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# Inefficient Intra–Firm Incentives Can Stabilize Cartels in Cournot Oligopolies.

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## Abstract

The instability of Cournot cartels can be overcome by a collective wage agreement if this agreement stipulates minimum fixed wages and piece rates that are legally enforceable. This new view on the institution of collective wage agreements is not only relevant for strategic management, it also has an important implication for economic policy: competition authorities should observe such agreements for their potentially collusive effect on product markets. Moreover, the model contributes to the explanation of the “fixed wage puzzle”, i.e., the observation that firms pay lower than efficient variable wages and higher fixed wages than predicted by contract theory.

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**Encyclopedia of Law and Economics:** *5550, 5300, 0550*

**Keywords:** *Piece rate, fixed wage, collective wage agreements.*

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# 1 Introduction

This paper analyzes how cartels can be stabilized by collective wage agreements that implement inefficient intra-firm incentives. Cartel agreements in Cournot oligopolies suffer from instability: No cartel solution is a Nash equilibrium, because each competitor has an incentive to choose an output greater than his cartel quota.<sup>1</sup> This instability could be overcome by a binding contract, but in general, cartel agreements are not legally enforceable.

The cartel instability rests on the assumption that production takes place in the absence of intra-firm conflicts. In our paper, we allow for the existence of intra-firm conflicts resulting from delegation and moral hazard in oligopolistic firms. These conflicts are modeled as a simple principal-agent problem. The principal is unable to determine the firm's output directly, but can choose a variable payment ("piece rates") and fixed wages to influence the agent's effort and, thereby, the firm's output. In a world with risk neutral agents and risk neutral principals, efficient intra-firm incentives can be achieved when the agent is assigned the position of the residual claimant. A contract that stipulates a piece rate below the efficient one induces the risk neutral agent to choose lower than efficient effort. Under such a contract, the firm's output is, *ceteris paribus*, smaller than under a first-best contract.

In our model, the principals can establish a cartel by a collective wage agreement which provides inefficient intra-firm incentives. This reduces each firm's output and increases the product market rent. To offset the lower piece rate, the fixed wage paid by the cartel members to their agents has to be higher than in the Cournot solution. Each firm has an individual incentive to deviate by offering efficient intra-firm incentives to its own agent and, thereby, increase its output. We prove that such a deviation is only beneficial for the respective firm if it can simultaneously decrease the fixed wage. The latter, however, is prohibited by the collective wage agreement. Thus, a legally enforceable fixed wage can effectively stabilize the cartel agreement.

This effect of linear contracts may contribute to the solution of the "fixed wage puzzle", i.e., the fact that fixed wages are ubiquitous in the real world although economic theory strongly advocates variable pay. Moreover, collective wage agreements that include profit-sharing elements are quite common. E.g.,

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<sup>1</sup>The shadow of the future may induce cartel agreements as Nash equilibria. In this paper, we focus on one-shot games.

the “Big Three” automobile producers in the US have introduced profit sharing components into the workers’ compensation after 1979.<sup>2</sup> The US automobile industry traditionally leads the way for collective wage bargaining in the US.

Our study is limited to input providers with linear contracts, consisting of a piece rate and a fixed wage. We assume that the minimum levels stipulated by the collective agreement can be legally enforced, but we neglect the exact enforcement process.<sup>3</sup> Labor is the only input and wages are the only costs the firms have to bear. A piece rate is a share of the value of the respective firm’s output. A fixed wage can be a monetary payment, but may also take the form of health care or pension benefits. Many papers on managerial incentives may not exactly capture the real-world meaning of the term “manager”. The typical principal-agent model sees the manager as the provider of “effort”, a crucial (and often the only) input which is required to produce the firm’s output. We follow this terminology of the economic literature here.

The rest of the paper is organized as follows. Section 2 presents the related literature. We set up and solve the model in Section 3. Finally, we draw conclusions in Section 4.

## 2 Related literature

Surprisingly, the number of papers that simultaneously model oligopolistic competition between firms and the existence of intra-firm conflicts between owners and managers is rather small. The most prominent idea in this area is that product market competition may serve as a device to discipline managers.<sup>4</sup> Hart (1983) has rigorously derived conditions under which increased product market competition can provide information for principals, while Hermalin (1992) has shown that competition can provide incentives for managers to work harder even if the market results do not provide such information. Demougin/Tschernig (1993) and Schmidt (1997) also discuss theoretically to which extent intra-firm inefficiency caused by asymmetric information can be reduced through the presence of market competition. The empirical evidence on the relationship between managerial incentives, competition and firm’s performance is, however, mixed. Gaver/Gaver/Battistel (1992) have not found significant stock market

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<sup>2</sup>See Katz/MacDuffie/Pil (2002, 22).

<sup>3</sup>Alexander/Reifen (1995) show that collusive minimum-price two-part tariff agreements require an outside enforcer, while price ceilings are self-enforcing.

<sup>4</sup>See Berle/Means (1932) and Leibenstein (1966).

reactions to the introduction of performance payment schemes for top managers, while Nickell (1996) has identified only weak empirical support for the idea that product market competition improves corporate performance. The strategic tool presented in our paper effectively reduces product market competition and thereby increases the firms' profit.

The mutual impact of competition and intra-team incentives is the subject of the experimental paper by Bornstein/Gneezy (2002). However, the intra-firm conflict in their paper is represented by two types of coordination games to be played between the team members. The intra-firm incentives are exogenously given and constitute the type of the firm. In our model, both the product market behavior and the choice of intra-firm contracts are endogenous. Some other papers deal with isolated aspects of the interplay between intra-firm incentives and competition: Glazer/Israel (1990) have shown that management compensation schemes can serve as a signaling mechanism on the product market. Toulemonde (1999) has observed that the wage structure may deter potential competitors from market entry. Aggarwal/Samwick (1999) explain the lack of compensation schemes that are based upon relative performance by the strategic interaction between the firms.

Two papers which are closely related to our model are Sklivas (1987) and Fershtmann/Judd (1987). The authors ask whether firms in an oligopoly actually choose intra-firm incentives so as to maximize profits. They show that intra-firm conflicts implement market outcomes which are more competitive than those in the Cournot model without intra-firm conflicts. This result is driven by the assumption that contracts cannot be made contingent on quantity outcomes. The agents' payments rather depend on a linear combination of the firm's profit and revenues, and it is optimal for principals to offer rewards which put a positive weight on revenues. These models and their results differ substantially from ours, as we limit our focus to linear contracts. Moreover, both Sklivas (1987) and Fershtmann/Judd (1987) do not make explicit the incentive mechanism, and they neglect its impact on the firms' costs. In our paper, we explicitly model the incentive problem and include the agents' wages into the firms' cost functions. Finally, they both overlook the collusive potential of a collective wage agreement, which is the subject of our model. Hence, we expect oligopolistic firms to behave less competitive than in a Cournot setting if a labor union makes available collective wage agreements.

Another paper which appears to be close to ours at the first glance is

Bensaïd/ Gary–Bobo (1991). In their model, however, effort costs within the firm are assumed to be zero. Therefore, profit–sharing contracts or fixed wages only serve to satisfy the participation constraint. Haucap/Pauly/Wey (2001) is also close to our subject, but their model highlights a different anti–competitive aspect of collective wage setting. They start with two types of firms in one industry, one type produces with a labor–intensive technology, the other operates capital–intensive. The latter type finds it beneficial to agree upon high wages in a collective wage agreement, which raises its rivals’ costs and increases its own market share. In our model, the firms are homogeneous, and it is the wage structure (piece rate vs. fixed wage) that plays the crucial role.

### 3 The model

#### 3.1 Setup

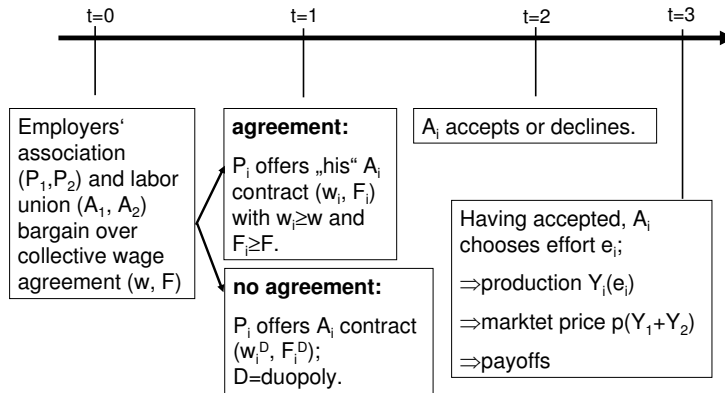
Consider a market with two symmetric firms  $i \in \{1; 2\}$ , referred to as principals  $P_i$ . Each principal can employ one out of two symmetric agents,  $A_i$ . No other firms or agents may enter the game. The interaction takes place in four stages  $t = 0..3$ :

1. In  $t = 0$ , both principals form an employers’ association and negotiate over a collective wage agreement with the labor union, which consists of both agents. A collective wage agreement consists of a fixed wage,  $F$ , and a piece rate,  $w$ . Hence, we limit our view to linear contracts.
2. In  $t = 1$ , each principal makes a take–it–or–leave–it offer to his agent. If a collective wage agreement,  $(F, w)$ , has been closed, a principal is not allowed to deviate downwards from this settlement.
3. In  $t = 2$ , the agent accepts or rejects the offer. If he accepts, then he produces output in  $t = 3$ , and payoffs are generated.

The agent spends effort, denoted  $e_i$ , to produce an amount of output  $Y_i$ . This causes effort costs  $c_i(e_i) = e_i^2$ . The production function is  $Y_i(e_i) = e_i \cdot \eta_i$  for  $i \in \{1; 2\}$ . The outputs are influenced by random variables, the realizations of which are denoted as  $\eta_i \in \mathbb{R}^+$ . These random variables are independently distributed with expected value  $E[\eta_i] = 1$  and positive variance. Therefore, the agents’ effort choices are unobservable and non–verifiable. All four players are

assumed to be risk-neutral. We neglect limited liability problems. The expected output of firm  $i$  is  $E[Y_i] = e_i$ . The total expected output offered in the market accrues to  $E[Y] = e_1 + e_2$ . Consumers' inverse demand is  $p = a - Y$  with  $a > 0$ , where  $p$  represents the market price. If a contract offer is rejected, the principal receives nothing, while his agent obtains his outside option payoff of  $u \geq 0$ .<sup>5</sup> The game is visualized in Figure 1.

Figure 1: The time line of the game



We solve the game by backward induction. Each agent's effort choice in  $t = 3$ , and his acceptance or refusal in  $t = 2$ , are discussed in Section 3.2. In Section 3.3, we analyze the situation in  $t = 1$  if no collective wage agreement has been previously closed. This subgame reflects the standard Cournot duopoly situation; its subgame value creates the outside option for the collective bargaining in  $t = 0$ . In Section 3.4, we first derive the optimal collective wage agreement under two assumptions which will be relaxed later: The employers' association has full bargaining power, and the parties obey the collective wage agreement. In Section 3.4.2, we discuss the principals' incentives to deviate. In

<sup>5</sup>For technical reasons we assume  $u < a^2/5$ , which makes sure that duopolists may find it profitable to engage in this market.

Section 3.4.3, we introduce bargaining power on the part of the union in  $t = 0$ .

### 3.2 Effort choices and acceptance decisions

In the last stage, each agent faces the maximization problem

$$e_i^* = \arg \max F_i + w_i E[Y_i(e_i)] - c_i(e_i).$$

The first-order condition for an internal maximum is  $w_i = 2e_i$ . Hence, the agent's optimal effort reaction to a wage offer  $(F_i, w_i)$  made by his principal is

$$e_i^*(w_i) = \frac{w_i}{2}. \quad (1)$$

Agent  $i$  expects the payoff  $F_i + w_i E[Y_i(e_i^*(w_i))] - c_i(e_i^*(w_i))$  when deciding whether or not to accept the offer. Substituting the production function and the effort cost function, this equals  $F_i + w_i^2/4$ . Agent  $A_i$  accepts if this payoff meets his outside option  $u$ . Therefore,

$$F_i^*(w_i) = u - w_i^2/4 \quad (2)$$

is the minimum fixed wage that obeys the participation constraint of agent  $A_i$ .

### 3.3 No collective wage agreement

Should the parties fail to reach a collective wage agreement, then both principals do not have to obey legal constraints when choosing their contract offer in  $t = 1$ . Using equations (1) and (2), their individual choice problems can be stated in piece rates  $w_i$  and  $w_j$ . The expected profit function of principal  $i$  is

$$E[\Pi_i^D(w_i, w_j)] = \left[ a - \frac{w_i + w_j}{2} - w_i \right] \frac{w_i}{2} - \left( u - \frac{w_i^2}{4} \right)$$

with  $i, j \in \{1, 2\}$ , and  $i \neq j$ . The label D indicates that this reflects a standard duopoly of the Cournot type.<sup>6</sup>

Each firm  $i$  chooses the piece rate to maximize profits. The first-order condition for an internal solution is  $a/2 - w_i - w_j/4 = 0$ . Hence, the optimal reaction of firm  $i$  to the other firm's choice,  $w_j$ , is

$$w_i^D(w_j) = \frac{2a - w_j}{4}. \quad (3)$$

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<sup>6</sup>The labor union can also be described as an upstream monopolist who is unable to commit to a restriction of factor supply, which leads to the Cournot outcome in the downstream market, see Rey/Tirole (2006, 12-14).



In a similar way, we can derive the reaction function of firm  $j$ . Substituting  $w_j^D(w_i)$  into equation (3) yields the Cournot duopoly solution (in piece rates)  $w_i^D = w_j^D = 2a/5$ . The corresponding minimum fixed wages are  $F_i^D = u - a^2/25$ . By offering  $(F_i^D, w_i^D)$ , both firms induce their agents to produce  $e_i^D = a/5$ . The market output amounts to  $Y^D = 2a/5$ , and the market price is  $p^D = 3a/5$ . Each firm's profit then accrues to  $\Pi_i^D = 2a^2/25 - u$ . The agents receive their outside option utility level of  $u$ .

In equilibrium, the revenue of firm  $i$  is  $R_i^D = (a - e_i^D - e_j^D)e_i^D$ . Using equation (1), the marginal revenue is  $MR_i^D = a - w_i - w_j/2$ . Substitution of the equilibrium piece rates yields  $MR_i^D = 2a/5$ . Thus, in equilibrium, both firms choose piece rates equal to their marginal revenues. From an individual firm's perspective, these piece rates create efficient incentives.

### 3.4 Collective wage agreement

To derive the optimal cartel solution, we first proceed with the assumption that the employers' association has full bargaining power. This will be relaxed in Section 3.4.3. Moreover, we assume that an agreement is obeyed by the two firms. In Section 3.4.2, we discuss the principals' incentives to deviate from this solution.

#### 3.4.1 The optimal collective wage agreement

Under a collective wage agreement, the two firms form a cartel and act like one monopolist who produces in two production sites with increasing marginal costs. The cartel's expected profits amount to

$$E\Pi^C = [p(e_i(w_i) + e_j(w_j)) - w_i]e_i - F_i + [p(e_i(w_i) + e_j(w_j)) - w_j]e_j - F_j.$$

The anticipated reactions of the two agents employed by the cartel are given by equation (1). Using this, we can simplify the cartel's profit to

$$E\Pi^C = \frac{a(w_i + w_j) - w_i^2 - w_j^2 - w_i w_j}{2} - 2u.$$

The first-order conditions for an internal solution are  $(a - 2w_i - w_j)/2 = 0$  and  $(a - 2w_j - w_i)/2 = 0$ . A cartel planner has to choose  $(w_i, w_j)$  such that these conditions are simultaneously fulfilled. The profit maximizing piece rates for

both production sites of the cartel hence are  $w_i^C = w_j^C = a/3$ , and the corresponding minimum fixed wage which induces the agents to accept the contract offer is  $F_i^C = F_j^C = u - a^2/36$ . Note that  $w_i^C < w_i^D$  and  $F_i^C > F_i^D$ .

A contract offer  $(F_i^C, w_i^C)$  induces efforts  $e_i^C = e_j^C = a/6$ . Thus, the cartel produces a total expected output of  $Y^C = a/3$ . The market price is  $p^C = 2a/3$ , and the cartel members' individual expected profits amount to  $\Pi_i^C = a^2/12 - u$ . In the unique cartel solution, each firm collects a higher profit than as a Cournot duopolist, since  $\Pi_i^C > \Pi_i^D$ . In the cartel optimum, each firms' marginal revenues amount to  $MR_i^C = a - w_i^C - w_j^C/2 = a/2$ . The cartel solution is characterized by  $MR_i^C > w_i^C$ . The marginal revenue of each firm exceeds the piece rate offered to its agent. While it would appear efficient from an individual point of view to offer a piece rate equal to the marginal revenue, the cartel profit is maximized if the members agree upon piece rates which create inefficient intra-firm incentives.

Table 1: Overview of the main results

	Duopoly (no collective wage agreement)	Cartel (optimal collective wage agreement)	comparison
$w_i$	$2a/5$	$a/3$	$w_i^D > w_i^C$
minimum $F_i$	$u - a^2/25$	$u - a^2/36$	$F_i^D < F_i^C$
$e_i$	$a/5$	$a/6$	$e_i^D > e_i^C$
$Y$	$2a/5$	$a/3$	$Y^D > Y^C$
$p$	$3a/5$	$2a/3$	$p^D < p^C$
$\Pi_i$	$2a^2/25 - u$	$a^2/12 - u$	$\Pi_i^D < \Pi_i^C$
$\Pi$	$4a^2/25 - 2u$	$a^2/6 - 2u$	$\Pi^C - \Pi^D = a^2/150 > 0$
$MR_i(e_i)$	$2a/5$	$a/2$	$MR_i^D = w_i^D; MR_i^C > w_i^C$

Table 1 compares the results of the decentralized Cournot duopoly with no collective wage agreement, to the centralized cartel planning with collective wage agreement. Just as in the Cournot cartel with output quotas, both firms would profit from forming a cartel, but the cartel is not self-enforcing. Both members may have an incentive to increase their output. The duopolists' incentives to deviate from the optimum cartel wages are analyzed in the following section.

### 3.4.2 Intra-firm incentives to deviate

In this section, we analyze a firm’s incentives to unilaterally deviate from an optimal cartel agreement. Both cartel members are required to pay a higher fixed wage to their agents than in the Cournot oligopoly. Even though, cartelization would increase the industry profit by  $\Pi^C - \Pi^D = 7a^2/225$ . However, the cartel piece rate  $w_i^C$  is smaller than each cartel member’s marginal revenue. Both cartel members thus have an incentive to deviate upwards from the piece rate that maximizes the cartel profit, regardless of whether the other firm complies with the cartel agreement or not.

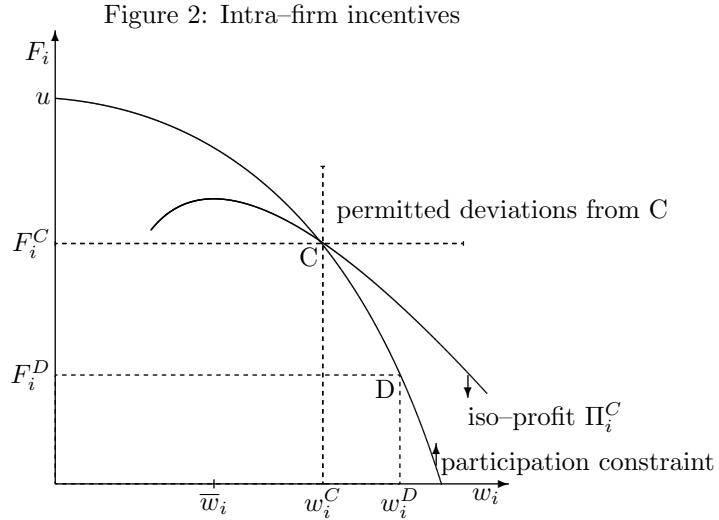


Figure 2 illustrates the intra-firm incentives within firm  $i$ . It displays the agent’s participation constraint, which consists of  $F_i$ - $w_i$ -combinations that leave the agent with an (expected) payoff equal to  $u$ . The curve slopes downward from the intercept  $u$  at the  $F_i$ -axis. The agent prefers  $F_i$ - $w_i$ -combinations above the participation constraint, as indicated by the tiny arrow. Furthermore, Figure 2 shows the cartel solution (point C) and the duopoly solution (point D). The area to the north-east of C depicts the  $F_i$ - $w_i$ -combinations a firm is allowed to offer under a collective (minimum) wage agreement; this area is labeled “permitted deviations from C.”

Figure 2 also depicts a firm’s iso-profit curve that represents its individual profit level in the cartel solution,  $\Pi_i^C$  (under the assumption that the other firm

sticks to the agreed upon cartel piece rate  $w_j^C$ ). In general, the firm's iso-profit curve at level  $\Pi_i$  is given by

$$F_i = \frac{2a - w_j}{4}w_i - \frac{3}{4}w_i^2 - \Pi_i$$

in the  $F_i$ - $w_i$ -diagram. The cartel situation is characterized by  $w_j^C = a/3$  and  $\Pi_i = \Pi_i^C$ , thus the iso-profit curve of  $P_i$  can be simplified to

$$F_i = \frac{5a}{12}w_i - \frac{3}{4}w_i^2 - \Pi_i^C. \quad (4)$$

If  $P_j$  sets the cartel wage  $w_j^C = a/3$ , then all iso-profit curves of  $P_i$  have their maximum at  $\bar{w}_i = 5a/18$ . Note that  $\bar{w}_i < w_i^C$ . The first derivative of this iso-profit curve with respect to  $w_i$  is

$$\frac{\partial F_i}{\partial w_i} = \frac{5a}{12} - \frac{3}{2}w_i.$$

For  $w_i > 5a/18$ , the iso-profit curve representing  $\Pi_i^C$  has a negative slope. This is surprising at first glance: The marginal profit in the cartel solution is positive; hence, the principal should be able to increase his profit by offering to the agent a higher piece rate. If this would describe the situation correctly, the iso-profit curve had a positive slope. However, recall that the collective wage agreement is limited to linear contracts in our model. Therefore, a higher piece does not only increase the marginal cost of additional output, but also of the infra-marginal units. Increasing the piece rate hence lowers the profit. Therefore, the iso-profit curve has negative slope. The comparison of equations (2) and (4) reveals that, in C, the iso-profit is flatter than the agent's participation constraint. The principal prefers lower wage combinations to higher ones, which is indicated by the tiny arrow in Figure 2. Thus, her iso-profit curve and the agent's participation constraint open up an area of wage combinations which are bilaterally beneficial, compared to the optimal collective wage agreement  $C$ .

For firm  $i$ , a unilateral deviation from point C in Figure 2 is only attractive if the increased piece rate is compensated by a lower fixed wage, resulting in a move towards the south-east. However, the collective minimum wage agreement only allows the principals to move north-east. The only intersection between the lens and the permitted deviations is point C itself. The collective wage agreement, therefore, stabilizes the cartel by effectively implementing a "fixed wage brake" against the temptation to deviate.

### 3.4.3 Bargaining power on the part of the union

We have demonstrated that the cartel agreement  $(F_i^C, w_i^C)$  attains a monopoly solution which maximizes the cartel's profit. It is stable if downwards deviations are legally prohibited by a collective wage agreement. If the agreement  $(F_i^C, w_i^C)$  is a take-it-or-leave-it offer to the labor union, its members obtain no more than their outside option utility level of  $u$ . In this section, we introduce bargaining power on the part of the union and derive the symmetric Nash-bargaining solution.<sup>7</sup> Let the index  $B$  indicate the Nash-bargaining results.

The symmetric Nash-bargaining solution rests on four axioms, among them Pareto-optimality and individual rationality. Pareto-optimality demands that the parties agree upon the cartel piece rate, hence  $w^B = w_i^C$ .<sup>8</sup> If a collective wage agreement allows for a stable product market cartel, then it generates a bargaining rent for the parties, which equals the cartel profits net of the duopoly profits. This rent is distributed among the parties via the fixed wage. The union receives a share of this rent if the agreed upon fixed wage  $F^B$  exceeds the minimum fixed wage, i.e., if  $F^B > F_i^C$ . In other words, each principal pays an "entrance fee" into the cartel which amounts to  $F^B - F_i^C$ .

The employers' association receives each firm's cartel profit and gives up the disagreement payoff, namely each firm's duopoly profit. Hence, the employers' association's share of the bargaining rent amounts to  $2[\Pi_i(F^B, w_i^C) - \Pi_i^D]$ . The union's threat point is given by twice the duopoly utility level,  $u$ . Its members each receive  $F^B$  plus the cartel piece rate on the efficient output, and have to bear the corresponding effort costs. The union's share of the bargaining rent thus is  $2[F^B + w_i^C e_i^C - c(e_i^C) - u]$ . This allows us to state the Nash product as

$$4[\Pi_i(F^B, w_i^C) - \Pi_i^D][F^B + w_i^C e_i^C - c(e_i^C) - u].$$

Recall that  $w_i^C = a/3$ ,  $e_i(w_i) = w_i/2$  and  $\Pi_i^D = 2a^2/25 - u$ . Substituting these results, the Nash product can be simplified further to

$$4 \left[ u - \frac{11a^2}{450} - F^B \right] \left[ F^B + \frac{a^2}{36} - u \right].$$

<sup>7</sup>For the main results of our paper, the solution concept applied to the bargaining stage is immaterial, as long as it satisfies the axioms of Pareto-efficiency and individual rationality.

<sup>8</sup>This simplification is due to the assumptions of linear demand and quadratic effort costs. In other models, the efficient variable wage is not necessarily constant, as has been pointed out in the literature on monopoly unions and efficient bargaining, see, e.g., McDonald/Solow (1981) or Espinosa/Rhee (1989).

The symmetric Nash bargaining solution  $\hat{F}^B$  maximizes this Nash product. The explicit solution then is  $\hat{F}^B = u - 47a^2/1800$ , which splits the total bargaining rent equally. The union obtains the payoff  $U^B$  with

$$U^B(\hat{F}^B, w_i^C) = 2u + \frac{\Pi^C - \Pi^D}{2} = 2u + \Pi_i^C - \Pi_i^D.$$

Each firm pays a part of the additional profit to its employee, in excess of the minimum fixed wage in the optimal cartel solution. Thus, the individual profit of each firm is smaller than in a cartel with collective wage agreement but full bargaining power; the axiom of individual rationality ensures, however, that the profit exceeds the individual duopoly profit:  $\Pi_i^C > \Pi_i^B > \Pi_i^D$ .

Figure 3: Intra-firm incentives with Nash-bargaining collective wage agreement

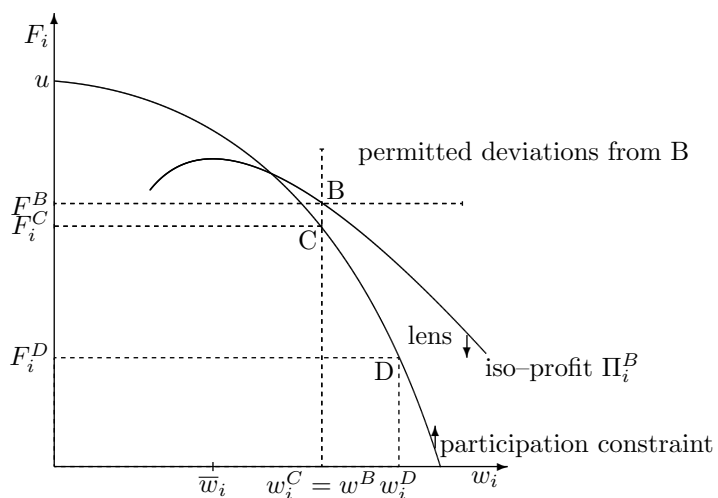


Figure 3 visualizes the incentive situation within one firm if a collective wage agreement  $(F^B, w^B)$  exists, which is represented by point B. This agreement could be the outcome of Nash bargaining if the union has positive bargaining power. Compared to the situation in which the bargaining power of the union is zero (point C), the area of allowed deviations from this agreement is shifted upwards. The agent's participation constraint is unmodified if we assume that he is left with his outside option  $u$  in case he rejects to work for his employer. This increases the size of the exchange lens that consists of mutually beneficial wage combinations. The only intersection between the lens and the permitted deviations area is the point B itself. Thus, even if the union captures

a part of the bargaining rent, the collective wage agreement prohibits any deviation from it that is bilaterally beneficial. Therefore, the cartel is stabilized by the collective wage agreement.

## 4 Conclusion

We set up a model that combines a Cournot duopoly with intra-firm conflicts in the context of a simple moral hazard model. We have derived both the Cournot equilibrium in wages, and the wages a cartel would choose when planning with two production sites and convex marginal costs. In comparison to the Cournot duopoly situation, the optimal wage structure for a cartel consists of a lower variable wages, in order to reduce output, and a higher fixed wage (to satisfy the agents' participation constraints).

This result has been derived under the assumption that both cartel members stick to the contract. However, the optimal cartel wage structure does not constitute a subgame perfect equilibrium. Insofar, the wage cartel is as instable as an output quota cartel. Yet, there is one important difference between these two settings: While the quota cartel is illegal, a collective wage agreement can be legally enforced. This stabilizing effect endows the labor union with a position which is remarkably similar to the economic function of the Sicilian Mafia. According to Bandiera (2003), the Mafia provided enforcement for cartels in exchange for a share of the increased profits.

An enforceable collective wage agreement can also be seen as a tool that solves the commitment problem of an upstream monopolist facing several firms in the downstream market.<sup>9</sup> Without such a commitment device, the monopolist cannot extract more than the oligopoly rent from the downstream market. With the commitment device at hand, the cartel rent is within reach.

Applying the Nash-bargaining solution to the collective bargaining stage allows us to derive a distribution scheme for the cartel rent between the two downstream firms and the upstream labor union. The side payment from the firms to the union has to take the form of a higher fixed wage. Thus, our results are in contrast to those of Chemla (2003), who finds that upstream monopolists may capture a higher share of the decreasing rents of the downstream market as competition becomes more intensive. In our model, the upstream union may

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<sup>9</sup>See Rey/Tirole (2006, 12-14).

bargain for a larger share when the collective wage agreement helps to stabilize a cartel on the downstream market.

The principal-agent model we have employed here is rather simple, yet sufficient to derive the basic insights. The limitation of our focus to linear contracts is a prerequisite for the stabilizing effect of enforceable collective wage agreements. However, there are many options to enrich the model. For instance, we could introduce risk-aversion on the side of the agent, but this would only reinforce the derived results. Hence, even under more sophisticated assumptions regarding the intra-firm conflict the strategic effect of collective wage agreements can be maintained.

The insights of this paper are relevant for strategic management considerations. They may also contribute to the solution of the “fixed wage puzzle”. Moreover, our results are relevant for economic policy, and in particular for cartel authorities: They should not only look for direct cartel agreements when trying to identify illegal collusive behavior. Collective wage agreements should also raise suspicion, in particular if they prescribe intra-firm incentives which appear inefficient at first glance. Such agreements may exert an anti-competitive behavior not only on the upstream labor market, but also on the downstream product market.

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