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# MODERN REGULATION OF FIRMS IN DEVELOPING COUNTRIES

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## Abstract

In developing countries, empirical evidence suggests that labor unions entail a positive wage gap for unionized workers, in particular in monopolistic and publicly controlled firms. In this paper, we analyze how the presence of a labor union affects the regulation of a monopoly under asymmetric information. Since part of the informational rent left to the monopolistic firm benefits to the syndicate, we prove that the regulator is induced to lower the rent when the union has a large bargaining power. The net consumers' surplus can either increase or decrease with the firm's bargaining power depending on the firm's efficiency type.

***JEL classification:*** D42, D82, J51

***Key words:*** Asymmetric information, labor union, monopolistic firm

## 1.Introduction

In less developed countries (LDCs), it is well recognized that a barrier to development stems from inefficiencies in the public sector because of excessive labor redundancy. As a consequence, movements of liberalization and privatization such as those occurring in African countries during the nineties constitute important reforms that should improve the efficiency of the public sector. This process of restructuration is always conducted within the framework inherited from developed countries. Indeed, statements concerning public reforms in LDCs rely on inferences from theoretical models inspired by the new regulatory economics and also on inferences from empirical studies conducted in developed countries. However, the particular findings from the study of developed economies are unlikely to extend to the case of developing economies, because of the different political and institutional contexts.

Thus, in the design of optimal regulatory policies, it is important to amend existing theoretical models to account for some particular circumstances of developing countries. Curiously, as noted

by Laffont (2001), problems in the theory of regulation for developing countries have received little attention. An important feature in LDCs concerns the lack of information suffered by regulators. Large firms have private information about their efficiency type, so that the regulator is forced to leave informational rent to discipline the firms and provide them with incentives to reveal their true type. While the consequences of asymmetric information on optimal contracts are now well established (see Laffont and Tirole, 1993), the significant role of labor unions has been neglected by economists in their theoretical analyses of restructuring the public sector.

The main objective of labor unions is to raise the wages of workers that they represent, so that unions are often identified as monopolies. Since the level of wage is higher with unions, such wage-making activities are more likely to persist in the long run when firms possess some monopolistic feature<sup>1</sup>. Across countries, it is well known that monopolistic product markets are most hospitable to unionism, whether the monopolies are private or public. Clearly, as one focuses on situations where unions share monopolistic rents with firms, these effects tend to be higher in public sector labor markets (see the

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<sup>1</sup> On the role of product market power on unionization, see among others Layard et alii (1991).

discussion in Pencavel, 1997). Since union membership of public sector workers usually exceeds that of private sector workers, it seems important to account for the role of unionization when implementing regulatory contract in developing countries.

It is often claimed that the levels of unionism are different in developed and less developed countries. Since unions mainly concerns employees and since a large fraction in LDCs are self-employed or participate in family activities, lower levels of unionism are expected in such countries. Labor unions are concentrated in the formal sector : workers concerned by collective bargaining are more likely to be employed by the public sector and by large private sector firms (see Pencavel, 1997). Clearly, monopolistic and publicly-controlled firms are mostly concerned by the implementation of regulatory contracts. Two stylized facts characterize the importance of unionism in developing countries.

First, the participation of workers in labor union is not uncommon. According to the data collected by the World Bank, union rates are generally comprised between 10 and 30 percents for

non-agricultural workers<sup>2</sup>. Of course, unionization rates strongly differ among countries, and they are affected by the level of economic development and also by the legal framework of collective bargaining. Second, recent empirical evidence outlines the power of labor unions in poor countries, with a significant wage premium for unionized workers (see Schultz and Mwabu, 1998, Teal, 1996, Velenchik, 1997). While a few studies exhibit a negative wage gap, most recent analyses from microeconomic surveys suggest that the impact of unionization on wages is greater in developing countries than in developed countries. Some authors obtain a positive wage gap that is less than 10 percent (MacIssac and Rama, 1997, Owoye, 1994, Velenchik, 1997), but the most frequent conclusion is a unionization wage premium with a magnitude of about 20 percents (Bhattacharjee and Chaudhuri, 1994, Moll, 1993, Schultz and Mwabu, 1998, Standing, 1992).

Despite the significant impact of unionization in developing countries, previous issues in the theory of regulation have failed to account for the presence of labor unions. Thus, the aim of the present paper is to extend the analysis of regulation models with asymmetric

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<sup>2</sup> Detailed results are available at [www.worldbank.org](http://www.worldbank.org); see also Upham (1995).

information in order to account for unionization. For that purpose, we draw on the case of the regulation of a monopolist with unknown costs (Baron and Myerson, 1982).

When a firm has better information regarding its costs than the regulator, the optimal regulatory policy satisfies the constraint that the firm is induced to report truthfully the information desired by the regulator. Thus, a feasible regulatory policy that maximizes social welfare entails a welfare loss due to informational asymmetry. To prevent the firm from misrepresenting its costs, the optimal regulatory price depends on the regulator information about the firm's costs (Guesnerie and Laffont, 1984). The regulatory price is generally higher than the firm's marginal costs and it may exceed the unregulated monopoly price<sup>3</sup>. Also, the optimal subsidy left to the monopolistic firm may either increase or decrease with the level of costs announced by the firm, while the firm's expected profit is always a decreasing function of the firm's cost parameter.

Since unionism affects the wage levels and then the cost structures of firms, it is also expected to modify the characterization of

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<sup>3</sup> In that case, the super monopoly price is a punishment less severe than the shut-down solution, since the regulated price still generates some consumers' surplus (Baron and Myerson, 1982).



the optimal regulatory contract. A fraction of the optimal subsidy from the regulator benefits to the syndicate. We present an extended framework that encompasses two stylized facts of labor markets, namely the lack of information suffered by regulators and the presence of labor unions. This type of theoretical reasoning operates satisfactorily for drawing inferences about labor markets in developing economies. We focus on the problem of how to regulate a unionized monopoly in a setting of asymmetric information. By accounting for a labor union that bargains efficiently with a monopolistic firm, we prove that unionized workers receive a fraction of the regulatory transfer through higher salaries. It follows that the optimal price decreases with the bargaining power of the monopoly, whose effect on the consumers' surplus may be either positive or negative depending on the efficiency type of the firm.

The remainder of the paper is organized as follows. We present the basic model in section 2 and examine how the informational rent is shared between the firm and the labor union. In section 3, we characterize the optimal regulatory contract and discuss its main properties. Concluding comments are in section 5.

## 2. A Model of a Unionized Monopoly

We now consider the problem of how to regulate a monopolistic firm with unknown costs and whose workers are all members of a labor union. Our purpose is to characterize the corresponding optimal regulatory contract using the theory of incentives contracting. To analyze the consequences of asymmetric information on the firm's efficiency parameter, we proceed in the following way. First, conditional on the expected subsidy provided by the regulator to the firm, we calculate the expected utilities both for the monopoly and the labor union. Second, given the previous rents, we derive the optimal mechanism that induces a truthful report and characterize the price and transfer of the optimal contract. For the presentation, we successively outline the decisions for the monopolistic firm and for the union and study the result of the bargaining between the two parties. The optimal policy and its properties are derived in the next section.

Let us consider a firm which produces a single homogenous good and is characterized by a monopolistic position on the market. We

rely on a static framework and we assume without loss a generality that the level of technology is fixed. It follows that the production function for the monopoly is defined over only one variable factor. Denoting by  $L$  the quantity of labor, the production function for the firm is expressed as <sup>4</sup> :

$$Q(L) = \frac{L}{\beta} \quad (1)$$

where  $Q(L)$  is the level of output realized by the firm, and  $\beta$  corresponds to the productivity of labor. This cost parameter is an indicator of the firm's performance. In particular, a more efficient firm is characterized by a lower value for the parameter  $\beta$ . While the production function  $Q(L) = \frac{L}{\beta}$  is common knowledge, the productivity parameter  $\beta$  is only known privately to the firm. The cost structure is not known to the regulator, but we assume that the regulator has some subjective prior probability distribution for the unknown parameter  $\beta$ . Unless otherwise, the parameter  $\beta$  can take on any value in the closed interval  $\Omega = [\underline{\beta}, \bar{\beta}]$ , with  $\bar{\beta} > \underline{\beta}$ . The parameter  $\beta$  is modeled as the realization of a random variable with distribution

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<sup>4</sup> Following Laffont and Tirole (1986), one can extend our analysis by considering a general production function of the form  $Q = \frac{L}{f(\beta - e)}$ ,  $f' > 0$  with  $e$  a level of effort which decreases the marginal costs which is  $\beta$ , but leads to similar qualitative results.

$F(\beta)$  and corresponding density  $f(\beta)$  defined over the support  $\mathcal{S}$ . We make the following assumption concerning the cumulative distribution function  $F(\beta)$ .

Assumption 1

$$\frac{d}{d\beta} \left( \frac{F(\beta)}{f(\beta)} \right) \geq 0$$

This may be seen as a decreasing returns assumption, and the monotone hazard rate for  $F(\beta)$  is a condition satisfied by the most standard distributions (Laffont and Tirole, 1993)<sup>5</sup>.

Now, let us denote by  $V(T, L)$  the utility function of the monopolistic firm. The utility level  $V(T, L)$  depends on the subsidy received from the planner and on the payment of salaries. If we denote by  $T$  the monetary transfer paid to the firm by the regulator, the utility function for the monopoly is given by :

$$V(T, L) = T - wL \tag{2}$$

where  $wL$  are incomes paid to workers. We assume that the monopoly does not face any fixed costs, so that production costs are simply equal to labor costs. Hence, the marginal production cost is

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<sup>5</sup> For instance, the monotone hazard rate is satisfied for uniform, normal, logistic, exponential or chi-squared distributions.

constant and equalized with the wage rate. In our setting, it is important to note that the wage rate  $w$  is the result of a bargaining between the monopolistic firm and the labor union.

Let us describe the behavior of the syndicate. There are two key assumptions for our problem. First, there exists only one labor union for the monopolistic firm. Second, all the workers of the firm are members of the labor union. It follows that the decisions of the syndicates emanate from one representative unionized agent, whose aim is to improve labor conditions in the workplace. As usual in the economic theory of trade union behavior, we assume that the union cares about its members' wages  $w$  and the level of employment in the firm  $L$  (see Oswald, 1985).

Let  $U(w, L)$  be a quasi-concave utility function for the union. Following Rosen (1970) and Calvo (1978), we rely on a specific structural form and adopt the following functional form known as the rent utility<sup>6</sup>:

$$U = (w - w_o)^{\gamma_1} (L - L_o)^{\gamma_2} \quad (3)$$

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<sup>6</sup> This utility is a special case of the Stone-Geary specification  $U = (w - w_o)^{\gamma_1} (L - L_o)^{\gamma_2}$ , where  $\gamma_1$  and  $\gamma_2$  indicate the relative importance of wage and employment to the union, and  $w_o$  and  $L_o$  are minimum acceptable levels of wage and employment (see MaCurdy and Pencavel, 1986). The rent utility function holds when  $\gamma_1 = \gamma_2 = 1/2$  and  $L_o = 0$ .

Where  $w_0$  is the reservation wage for the workers of the monopoly. It follows that the union aims to maximize its rent which is defined as the surplus income on top of the wage bill under perfect competition in the labor market.

The output is marketed by the firm and the demand function is supposed to be known by both the monopoly and the regulator. If we denote by  $P(\cdot)$  the inverse demand function,  $P(Q)$  is the price at which the consumers demand the output  $Q$  and the inequality  $P'(Q) \leq 0$  holds. The private good provides the gross surplus  $S(Q)$  for consumers such that

$$S(Q) = \int_0^Q P(\tilde{Q}) d\tilde{Q} \quad , \quad \text{with } S'(Q) > 0 \quad \text{and} \quad S''(Q) < 0. \text{The net consumer}$$

surplus is  $S(Q) - P(Q)Q$ . Also, the subsidy  $T$  made by the regulator to the monopoly can be raised only through a distortionary mechanism. It follows that the cost of redistributing public funds is  $(1 + \lambda)T$ , with  $\lambda > 0$  (see the discussion in Laffont and Tirole, 1986).

We can now turn to the planner's problem. The regulator has both consumer, producer and union surplus objectives. If we denote by  $W$  the social level of well-being, the utilitarian planner seeks to maximize  $W$  such that :

$$W = S(Q) - (1 + \lambda)T + V + \alpha U \quad (4)$$

For political and ideological reasons, we assume that the regulator places a weight  $0 \leq \alpha \leq 1$  on the satisfaction of the trade union  $U$ . Under perfect information, the regulator would solve :

$$\text{Max } W = S(Q) - (1 + \lambda)T + V + \alpha U$$

subject to the individual rationality constraint :  $V(T, L) \geq 0$ , meaning that the regulator cannot force the monopolistic firm to operate if it expects a negative profit. At the equilibrium, the marginal utility of the commodity  $S'(Q)$  would equate to the social marginal cost. However, in our context, the regulator cannot observe the productivity parameter  $\beta \in \Omega$  and we have to characterize the optimal mechanism based on the observability of the output level  $Q$ <sup>7</sup>.

When the regulator uses a feasible regulatory policy, the monopolistic firm is expected to receive a subsidy  $T$  when reporting its productivity parameter  $\beta \in \Omega$ . Since the level of wage is the result of a bargaining between the firm and the union, we have to study

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<sup>7</sup> In this paper, we consider a control mechanism based on the output because the input is not supposed observed. Further, Maskin and Riley (1984) have shown the superiority of the relation based on the output level for a monopolist firm.

how the regulatory transfer is shared between the two parties for a fixed amount  $T$  before deriving the optimal policy. It follows that a specific model of bargaining has to be selected in order to find the ex post wage rate negotiated by the union with the firm. For our purpose, we focus an efficient bargain framework which generates a Pareto-optimal outcome for the two parties.

More precisely, we rely on the standard Nash cooperative solution to model how the wage is determined. Conditionally on the subsidy received from the planner, the firm and the labor union seek to maximize the following joint product  $N(w)$  :

$$N(w) = (V - V_o)^{\delta_1} (U - U_o)^{1-\delta_1} \quad (5)$$

where  $V_o$  and  $U_o$  are the minimum levels of satisfaction for the two parties. Without loss of generality, these two reservation payoffs are set to zero. Finally, the parameter  $\delta$  is an indicator of the relative importance of the firm and the union in the bargaining process. This framework allows us to characterize the equilibrium wage given the amount of subsidy  $T$  received from the social planner.



**Proposition 1:** *Under the equilibrium , the optimal wage expected by the firm is such that:*

$$w^* = w_o + \frac{1-\delta}{\delta} \frac{V}{L}$$

.

Proof:

Indeed , the optimal wage such that :

$$w^* = \arg \text{Max}_w (V - V_o)^\delta (U - U_o)^{1-\delta} = (T - wL)^\delta (w - w_o)^{1-\delta} L^{1-\delta} = w_o + \frac{1-\delta}{\delta} \frac{V}{L}$$

(Q.E.D).

It follows that at the equilibrium, the wage is an increasing function of the firm's profit  $V$  and thus of the subsidy received from the planner since :

$$V(T, L) = T - wL, \quad \left( \frac{\partial w^*}{\partial T} > 0 \right)$$

In addition, we note that the conditions of bargaining matter for the optimal wage. The expected wage is higher when the labor union is characterized by an important power in the decision process :

$\left( \frac{\partial w^*}{\partial \delta} < 0 \right)$  . The receipt of an important wage from the firm leads

in turn to an increase of the workers' rent since the derivative  $\partial U / \partial w > 0$  is positive. Now, we are in a position to indicate how the expected subsidy is shared between the firm and the union given the optimal wage.

**Corollary 1** *Given the optimal expected wage  $w^*$ , the expected utility levels are :*

i) for the firm ,  $V(\beta) = \delta(T - w_o \beta Q)$

ii) for the union ,  $U(\beta) = (1 - \delta)(T - w_o \beta Q)$

.

Proof

The utility function of the firm is:

$V(T, L) = T - w^* L$ . Using the definition of  $w^*$  and rearranging some terms, we deduce that  $V(T, L) = \delta(T - w_o L)$ . Since  $Q(L) = \frac{L}{\beta}$ , it follows that

$$V(\beta) = \delta(T - w_o \beta Q).$$

For the labor union characterized by  $U = (w^* - w_o)L$ , we easily obtain

$$U = (1 - \delta) \frac{V}{\delta} \quad \text{and} \quad \text{thus} \quad U(\beta) = (1 - \delta)(T - w_o \beta Q).$$

(QED)

The previous corollary characterizes the optimal rent respectively for the firm and the union. We remark that the rent of the regulated firm is an increasing function of its bargaining power. A dominant monopoly firm succeeds in setting low wages, and thus benefits from a higher level of satisfaction. Of course, this effect is magnified when the value of the productivity parameter is low  $V'(\beta) < 0$ . Conversely, when the weight of the union in the wage decision is important, the labor union receives a significant part of the firm's rent. In that case, the labor union may be seen as a secondary beneficiary: the benefits of the regulatory transfer are shifted in part to unionized workers through higher salaries. One observes a partial slide of the firm's rent over to the labor union.

We can now characterize the optimal contract between the social planner and the firm. Since the regulator is unable to observe the efficiency type of the firm and has only prior beliefs on the range of efficiency parameters and the associated distribution, the planner is constrained to make contracts menu contingent on the level of production. When implementing the optimal contract, the planner is forced to account for the partial slide of the benefit to the trade union

### 3. The Optimal Regulatory Contract

We examine the regulator's problem, which is to design a compensation structure that maximizes the expected utility  $V(\beta)$  of the monopolistic firm given the presence of the trade union and the bargaining over wages.

Using the literature on incentive contracting and the revelation principle, it is known that without loss of generality, one can restrict the search to the class of mechanisms that induces a truthful revelation of the productivity parameter  $\beta \in \Omega$  of the firm (see Laffont and Tirole, 1993). In the context of our model, any optimal mechanism denoted by  $M$  that induces a truthful reporting can be represented as the following two uple :

$$M(\beta) = \langle Q(\beta), T(\beta) \rangle$$

For each value of  $\beta \in \Omega$  announced by the monopolistic firm, the optimal contract defines the expected level of production  $Q(\beta)$  and the subsidy  $T(\beta)$  received from the regulator as a function of the report  $\beta \in \Omega$ . The regulator offers a menu of type-revealing contracts and the firm is expected to choose one of these self-selection contracts.

Considering a mechanism  $M(\beta) = \langle Q(\beta), T(\beta) \rangle$ , let  $v(\tilde{\beta}, \beta)$  be the net level of satisfaction that is achieved by a monopoly of type  $\beta \in \Omega$  if the firm chooses to report the type  $\tilde{\beta} \in \Omega$ <sup>8</sup>. It follows that the rent  $v(\tilde{\beta}, \beta)$  can be expressed as :

$$v(\tilde{\beta}, \beta) = \delta(T(\tilde{\beta}) - w_o \beta Q(\tilde{\beta})) , \quad \forall \tilde{\beta}, \beta \in \Omega \quad (6)$$

Finally denote by  $V(\beta, \beta)$  the situation where the firm's utility is truthfully reported. Given asymmetric information, there are two constraints in the determination of the regulator's problem. First, the requirement of truthful reporting gives the following incentive compatibility constraint (IC) :

$$V(\beta, \beta) \geq v(\tilde{\beta}, \beta) \quad \forall \tilde{\beta}, \beta \in \Omega \quad (7)$$

Second, imposing the condition of individual rationality (IR), we can write :

$$V(\beta) = V(\beta, \beta) \geq 0 \quad \forall \beta \in \Omega \quad (8)$$

In this setting, the regulator's fundamental problem is given by the maximization of the expected social welfare  $E(W = S(Q) - (1 + \lambda)T + V + \alpha U)$  given the distribution function  $F(\cdot)$

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<sup>8</sup> Let us recall that the reservation payoff of the monopolistic firm is set to zero.

under both the incentive compatibility and the individual rationality constraints.

Let us solve this model of unionized monopoly given the asymmetric information on the Parameter  $\beta \in \Omega$ . To find the optimal level of output, we begin by characterizing the class of regulatory contracts that satisfies the incentive constraints in order to implement  $M(\beta) = \langle Q(\beta), T(\beta) \rangle$  in adominant strategy.

**Proposition 2.** *The Contract  $M(\beta) = \langle Q(\beta), T(\beta) \rangle$  satisfies the incentive constraint if and only if :*

$$i) V(\beta) = \delta w_o \int_{\beta}^{\bar{\beta}} Q(x) dx \quad \forall \beta \in \Omega$$

$$ii) Q'(\beta) \leq 0 \quad \forall \beta \in \Omega$$

.

Proof:

From the definition of  $V(\beta)$  such that:

$$V(\beta) = \text{Max}_{\tilde{\beta} \in \Omega} \delta (T(\tilde{\beta}) - w_o \beta Q(\tilde{\beta}))$$

$V(\beta)$  is an upper envelope of linear function in  $\beta$ , then it is convex and we have almost everywhere using the envelope theorem ,  $\forall \beta \in \Omega$ :

$$V'(\beta) = -\delta w_o Q(\beta) \leq 0 \quad \text{and}$$

$$V''(\beta) = -\delta w_o Q'(\beta) \geq 0$$

The necessary condition for a maximum is

$$V''(\beta) = -\delta w_o Q'(\beta) \geq 0 \Rightarrow Q'(\beta) \leq 0, \forall \beta.$$

Now, by integration of  $V'(\beta) = -\delta w_o Q(\beta)$ , such that  $V(\bar{\beta}) = 0$ , we obtain<sup>9</sup>:

$$V(\beta) = \delta w_o \int_{\beta}^{\bar{\beta}} Q(x) dx \quad \forall \beta \in \Omega$$

which corresponds to the informational rent left to the type  $\beta \in \Omega$  of firm. (Q.E.D)

Because of asymmetric information about the firm's productivity parameter  $\beta \in \Omega$ , it follows that the regulator is forced to give up a costly rent to the monopolistic firm. The rent is used to discipline the firm into revealing its true efficiency type. In comparison, under symmetric information, the social planner would solve the problem of maximization of social welfare subject to the individual rationality constraint, so that the optimal subsidy satisfies  $T(\beta) = w_o \beta Q(\beta)$  and hence the rent for the monopoly is null.

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<sup>9</sup> The less efficient type of monopoly obtains no rent from the regulatory contract.

Proposition 2 gives us two additional pieces of information about the informational rent. First, the rent value  $V(\beta)$  received by the monopoly is a decreasing function of the efficiency parameter  $\beta \in \Omega$ . Hence, to be willing to reveal the firm's true type, the regulator must reward the lower  $\beta \in \Omega$ -type of firm with a more important rent value than the higher  $\beta \in \Omega$  type. Second, using the monotonicity condition such that  $Q'(\beta) \leq 0, \forall \beta \in \Omega$ , it follows that an efficient monopoly characterized by a low value for  $\beta \in \Omega$  is induced to lessen its level of production in order to extract a higher rent value from the regulator<sup>10</sup>.

We now examine in greater detail the two components  $T(\beta)$  and  $Q(\beta)$  of the optimal implemented contract  $M(\beta) = \langle Q(\beta), T(\beta) \rangle$ . For that purpose, we have to solve the regulator's problem whose aim is to maximize the expected level of social well-being  $E(W)$  such that :

$$E(W) = \int_{\Omega} (S(Q(\beta)) - (1 + \lambda)T(\beta) + V(\beta) + \alpha U(\beta)) dF(\beta) \quad (9)$$

Let us begin by the calculation of the regulatory transfer  $T(\beta)$ . Since the firm's utility is defined by:

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<sup>10</sup> From the definition of the rent value, it is an increasing function of the produced output  $Q(\cdot)$ .



$V(\beta) = \delta(T(\beta) - w_o\beta Q(\beta))$  from corollary 1 and using the rent value  $V(\beta)$  defined in proposition 2, we can express the optimal subsidy  $T(\beta)$  as :

$$T(\beta) = w_o\beta Q(\beta) + w_o \int_{\beta}^{\bar{\beta}} Q(x) dx \quad \forall \beta \in \Omega \quad (10)$$

Now, again from proposition 2, we know that the following equality holds :

$$U(\beta) = (1 - \delta) \frac{V(\beta)}{\delta}$$

We deduce the optimal value for the rent of the labor union as a report of  $\beta \in \Omega$  :

$$U(\beta) = (1 - \delta) w_o \int_{\beta}^{\bar{\beta}} Q(x) dx \quad \forall \beta \in \Omega \quad (11)$$

Finally, we insert both the transfer expression  $T(\beta)$  and the optimal rents  $V(\beta)$  and  $U(\beta)$  in the expected social welfare function, which becomes accordingly :

$$E(W) = \int_{\Omega} (S(Q(\beta)) - (1 + \lambda)w_o\beta Q(\beta) - w_o(1 + \lambda - \delta - \alpha + \alpha\delta) \int_{\beta}^{\bar{\beta}} Q(x) dx) dF(\beta)$$

By integration by parts , we obtain the following regulator's problem , which is given by the maximization of the expected social welfare subject to the monotonicity constraint:

$$\begin{aligned} & \underset{Q(\cdot)}{\text{Max}} \int_{\Omega} (S(Q(\beta)) - (1 + \lambda)w_o\beta Q(\beta) - w_o(\lambda + (1 - \delta)(1 - \alpha)) \frac{F(\beta)}{f(\beta)} Q(\beta)) dF(\beta) \\ \text{s.t. } & Q'(\beta) \leq 0, \forall \beta \in \Omega \end{aligned} \quad (13)$$

### Proposition 3

Under asymmetric information, the optimal contract for the unionized monopoly is given by:

$$\begin{aligned} i) \quad & P(Q(\beta)) = (1 + \lambda)w_o\beta + w_o(\lambda + (1 - \delta)(1 - \alpha)) \frac{F(\beta)}{f(\beta)} \\ ii) \quad & T(\beta) = w_o\beta Q(\beta) + w_o \int_{\beta}^{\bar{\beta}} Q(x) dx \quad \forall \beta \in \Omega \end{aligned}$$

.

Proof :

Let us first ignore the monotonicity constraint  $Q'(\beta) \leq 0, \forall \beta \in \Omega$  and focus on the less constrained problem. Then, since  $S(Q) = \int_0^Q P(\tilde{Q}) d\tilde{Q} dx$ ,

we easily obtain the optimal level of output by solving the equality

$$\frac{\partial}{\partial Q(\beta)} E(W) = 0$$

Now, to show that the optimal contract also satisfies the monotonicity condition  $Q'(\beta) \leq 0, \forall \beta \in \Omega$ , we define the function:

$$\Gamma(\beta, Q(\beta)) = P(Q(\beta)) - (1 + \lambda)w_o\beta - w_o(\lambda + (1 - \delta)(1 - \alpha)) \frac{F(\beta)}{f(\beta)}$$

Thus we observe that the sign  $Q'(\beta) = \text{sign} \frac{\partial \Gamma(\beta, Q(\beta))}{\partial \beta}$ , it follows that:

$$\frac{\partial \Gamma(\beta, Q(\beta))}{\partial \beta} = -(1 + \lambda)w_o - w_o(\lambda + (1 - \delta)(1 - \alpha)) \frac{d}{d\beta} \left( \frac{F(\beta)}{f(\beta)} \right), \text{ hence we have :}$$

$Q'(\beta) = \frac{\partial \Gamma(\beta, Q(\beta))}{\partial \beta} \leq 0$  by using assumption 1, so the monotonicity condition is satisfied for the optimal level of the produced output  $Q(\beta)$ ,  $\forall \beta \in \Omega$ . (Q.E.D)

Let us interpret the characterization of the optimal contract between the social planner and the monopolistic firm. At the equilibrium, the level of price is given by the sum of the marginal cost of production  $(1+\lambda)w_o$  and the marginal cost of the informational rent  $w_o(\lambda + (1-\delta)(1-\alpha))\frac{F(\beta)}{f(\beta)}$ . Clearly, the optimal price exceeds the social marginal cost and the role of the rent is to induce the firm to reveal its true type. Under asymmetric information, the level of output is lower than the first-best solution. The explanation concerning the distortion in  $Q(\beta)$ ,  $\forall \beta \in \Omega$  is that the imitation of inefficient types of firms by efficient monopolies is undesirable<sup>11</sup>.

How does the labor union influence the optimal contract ? Clearly, the regulator knows that part of the subsidy provided to the monopolistic firm is shifted to the labor union because of the

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<sup>11</sup> When social planner chooses to reduce the level of the output, a monopolist firm of type  $\beta$  finds it less profitable to mimic the type  $\tilde{\beta} > \beta$ .

bargaining over wages. Thus, the planner has to make its subsidy contingent on the decision power of the firm.

## Corollary 2

*The optimal price is a decreasing function of the bargaining power of the monopolistic firm.*

From the optimal price, we obtain  $\frac{\partial P(.)}{\partial \delta} = -w_o((1-\alpha))\frac{F(\beta)}{f(\beta)} \leq 0$ . When the parameter  $\delta$  is important, which is a situation corresponding to a dominant firm in the bargaining, the optimal price is set at a low value still above the marginal cost of production and the level of output is important. Conversely, for a dominant labor union, the regulator modifies the intensity of the distortion by choosing a low level of production. In so doing, the regulator prevents from an eventual slide of the transfer's benefit over to the union. Reducing the expected rent of the monopolistic firm is thus an efficient mechanism for avoiding the conversion of firm's transfer into union's benefit<sup>12</sup>

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<sup>12</sup> When the parameter  $\alpha$  is such that  $\alpha = 1$ , we note that the regulator is indifferent with respect to the distribution of the rent between the firm and the labor union.

Finally, we can examine the effect of the parameter  $\delta$  on the different agents' situation.

Since the level of production is an increasing function of the firm's bargaining power, it follows that the parameter  $\delta$  exerts a positive impact on the rent of the monopoly :

$$\frac{d}{d\delta}V(\beta) = w_o \int_{\beta}^{\bar{\beta}} Q(x) dx + \delta w_o \int_{\beta}^{\bar{\beta}} \frac{\partial Q(x, \delta)}{\partial \delta} dx > 0 \quad \forall \beta \in \Omega \quad (14)$$

Conversely, when the firm's decision power is modified, we cannot determine its effects on the union's utility. Indeed, we have:

$$\frac{d}{d\delta}U(\beta) = -w_o \int_{\beta}^{\bar{\beta}} Q(x) dx + (1 - \delta) w_o \int_{\beta}^{\bar{\beta}} \frac{\partial Q(x, \delta)}{\partial \delta} dx \quad \forall \beta \in \Omega \quad (15)$$

The situation for the consumers is clearer, but slightly more complex. In the context of our problem, the consumers' surplus is affected by the regulation policy and it may either increase or decrease with the parameter  $\delta$  depending on the type of firm.

**Corollary 3** *A rise in the firm's bargaining power leads to :*

- i) *a reduction of the consumers' surplus for an efficient type of firm(  
 $\beta \rightarrow \underline{\beta}$ )*
- ii) *an increase of the consumers' surplus for an inefficient type of firm  
( $\beta \rightarrow \underline{\bar{\beta}}$ )*

Proof.

From the definition of the net surplus such that,

$$S_n(Q(\beta)) = S(Q(\beta)) - (1 + \lambda)T^*(\beta)$$

we obtain the following derivative :

$$\frac{\partial}{\partial \delta} S_n(Q(\beta)) = (S'(Q) - (1 + \lambda)w_o\beta) \frac{\partial Q}{\partial \delta} - (1 + \lambda) \int_{\beta}^{\bar{\beta}} \frac{\partial Q(x, \delta)}{\partial \delta} dx$$

Now, given the definition of  $S'(Q(\beta)) = P(Q(\beta))$  from proposition 3,

we get :

$$\frac{\partial}{\partial \delta} S_n(Q(\beta)) = (\lambda + (1 - \delta)(1 - \alpha)) \frac{F(\beta)}{f(\beta)} \frac{\partial Q}{\partial \delta} - (1 + \lambda) \int_{\beta}^{\bar{\beta}} \frac{\partial Q(x, \delta)}{\partial \delta} dx$$

which proves the announced result. (Q.E.D)

Let us interpret this result. With an efficient type of firm, the regulator expects a high level of production from the monopoly and this increases the gross consumers' surplus. But in that case, the regulator has also to compensate the firm with a more important amount of subsidy. The rise in the transfer value exceeds the rise in the consumer's surplus for an efficient monopolistic firm, which lowers the situation for consumers. Conversely, with an inefficient monopoly, the consumers' surplus is expected to go up.

## 4 .Concluding comments

When focusing on regulatory contracts, analyzing a conceptual framework that is more specifically concerned with developing countries is a purposeful task. Specifically, this paper develops a regulation model of a monopoly integrating both asymmetric information and unionization. Curiously, in the recent movement of public sector reforms in poor countries, especially in Africa, the potential role of labor unions as wage-making institutions has been widely neglected. Given the significant impact in the process of wage setting in poor countries, we examine the incidence of unionization on the characterization of optimal regulatory contracts.

Our main result is to show that the labor union captures part of the informational rent involved by asymmetric information. The union may be seen as a secondary recipient, and the size of the rent is an increasing function of the union's bargaining power. As a consequence, when setting the optimal contract, the regulator is induced to lower the rent when the union has a large bargaining power. The optimal price for the monopolistic market is reduced when the labor union is dominant in the bargaining. Also, a change in the

firm's bargaining power may either exert a positive or negative effect on the net consumers' surplus. This depends on the firm's efficiency type, an inefficient production process leading to an increased consumers' surplus. Clearly, our theoretical analysis points out that accounting for the presence of a labor union greatly affect the characterization of the optimal regulatory policy.

A final comment concerns the enforcement of regulatory contracts for unionized monopolies. Indeed, there exist numerous examples of enforcement failures for regulatory contracts in poor countries (see Laffont, 2001). These low enforcement capabilities mainly result from insufficient financial and auditing resources and also from the corruption of enforcement institutions. While accounting for imperfect information suffered by regulators when regulating unionized monopolistic firms is particularly adapted to developing countries with the recent privatization and liberalization movement, it would also be useful to examine such regulatory contracts in the case of imperfect enforcement.



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