j > 0$ : here this requires  $\Delta_{ij} > DD_{12}g'(p_j)/D_1$ .

All active firms choose their prices simultaneously. The equilibrium number of active firms  $n$  is such that expected profits for the  $n$ -th entrant are zero.<sup>6</sup> Therefore, in a symmetric

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<sup>5</sup>Any utility function as  $U = \Psi\left(\sum_{j=1}^n u(x_j)\right)$ , with  $\Psi$  positive and increasing and  $u(x)$  positive, increasing and concave in the quantity  $x$ , generates a demand function as specified in the text.

<sup>6</sup>As usual we neglect the integer constraint on the number of firms, but we restrict the analysis to the

situation, a first order condition  $D(p, P) + (p - c)D_1(p, P) = 0$  and a free entry condition  $(p - c)D(p, P) = F$  determine the equilibrium values of the common price  $p$  and of the number of firms  $n$  through the price aggregator  $P = (n - 1)g(p)$ .

As we will verify (and contrary to what happens with a fixed number of firms), strategic contracts by a firm cannot affect the equilibrium price ( $p$ ), the demand ( $D(p, P)$ ) and the net profits (zero) of the other firms in an endogenous market structure. Nevertheless, in the following sections we will analyze different strategic contracts and show how a firm can use them to obtain a comparative advantage over the other firms and gain strictly positive profits.<sup>7</sup>

We remind the reader that our purpose is to verify how the endogeneity of market structures affects a number of traditional results on different strategic contracts, therefore each one of the following sections should be seen as a separate application in itself.

### 3 Strategic delegation to non-profit maximizers

In this section we consider the simplest example of strategic contract, introduced by Fershtman and Judd (1987), to show our general results. Suppose that the profit-maximizing equity holders of firm  $L$  delegate the pricing decision to a manager whose objective function depends on both profits and sales, for instance because of a contract with explicit sale incentives. In such a case we can express the objective function of the management as:<sup>8</sup>

$$\begin{aligned} \Pi(p_L, P_{-L}, k) &= \pi_L + k \cdot p_L D(p_L, P_{-L}) = \\ &= [p_L(1 + k) - c] D(p_L, P_{-L}) - F \end{aligned} \tag{2}$$

where the weight on sales  $k$  is chosen *ex ante* by the firm's owner to maximize pure profits. All the other firms directly maximize profits. In this set up, the important works by Fershtman and Judd (1987) and Sklivas (1987) have shown that with  $n = 2$  it is optimal to choose set of parameters for which at least two firms remain active (this is the relevant case for small enough fixed costs).

<sup>7</sup>While one could extend the analysis to a Nash equilibrium where all firms adopt similar strategic commitments, the analysis of a unilateral adoption is the simplest way to capture the nature of the mechanisms that we want to study.

<sup>8</sup>Similar results emerge in case of quantity incentives as opposed to sale incentives (Vickers, 1985). The linear contract has been chosen only for tractability, and to emphasize the need of positive or negative sale incentives.

$k < 0$ , that is negative sale incentives. To verify this in our framework, notice that the duopoly equilibrium is characterized a system of first order conditions determining the prices  $p_L(k)$  for firm  $L$  and  $p_j(k)$  for the rival  $j$ .<sup>9</sup> These prices are both decreasing in  $k$  because of strategic complementarities. Given this, one can easily derive an implicit expression for the incentive scheme that maximizes profits  $\Pi(p_L(k), g(p_j(k)), 0)$  as:

$$k = \frac{-(p_L - c)\Delta_{Lj}p'_j(k)}{(p_L - c)\Delta_{Lj}p'_j(k) - cD_1(p_L, g(p_j))p'_L(k)} < 0$$

where we used the equilibrium pricing condition for firm  $L$ . Negative sale incentives are used to soften competition and maintain a low production while increasing prices and profits. The result generalizes to any other exogenous number of firms.

Consider now the case of free entry in the market. For a given  $k$ , the endogenous market structure is characterized by the price  $p_L$  for firm  $L$ , the price  $p$  for all the other firms (by symmetry), and a number  $n$  of firms. These equilibrium variables satisfy the respective first order conditions and the zero profit condition:

$$[D(p_L, P_{-L}) + p_L D_1(p_L, P_{-L})](1 + k) = cD_1(p_L, P_{-L}) \quad (3)$$

$$D(p, P) + pD_1(p, P) = cD_1(p, P) \quad \text{and} \quad (p - c)D(p, P) = F \quad (4)$$

This system is characterized by a price  $p$  and a price aggregator  $P = (n - 2)g(p) + g(p_L)$  which do not depend on the parameter  $k$  (see the two equations in (4)), and by a price of the firm  $L$  given by  $p_L = p_L(k)$ , which is decreasing in  $k$  ( $p'_L(k) < 0$  from the first equation). Finally, we can express the price index perceived by firm  $L$  as:

$$P_{-L} = (n - 1)g(p) = P + g(p) - g(p_L(k))$$

Accordingly, a larger weight on sales in the compensation of the manager induces a lower price to expand sales, but does not affect the equilibrium prices of the other firms (while it reduces the endogenous number of firms). Given this, we can investigate the choice of the optimal strategic delegation through the problem:

$$\max_k [p_L(k) - c] D [p_L(k), P + g(p) - g(p_L(k))] - F$$

where  $p_L(k)$  satisfies the equilibrium system above. The optimality condition is:

$$D(p_L, P_{-L}) + (p_L - c)[D_1(p_L, P_{-L}) - \Delta_{LL}] = 0 \quad (5)$$

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<sup>9</sup>The equilibrium conditions are  $D(p_L, g(p_j)) + (p_L - c/(1 + k))D_1(p_L, g(p_j)) = 0$  and  $D(p_j, g(p_L)) + (p_j - c)D_1(p_j, g(p_L)) = 0$ .



where  $p_L = p_L(k^*)$  and we defined  $\Delta_{LL} = D_2(p_L(k^*), P_{-L})g'(p_L(k^*)) > 0$ . Using the first order equilibrium condition of firm  $L$  we can implicitly solve for the optimal strategic contract:

$$k^* = \frac{(p_L - c) \Delta_{LL}}{-[D(p_L, P_{-L}) + p_L D_1(p_L, P_{-L})]} > 0 \quad (6)$$

The optimality of positive sale incentives derives from their strategic impact on entry. The term  $\Delta_{LL}$  represents the indirect effect that an induced price change exerts on demand through the change in the endogenous number of entrants. The larger is the negative impact on entry of a price reduction of firm  $L$  (due to the sale incentives), the larger is the increase in its demand, which makes it more profitable to adopt sale incentives (increases  $k^*$ ). Summing up, we have:

*PROPOSITION 1. Under competition in prices with endogenous entry, a firm would always gain from delegating the pricing decisions to a manager whose objective function depends on both profits and sales (or from committing to positive sale incentives for the management).*

As noticed before, in case of Bertrand competition between  $n$  firms where the number  $n$  is exogenously set, it was optimal for profit-maximizing equity holders to delegate management to someone with negative sale incentives (Fershtman and Judd, 1987, and Sklivas, 1987). Contrary to this, when the market is endogenously characterized by the same number of firms, we obtain that it is optimal to delegate the management to someone that has incentives to maximize a weighted average of profits and sales, for instance through positive sale incentives.<sup>10</sup> It is immediate to verify that the same result holds also under quantity competition with endogenous entry (because it is optimal to promote production and reduce the total production of the rivals), therefore strategic delegation with positive sale incentives is always optimal in case of endogenous market structures.

This result can be related to the general principle of strategic commitments derived by Etro (2006) for which there is always a strategic incentive to adopt an investment  $k$  which increases the marginal profitability of a higher production, or, equivalently in our framework, decreases the marginal profitability of a higher price (for the delegated agent). Here, we have  $\Pi_{13}(p_L, P_{-L}, k) = D(p_L, P_{-L}) + p_L D_1(p_L, P_{-L})$ , which is negative in equilibrium, therefore the general principle applies. However, strategic delegation has obtained something more:

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<sup>10</sup> Analogously, we could consider the bargaining power of labor unions in setting wages at the firm level. Since this increases wages and induces the firm to increase prices, a firm would like to grant some bargaining power to the union when facing exogenous entry in the product market, but not when facing endogenous entry pressure.

through it, the firm has been able to exactly replicate the best pre-commitment equilibrium. We define this best equilibrium as the profit-maximizing equilibrium that can be obtained by firm  $L$  with a direct commitment on the price before entry and price decisions by the other firms are taken, namely the Stackelberg equilibrium with endogenous entry.<sup>11</sup> To verify this, notice that such an equilibrium is characterized by a price of the followers  $p$  and a corresponding price aggregator  $P$  which depend on the price of the leader  $p_L$  according to the first order condition and the endogenous entry condition in (4). Given this, the optimal price of the leader  $p_L$  is the one chosen to maximize  $(p_L - c)D(p_L, P_{-L})$ , where  $P_{-L} = P + g(p) - g(p_L)$ , which provides the first order condition (5). One can immediately verify that all these conditions are met by the optimal strategic delegation  $k^*$  derived above. This equivalence result is due to the absence of any costs in the enforcement of the desired contract: strategic delegation by firm  $L$  delivers the same outcome as if firm  $L$  were able to precommit on a price strategy.

Until now we assumed that the principal (the equity holder of the firm) could choose a parameter of the objective function of the agent (the manager). A more accurate description of a principal-agent relation requires the former to choose the optimal contract with the latter, a problem that becomes more complex in the presence of asymmetric information between the parties. The next sections focus on this problem introducing costly effort by the manager.

## 4 Incentive contracts and moral hazard

Delegation through explicit incentive schemes is crucial in the presence of moral hazard of the managers. As shown by Raith (2003) the nature of these schemes depends on the intensity of competition: under price competition, lower variable compensations are used when the number of competitors increases. Moreover, these schemes can also be used to obtain a competitive advantage in the market, with lower variable compensations adopted to relax price competition.<sup>12</sup>

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<sup>11</sup>The general characterization of Stackelberg equilibria with a first mover and endogenous entry of followers is developed in Etro (2008).

<sup>12</sup>Generalization of these results are in Vives (2008). On incentive contracts and competition in quantities see also Hermalin (1994). On the empirical evidence on incentive contracts see Prendergast (1999) and on the positive relation between competition and incentives to promote effort see Cuñat and Guadalupe (2005) and Bloom and Van Reenen (2007)

Following the classic work of Holmstrom and Milgrom (1991, 1994), let us focus on a firm whose manager receives a linear compensation  $w$  which includes a constant part,  $\alpha$ , and a part depending on the observable performance, expressed in terms of unitary cost reductions of size  $q$ , according to a linear parameter  $k$ :

$$w = \alpha + kq \quad (7)$$

The manager exerts effort  $e$  and the utility function is assumed to satisfy constant absolute risk aversion:

$$u(w, e) = -\exp \left[ -\gamma \left( w - \frac{de^2}{2} \right) \right] \quad (8)$$

where  $\gamma > 0$  is the coefficient of absolute risk aversion and the cost of effort has been assumed quadratic with  $d$  positive parameter. The manager must be compensated enough to reach the reservation utility corresponding to an alternative riskless wage  $\bar{w}$ . The cost reduction is stochastic but positively related to effort, with  $q = e + \varepsilon$ , where  $\varepsilon$  is a random variable which is normally distributed with zero mean and variance  $\sigma^2$ , and whose realization is known at the time of production. Therefore, the firm produces at the constant marginal cost  $c - q = c - e - \varepsilon$  and the manager exerts effort  $e$  to maximize the certainty equivalent payoff:

$$CE = \alpha + ke - \frac{\gamma k^2 \sigma^2}{2} - \frac{de^2}{2}$$

Now, imagine that a firm  $i$  facing this incentive problem with its manager is also competing with other firms in the product market (the production/pricing decision is non-contractable and is taken at the competition stage with the other firms to maximize profits). Effective profits are:

$$\pi_i = D(p_i, P_{-i}) [p_i - (c - e_i - \varepsilon_i)] - \alpha_i - k_i(e_i + \varepsilon_i) - F$$

whose equilibrium expectation is:

$$\Pi(p_i, P_{-i}, k) = D(p_i, P_{-i}) \left( p_i - c + \frac{k_i}{d} \right) - \bar{w} - \frac{k_i^2}{2d} - \frac{\gamma k_i^2 \sigma^2}{2} \quad (9)$$

where we used the incentive compatibility constraint  $e_i = k_i/d$  and the individual rationality constraint  $\bar{w} = \alpha_i + k_i^2/2d - \gamma k_i^2 \sigma^2/2$ . Given the incentive contracts, all firms choose independently their prices to maximize expected profits, according to the condition:

$$D(p_i, P_{-i}) + \left( p_i - c + \frac{k_i}{d} \right) D_1(p_i, P_{-i}) = 0 \quad (10)$$

For simplicity, let us now evaluate the optimal contract of a single firm, summarized by the parameter  $k$ , when the other competitors do not adopt incentive contracts, i.e. setting  $k_i = 0$

(later on, we will briefly consider the case in which all firms choose their optimal incentive contracts as well, showing that the spirit of our results is not affected).

Consider first the case of a duopoly. The system of first order conditions provides prices  $p_L(k)$  for firm  $L$  and  $p_j(k)$  for the single competitor which are both decreasing in the incentive contract of firm  $L$ . Given this, one can easily derive an implicit expression for the optimal incentive scheme as:

$$k = \frac{D(p_L, g(p_j)) + d(p_L - c)\Delta_{Lj}p'_j(k)}{1 + \gamma d\sigma^2 - \Delta_{Lj}p'_j(k)}$$

where we used the equilibrium pricing condition for firm  $L$ . This optimal scheme differs from the Holmstrom-Milgrom (1991) contract because of the terms including  $\Delta_{Lj} = D_2(p_L, g(p_j(k)))g'(p_j(k))$ , which reflects the negative impact of a price reduction of the competitor on demand. The optimal incentive scheme is still decreasing in the cost of effort  $d$ , in the degree of risk aversion  $\gamma$  and in the randomness of the performance  $\sigma^2$ , but it is now reduced because more high-powered incentive mechanisms strengthen competition and reduce the prices of both firms and the associated profits (such a result would emerge also in the model of Raith, 2003).

Consider now the case of free entry. Firm  $L$  can choose its incentive contract  $k$  before entry occurs. This implies that the endogenous market structure will be characterized by a price  $p_L(k)$  for firm  $L$  which is again decreasing in  $k$ , and by a price  $p$  for all the other firms and a associated price aggregator  $P$  which satisfy optimality and free entry conditions and do not depend on  $k$ . Using the equilibrium expression  $P_{-L} = P + g(p) - g(p_L(k))$ , the optimal incentive scheme for firm  $L$  must solve the problem:

$$\max_k D[p_L(k), P + g(p) - g(p_L(k))] \left( p_L(k) - c + \frac{k}{d} \right) - \bar{w} - \frac{k^2}{2d} - \frac{\gamma k^2 \sigma^2}{2} \quad (11)$$

whose optimality condition provides the following implicit expression:

$$k^* = \frac{D(p_L, P_{-L}) - d(p_L - c)\Delta_{LL}p'_L}{1 + \gamma d\sigma^2 + \Delta_{LL}p'_L} \quad (12)$$

where we used the equilibrium pricing condition for firm  $L$  and  $\Delta_{LL} = D_2(p_L, P_{-L})g'(p_L)$ . Now, the difference compared to the Holmstrom and Milgrom (1991) scheme is due to the positive impact on demand that derives from a price reduction induced by stronger incentive mechanisms. It is exactly the indirect impact of a price reduction on demand (due to the lower number of rivals) that makes it useful to adopt a larger variable compensation for the manager to enhance cost efficiency.

It is important to verify that the same optimal mechanism emerges when all the other firms simultaneously choose their incentive contracts and their market strategies (given the incentive contract of firm  $L$ ). In such a case, the symmetric equilibrium incentive mechanism for all the other firms<sup>13</sup> would require the standard Holmstrom-Milgrom mechanism  $\bar{k} = D(p, P) / (1 + \gamma d \sigma^2)$  because strategic considerations are absent for these firms, and the prices would satisfy the symmetric pricing condition  $D(p, P) + D_1(p, P) (p - c + \bar{k}/d) = 0$  and the free entry condition  $D(p, P) (p - c + \bar{k}/d) = F$ . Given this, firm  $L$  would choose its contract according to the same rule as in (12), which shows that  $k^* > \bar{k}$  again.

We can summarize our findings as follows:

**PROPOSITION 2.** *Under competition in prices with endogenous entry and with moral hazard of the managers in cost-reducing activities, a firm would always gain from committing to stronger high-powered incentive schemes for its managers than the other firms.*

In case of endogenous market structures a firm has an incentive to reward more a better performance so as to reduce expected costs and increase expected sales and profits.<sup>14</sup> Correspondingly, the effort and the expected wage must be increasing with the optimal  $k$ . In other words, a firm gains from paying its managers more and with more high-powered schemes under an endogenous competitive pressure: this happens to stimulate their effort and develop a comparative cost advantage over the competitors.

It is easy to verify that the same results hold also under quantity competition and endogenous entry (because it is always convenient to promote production and reduce the total production of the rivals). However, notice that the optimal strategic contract does not replicate the best pre-commitment equilibrium (here the Stackelberg equilibrium in prices with endogenous entry), which would require the Holmstrom-Milgrom scheme with a precommitment to a lower price.<sup>15</sup> In the presence of moral hazard, the marginal benefit of a tougher management must be balanced with the marginal cost of inducing extra effort.

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<sup>13</sup>Here we are implicitly assuming that both contract and pricing decisions are taken simultaneously. If contract decisions were taken before pricing decisions, there would be an additional incentive to reduce  $\bar{k}$  due to the strategic effects on equilibrium prices (see also Vives, 2008).

<sup>14</sup>Also this result can be derived from the general principle of strategic commitments because  $\Pi_{13}(p_L, P_{-L}, k) = D_1(p_L, P_{-L})/d < 0$ . Notice that the results would change if the agent's effort was affecting demand rather than costs.

<sup>15</sup>The optimal pre-commitment would require a price  $p_L$  satisfying  $D(p_L, P_{-L}) + (p_L - c + \bar{k}/d) [D_1(p_L, P_{-L}) - \Delta_{LL}] = 0$ .

This example has shown that a principal-agent contract should adopt incentive schemes not only to encourage effort and provide risk sharing, but also to encourage the management to be tougher in the market. In the next section we will see that a similar result emerges in the presence of adverse selection.

## 5 Screening contracts and adverse selection

The purpose of this section is to characterize the optimal screening contracts for managers with private information on their productivity.<sup>16</sup>

Consider a manager exerting effort  $k$  which reduces the marginal cost of production to  $c - f(k)$  with  $f'(k) > 0$ ,  $f''(k) < 0$  and  $f(0) = 0$ . Effort and compensation  $w$  determine the utility:

$$u(w, k) = w - \theta k \quad (13)$$

where  $\theta$  is a productivity parameter that is private information and can take values  $\theta_1$  or  $\theta_2 > \theta_1$  with probabilities  $\nu$  and  $1 - \nu$ . For a given contract  $(k, w)$ , the profits of firm  $L$  are given by:

$$\pi_L = D(p_L, P_{-L}) [p_L - (c - f(k))] - w - F$$

while the profits of the other firms are given by  $\pi_i = D(p_i, P_{-i}) (p_i - c) - F$  under the simple assumption that there are no incentive contracts (below we briefly discuss how to relax this assumption).

It is easy to verify that in the case of a duopoly, firm  $L$  would have a strategic incentive to distort downward the effort of its manager, and would choose its contracts accordingly to soften price competition. However, here we will characterize the optimal screening contract offered by firm  $L$  in the presence of endogenous entry.

Once a contract  $(k, w)$  is decided and the manager exerts effort  $k$ , the endogenous market structure is characterized by the usual optimality and free entry conditions:

$$D(p_L, P_{-L}) + D_1(p_L, P_{-L}) [p_L - c + f(k)] = 0$$

$$D(p, P) + D_1(p, P) (p - c) = 0, \quad D(p, P) (p - c) = F$$

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<sup>16</sup>For a good introduction to the principal-agent theory with adverse selection see Laffont and Martimort (2002). Only few papers have analyzed the optimal principal-agent contracts for firms engaged in market competition: see Martin (1993), Martimort (1996) and, more recently, Etro and Cella (2010).

where  $p$  and  $P$  are independent from the effort of the manager, but  $p_L(k)$  is decreasing in it. It follows that  $P_{-L}(k) = P + g(p) - g(p_L(k))$  is decreasing in  $k$ .

The optimal screening contract involves two alternatives  $(w_1, k_1)$  and  $(w_2, k_2)$  for managers of types  $\theta_1$  and  $\theta_2$ . The contract must maximize expected profits under individual rationality and incentive compatibility constraints:

$$w_j \geq \theta_j k_j, \quad w_j - \theta_j k_j \geq w_q - \theta_j k_q \quad \text{with } i, q = 1, 2$$

Usual arguments deliver that the binding constraints will be the individual rationality constraint for the inefficient type,  $w_2 = \theta_2 k_2$ , and the incentive compatibility constraint for the efficient type,  $w_1 = \theta_1 k_1 + (\theta_2 - \theta_1) k_2$ . Therefore, we can state the problem as follows:

$$\begin{aligned} \max_{(k_1, k_2)} \nu [D(p_L(k_1), P_{-L}(k_1)) [p_L(k_1) - c + f(k_1)] - \theta_1 k_1 + (\theta_2 - \theta_1) k_2] + \\ + (1 - \nu) [D(p_L(k_2), P_{-L}(k_2)) [p_L(k_2) - c + f(k_2)] - \theta_2 k_2] \end{aligned} \quad (14)$$

Defining  $D(k) \equiv D[p_L(k), P + g(p) - g(p_L(k))]$  and using the envelope theorem, we can express the first order conditions as:

$$f'(k_1^*) D(k_1^*) = \theta_1 - \frac{\Delta_{LL} p'_L(k_1^*) D(k_1^*)}{D_1(k_1^*)} \quad (15)$$

$$f'(k_2^*) D(k_2^*) = \theta_2 + \frac{\nu}{1 - \nu} (\theta_2 - \theta_1) - \frac{\Delta_{LL} p'_L(k_2^*) D(k_2^*)}{D_1(k_2^*)} \quad (16)$$

whose difference relies in the usual downward distortion of the effort of the inefficient type, which depends on the productivity difference  $(\theta_2 - \theta_1)$ . More interestingly for our purposes, both efforts are increased through the last terms on the right hand side, which decreases the marginal cost of effort.<sup>17</sup> Both types are required to exert more effort for strategic purposes: this reduces the prices in both states of the world, with a positive impact on the expected profits.

However, notice that this increases also the informative rent of the efficient type, which is simply  $u(w_1, k_1) = (\theta_2 - \theta_1) k_2$ : in the presence of adverse selection, part of the gains in profits from a more aggressive competition must be shifted to the managers, and in particular to the efficient one.<sup>18</sup>

Summing up:

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<sup>17</sup>To verify that the general principle of strategic commitments applies, notice that  $\Pi_{13}(p_L, P_{-L}, k) = D_1(p_L, P_{-L}) f'(k) < 0$ . The optimal effort is higher for both types when  $\Delta_{LL}$  is large, that is when there is a large indirect impact of a price cut on demand (through the reduction of the number of competitors).

<sup>18</sup>The same results hold in a more general setting. In case of a general distribution of  $\theta$  on  $[\theta_1, \theta_2]$  according

PROPOSITION 3. *Under competition in prices with endogenous entry and with asymmetric information on the productivity of the managers in cost-reducing activities, a firm would always gain from screening contracts inducing extra effort for all types.*

What happens when all firms are allowed to choose their screening contracts (that is when we have genuine competition in contracts)? This interesting issue raises more complex problems, because strategic interactions between firms affect the nature of the incentive contracts and *vice versa*. In a duopoly, the profits depend on the efforts of both managers, and therefore the contracts of each firm affect the absolute and marginal profitability of the other firm. The downward distortion of the effort required from the inefficient managers leads the equilibrium contracts to increase the effort required from the efficient managers (above the level obtained without asymmetric information).<sup>19</sup> However, when possible, a firm would still like to commit to contracts that require lower efforts with the purpose of softening competition: such a motivation would disappear in case of endogenous entry, because lower effort would simply attract new competitors and reduce profitability.

As we have seen, a vertical principal-agent structure can be used to promote aggressive competition and increase its profits in a market characterized by free entry. In the next section we will see that even in the absence of incentive contracts, the same purpose can be achieved through vertical separation and appropriate franchising contracts.

## 6 Vertical contracts and hold up

Following Bonanno and Vickers (1988) and Rey and Stiglitz (1995), let us reconsider our model of price competition in which a firm decides to delegate distribution to a separate firm through a vertical contract of franchising.

Assume that firm  $L$  separates vertically: an upstream firm produces the good and delegates its distribution on the market to a downstream firm through a two-part tariff implying a fixed fee  $\Upsilon$  and a wholesale price  $w$  for the good. The downstream firm sells this same

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to a cumulative distributive function  $F(\theta)$  with density  $f(\theta)$ , and satisfying the monotone hazard rate property for which  $F(\theta)/f(\theta)$  is increasing in  $\theta$  the optimal contract requires effort choices with:

$$f'(k^*)D(k^*) = \theta + \frac{F(\theta)}{f(\theta)} - \frac{\Delta_{LL}P'_L(k^*)D(k^*)}{D_1(k^*)}$$

<sup>19</sup>In other words, the “no distortion on the top” property disappears. See Etro and Cella (2010) for an investigation of this form of competition in contracts.



good at the price  $p_D$  to maximize net profits:

$$\pi_D = (p_D - w)D(p_D, P_{-D}) - \Upsilon \quad (17)$$

while the other firms remain vertically integrated and bear a marginal cost  $c$  and a fixed cost  $F$ . The upstream firm produces its good with the same technology and chooses the franchising contract with the downstream firm, that is the pair  $(w, \Upsilon)$  that maximizes net profits:

$$\pi_L = (w - c)D(p_D, P_{-D}) + \Upsilon - F \quad (18)$$

It is always optimal to choose  $w$  such that the profits of the downstream firm are maximized, and the fee that fully expropriates these profits. Of course, a choice  $w = c$  would be neutral for the market outcome, but Bonanno and Vickers (1988) have shown that when  $n = 2$  it is optimal to choose a high wholesale price  $w > c$  to soften price competition, and increase prices and profits. When entry in the market is endogenous, however, the firm cannot operate in this way, because high wholesale prices would put the downstream firm out of business. Nevertheless, the firm can still gain from delegating pricing decisions to a downstream division, but with an optimal contract which is now radically different.

As in the previous applications, given the pair  $(w, \Upsilon)$ , the endogenous market structure is characterized by a price of the downstream firm  $p_D(w)$  which depends on  $w$ , and is now increasing in it, and by a price for the other firms  $p$  and an endogenous value for the price aggregator  $P$  that are both independent from  $w$ , with  $P_{-D} = P + g(p) - g(p_D(w))$ . The optimal contract solves the problem:

$$\begin{aligned} \max_{(w, \Upsilon)} \pi_L &= (w - c)D[p_D(w), P_{-D}] + \Upsilon - F \\ \text{s.v.} \quad &: \quad \pi_D = [p_D(w) - w]D[p_D(w), P_{-D}] - \Upsilon \geq 0 \end{aligned}$$

Since the constraint is always binding, we can substitute this and the equilibrium definition of  $P_{-D}$  to rewrite the problem as:

$$\max_w \pi_L = [p_D(w) - c]D[p_D(w), P + g(p) - g(p_D(w))] - F$$

The solution requires a wholesale price for the retailer smaller than the marginal cost and implicitly given by:

$$w^*(c) = c - \frac{(p_D - c)\Delta_{DD}}{[-D_1(p_D, P_{-D})]} < c \quad (19)$$

where we combined the optimality condition with the equilibrium pricing condition for the downstream firm and we defined  $\Delta_{DD} = D_2(p_D, P_{-D})g'(p_D) > 0$ . This wholesale price

generates a lower equilibrium price and a higher output for the downstream retailer than for the other firms, and provides positive profits for the upstream firm.<sup>20</sup>

Summing up:

PROPOSITION 4. *Under competition in prices with endogenous entry, a firm would always gain from separating vertically and adopting a franchising contract toward the downstream firms with a wholesale price below the marginal cost.*

Contrary to the result of Bonanno and Vickers (1988), under endogenous entry, it is optimal to delegate distribution to a downstream retailer with a franchise fee contract involving a wholesale price below marginal cost, because this induces the retailer to price aggressively in the market, to conquer a larger market share and to retain positive profits in spite of free entry.<sup>21</sup> It is immediate to verify that the same qualitative result holds also under quantity competition (once again, it is convenient to induce higher production of the retailer to reduce total production of the rivals), therefore strategic vertical separation with wholesale prices below cost is always optimal in case of endogenous market structures. The theory of vertical separation under price competition has been used to motivate anti-competitive behavior through vertical restraints (see Motta, 2004, for an extensive treatment of this model with exogenous entry). Our result shows that in case of endogenous market structures, the contract chosen under vertical restraints leads always to a lower price for the consumers. Therefore, there is no ground for conjecturing any anti-competitive behavior in markets open to entry.<sup>22</sup>

Since we did not introduce yet any transaction costs, the optimal vertical contract replicates the best reachable equilibrium, that is the Stackelberg equilibrium in prices with endogenous entry. However, as pointed out in a general framework by Grossman and Hart (1986) and Hart and Moore (1990), contractual incompleteness can undermine the optimality of vertical separation when the two firms undertake relation-specific and unverifiable investments. In the rest of the section we briefly examine this possibility in the tradition of

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<sup>20</sup>To verify that the general principle of strategic commitments applies, define  $k = c - w$  as the wholesale discount, and  $\Pi(p_D, P_{-D}, k) = (p_D - c + k)D(p_D, P_{-D})$  as the gross profit of the delegated firm. Then, we have  $\Pi_{13}(p_D, P_{-D}, k) = D_1(p_L, P_{-L}) < 0$ . Once again, notice that the wholesale discount is larger when  $\Delta_{DD}$  is large, that is when there is a large indirect impact of a price cut on demand (through the reduction of the number of competitors).

<sup>21</sup>The same result could be reached with a mechanism of Resale Price Maintenance analyzed by Shaffer (1991), that is imposing the optimal price on the downstream firm while extracting all its profits with an appropriate wholesale price. I am thankful to Ryoko Oki for pointing this out.

<sup>22</sup>On applications of the endogenous market structure approach to antitrust issues see Etro (2007).

the property rights theory.

Suppose that, in a preliminary stage, the upstream firm can invest  $\mathbf{e}$  to reduce the marginal cost at the level  $c(\mathbf{e})$ , and the downstream firm can invest  $\mathbf{i}$  to increase demand at the level  $D(p_D, P_{-D}, \mathbf{i})$ , with  $c(0) \equiv c$ ,  $c_{\mathbf{e}} < 0$  and  $c_{\mathbf{e}\mathbf{e}} > 0$  and with  $D(p, P, 0) \equiv D(p, P)$ ,  $D_{\mathbf{i}} > 0$  and  $D_{\mathbf{i}\mathbf{i}} < 0$ .

In case of *vertical separation*, the market equilibrium is characterized as above, with a wholesale price  $w^*(c(\mathbf{e}))$ . As noticed, all the surplus goes to the upstream firm and nothing to the downstream firm. With such an expectation, the downstream firm tends to underinvest *ex ante*, which in turn reduces the investment of the upstream firm as well. More precisely, we have the following equilibrium investments:<sup>23</sup>

$$\mathbf{i}^S = 0 \quad (20)$$

$$|c_{\mathbf{e}}(\mathbf{e}^S)D(p_D, P_{-D}, 0)| = 1 \quad (21)$$

This is the classic “hold up” problem which limits the benefits of vertical separation. Both firms could gain from committing to the higher first-best investment (which maximizes their joint surplus), that is:

$$[p_D - c(\mathbf{e}^*)] D_{\mathbf{i}}(p_D, P_{-D}, \mathbf{i}^*) = 1 \quad \text{and} \quad |c_{\mathbf{e}}(\mathbf{e}^*)D(p_D, P_{-D}, \mathbf{i}^*)| = 1 \quad (22)$$

but the impossibility of writing (or enforcing) contracts on the division of the surplus leads to inefficient underinvestment.

In case of *vertical integration*, the integrated firm  $L$  competes simultaneously with the other firms, losing the commitment power associated with the franchising contract. In equilibrium, firm  $L$  chooses a price  $p_L = p(\mathbf{e}, \mathbf{i})$  that satisfies the standard optimality condition:

$$D(p_L, P_{-L}, \mathbf{i}) + D_1(p_L, P_{-L}, \mathbf{i}) [p_L - c(\mathbf{e})] = 0$$

and is decreasing in  $\mathbf{e}$  and increasing in  $\mathbf{i}$ . As usual, the endogenous market structure is characterized by a price for the other firms  $p$  and an endogenous value for the price aggregator  $P$  that are both independent from  $p(\mathbf{e}, \mathbf{i})$ , with  $P_{-L} = P + g(p) - g(p_L)$  depending on the two investments. *Ex ante*, these investments are chosen by the integrated firm to solve the problem:

$$\max_{\mathbf{e}, \mathbf{i}} D(p_L, P + g(p) - g(p(\mathbf{e}, \mathbf{i})), \mathbf{i}) [p_L - c(\mathbf{e})] - F - \mathbf{e} - \mathbf{i}$$

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<sup>23</sup>Notice that  $d\mathbf{e}/d\mathbf{i} = -c_{\mathbf{e}}D_{\mathbf{i}}/c_{\mathbf{e}\mathbf{e}}D > 0$  under our assumptions. The suboptimality of both investments follows from the fact that they are complements in the sense of Hart (1995): the cross derivative of total surplus with respect to  $\mathbf{e}$  and  $\mathbf{i}$  is positive.

which leads to the following optimality conditions:

$$[p(\mathbf{e}^I, \mathbf{i}^I) - c(\mathbf{e}^I)] (D_{\mathbf{i}}(\cdot, \mathbf{i}^I) - \Delta_{LL} p_{\mathbf{i}}(\mathbf{e}^I, \mathbf{i}^I)) = 1 \quad (23)$$

$$|c_{\mathbf{e}}(\mathbf{e}^I) D(\cdot, \mathbf{i}^I) + (p(\mathbf{e}^I, \mathbf{i}^I) - c(\mathbf{e}^I)) \Delta_{LL} p_{\mathbf{e}}(\mathbf{e}^I, \mathbf{i}^I)| = 1 \quad (24)$$

The two investments are used beyond their direct benefits. Once again, the strategic purpose is to commit to a low price against the rivals, which requires extra investment in  $\mathbf{e}$  and less investment in  $\mathbf{i}$ . However, since these investments are costly, they do not allow the integrated firm to replicate the best precommitment equilibrium. In conclusion, strategic reasons lead the integrated firm to distort investment to reduce the price.

At this point we can compare the relative merits of vertical separation and vertical integration in markets whose structure is endogenous. Vertical separation allows one to implement the optimal aggressive pricing strategy through the franchising contract, but leads to suboptimal investments (especially for the downstream firm) in relation-specific activities. Vertical integration allows one to fully internalize the investment strategies, but requires costly distortions from the optimal investments to obtain a strategic advantage in the market. Of course, the trade-off between these benefits and costs determines whether vertical contracts are optimal. Nevertheless, even when these contracts remain optimal, this simple example shows that hold up problems (and not only informational asymmetries) can create distortions that limit the effectiveness of strategic contracts.

There are many other contractual arrangements that affect market competition. Some of them, just as the vertical contracts examined in this section, are also relevant for the antitrust analysis of dominant firms. This is the case of predatory strategies, mergers, price discrimination and tying contracts adopted by dominant firms. In the next section we focus on the last typology of these strategies.

## 7 Tying contracts

Tying involves a contractual agreement whereby a seller gives buyers access to a product only if the buyers agree to purchase another product as well. In an influential article, Whinston (1990) has shown that when a monopolist in a primary market is active also in a secondary market characterized by a Bertrand duopoly, tying of the two goods can only be used for entry deterrence purposes, because by itself it can only strengthen competition and reduce profits in both markets. However, this result, which has been at the basis of the modern antitrust

approach to tying and bundling,<sup>24</sup> breaks down when the structure of the secondary market is endogenous.<sup>25</sup>

To verify this, let us follow Whinston (1990) and consider two markets without any complementarities on the supply or demand side. Imagine for simplicity that the primary market is a monopolistic one characterized by zero costs of production and a constant demand  $D_M$  at the price  $v$ , which corresponds to the valuation of the primary good alone. The secondary market is characterized by product differentiation and price competition as in our usual set-up. Gross profits for the monopolist in the primary market, which is active also in the secondary one as firm  $M$ , are the sum of the profits in both markets:

$$\pi_M = vD_M + (p_M - c)D(p_M, P_{-M}) - F \quad (25)$$

while profits for any other firm  $i$  derive from the secondary market only:

$$\pi_i = (p_i - c)D(p_i, P_{-i}) - F$$

Without tying, endogenous entry exhausts all the profitable opportunities in the secondary market, and the monopolist enjoys equilibrium profits from the primary market only:

$$\pi_M = vD_M \quad (26)$$

Under tying, the demand for the monopolistic good is constrained by the demand for the other good, which is assumed to be lower than  $D_M$  (to focus on the interesting case). The bundle price  $p_{MB}$  can be decomposed as  $p_{MB} = v + p_M$  where  $p_M$  can be now interpreted as an implicit price of the secondary good produced by the monopolist. In such a case, the profits for the monopolist become:

$$\pi_{MB} = (p_{MB} - c)D(p_{MB} - v, P_{-M}) - F = (p_M + v - c)D(p_M, P_{-M}) - F \quad (27)$$

The other firms have the same objective function as before. In Bertrand equilibrium the monopolist chooses the bundle price  $p_{BM} = p_M + v$  satisfying:

$$(p_M + v - c)D_1(p_M, P_{-M}) + D(p_M, P_{-M}) = 0 \quad (28)$$

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<sup>24</sup>For a recent development always in a duopolistic set up, see Nalebuff (2004).

<sup>25</sup>An earlier version of this model (presented in Etro, 2007) based the optimality of tying on network effects or cost synergies. I am grateful to Jan Vandekerckhove, whose numerical simulations led me to realize the importance of the size of the demand for the stand alone product (relative to the demand for the bundle) for the general optimality of tying contracts.

while each one of the other firms chooses  $p$  satisfying the first order and free entry conditions:

$$(p - c)D_1(p, P) + D(p, P) = 0 \quad \text{and} \quad (p - c)D(p, P) = F \quad (29)$$

so that the profits of the tying monopolist become  $\pi_{MB} = (p_M + v - c)D(p_M, P_{-M}) - F$ . As usual,  $p$  and  $P$  do not depend on  $v$  and on the tying strategy, while  $p_M(v)$  has to be decreasing in  $v$ .<sup>26</sup> Therefore, the price of the bundle  $p_{BM} = p_M(v) + v$  increases less than proportionally with  $v$ , and the monopolist offers the bundle with a discount on the secondary good compared to its competitors. Clearly, tying is optimal if  $\pi_{MB} > \pi_M$ , that is, if:

$$[p_M(v) - c]D[p_M(v), P_M] - F > v\{D_M - D[p_M(v), P_M]\} \quad (30)$$

whose left hand side is the gain in profits in the competitive market and whose right hand side is the loss in profits in the monopolistic market: as long as the demand in the primary market, given by the exogenous parameter  $D_M$ , is close enough to the demand for the bundled good  $D[p_M(v), P_M]$ , this inequality is automatically satisfied. For instance, consider the case of isoelastic demand  $D(p_i, P_{-i}) = Ep_i^{-\theta} / \sum_{j=1}^n p_j^{1-\theta}$  with  $E$  demand size and  $\theta$  elasticity of substitution. The equilibrium price of the other firms is:

$$p = \frac{c\theta E}{(\theta - 1)(E - F)}$$

and the equilibrium price of the bundle satisfies:

$$p_M(v) < p \quad \text{and} \quad p_M(v) > \frac{(c - v)\theta E}{(\theta - 1)(E - F)}$$

The condition for the profitability of tying can be solved for

$$p_M(v) > \frac{(c - v)\theta E}{(\theta - 1)(E - F - vD_M)}$$

which is always satisfied for  $D_M$  small enough.

Summing up our general insights, we have:

**PROPOSITION 5.** *When a monopolist in a primary market is active in a secondary market under competition in prices with endogenous entry, the monopolist gains from tying its two goods (without fully deterring entry) as long as the demand for the bundle is close enough to the demand of the monopolistic product.*

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<sup>26</sup>In particular we have:

$$p'_M(v) = \frac{-D_1[p_M, P + g(p) - g(p_M)]}{\Delta} < 0$$

where  $\Delta \equiv 2D_1 + (p_M + v - c)[D_{11} - g'(p_M)D_{12}] - g'(p_M)D_2 < 0$  by the stability of the equilibrium system.

It should be clear that tying does not allow the monopolist to replicate the best equilibrium (that would require monopolistic pricing in the primary market and price leadership in the secondary one), because it is a discrete strategy that generates an advantage from the pre-commitment on the bundle price, but also a cost from the uniformity of the price strategy in the two separate markets.<sup>27</sup> However, it is an example of a contractual restriction on consumers that can improve profits while reducing prices. This is possible because of the inefficient pricing emerging without tying, which allows the monopolist to reduce the bundle price and still be able to gain market shares and profits.

In conclusion, we have shown that when 1) the secondary market is characterized by differentiated goods and an endogenous market structure and 2) demand for the bundled good is close enough to the demand of the primary product, tying is a profitable device to reduce prices without fully deterring entry in the secondary market, which is impossible in case of market power in the secondary market (Whinston, 1990). It is important to remark that, in this case, tying does not have an exclusionary purpose as assumed by the *leverage theory of tied good sales*, even if it tends to strengthen competition and to reduce the number of competitors in the secondary market. Moreover, our result rejects also the *single-monopoly profit theorem* of the Chicago school, for which a monopolist in one market cannot use tying to leverage market power in another market where entry is free: as we have seen, a monopolist can do that, because tying can create larger gains in the secondary market than losses in the primary one. Again, this is possible because of the inefficient pricing emerging in the free entry equilibrium.

## 8 Conclusion

In this note we have characterized a number of optimal strategic contracts for firms active in markets with endogenous structures. Traditional results on sale incentives, managerial schemes, screening contracts, franchising and tying radically change when firms compete in prices but entry in the market is endogenous. A side effect of our analysis is that the traditional ambiguity of a wide literature on strategic contracts vanishes when these are evaluated

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<sup>27</sup>For the same reason (the discreteness of the choice) we cannot employ the general principle of strategic commitments of Etro (2006). However,  $\partial\pi_{MB}/\partial p_M - \partial\pi_M/\partial p_M = vD_1 < 0$ , therefore tying makes the monopolist tough. This implies that the monopolist is led to reduce the effective price in the secondary market by choosing a low price of the bundle.

in markets with endogenous structures: in such a case, the nature of the optimal contracts does not depend on the mode of competition, but only on their impact on endogenous entry decisions.

In this paper we have been dealing with contracts between the firm and its managers (incentive contracts) and between the firm and its customers (vertical contracts and tying), but other applications concern other stakeholders.<sup>28</sup> For instance, in Etro (Forthcoming,a) I have looked at contracts between different shareholders to characterize the optimal debt contracts for a firm competing in a market with endogenous entry. Also in that case, traditional results (by Brander and Lewis, 1986; Showalter, 1995; Franck and Le Pape, 2008; Haan and Toolsema, 2008) change and, under competition in prices with endogenous entry and cost uncertainty, the equity holders of a firm always gain from adopting debt contracts with the purpose of committing to aggressive strategies. Further theoretical research could investigate other contractual arrangements as well. Finally, our results could be used to re-evaluate the empirical analysis on the relation between competitive entry pressure and strategic contracts.

Hopefully, these investigations can promote additional interest on the interaction between contract theory and market interactions.

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<sup>28</sup>Similar results emerge in the analysis of strategic policy for firms active in foreign markets with endogenous structures: under endogenous entry it is always optimal to implement policies that induce an aggressive behavior of the domestic firms abroad. See Etro (2009) for a review of strategic macroeconomic policies.



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