BARGAINING AND COLLUSION IN REGULATION

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We examine a situation of natural monopoly where Congress (the political principal) delegates the pricing policy to a regulatory agency, which is charged with monitoring the firm's unknown fixed costs. The classical three-tier regulatory hierarchy is altered by devising the regulatory mechanism as a settlement between the agency and the firm. Following the Nash bargaining approach, we find that, whether the agency is benevolent or not, price is Pareto optimal while subsidy finances an information rent to the firm in case of failure of the audit activity. A self-interested agency has an incentive to hide its information from Congress and share the gains of the coalition with the firm. By modelling the side contracting as a bargaining activity parallel to the negotiations over the regulatory mechanism, we find that consumers are requested to subsidize the firm's extrarent from collusion. The characterization of the institutional responses to collusion shows that, even under discrimination between the agency's types, Tirole's equivalence principle fails and allowing collusion may be optimal. This result is reinforced if a screening contract is not feasible.

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JEL classification: D73, D82, L51.

1. Introduction

The aim of this paper is to adopt a bargaining approach to the regulation of a natural monopoly in order to investigate the main determinants and features of collusion between the regulatory agency and the firm and characterize the institutional responses to this threat.

We start from an idealized but illuminating view of regulatory institutions, as recast by Laffont and Tirole [**10**], according to which they result from a constitution drafted by some benevolent "founding fathers" or "social

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planners", which are represented by lawmakers. In our model, the latter, that we simply call "Congress", are supposed to be only concerned with the welfare of consumers (who are also taxpayers) while designing the set of rules and institutions that are meant to cope with a situation of natural monopoly. Congress is not able to determine the regulatory mechanism and delegates social choices to a "public decision maker", which is represented by a regulatory agency[2].

The regulator's legislative mandate provides for two activities: a supervisory task and a bargaining function. Therefore, the agency is not only ‹‹mere conduit›› of information *à la* Tirole [**15**, p. 182], which is standard in the collusion literature, but also performes the innovative role of negotiating with the firm the regulatory settlement[3]. On the one hand, the regulator is charged with monitoring the monopolist's cost function, which is unknown to Congress. The two-type supervisory technology assumed by Tirole [**15**] is generalized to the case of a *continuum* of the firm's types. On the other hand, we assume that the agency cannot impose on the firm a specific regulatory mechanism. Rather, regulation is the outcome of a bargaining process between the two parties. This idea is consistent with Kahn's [**4**] suggestion that the relationship between the regulator and the firm closely resembles bilateral monopoly. The regulator is given the power to negotiate over a two-part pricing policy in which consumers pay a unit price plus an amount independent of the quantity purchased.

A benevolent agency perfectly internalizes Congress's objective of maximizing the consumers' surplus and reports truthfully the evidence about the firm's fixed costs. However, the regulator cannot be trusted to perfectly enforce Congress's intent because it may be self-interested and have an incentive to favour some interest groups. If the monitoring fails, the agency has no discretion and collusion cannot occur. Instead, if the cost parameter is discovered, there is scope for a side contract between the firm and the regulator, according to which the latter conceals its information from Congress (by declaring that it has observed nothing) and the former in exchange offers a side transfer[4]. By modelling the side contracting as a bargaining activity parallel to the negotiations over the regulatory mechanism, we find that con-

[2] We take Tirole's [**15**] assumption of unique regulator, which may be justified either by a cost of duplication of the regulatory function or by a collusive behaviour between regulators.

[3] The important contribution by Scarpa [**13**] represents one of the few attempts of modelling the phenomenon of bargaining between firms and regulatory agencies.

[4] Tirole [**15**] stresses the emportance of reciprocity in the side contracting: one-sided favors call for reciprocated ones.

sumers are requested to subsidize the firm's extrarent from collusion, which is maximized when the bargaining power is equally split between the agency and the firm.

In this regulatory setting, Congress must design the adequate organizational responses to the threat of collusion. This essentially implies the determination of the reward to the regulatory staff, which must be financed through socially costly public funds[5]. According to Tirole's [**15**] equivalence principle, under some conditions, there is no welfare loss in designing organizations which do not leave scope for collusion. One of the main assumptions is that the principal (Congress in our framework) can perfectly anticipate the collusive agreement and make the transfer that induces revelation and deters collusion. We find that, even if this assumption is still valid and a contract which discriminates between the agency's types can be devised, tolerating collusion turns out to be optimal in equilibrium as long as the agency is sufficiently strong in the regulatory process. Therefore, our approach weakens the validity of Tirole's equivalence principle. This result is reinforced if a screening contract is not feasible.

The plan of the paper is as follows. Section 2 describes the basic structures of the model. In Section 3, we consider the case of benevolent agency. In Section 4, we show the main results under the assumption of nonbenevolent agency. Section 5 analyzes the institutional responses to the threat of collusion under the assumptions of discrimination and no discrimination between the agency's types respectively. Finally, we devote Section 6 to some concluding remarks.

2. The model

We assume a linear demand function of the form

$$q(p) = a - bp, \tag{2.1}$$

where a and b are strictly positive parameters and $q(p)$ denotes the quantity of good or service that consumers demand at the price p.

Given the demand function in (2.1) and ignoring income effects, the consumers' net surplus is equal to[6]

[5] Following Laffont [**9**, cap. 2], we assume that limited liability constraints prevent Congress from designing a system of punishments and fines against the agency.

[6] The upper extreme of the integral is constrained to be $\frac{a}{b}$, since we only consider the positive range of the demand function.

$$CS = \int_{p}^{\frac{a}{b}} (a - bp^o)\, dp^o - S - (1 + \lambda)\, T^C. \tag{2.2}$$

The consumers' net gain is equal to the net benefit from the marketplace minus the aggregate fixed charges $S \geq 0$ (which are a subsidy) to the firm and a transfer $T^C \geq 0$ to the agency that must be financed by consumers through possibly distortive taxes which impose a shadow cost $\lambda \geq 0$.

The firm's profit function is given by

$$\pi = p\,(a - bp) + S - C. \tag{2.3}$$

This is the sum of the operanting profit $p\,(a - bp) - C$ and the subsidy S. The firm's cost function C is equal to

$$C = c\,(a - bp) + \theta, \tag{2.4}$$

where the marginal cost $c > 0$ is common knowledge. The fixed costs $\theta \in \left[\theta^-, \theta^+\right]$ are private information of the firm and Congress only knows their density function $f\,(\theta)$, which is common knowledge. In a natural monopoly usually characterized by huge investments it is sensible to assume that asymmetric information regards the firm's fixed costs.

In order to pursue its objective of maximizing the consumers' surplus, Congress hires a regulator, whose role is twofold: supervising the firm and bargaining with it the regulatory mechanism.

The supervisory technology is characterized by a signal which may or may not reveal the firm's private information.

The signal σ is about the firm's fixed costs. With probability ζ the agency discovers the true θ, so $\sigma = \theta$; with probability $(1 - \zeta)$ the agency learns nothing, so $\sigma = \phi$. The signal is supposed to be "hard information" (i.e. verifiable[7]). This means that when the agency observes the firm's cost parameter ($\sigma = \theta$) it can supply a report $r = \theta$ to Congress in a credible way[8]. However, the regulator may lie and convey a report $r = \phi$, by claiming that its search for information has been unfruitful. Concealing information

[7] For a discussion about the difference between "hard information" and "soft information" models, see Laffont and Rochet [**10**].

[8] Congress can look at the evidence and convince itself that the regulator has announced the true cost parameter.

is the agency's degree of discretion[9]. When the regulator learns nothing ($\sigma = \phi$) it can only announce $r = \phi$.

For simplicity, we assume that the firm observes what signal the agency receives[10]. Finally, notice that the degree of informativeness of supervisory technology, which is represented by ζ, is exogeneous. This implies that we take the agency's effort to discover the cost parameter as given[11].

A benevolent regulator, which is drawn with probability γ, settles for a transfer equal to the reservation value $\overline{T}$, which is normalized to zero. Moreover, it perfectly represents Congress's interests in the consumers' surplus during the bargaining process with the firm. Therefore, the utility function of a benevolent agency is

$$V_B = CS. \tag{2.5}$$

A dishonest regulator, which occurs with probability $(1-\gamma)$, is concerned to receive a transfer $T \geq \overline{T}$. Moreover, it internalizes only partly Congress's interests while bargaining with the firm. Hence, the utility function of a nonbenevolent agency is given by

$$V_{NB} = T + \beta CS, \tag{2.6}$$

where $\beta \in [0,1]$ is a parameter that captures the regulator's degree of internalization of Congress's objective. If $\beta = 0$, the agency is only interested in the transfer. If $\beta = 1$, it gives the same weight to its private concern as to Congress's aim.

The timing of the regulatory game is as follows.

(I) Nature draws a type θ for the firm, according to the density function $f(\theta)$, and the signal σ for the agency. It also determines whether the agency is benevolent or not with probabilities γ and $(1-\gamma)$ respectively.

(II) The firm and the agency learn their respective types.

(III) Congress offers to the agency a contract which determines a transfer $T^C(r)$ conditional on the report r. The contract is signed or rejected by the agency. Congress commits itself to accept any regulatory mechanism

[9] The agency could not announce a wrong cost parameter since this report could not be substantiated.

[10] This rules out the possibility of blackmail by the agency. Khalil and Lawarrée [**6**] underline the importance for future research of studying the phenomenon of blackmail. Alternatively, we could suppose that before signing the collusive agreement the agency must disclose to the firm the signal it has received.

[11] Demski and Sappington [**3**] consider a regulatory problem in which a self-interested regulator must be motivated to expend monitoring effort to become informed about the firm's expected productivity. Unfortunately, this study ignores the possibility of collusion.

arising from negotiations provided that it is direct and incentive compatible whenever the agency reports that its supervisory activity has failed.

(IV) The agency negotiates with the firm over a regulatory mechanism (p, S), which determines the price p of the service and the subsidy S to the firm. At the same time, the agency performes its audit activity and learns the signal σ, which is also observed by the firm. If $\sigma = r = \phi$, the two parties agree on a direct incentive compatible mechanism $M = \left\{p\left(\widehat{\theta}\right), S\left(\widehat{\theta}\right), \widehat{\theta} \in \left[\theta^{-}, \theta^{+}\right]\right\}$, which specifies the price $p(.)$ and the subsidy $S(.)$ as functions of the firm's report $\widehat{\theta}$ about θ. The firm just selects the policy that reveals its true type. If $\sigma = \theta$, a benevolent agency always conveys to Congress a report $r = \theta$ and bargains with the firm by sharing the same information. Nevertheless, a dishonest agency may find it convenient to collude with the firm by signing a side contract which specifies a transfer $T^{F}(r)$ from the firm to the agency in exchange for the retention of information through a report $r = \phi$.

(V) Contracts are executed and the regulatory policy is implemented.

To solve the model and derive the optimal institutional response to the threat of collusion, we study four cases. In case I, the agency is benevolent and there is symmetric information about the firm's cost function. In case II, the agency is still benevolent but has asymmetric information about the cost parameter. Cases III and IV refer to a nonbenevolent agency, whose supervisory activity fails and succeeds respectively.

3. Benevolent agency

With probability γ Congress faces a benevolent agency, which completely internalizes the objective of maximizing the consumers' surplus and contents itself with receiving the reservation transfer $\overline{T} \equiv 0$. For the moment, we suppose that Congress tolerates the threat of collusion. Hence, it offers a reward $T^{C} = \overline{T}$ to the agency, independently of its report r. As long as the regulator is benevolent, it transmits its information truthfully. In the two following subsections we consider cases I and II respectively.

3.1. Symmetric information ($\sigma = r = \theta$)

A benevolent agency discovers with probability ζ the cost parameter and negotiates with the firm over a regulatory mechanism, by sharing the same information. Adopting the Nash approach, the bargaining problem can be modelled through the following maximization program

$$\max_{V_B,\pi} V_B^{\alpha} \cdot \pi^{1-\alpha} \tag{3.1.1}$$

$$s.t.$$

$$V_B \geq 0 \tag{PC$_A$}$$

$$\pi \geq 0. \tag{PC$_F$}$$

The parameter $\alpha \in (0,1)$ denotes the agency's bargaining strength.

The nonnegativity constraints (PC$_A$) and (PC$_F$) are respectively the agency's and firm's participation constraints.

After substituting (2.5), as defined by (2.2), and (2.3) into (3.1.1), the regulatory mechanism $\left(p_B^{SI}, S_B^{SI}\right)$, which determines the price of the service and the subsidy to the firm in the case of informed benevolent agency, is the solution of the following

$$\max_{p,S} \left[\int_p^{\frac{a}{b}} (a - bp^o)\, dp^o - S\right]^{\alpha} \cdot \left[p\,(a - bp) + S - c\,(a - bp) - \theta\right]^{1-\alpha} \tag{3.1.2}$$

$$s.t. \quad (PC_A),\ (PC_F),\ (C_p),\ (C_S),$$

where (C$_p$) and (C$_S$) are the nonnegativity constraints on price and subsidy given respectively by

$$p \geq 0 \tag{C$_p$}$$

and

$$S \geq 0. \tag{C$_S$}$$

If we replace the choice variable S with π from (2.3) into (3.1.2), the maximization problem may be rewritten as

$$\max_{p,\pi} \left[\int_p^{\frac{a}{b}} (a - bp^o)\, dp^o - \pi + p\,(a - bp) - c\,(a - bp) - \theta\right]^{\alpha} \cdot \pi^{1-\alpha}$$

$$s.t. \quad (PC_A)\,,\ (PC_F)\,,\ (C_p)\,,\ (C_S)\,.$$

The price arising from negotiations is equal to

$$p_B^{SI} = c. \tag{3.1.3}$$

The pricing policy on which the informed benevolent agency and the firm agree applies the marginal cost pricing rule[12]. Hence, the agency perfectly succeeds in maximizing the consumers' net gain from the marketplace, independently of its bargaining strength. Evidently, not even the firm has any incentive to distort price above marginal cost, since it prefers to extract the consumers' surplus through a subsidy[13].

The predicted profit is equal to

$$\pi_B^{SI} = (1-\alpha)\left[\frac{a^2}{2b} - \frac{c}{2}(2a - bc) - \theta\right]. \tag{3.1.4}$$

Expression (3.1.4) shows that the profit arising from negotiations is decreasing in α[14]. The better the agency is organized and equipped with human and financial endowments in the bargaining process, the smaller is the profit that the firm can obtain from the regulatory arrangement.

Substituting (3.1.4) into (2.3) yields the equilibrium subsidy

$$S_B^{SI} = (1-\alpha)\left[\frac{a^2}{2b} - \frac{c}{2}(2a - bc)\right] + \alpha\theta. \tag{3.1.5}$$

It can be easily shown from (3.1.5) that there is a negative relation between the subsidy to the firm and the agency's bargaining power[15]. A very weak agency ($\alpha \to 0$) allows the firm to get a high subsidy which finances its profit. If all the bargaining power is allocated to the agency ($\alpha \to 1$), the firm is barely able to cover its fixed costs through the subsidy ($S_B^{SI} \to \theta$) and receives no rent.

[12] Notice that this result holds as long as $c \in \left(0, \frac{a}{b}\right)$. If $c \geq \frac{a}{b}$, no production can occur.

[13] A firm that could maximize its profit subject to a zero consumers' surplus constraint would set a price equal to marginal cost and capture all the consumers' gain through a subsidy.

[14] Notice that the expression in square brackets must be positive.

[15] To see this result, consider that $\frac{\partial S_B^{SI}}{\partial \alpha}$ is just the opposite of the expression in square brackets in (3.1.4). Moreover, observe that the nonnegativity constraint on subsidy (C_S) is slack in equilibrium since the expression in (3.1.5) is strictly positive.

3.2. Asymmetric information ($\sigma = r = \phi$)

With probability $(1-\zeta)$ the supervisory activity fails and the agency does not observe the firm's cost parameter. Hence, the two bargaining parties agree on a regulatory mechanism $\left(p_B^{AI}, S_B^{AI}\right)$, which specifies the price of the service and the subsidy to the firm when the benevolent agency faces a situation of asymmetric information. Such a mechanism must be direct and incentive compatible in order to induce the firm to reveal its private information. Formally, the bargaining problem may be set up as follows

$$\max_{p(\theta),S(\theta)} \int_{\theta^-}^{\theta^+} \left[\int_{p(\theta)}^{\frac{a}{b}} (a - bp^o)\, dp^o - S \right]^{\alpha} \cdot \{p(\theta)\,[a - bp(\theta)] + S(\theta) + -c\,[a - bp(\theta)] - \theta\}^{1-\alpha} f(\theta)\, d\theta \tag{3.2.1}$$

$$s.t. \quad (PC_A),\ (PC_F),\ (C_p),\ (C_S),\ (ICC_F),$$

where (ICC_F) is the incentive compatibility constraint of the firm given by[16]

$$\pi(\theta) = \pi\left(\theta^+\right) + \theta^+ - \theta. \tag{ICC_F}$$

Substituting the choice variable $S(\theta)$ with $\pi\left(\theta^+\right)$ from (2.3), as determined by (ICC_F), into (3.2.1) yields

$$\max_{p(\theta),\pi\left(\theta^+\right)} \int_{\theta^-}^{\theta^+} \left\{ \int_{p(\theta)}^{\frac{a}{b}} (a - bp^o)\, dp^o - \pi\left(\theta^+\right) + p(\theta)\,[a - bp(\theta)] - c\,[a - bp(\theta)] - \theta^+ \right\}^{\alpha} \cdot \left[\pi\left(\theta^+\right) + \theta^+ - \theta\right]^{1-\alpha} f(\theta)\, d\theta \tag{3.2.2}$$

$$s.t. \quad (PC_A),\ (PC_F),\ (C_p),\ (C_S),\ (ICC_F).$$

The price arising from negotiations is

$$p_B^{AI} = p_B^{SI} = c. \tag{3.2.3}$$

[16] Baron [**1**] provides the formal derivation of the condition for incentive compatility, which is necessary and sufficient for the cost function in (2.4).

The failure of the audit activity does not prevent the pricing policy agreed upon from being Pareto efficient. Anyway, notice that this result cannot be generalized to situations of asymmetric information different from that considered here. Only if the uncertainty just concerns the fixed costs, there is not any reason to distort price. The formal justification for this result comes from the fact that the only additional condition in the asymmetric-information problem - the incentive compatibility constraint - does not depend on price as long as the firm's private information is about the fixed costs[17].

The predicted profit of the most inefficient firm is

$$\pi_B^{AI}\left(\theta^+\right) = (1-\alpha)\left[\frac{a^2}{2b} - \frac{c}{2}\left(2a - bc\right) - \theta^+\right]. \tag{3.2.4}$$

A comparison between (3.2.4) and (3.1.4) reveals that $\pi_B^{AI}\left(\theta^+\right)$ is the same profit that a θ^+-firm would get under symmetric information. The most inefficient firm does not have any informational advantage and then there is no need to reward it for its private information. Substituting (3.2.4) into (ICC_F) yields the predicted profit of a θ-firm

$$\pi_B^{AI}\left(\theta\right) = (1-\alpha)\left[\frac{a^2}{2b} - \frac{c}{2}\left(2a - bc\right) - \theta^+\right] + \theta^+ - \theta = \pi_B^{AI}\left(\theta^+\right) + \theta^+ - \theta, \tag{3.2.5}$$

using (3.2.4). Equation (3.2.5) shows that under asymmetric information a firm of type θ is able to obtain the information rent $\left(\theta^+ - \theta\right)$ besides the θ^+-firm's profit.

Taking the difference between (3.2.5) and (3.1.4) yields

$$\pi_B^{AI} - \pi_B^{SI} \equiv \Delta\pi = \alpha\left(\theta^+ - \theta\right), \tag{3.2.6}$$

which represents the extraprofit that a firm of type θ can extract under asymmetric information. Of course, this is increasing in the information rent $\left(\theta^+ - \theta\right)$. More striking is the positive relation between α and $\Delta\pi$. The better are the agency's professional and financial endowments in the bargaining process, the greater is the firm's stake in having an informational advantage. To understand the rationale of this result, notice that with a very weak agency ($\alpha \to 0$) the firm captures all the consumers' surplus even under symmetric information. Therefore, it is indifferent whether to use its informational advantage or not ($\Delta\pi \to 0$). If all the bargaining power is

[17] See Baron [**1**] for a technical analysis of this topic.

allocated to the agency ($\alpha \to 1$), the firm does not obtain any profit under symmetric information but it is able to extract an information rent in case of asymmetric information [$\Delta\pi \to \left(\theta^{+} - \theta\right)$]. The result in (3.2.6) has crucial implications for the following analysis.

If we replace (3.2.6) into (2.3), we get the subsidy arising from negotiations

$$S_B^{AI} = (1-\alpha)\left[\frac{a^2}{2b} - \frac{c}{2}(2a - bc)\right] + \alpha\theta^{+}. \tag{3.2.7}$$

If we subtract (3.1.5) from (3.2.7), we get

$$S_B^{AI} - S_B^{SI} = \alpha\left(\theta^{+} - \theta\right) = \Delta\pi,$$

by (3.2.6). It is immediate to notice that the extraprofit $\Delta\pi$ appropriated by the firm under asymmetric information is enterely subsidized by consumers.

4. Nonbenevolent agency

A nonbenevolent agency, which is drawn with probability $(1-\gamma)$, is interested in the consumers' surplus, according to the parameter β, and in the private transfer T that may come from either consumers, through the taxes they pay, or the firm, which may be willing to grant a side transfer to the agency in exchange for the concealment of the informative signal. We continue to assume that Congress tolerates the threat of collusion. Hence, it offers a reward $T^C = \overline{T}$ to the agency, independently of its report r. A dishonest regulator has an incentive to collude with the firm. In the two following subsections, we consider cases III and IV respectively.

4.1. Asymmetric information ($\sigma = r = \phi$)

If the supervisory activity fails, the agency does not have any discretion and can only convey to Congress the uninformative signal. The firm enjoys its informational advantage without bribing the agency. Therefore, the regulatory mechanism $\left(p_{NB}^{AI}, S_{NB}^{AI}\right)$, which specifies the price of the service and the subsidy to the firm with an asymmetrically informed nonbenevolent regulator, can be derived from the following maximization problem

$$\max_{p(\theta),S(\theta)} \int_{\theta^-}^{\theta^+} \left\{ T + \beta \left[\int_{p(\theta)}^{\frac{a}{b}} (a - bp^o)\, dp^o - S \right] \right\}^{\alpha} \cdot$$

$$\cdot \left\{ p(\theta)\left[a - bp(\theta)\right] + S(\theta) - c\left[a - bp(\theta)\right] - \theta \right\}^{1-\alpha} f(\theta)\, d\theta \qquad (4.1.1)$$

$$s.t. \quad (PC_A),\ (PC_F),\ (C_p),\ (C_S),\ (ICC_F).$$

The expression in the first braces represents the utility of a dishonest agency, which is given by (2.6), as specified by (2.2). The term in the second braces is the firm's profit, as defined by (2.3) and (2.4). Notice that the participation contraint (PC_A) is now given by $V_{NB} \geq 0$, because the agency is nonbenevolent.

Since the regulator is not able to collect any transfer greater than its reservation income ($T = \overline{T} = 0$), the program in (4.1.1) reduces to (3.2.1) except for the parameter β, which anyway does not affect the solution of the problem. Hence, we get $\left(p_{NB}^{AI}, S_{NB}^{AI}\right) = \left(p_B^{AI}, S_B^{AI}\right)$. A self-interested agency behaves like a benevolent one under asymmetric information since there is no scope for collusion.

4.2. Symmetric information: scope for collusion ($\sigma = \theta \neq r = \phi$)

The agency's detection of the firm's cost parameter opens the possibility of collusion. The firm has a stake in the agency's report, since the retention of the informative signal guarantees the extraprofit $\Delta\pi$ given by (3.2.6). Hence, the firm is willing to sign with the agency a side contract which provides for the concealment of information in exchange for a covert transfer T^F. As long as Congress tolerates the threat of such a coalition and offers $T^C = \overline{T}$ to the agency, the latter has an incentive to reach a collusive agreement with the firm.

The side contract between the firm and the regulator is assumed to be enforceable, even though it is illegal. This approach, which is usually taken in the literature, is clearly a shortcut since it simply presumes that any gain from trade between parties is realized[18]. Anyway, the enforceability-of-side-

[18] Really, the enforcement of side contracts may be assumed to rely on non-judicial mechanisms, like reputation in long-term relationships and the "word of honor" in the one-shot relationships. See Tirole [**16**], Laffont and Tirole [**12**, cap. 11] and Laffont [**8**, cap. 2] for a deeper discussion on this topic.

contracts assumption is a good description of cases in which collusion works well.

The side contracting is supposed to involve a deadweight loss. Following Laffont and Tirole [**11**], we capture this inefficiency by introducing an exogenous shadow cost of side transfers $\mu \geq 0$. This parameter determines the kind of transaction technology between the firm and the agency. If $\mu \to +\infty$, the transaction technology is too inefficient and no coalition forms. If the shadow cost is lower, the transaction technology makes collusion profitable. When $\mu = 0$, there is no deadweight loss from the side contracting.

The firm and the agency bargain at the same time over a regulatory mechanism and a side contract. The regulatory arrangement $\left(p_{NB}^{SI}, S_{NB}^{SI}\right)$ arising from collusive negotiations allows the firm to keep its informational advantage with respect to Congress even though the agency is symmetrically informed about the cost function. The side contract specifies a covert transfer $T_{NB}^{F}(r) \geq 0$ conditional on $r = \phi$ through which the firm reciprocates the favour.

We assume that in case of disagreement about the side contract the agency and the firm continue to negotiate over the regulatory mechanism and can reach the no-collusion outcome[19]. In this case, the agency would not receive any bribe ($T^F = 0$) and would reveal the informative signal to Congress, which could save the extraprofit to the firm ($\Delta\pi = 0$). Hence, the solution of the complex bargaining problem explained above is given by the maximization of the expected product[20] of the two parties' gains in utility over the no-side-contract outcome. Formally,

$$\max_{V_{NB},\pi} \int_{\theta^-}^{\theta^+} \left[V_{NB}(\theta) - (V_{NB})_{T^F=0}\right]^{\alpha} \cdot \left[\pi(\theta) - (\pi)_{\Delta\pi=0}\right]^{1-\alpha} f(\theta)\, d\theta \qquad (4.2.1)$$

$$s.t. \quad (PC_A),\ (PC_F),\ (C_p),\ (C_S),\ (C_{T^F}),\ \left(ICC_F^C\right),$$

where (C_{T^F}) is the nonnegativity constraint on the side transfer T^F, which is given by

$$T^F \geq 0, \qquad (\mathrm{C}_{T^F})$$

[19] This is consistent with Tirole's [**16**] view, according to which each party can guarantee itself the no-side-contract outcome.

[20] The expectation is taken from Congress's point of view.

and (ICC_F^C) is the incentive compatibility constraint of the firm under collusion, which is equal to

$$\pi(\theta) = \pi_B^{AI}\left(\theta^+\right) + \theta^+ - \theta - (1+\mu)\,T^F. \qquad (\text{ICC}_F^C)$$

Since the agency claims that its supervisory activity has failed, Congress is willing to accept a regulatory mechanism which is incentive compatible and guarantees to the firm the profit of the most inefficient type [$\pi_B^{AI}\left(\theta^+\right) = \pi_{NB}^{AI}\left(\theta^+\right)$, see Subsection 4.1] plus the information rent $\left(\theta^+ - \theta\right)$. The side transfer T^F to the agency costs $(1+\mu)\,T^F$ to the firm.

To solve the maximization program, first observe that in case of disagreement about the side contract the bargaining problem reduces to (3.1.2) except for the parameter β which anyway does not influence the outcome of the problem. Therefore, the agency's no-collusion utility is equal to the symmetric-information consumers' surplus CS_B^{SI} weighted by β [i.e. $(V_{NB})_{T^F=0} = \beta CS_B^{SI}$], while the firm's no-collusion profit is given by π_B^{SI} [i.e. $(\pi)_{\Delta\pi=0} = \pi_B^{SI}$]. After substituting (2.6), as defined by (2.2), and (2.3) into (4.2.1), the regulatory mechanism $\left(p_{NB}^{SI}, S_{NB}^{SI}\right)$ and the side transfer T_{NB}^F can be derived from the following maximization program

$$\max_{T^F,p(\theta),S(\theta)} \int_{\theta^-}^{\theta^+} \left\{ T^F + \beta \left[\int_{p(\theta)}^{\frac{a}{b}} (a - bp^o)\,dp^o - S \right] - \beta CS_B^{SI} \right\}^{\alpha} \cdot$$

$$\cdot \left\{ p(\theta)\left[a - bp(\theta)\right] + S(\theta) - c\left[a - bp(\theta)\right] - \theta - \pi_B^{SI} \right\}^{1-\alpha} f(\theta)\,d\theta \qquad (4.2.2)$$

$$s.t. \quad (PC_A),\ (PC_F),\ (C_p),\ (C_S),\ (C_{T^F}),\ \left(ICC_F^C\right).$$

If we replace from (2.3) the choice variable $S(\theta)$ with $\pi(\theta)$ and notice from (ICC_F^C) that $\pi(\theta)$ is entirely determined by T^F, the program in (4.2.2) reduces to the maximization with respect to $p(\theta)$ and T^F. Substituting (ICC_F^C), as specified by (3.2.5), and (3.1.4) into (4.2.2) yields after a simple manipulation

$$\max_{T^F,p(\theta)} \int_{\theta^-}^{\theta^+} \left\{ T^F + \beta \left[\int_{p(\theta)}^{\frac{a}{b}} (a - bp^o)\,dp^o - (1-\alpha)\left[\frac{a^2}{2b} - \frac{c}{2}(2a - bc) - \theta^+\right] + \right.$$

$$-\theta^{+}+(1+\mu)\,T^{F}+p\,(\theta)\,[a-bp\,(\theta)]-c\,[a-bp\,(\theta)]-CS_{B}^{SI}\big]\big\}^{\alpha}\cdot$$

$$\cdot\left[\alpha\left(\theta^{+}-\theta\right)-(1+\mu)\,T^{F}\right]^{1-\alpha}f\,(\theta)\,d\theta \tag{4.2.3}$$

$$s.t.\quad (PC_{A})\,,\ (PC_{F})\,,\ (C_{p})\,,\ (C_{S})\,,\ (C_{T^{F}})\,.$$

Notice that the firm's gain in profit over the no-collusion outcome, represented by the second factor in square brackets of the product maximization, is just the extraprofit $\Delta\pi=\alpha\left(\theta^{+}-\theta\right)$ in (3.2.6) that the firm extracts under asymmetric information minus the expense $(1+\mu)\,T^{F}$ to bribe the agency.

The predicted price is

$$p_{NB}^{SI}=p_{B}^{SI}=c. \tag{4.2.4}$$

The collusion between the firm and the agency does not affect the equilibrium price, which is still Pareto efficient. Neither of the two parties has any interest in inducing allocative inefficiency, since the consumers' surplus can be eroded through the subsidy at zero social costs.

The side transfer agreed upon is

$$T_{NB}^{F}=\alpha\frac{\alpha+\beta\,(1+\mu)}{(1+\mu)\,[1+\beta\,(1+\mu)]}\left(\theta^{+}-\theta\right). \tag{4.2.5}$$

The bribe that the agency can extort from the firm is increasing in its bargaining power. If $\alpha\to 0$, the regulator does not collect anything ($T_{NB}^{F}\to 0$) since it is too weak. If $\alpha\to 1$, all the bargaining power is allocated to the agency and the side transfer tends to

$$\lim_{\alpha\to 1}T_{NB}^{F}=\frac{\theta^{+}-\theta}{1+\mu}=\frac{\Delta\pi}{1+\mu}, \tag{4.2.6}$$

by (3.2.6). This is just the extraprofit that the firm can obtain under asymmetric information discounted by the shadow cost of side transfers. It represents the maximum reward to the agency in order to manipulate the evidence. Notice that, as expected, the side transfer in (4.2.5) approximates the take-it-or-leave-it proposal by the agency usually assumed in the literature[21].

[21] See, among others, Laffont [**9**, cap. 2].

Finally, it is important to notice from (4.2.5) the positive relation between the side transfer T_{NB}^{F} and the information rent $\left(\theta^{+}-\theta\right)$. A more inefficient firm has a reduced stake in collusion and offers a smaller side payment to the agency. In particular, a θ^{+}-firm does not bribe the regulator at all ($T_{NB}^{F}=0$) since it has no informational advantage to keep. This result is consistent with the standard formulation of two-type models of collusion, in which only the most efficient firm has an incentive to collude with the agency.

After substituting (4.2.5) into (ICC_{F}^{C}), as specified by (3.2.5), we get the profit of a θ-firm arising from collusive negotiations

$$\pi_{NB}^{SI}(\theta)=(1-\alpha)\left[\frac{a^{2}}{2b}-\frac{c}{2}(2a-bc)-\theta^{+}+\left(\theta^{+}-\theta\right)\frac{1+\alpha+\beta(1+\mu)}{1+\beta(1+\mu)}\right]. \tag{4.2.7}$$

For our purposes it is useful to express (4.2.7) as a function of (3.1.4). Hence,

$$\pi_{NB}^{SI}=\pi_{B}^{SI}+\alpha\frac{1-\alpha}{1+\beta(1+\mu)}\left(\theta^{+}-\theta\right).$$

Taking the difference between π_{NB}^{SI} and π_{B}^{SI} yields the firm's extrarent $\Delta\pi^{C}$ from collusion

$$\pi_{NB}^{SI}-\pi_{B}^{SI}\equiv\Delta\pi^{C}=\alpha\frac{1-\alpha}{1+\beta(1+\mu)}\left(\theta^{+}-\theta\right)=\frac{1-\alpha}{1+\beta(1+\mu)}\Delta\pi, \tag{4.2.8}$$

by (3.2.6). Condition (4.2.8) shows how the firm's extraprofit $\Delta\pi$ under asymmetric information, which represents the total stake in collusion, may be split between the agency and the firm. The latter only obtains a fraction of the total pie, which is equal to $\frac{1-\alpha}{1+\beta(1+\mu)}\Delta\pi$. The remaining part $(1+\mu)\,T_{NB}^{F}$ just finances the bribe to the agency.

It is interesting to study the relation between $\Delta\pi^{C}$ and α. Whenever the bargaining power is concentrated in the hands of just one party ($\alpha\rightarrow 0$ or $\alpha\rightarrow 1$), the firm is indifferent whether to collude or not ($\Delta\pi^{C}\rightarrow 0$). Two opposite reasons lead to this result. A very strong firm ($\alpha\rightarrow 0$) is able to extract all the consumers' surplus even under symmetric information and does not have any stake in the agency's report. A very weak firm ($\alpha\rightarrow 1$), even if it has the greatest stake in keeping an informational advantage [$\Delta\pi\rightarrow\left(\theta^{+}-\theta\right)$, see equation (3.2.6)], cannot retain any part of the information rent arising from the concealment of the signal. If the bargaining process does not degenerate into take-it-or-leave-it offers and the bargaining power

is split between the two parties, collusion becomes profitable for the firm ($\Delta\pi^C > 0$). The study of the derivative of $\Delta\pi^C$ with respect to α, equal to

$$\frac{\partial \Delta\pi^C}{\partial \alpha} = \frac{1-2\alpha}{1+\beta\,(1+\mu)}\left(\theta^+ - \theta\right), \tag{4.2.9}$$

shows that the firm maximizes its extrarent from collusion when the bargaining process is symmetric ($\alpha = \frac{1}{2}$)[22]. In other words, the firm has the greatest incentive to form a coalition with an agency which holds the same bargaining strength.

Substituting the firm's profit in (4.2.7) into (2.3) yields immediately the subsidy received by the firm under collusion

$$S_{NB}^{SI} = (1-\alpha)\left[\frac{a^2}{2b} - \frac{c}{2}\,(2a - bc) - \theta^+ + \left(\theta^+ - \theta\right)\frac{1+\alpha+\beta\,(1+\mu)}{1+\beta\,(1+\mu)}\right] + \theta. \tag{4.2.10}$$

In order to get some useful insights about S_{NB}^{SI}, we express (4.2.10) as a function of (3.1.6)

$$S_{NB}^{SI} = S_B^{SI} + \alpha\frac{1-\alpha}{1+\beta\,(1+\mu)}\left(\theta^+ - \theta\right). \tag{4.2.11}$$

Taking the difference between S_{NB}^{SI} and S_B^{SI} yields

$$S_{NB}^{SI} - S_B^{SI} \equiv \Delta S^C = \Delta\pi^C. \tag{4.2.12}$$

Equation (4.2.12) shows that the firm's extrarent $\Delta\pi^C$ is just financed through the extrasubsidy ΔS^C paid by consumers under collusion. We know from (4.2.9) that the firm maximizes its extrarent from collusion when the bargaining process is symmetric. Therefore, consumers are particularly penalized by a collusive agreement between parties which hold the same bargaining power.

5. The institutional responses to collusion

So far we have supposed that Congress *tout court* tolerates the threat of collusion. However, Congress's behaviour is unconsistent with policy recommendations arising from Tirole's equivalence principle, according to which without any loss of generality the organization designer may restrict itself to

[22] The negativity of the second derivative $\frac{\partial^2 \Delta\pi^C}{\partial \alpha^2}$ guarantees that $\alpha = \frac{1}{2}$ is a maximizer.

contracts that do not induce collusion in equilibrium[23]. One of the main assumptions on which this principle is based is the screening condition, which allows to the principal, that perfectly anticipates the collusive agreement, to devise mechanisms where different types of agents distinguish themselves from one another. Therefore, if a screening contract is feasible, deterring collusion should be optimal in equilibrium. We find that, even if Congress is able to discriminate between the agency's types, Tirole's equivalence principle fails in our setting and allowing collusion turns out to be optimal as long as the agency is sufficiently strong in the regulatory process. Hence, Congress's decision of tolerating corruption, which *facie prima* might seem naive, turns out to be the best strategy under certain conditions. Consistently with Kofman and Lawarrée [**7**], this result is reinforced when a screening contract is not enforceable. We devote the following two subsections to the derivation and the assessment of these important findings.

5.1. Discrimination between the agency's types

If Congress decides to fight collusion, the consumers' expected surplus under type discrimination is given by

$$E\left[CS_D^{NC}\right] = E\left[CS_B\right] - \zeta\left(1-\gamma\right)\left(1+\lambda\right)T_{NB}^F. \tag{5.1.1}$$

Preventing corruption guarantees the same expected surplus as with a certainly benevolent agency $E\left[CS_B\right]$ minus an incentive reward equal to the firm's bribe T_{NB}^F, paid through consumers' taxes at a social cost λ, only to the informed dishonest regulator that occurs with probability $\zeta\left(1-\gamma\right)$.

Tolerating collusion involves a consumers' expected surplus equal to

$$E\left[CS^C\right] \equiv \gamma E\left[CS_B\right] + \left(1-\gamma\right)E\left[CS_{NB}\right] =$$

$$= CS^{AI} + \zeta\gamma\Delta\pi + \zeta\left(1-\gamma\right)\left(1+\mu\right)T_{NB}^F. \tag{5.1.2}$$

Under the possibility of collusion, consumers expect a welfare equal to the asymmetric-information level $CS^{AI} \equiv CS_B^{AI} = CS_{NB}^{AI}$ (see Subsection 4.1) plus the extraction of the firm's extraprofit $\Delta\pi$ if the agency is benevolent and informed, which occurs with probability $\zeta\gamma$, and the firm's expense $\left(1+\mu\right)T_{NB}^F$ to bribe an informed dishonest agency, which is drawn with

[23] Notice that the theory is silent on whether collusion occurs in equilibrium. The logic of the equivalence principle implies that, if there is an optimal contract where collusion persists in equilibrium, then it is possible to replicate the payoff vector of this contract by using a truth-telling machanism.

probability $\zeta(1-\gamma)$, since *ceteris paribus* this expense reduces the firm's extrarent from collusion subsidized by consumers.

Congress finds it optimal to deter collusion if and only if $E\left[CS_D^{NC}\right]$ that consumers expect to receive under this strategy is at least as high as $E\left[CS^C\right]$ under collusion. That is,

$$E\left[CS_D^{NC}\right] \geq E\left[CS^C\right]. \tag{5.1.3}$$

Substituting (5.1.1) and (5.1.2), condition (5.1.3) becomes after some simple manipulations

$$\frac{T_{NB}^F}{\Delta\pi} \leq \frac{1}{2+\mu+\lambda} \equiv \Psi_D, \tag{5.1.4}$$

Condition (5.1.4) states that preventing collusion is optimal if and only if the fraction of the total stake in collusion appropriated by the agency $\frac{T_{NB}^F}{\Delta\pi}$ does not exceed a threshold value Ψ_D. In other words, Congress finds it convenient to avoid collusion as long as the incentive reward to the agency for disclosing the informative signal is relatively small.

Not surprisingly, Ψ_D is decreasing in μ and λ. When the side contracting becomes more inefficient (μ goes up), the increase in the firm's expense to bribe the agency benefits consumers who enjoy a reduction in the subsidy which finances the firm's extrarent from collusion. Hence, a decreased cost of corruption for consumers makes more binding the condition for deterring this threat. An increase in the level of tax distortion (λ goes up) lowers Ψ_D since the reward to the agency becomes more socially costly to finance.

Replacing T_{NB}^F and $\Delta\pi$ with their expressions given by (4.2.5) and (3.2.6) and combining terms, (5.1.4) may be rewritten as follows

$$\alpha \leq \frac{(1+\mu)\left[1-\beta(1+\lambda)\right]}{2+\mu+\lambda} \equiv \alpha_D^*, \tag{5.1.5}$$

where

$$\alpha_D^* < 1. \tag{5.1.6}$$

Condition (5.1.5) shows that Congress prefers to deter collusion if and only if the regulatory agency is not sufficiently endowed with financial and institutional powers to negotiate with the firm. Avoiding collusion is optimal because a weak agency requires a low reward to refuse the coalition with the firm.

If $\alpha > \alpha_D^*$, condition (5.1.5) is not fulfilled and Congress finds it optimal to allow collusion. A corrupted agency with a high bargaining power makes

consumers better off with respect to the no-collusion outcome since it is able, on the one hand, to capture a high bribe from the coalition (which implies a high reward to refuse collusion), by limiting the firm's extrarent financed by consumers, and, on the other hand, to defend, even if partially (as long as $\beta \neq 0$), consumers' interests in the bargaining process. When the regulator is very strong ($\alpha \to 1$), consumers are not affected at all by corruption since the firm is not able to capture any gain from the collusive agreement. Indeed, condition (5.1.6) implies that there exists a range $(\alpha_D^*, 1)$ of values for α where it is optimal to allow collusion.

5.1.1. Interpretation of results. Why does Tirole's equivalence principle fail?

It is interesting to understand why in our setting the standard conclusions on the optimality of deterring collusion, which arise from Tirole's equivalence principle, do not hold even under the usual assumptions of collusion models. As shown before, by adopting the common hypothesis of allocation of all the bargaining power to the agency, our model even predicts that allowing collusion is always optimal in equilibrium.

To this purpose, it is important to identify the key elements of our framework which may lead to an alteration of the standard optimal organizational response to the threat of collusion.

The explanation for our results should be found in the overcoming of the classical three-tier regulatory hierarchy. Remember that in our setting the regulatory agency is not a mere auditor whose unique task is to disclose the firm's cost parameter to the principal that maximizes a social welfare function, as is usually supposed in the collusion literature. The regulator is also endowed with financial and institutional powers to bargain the regulatory mechanism with the firm. This approach, which reflects the crucial role actually played by these two parties in the regulatory process, makes collusion less detrimental to consumers for two reasons. Firstly, the profitability of collusion is reduced in our model, since the total gains of the coalition $\Delta\pi = \alpha\left(\theta^+ - \theta\right)$ are lower than the total stake in collusion which the standard collusion models suppose to be equal to the information rent $\left(\theta^+ - \theta\right)$ kept by the firm when the supervisor hides its signal. Secondly, consumers benefit indirectly from the side contracting because they can save an amount corresponding to the firm's expense to bribe the agency on the subsidy which finances the firm's extrarent from collusion. Therefore, collusion turns out to be a phenomenon which may be worth tolerating in a regulatory setting.

5.2. No discrimination between the agency's types

The results derived in the previous subsection crucially depend on Congress's ability to discriminate between honest and dishonest agencies. In this subsection we remove this assumption, which may seem too strong and unrealistic. When it decides to fight collusion, Congress is now supposed to design an incentive scheme which applies to both an honest and a dishonest regulator. As Tirole [**16**] suggests, this condition may be given the following interpretation. From Subsection 4.2 we know that if $\mu \to +\infty$ the side contracting is so inefficient to make collusion unfeasible. This is the same outcome as with a benevolent agency. With a lower shadow cost of side transfers collusion becomes profitable. This is what occurs with a nonbenevolent agency. Therefore, the impossibility of signing a screening contract may be thought of as Congress's uncertainty about a binary transaction technology of collusion.

We suppose that institutional constraints - arising from the incompleteness of contracts - prevent Congress from devising an incentive compatible mechanism which induces the self-selection of regulators according to their type. In other words, Congress cannot distinguish between the regulator's types because legal arrangements prohibit to make the reward of the agency's staff contingent on some variables that reveal the regulator's type.

As emphasized in the collusion literature[24], removing the screening condition implies that Tirole's equivalence principle fails. Therefore, we expect that allowing collusion may be optimal. Our main purpose is to analyze how the impossibility of discerning between the agency's types affects our previous results about the optimal response to collusion.

If Congress decides to prevent collusion, the consumers' expected surplus under no type discrimination is equal to

$$E\left[CS_{ND}^{NC}\right] = E\left[CS_B\right] - \zeta\left(1+\lambda\right)T_{NB}^{F}. \tag{5.2.1}$$

In order to get the no-collusion outcome and the associated consumers' expected surplus $E\left[CS_B\right]$, Congress has to design a "bunching mechanism", that gives a reward T_{NB}^{F}, paid through consumers' taxes at a social cost λ, to any type of informed agency, which occurs with probability ζ.

Taking the difference between $E\left[CS_{ND}^{NC}\right]$ and $E\left[CS_{D}^{NC}\right]$, as expressed by (5.2.1) and (5.1.1), we get the consumers' expected surplus loss $\left|\Delta E\left[CS^{NC}\right]\right|$ from the prohibition of screening

[24] See Kofman and Lawarrée [**8**] and Tirole [**17**].

$$\left|E\left[CS_{ND}^{NC}\right] - E\left[CS_{D}^{NC}\right]\right| \equiv \left|\Delta E\left[CS^{NC}\right]\right| = \zeta\gamma\left(1+\lambda\right)T_{NB}^{F}. \tag{5.2.2}$$

To make sure that collusion does not occur, Congress that cannot type discriminate must grant an incentive payment, for which consumers expend $(1+\lambda)\,T_{NB}^{F}$, even to the informed benevolent agency, which occurs with probability $\zeta\gamma$. Notice that the amount of money given by (5.2.2) represents a sheer waste of resources because a benevolent agency does not need to be remunerated for disclosing its information.

Congress finds it optimal to deter collusion if and only if $E\left[CS_{ND}^{NC}\right]$ that consumers expect to receive under this strategy is at least as high as $E\left[CS^{C}\right]$ under collusion. That is,

$$E\left[CS_{ND}^{NC}\right] \geq E\left[CS^{C}\right]. \tag{5.2.3}$$

After substituting (5.2.1), as determined by (3.3.2), and (5.1.2) and combining terms, condition (5.2.3) becomes

$$\frac{T_{NB}^{F}}{\Delta\pi} \leq \frac{1-\gamma}{2+\mu+\lambda-\gamma\left(1+\mu\right)} \equiv \Psi_{ND} \text{ for } \gamma \in [0,1), \tag{5.2.4}$$

where

$$\Psi_{ND} > 0. \tag{5.2.5}$$

It can be easily shown that condition (5.2.4), as specified by (5.2.5), does not apply if $\gamma = 1$. Indeed, Congress simply does not need to care about collusion if the agency is certainly benevolent.

Notice that Ψ_{ND} is decreasing in γ. When the probability of unnecessarily awarding the agency increases (γ goes up), condition (5.2.4) becomes more restrictive (Ψ_{ND} decreases), since deterring collusion is more wasteful.

Taking the difference between Ψ_D and Ψ_{ND}, as expressed by (5.1.4) and (5.2.4), yields

$$\Psi_D - \Psi_{ND} \equiv \Delta\Psi = \frac{\gamma\left(1+\lambda\right)}{\left(2+\mu+\lambda\right)\left[2+\mu+\lambda-\gamma\left(1+\mu\right)\right]} \geq 0. \tag{5.2.6}$$

The nonnegativity of $\Delta\Psi$ in (5.2.6) implies that $\Psi_{ND} \leq \Psi_D$. Without type discrimination, rewarding the agency not to collude is more expensive for consumers, which incur an expected surplus loss given by (5.2.2). This makes more binding the condition for preventing collusion. Therefore, $\Delta\Psi$

may be interpreted as a measure of the negative impact of the impossibility of discriminating on the optimality of deterring collusion.

Notice that $\Delta\Psi$ vanishes and $\Psi_{ND} = \Psi_D$ if and only if $\gamma = 0$. In this case, consumers are not penalized by the impossibility of type screening - i.e. the surplus loss in (5.2.2) disappears - and condition (5.2.4) reduces to (5.1.4). Therefore, allowing collusion may be optimal even if the agency is certainly dishonest. Moreover, there is a positive relation between $\Delta\Psi$ and γ. A higher probability of drawing a nonbenevolent agency (γ goes down) reduces the distortion of Ψ_{ND} from Ψ_D ($\Delta\Psi$ decreases), since deterring collusion is less harmful to consumers [see equation (5.2.2)]. This is consistent with Kofman and Lawarrée's result [**6**], which anyway diverges from ours since it implies the optimality of deterring collusion as long as the agency is certainly dishonest (according to the equivalence principle).

Replacing $\Delta\pi$ and T^F_{NB} with their definitions given by (3.2.6) and (4.2.5), condition (5.2.4) may be rewritten as

$$\alpha \leq \frac{(1+\mu)\left[1-\gamma-\beta\left(1+\lambda\right)\right]}{2+\mu+\lambda-\gamma\left(1+\mu\right)} \equiv \alpha^*_{ND}, \tag{5.2.7}$$

where

$$\alpha^*_{ND} \leq \alpha^*_D. \tag{5.2.8}$$

Consistently with (5.2.6), conditions (5.2.7) and (5.2.8) show that $\alpha^*_{ND} \leq \alpha^*_D$ with the strict equality for $\gamma = 0$. The impossibility of discriminating restricts the range of values for α wherein it is optimal to fight corruption.

If $\alpha^*_{ND} \leq 0$, condition (5.2.7) is never satisfied and Congress prefers to allow collusion whatever the agency's bargaining power is. This occurs when

$$\beta \geq \frac{1-\gamma}{1+\lambda}. \tag{5.2.9}$$

An increase in γ widens the range $\left[\frac{1-\gamma}{1+\lambda}, 1\right]$ of values for β where tolerating collusion is always optimal. In other words, if hiring a benevolent agency becomes likelier, Congress is willing to accept collusion by an agency with a higher degree of corruptability.

6. Concluding remarks

By applying a bargaining approach to the regulation of a natural monopoly, in this paper we have investigated the main determinants and features of

collusion and characterized the institutional responses to this threat. The consumers' surplus maximizing Congress has been supposed to delegate to the regulatory agency both the usual task of monitoring the monopolist's cost function, by adopting a standard supervisory technology which has been generalized to the case of a continuum of the firm's types, and the innovative role of negotiating with the firm the regulatory mechanism, by altering the classical three-tier regulatory hierarchy.

We believe that there exists much scope for future research in this stimulating field. Indeed, our model may be extended in a variety of directions. For instance, the supervisory technology may be modified in order to consider the possibility that the agency can forge the evidence by announcing a wrong cost parameter. This would allow to study the phenomenon of blakmail. Another suggestion is to extend the model by endogenizing the agency's effort to audit, since in practice the regulator can affect the functioning of the supervisory technology and moral hazard turns out to be an important issue. Finally, it may be interesting to see what happens if Congress - whose objective function may be generalized by including also the firm's profit - is allowed to charge pecuniary and nonpecuniary punishments to the agency.

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