Government Outsourcing:
Contracting with Natural Monopoly

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\textbf{Abstract:} This paper studies the effect of soft-budget constraints in a pure adverse selection model of monopoly regulation. We consider a government maximizing total surplus but incurring some cost of public funds à la Laffont Tirole (1993). We propose a regulatory set-up in which firms are free to enter natural monopoly markets and to choose their price and output levels as in the laisser-faire. In addition, the government proposes ex-post contracts to the private firms. We show that this regulatory set-up allows governments to avoid re-funding money-losing firms and that welfare is larger than under traditional regulation where governments commits to both investment and operation cash-flows.

\textbf{Keywords:} Privatization, soft-budget constraint, adverse selection, regulation, natural monopoly.

\textbf{JEL Classification:} L43, L51, D82, L33.

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1 Introduction

Poor economic performances of public enterprises have motivated many policy makers to privatize public firms. To many economists, public ownership generates problems of ‘soft-budget constraints’ that stems from the lack of government commitment not to bail out money-losing firms (see Kornai 1980). Less efficient firms rely on the government for funding bad projects and lack the financial discipline required for efficient management. In the economic literature, soft-budget constraints and privatization are usually related to their causes: a lack of economic focus of governments (see Shapiro and Willig 1990, Schleifer and Vishny 1994) or, contract incompleteness and time inconsistency between governments and firms (see Dewatripont and Maskin 1995, Schmidt 1996a and 1996b, Segal 1998, Maskin 1999). The consequences of soft-budget constraints are cost inefficiencies.

The first objective of the present paper is to show that neither the lack of economic focus nor contract incompleteness and time inconsistency are necessary conditions to privatization. Indeed, the present paper focuses on the monitoring of natural monopolies with pure adverse selection problems in which benevolent governments propose complete contracts and fully commit on the payments to the firms. In this set up we are able to show that privatization can be a preferred policy when there exists a social cost of public funds.

Yet, there is a widespread belief amongst economic theorists and practitioners that it is not socially optimal to privatize natural monopolies and to leave laissez-faire profits to private entrepreneurs. Private incentives generate too strong allocative inefficiencies to leave the full control of natural monopolies to private individuals. Government are advised to set up regulation regimes in which prices and investments are monitored so that the firms break even or earn no supra-normal profit. When firms earn zero profit, their ownership structure is not an issue. Even in presence of information

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5 Interesting surveys are available in Kornai (2000), Kornai, Maskin and Roland (2002) and Glaeser and Shleifer (2003).
asymmetry where firm’s management is delegated to managers who earns rents, the debate about ownership structure simply turns out to be a debate over the redistribution of rents to public managers (or workers) or to private owners (see Baron and Myerson 1982 and Laffont and Tirole 1993).

The second objective of the paper is to challenge this view that ownership structure is not relevant in Baron and Myerson’s (1982) and Laffont and Tirole’s (1993) models of natural monopoly regulation. In this literature, firms are owned and monitored by benevolent governments, public managers have private information about marginal costs and transferring funds to the firms is costly. In addition, we assume that firms and governments make fixed sized, specific and non recoupable investments to operate in each market. Ownership is then related to the party committing the investment, but the size of investment is fixed and not subject to moral hazard and time inconsistency. As in the soft-budget constraint literature, we show that private ownership can be preferred by governments who then avoid transfers to money-loosing publicly-owned firms.

We compare the ex-ante welfare of natural monopolies in two situations. In the regulation regime, the government decides to set up a public regulated firm run by a public manager who benefits from private information about productivity. The government makes the investment and designs incentive contracts to entice the efficient level of production at some informational cost. The regulation regime is based on Baron and Myerson’s (1982) and Laffont and Tirole’s (1993) models and it provides our benchmark case. In the privatization regime, which we here call outsourcing, investors are free to enter markets, to make their investments and to choose their price and output levels as in laissez-faire. Yet, laissez-faire is not optimal because governments can improve welfare by offering ex-post contracts to private firms. In this respect, the present paper goes beyond Auriol and Picard (2002) who already show that laissez-faire can yield larger welfare than regulation when governments’ budget constraints are at stake. Here, the government proposes ex-post contracts to the private firms once they have entered and they know
their cost realization; and to accept such ex-post contracts, private firms must at least obtain their *laissez-faire* profits. This outsourcing regime is called ‘ex-post contracting’ because the government contracts ex-post (i.e., after entry and cost realization) with a private firm which is free to participate or not in the subsidy program.

The model yields the following results. On the one hand, governments offer more selective contracts under outsourcing than under regulation. High costs firms indeed receive no ex-post contracts under outsourcing for the following two reasons. First, because firms get both control rights and cash-flow rights, the business risk is held by firm owners and governments do not have to compensate the losses of high cost firms. Second, if governments subsidize high cost firms, incentive considerations impose to increase transfers to low cost firms and to reduce the output levels of low productivity firms. Still, the output levels of high productivity firms as well as their consumption and production surpluses may become smaller under outsourcing than under *laissez-faire*. The government is better-off by offering no ex-post contracts to high cost firms.

On the other hand, we show that welfare is larger under outsourcing in many situations. First, when the cost of public funds is small, outsourcing is optimal as soon as the least efficient firm makes a loss. Second, outsourcing is optimal when the government is able to tap large enough revenues with ex-ante franchise fees. Examples with linear demand functions and uniform cost distributions show that the set of economic parameters supporting outsourcing is not negligible. This result may seem at odd with usual recommendations in the regulation literature whereby governments should hold a tight control on natural monopolies through various policies such as price regulation or public ownership. Still, because such policies make governments accountable for profits and losses, they oblige governments to subsidize inefficient firms too often. In contrast, under outsourcing, governments are not accountable for losses and they are able to avoid subsidies to high cost firms. Losses are transferred to the private investors who have taken the business
The paper relates to the existing literature in several ways. It studies the actual benefit of privatization of natural monopolies in the context of pure adverse selection, where many authors have advocated or assumed regulation (e.g., Baron and Myerson 1982, Laffont and Tirole 1993, and others). As already stated, the paper provides an approach complementary to most recent models that discuss privatization under the moral hazard issue or time inconsistency problem induced by the soft budget constraint (Dewatripont and Maskin 1995, Schmidt 1996a, and 1996b, Segal 1998, Maskin 1999). The paper also links to the literature of industry design under incomplete information (Dana and Spier 1994, McGuire and Riordan 1995) as it adds the possibilities of ex-post contracting. The paper is finally closely related to the literature on mechanism design under type-dependent utility (see Lewis and Sappington 1989, Jullien 2000, Laffont and Martimort 2002, Chapter 3).

The paper is structured as it follows. Section 2 describes the model. Section 3 and 4 derive the contracts under regulation and outsourcing. Section 5 determines when outsourcing yields higher welfare than regulation. Section 6 concludes.

2 The Model

The government has to decide whether a natural monopoly should be operated under public or private management. In line with Laffont and Tirole (1993), we call regulation regime the regime in which the government has control and cash-flow rights over a regulated firm. The government’s control rights are associated with accountability on profits and losses.\footnote{Shleifer and Vishny (1994) have demonstrated that the allocation of control right leads to economic efficiency when control rights are congruent to cash flows rights (see definition of the latter rights in Shleifer and Vishny, 1994).} That is, it subsidizes the firm in case of losses whereas it taxes the regulated firm in
case of profits.\textsuperscript{7} In contrast, we call \textit{outsourcing} the regime in which a private unregulated firm produce the commodity. Under outsourcing, control and cash-flow rights belong to a private entrepreneur or, namely, a \textit{private firm}. The government takes no responsibility for the firm’s profits and losses. It can nevertheless asks the potential producer to pay a franchise fee for the right to operate as a monopoly. The government can also contract ex-post with the firm to increase the supply of the commodity. We refer to the situation in which transfers are allowed between the government and the firm as \textit{ex-post contracting}. When the government offers no ex-post contracts, the firm sets the privately optimal production as under \textit{laissez-faire}.

The paper focuses on natural monopoly. That is, the firm needs to make an investment $K > 0$ before being able to produce. The investment $K$ is sunk. For instance if one focuses on public health care the investment $K$ might correspond to R&D costs which are necessary to bring a new medicine or a new vaccine to the market. To keep the analysis tractable we assume that the investment $K$ has a fixed size and is verifiable.\textsuperscript{8} The uncertainty lies on the impact of the investment on the production cost of the commodity. That is, after the investment stage, the firm incurs an idiosyncratic marginal cost $\beta$ to produce the output in quantity $Q$. We assume that the marginal cost $\beta$ is independently drawn from the support $[\beta, \bar{\beta}]$ according to the density and cumulative distribution functions $g(\cdot)$ and $G(\cdot)$. The expectation operator is denoted $E$ so that $E[h(\beta)] = \int_{\beta}^{\bar{\beta}} h(\beta) dG(\beta)$. For example, $\beta$ captures the uncertainty inherent to a R&D project. A larger variance corresponds to a more risky project. In the sequel, the terms ‘ex-post’ and ‘ex-ante’

\textsuperscript{7}This is obviously the case with public ownership. This is also the case to some extent with privately-owned regulated public utilities that are under tight government control. Such privately-owned regulated public utilities are rarely allowed to go bankrupt and receive subsidies, increases in tariff or preferential loans in case of losses (see Kornai et al. 2000).

\textsuperscript{8}This assumption simplifies the analysis by ruling out moral hazard issue about the optimal size of investment or manager’s effort. For an analysis of the moral hazard issue see for instance Dewatripont and Maskin (1995).
correspond to the period before and after the realization of $\beta$.

To summarize the firm cost function is as in Baron and Myerson (1982)

$$C(\beta, Q) = K + \beta Q$$

where $K$ (e.g., the budget allocated to R&D) is known in advance while the benefit $\beta$ is random.

Consumers have a decreasing inverse demand function, denoted $P(Q)$. The gross surplus associated with the consumption of $Q$ units of the commodity is defined as $S(Q) = \int_0^Q P(x)dx$. We focus on commodity that generates a large surplus so that shutting down production is never optimal. Technically the willingness to pay for the first unit of the produced good must be sufficiently large (i.e., above the highest possible virtual cost). This is formally stated in the following assumption:

**A1**

$$P(0) > \beta + \frac{G(\beta)}{g(\beta)}$$

Under assumption **A1**, public and private firms are always able to make a positive margin. Since fixed costs are sunk, firms never shut down production. The firm’s profit in the absence of public transfer is equal to

$$\pi(\beta, Q) = P(Q)Q - \beta Q - K$$ (1)

The firm’s profit with public transfer is equal to

$$\Pi(\beta, Q, t, F) = \pi(\beta, Q) + t - F$$ (2)

where $t$ is the ex-post transfer that the firm gets from the government and where $F$ is a possible ex-ante franchise fee paid to the government. The transfer to the firm can either be positive (i.e., a subsidy), or negative (a tax).

As in Laffont and Tirole (1993), the government is benevolent and utilitarian. It maximizes the sum of consumer’s and producer’s surpluses minus the social cost of transferring public funds to the firm. The government’s objective function is

$$W(\beta, Q, t, F, \lambda) = S(Q) - \beta Q - K - \lambda t + \lambda F$$ (3)
where  is the shadow cost of public funds.

The shadow cost of public funds, , drives the results of the paper. This shadow cost, which can be interpreted as the Lagrange multiplier of the government budget constraint, measures the social cost of the government’s economic intervention. For close to 0, the government maximizes the net consumers’ surplus; for larger , the government puts more weight on the social cost of transfers. The shadow cost of public funds is positive because transfers to regulated firms imply either a decrease in the production of public goods, such as schooling and health care, or an increase in distortionary taxation. Each dollar that is transferred to the regulated firm costs dollars to society. In developed economies, is mainly equal to the deadweight loss accrued to imperfect income taxation. It is assessed to be around 0.3 ( and 1996). In developing countries, low income levels and difficulties in implementing effective taxation programs are strong constraints on the government’s budget, which leads to higher values of . In particular, the value is very high in countries close to financial bankruptcy. As a benchmark case the World Bank (1998) suggests a shadow cost of 0.9.

In the next section we study the benchmark case of regulation.

3 Regulation

This section is based on  and Laffont and Tirole (1993). It focuses on public management. The timing is as follows. The government firstly decides or not to invest ; if is sunk, nature chooses the marginal cost according to the distribution function ; the regulated firm’s manager learns , but the government does not; the government proposes a production and transfer scheme ; the regulated firm reveals the information ; production and transfer take place according to the contract . Finally the government being residual claimant for the profits and losses of the regulated firm, there is no need to consider a franchise fee. Without any loss of generality we set .
By the revelation principle, the analysis can be restricted to direct truthful revelation mechanism ($\beta = \beta$). To avoid the technicalities of ‘bunching’, we make the classical monotone hazard rate assumption (see Guesnerie and Laffont 1984, Jullien 2002):

**A2** \[ G(\beta)/g(\beta) \text{ and } (G(\beta) - 1)/g(\beta) \text{ are non decreasing.} \]

Moreover in order to rule out corner solution in the sequel of the paper we focus on not too convex demand function. That is,

**A3** \[ P''(Q)Q + P'(Q) < 0 \]

Under asymmetric information the government maximizes the utilitarian welfare function:

\[
\max_{\{Q(\cdot),t(\cdot)\}} \text{EW} [\beta, Q(\beta), t(\beta), 0, \lambda] = E [S(Q(\beta)) - \beta Q(\beta) - K - \lambda t(\beta)]
\]

subject to

\[
\frac{d}{d\beta}\Pi(\beta, Q(\beta), t(\beta), 0) = -Q(\beta) \tag{4}
\]
\[
\frac{d}{d\beta}Q(\beta) \leq 0 \tag{5}
\]
\[
\Pi(\beta, Q(\beta), t(\beta), 0) \geq 0 \tag{6}
\]

Conditions (4) and (5) are the first and second order incentive compatibility constraints and condition (6) is the public manager’s participation constraint.9 This problem is a standard adverse selection problem of regulation under asymmetric information. Under assumption A3 it admits an interior solution. The optimal output, denoted $Q^r(\beta)$, solves (see for instance Baron and Myerson 1982)

\[
P(Q) + \frac{\lambda}{1 + \lambda}P'(Q)Q = \beta + \frac{\lambda}{1 + \lambda} \frac{G(\beta)}{g(\beta)} \tag{7}
\]

9The public manager’s earnings is normalized to zero. Allowing a positive earning would reduce further the attractiveness of regulation compared to outsourcing.

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Under assumption A2 the output \( Q^r (\beta) \) is non increasing in \( \beta \) so that condition (5) is satisfied. Under perfect information on the firm’s cost the output level, denoted \( Q^* (\beta) \), solves equation (7) for \( G(\beta)/g(\beta) \equiv 0 \). We deduce that the asymmetric information output level is lower than the level under perfect information: \( Q^r (\beta) \leq Q^* (\beta) \forall \beta \in [\underline{\beta}, \overline{\beta}] \). In order to reduce the firm’s incentive to inflate its cost report, the government orders high cost firms to produce less than it would ask under perfect information. The distortion increases with \( \lambda \).

We next turn to the computation of the regulated firm’s transfer. Integrating equation (4) while using equation (6) the firm net rent is equal to

\[
\Pi^r (\beta) = \int_\beta^{\overline{\beta}} Q^r (\beta) \, d\beta
\]  

(8)

The firm with the lowest productivity (i.e., the highest cost \( \overline{\beta} \)) gets zero information rent: \( \Pi^r (\overline{\beta}) = 0 \). More efficient firm gets an informational rent. Substituting (8) into (2) yields the regulated firm’s transfer

\[
t^r (\beta) = \int_\beta^{\overline{\beta}} Q^r (\beta) \, d\beta + \beta Q^r (\beta) + K - P(Q^r(\beta))Q^r(\beta)
\]  

(9)

Larger fixed costs raise the transfers to the regulated firm. The ex-ante welfare writes as

\[
EW^r = \int_\beta^{\overline{\beta}} \left[ S(Q^r (\beta)) - \beta Q^r (\beta) - K - \lambda t^r (\beta) \right] dG(\beta)
\]  

(10)

The paper aims to study contracting arrangement that permits to deliver the commodity to consumers in the most efficient way. In what follow we study outsourcing as an alternative to regulation. The government lets the private sector invest. If the private firm investment is worthwhile the government might contract ex-post with it to avoid the welfare loss due to monopoly pricing. In this case it subsidies the firm to produce more than its monopoly quantity. We refer to this alternative to regulation as \textit{ex-post contracting}. 

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4 Government Outsourcing

Under outsourcing the firm is managed private investors or entrepreneurs. The timing is as follows. First, the private firm chooses to enter the market by paying the franchise fee $F$ and by investing $K$. If it enters, then nature chooses the marginal cost $\beta$ according to the distribution $G(\cdot)$. The private firm’s manager learns $\beta$. The government proposes a set of contracts $\{t^c(\beta), Q^c(\beta)\}$. The firm either chooses to commit with the government by picking a contract and by implementing its terms, or it chooses not to contract with the government by setting its production at the *laissez-faire* monopoly level. Production, exchange and transfer occur as agreed upon.

Because under outsourcing, firm’s fall back position is given by its unregulated monopoly profit, we first study the *laissez-faire* regime.

4.1 Laissez-faire equilibrium

Under *laissez-faire*, the production levels are not controlled by the government and firms receive no ex-post transfer: $t = 0$. The government can nevertheless raise money at the entry of private monopolies by auctioning the right to operate. Let $F$ be the franchise fee that a private firm pays to the government in order to operate in the product market.\(^{10}\) The private firm contemplates the following sequential choices. First, it chooses to enter the market by paying the franchise fee $F$ and by investing $K$. If it enters, then nature chooses the marginal cost $\beta$ according to the distribution $G(\cdot)$. Then, the private firm learns $\beta$ and chooses freely a production level $Q$. The firm sells its output at price $P(Q)$ and pays the variable cost $\beta Q$.

Under *laissez-faire*, the production level of the private firm is not controlled by the government. After knowing the realization of $\beta$, the private monopoly maximizes its profit $\pi(\beta, Q)$. It solves the first order condition

\(^{10}\)Because there is no time discounting, the ex-ante lump sum fee ($F$) is equivalent to an ex-post lump sum tax ($-t$).
\[\pi_Q(\beta, Q) = 0, \text{ or equivalently,} \]
\[P(Q) + P'(Q)Q - \beta = 0 \quad (11)\]

which yields the monopoly production under laissez-faire \(Q^m(\beta)\). Under Assumption A3 the demand function is not too convex so that we get an interior maximum. Substituting \(Q^m\) in equations (2) and (3), the ex-post profit of the private monopoly is equal to \(\pi(\beta, Q^m(\beta)) - F\) whereas the ex-ante profit and welfare of a private monopoly are given by

\[
E\Pi^m(\beta) = \int_{\beta}^{\pi} [P(Q^m(\beta))Q^m(\beta) - \beta Q^m(\beta)] dG(\beta) - K - F
\]

\[
EW^m(\lambda) = \int_{\beta}^{\Pi} [S(Q^m(\beta)) - \beta Q^m(\beta)] dG(\beta) - K + \lambda F
\]

It is generally suboptimal to let private monopoly operate at the laissez-faire level. The government can offer ex-post transfers to correct the monopoly distortion. We first show that only a fraction of firms signs a contract with the government and second that the number of firms signing a contract decreases with the shadow cost of public funds.\(^{11}\)

### 4.2 Selective ex-post contracts

Let \(Q^c(\beta)\) and \(\Pi^c(\beta)\) denote the output and the profit of the private monopoly under ex-post contracting. After entry, the franchise fee is sunk. Since it plays no role in the quantity/price decision, we temporarily set \(F\) to zero. The government solves

\[
\max_{\{Q(\cdot), t(\cdot)\}} EW(\beta, Q(\beta), t(\beta), 0, \lambda) = E [S(Q(\beta)) - \beta Q(\beta) - K - \lambda t(\beta)]
\]

\(^{11}\)Note that we here voluntarily eliminates government’s re-nationalization strategies as in Schmidt (1996a, 1996b) and multi-principal issues such as in Laffont and Tirole (1991) where an additional agency issue arises between firm’s manager and owners.
subject to

\[
\frac{d}{d\beta} \Pi(\beta, Q(\beta), t(\beta), 0) = -Q(\beta) \quad (12)
\]

\[
\frac{d}{d\beta} Q(\beta) \leq 0 \quad (13)
\]

\[
\Pi(\beta, Q(\beta), t(\beta), 0) \geq \pi(\beta, Q^m(\beta)) \quad (14)
\]

Incentive compatibility constraints (12) and (13) are equivalent to (4) and (5). However, the private firm’s participation constraint (14) differs from the participation constraint under regulation (6). Under ex-post contracting, the minimum profit acceptable to the firm is the operating profit level it would get under laissez-faire and after having sunk the fixed cost $K$. That is, the amount $P(Q)Q - \beta Q + t$ should remain larger than the operating profit under laissez-faire, $P(Q^m)Q^m - \beta Q^m$. Subtracting $K$ in each expression yields the condition (14). Contrary to regulation, the firm’s participation constraint now depends on its type $\beta$.

The government is obliged to leave large rent to low cost firms if it wants to contract with them. However it is not committed to compensate for the losses of high cost firms. As firms are private and unregulated, they endorse the responsibility of their investments. When costs are too high, the government may decide not to contract with the private firm. This result is formally stated in the following lemma.

**Lemma 1** Under Assumptions A1 to A3 there exist a unique $\beta_0 \in [\underline{\beta}, \overline{\beta}]$ such that

\[
P(Q^m(\beta_0)) = \beta_0 + \frac{G(\beta_0)}{g(\beta_0)} \quad (15)
\]

Output and profit of the firm under ex-post contracting are equal to

\[
Q^e(\beta) = \begin{cases} 
Q^e(\beta) > Q^m(\beta) & \text{if } \beta < \beta_0 \\
Q^m(\beta) & \text{if } \beta \geq \beta_0
\end{cases} \quad (16)
\]

\[
\Pi^e(\beta) = \begin{cases} 
\Pi^m(\beta_0) + \int_{\beta_0}^{\beta} Q^e(\beta) d\beta > \Pi^m(\beta) & \text{if } \beta < \beta_0 \\
\Pi^m(\beta) & \text{if } \beta \geq \beta_0
\end{cases} \quad (17)
\]
Proof. See Appendix 1.

Figure 1 illustrates output and profit functions under regulation (thin curves), laissez-faire (dashed curves) and ex-post contracting (bold curves). Under regulation and ex-post contracting, low cost firms are enticed to claim larger subsidies by reporting higher cost levels. Because the high cost firms’ profits are more sensitive to output than low cost firms, the government alleviates the mis-reporting effect by imposing smaller output levels in firms that report high costs. However, under regulation, the output distortion can be so strong that the high cost firms may produce less than under laissez-faire: \( Q_r(\beta) \leq Q_m(\beta) \) for all \( \beta \geq \beta_0 \). Yet this situation cannot occur under ex-post contracting. Indeed, consider the following two cases. First, consider the firm with \( \beta = \beta_0 \) so that \( Q^r(\beta_0) = Q^r(\beta_0) = Q^m(\beta_0) \). This firm brings the same consumer and producer surpluses under ex-post contracting as under laissez-faire. Under ex-post contracting, there is no point to give a transfer to this firm since its output level is perfectly aligned with the government’s preferred output level. Consider secondly that the government outsources to a firm with \( \beta > \beta_0 \). Then, on the one hand, the government is unable get to a surplus larger than the surplus under laissez-faire because incentive compatibility obliges it to distort output further down to \( Q^r(\beta) < Q^m(\beta) \). On the other hand, any transfer to this firm also increase the subsidies to all firms having smaller costs. Both effects harms the government.

We have restricted our analysis to the case of not too convex demand function (i.e., to \( P'' + P'Q < 0 \)). Suppose instead that the demand is very convex. For low marginal costs \( \beta \) laissez-faire profits increase very fast as \( \beta \) drops. Hence, the ex-post contracts to the firms with low costs would involve very large rents and would definitively attract firms with higher marginal costs. Incentive compatibility constraint would then be difficult to maintain. Therefore, firms with very low marginal cost would also be excluded from
contracting. With type dependent participation constraints, exclusion can thus affect both very high and very low types simultaneously (see Jullien 2000, Proposition 2). For the sake of simplicity we rule out this case by making assumption A3.

If we assume that output and profit are continuous variables, ex-post contracting and regulation yield the same output level at $\beta_0$. That is $Q^m(\beta_0) = Q^r(\beta_0)$ and $\Pi^c(\beta_0) = \Pi^m(\beta_0)$. Moreover if $\lambda \rightarrow \infty$, we have $\beta_0 \rightarrow \beta$ so that with very large shadow cost of public funds ex-post contracting is never optimal. Finally define $\lambda_0$ as the shadow cost which gives $\beta_0 = \beta$:

$$\lambda_0 = g(\beta) \left[ P(Q^m(\beta)) - \beta \right].$$

(18)

We deduce the following result.

**Proposition 2** Let $\beta_0$ and $\lambda_0$ be defined equation (15) and (18).

(i) If $\lambda \leq \lambda_0$ all firms receive an ex-post contract.

(ii) If $\lambda > \lambda_0$ a fraction $G(\beta_0)$ of private firms receives an ex-post contract. This fraction decreases with $\lambda$ and tends to zero when $\lambda \rightarrow \infty$.

**Example:** In a linear demand model where $P(Q) = a - bQ$ and where types $\beta$ are uniformly distributed over $[0, a/2]$, we have $G(\beta)/g(\beta) = \beta$ so that $\beta_0 = a/(1 + 2\lambda)$ and $\lambda_0 = 1/2$. All private firms receive an ex-post contract if $\lambda \leq 1/2$. We deduce that for $\lambda \simeq 0.3$, the value generally retained for the marginal cost of public funds in advanced economies, all private firms are offered an ex-post contract. If $\lambda > 1/2$, the fraction of private firms that contract ex-post with the government is equal to $G(\beta_0) = 2/(1 + 2\lambda)$. For instance at $\lambda = 0.9$, 71% of the firms are offered an ex-post contract and at $\lambda = 2$, this figure falls to 40%. This example suggests that ex-post contracting is more likely in advanced economies. In developing countries outsourcing might often take the extreme form of laissez-faire.

We now study transfers under ex-post contracting. We show that they have very similar properties to those under regulation.
4.3 Transfers

By the envelop theorem, we have \( \frac{d}{d\beta} \Pi^m(\beta) = \pi_\beta(\beta, Q^m(\beta)) = -Q^m(\beta) \).

We deduce that

\[
\Pi^m(\beta) = \int_\beta^{\beta_0} Q^m(\beta) d\beta + \Pi^m(\beta_0) = \int_\beta^{\beta} Q^m(\beta) d\beta + \Pi^m(\beta) \tag{19}
\]

Combining (19) with (17) into (2) we easily get

\[
t^c(\beta) = \begin{cases} 
\int_\beta^{\beta_0} [Q^r(\beta) - Q^m(\beta)] d\beta + \pi(\beta, Q^m(\beta)) - \pi(\beta, Q^r(\beta)) & \text{if } \beta < \beta_0 \\
0 & \text{if } \beta \geq \beta_0
\end{cases}
\]

High cost firms with \( \beta \geq \beta_0 \) receive no transfers. The difference between the transfer under ex-post contracting and regulation is simply equal to \( t^c(\beta) - t^r(\beta) = -t^r(\beta) \). This difference is positive if the government would tax the firm under regulation; it is negative if the government would subsidize it.

Low cost firms with \( \beta < \beta_0 \) receive transfers that consist of two positive terms: an information rent and a compensation that balances out the fall of revenue associated to the higher output levels specified in the contracts. Since \( t^c(\beta) \) involves a difference between profits under regulation and under laissez-faire, fixed costs have no impact on the level of transfers. In contrast to regulation, the government does not compensate here for fixed cost investments. Note also that, by construction, the transfer \( t^c(\beta) \) is non-negative. Indeed, after collecting the franchise fee (which is a lump sum tax), the government takes no responsibility for the firm ex-post profits and losses; ex-post, it can neither tax firm’s positive profits nor can it oblige the firm to produce more without monetary compensation. We next compare the transfer \( t^c(\beta) \) with the transfer for regulated firms, \( t^r(\beta) \). It turns out that for low cost firms the difference in transfers between regulation and ex-post contracting is a constant which depends on \( \beta_0 \).
Lemma 3 Let $\Delta t \equiv t^c(\beta) - t^r(\beta)$. Then, for all $\beta < \beta_0$

$$\Delta t = \Pi^m(\beta_0) - \Pi^r(\beta_0) = \int_{\beta_0}^{\beta} [Q^m(\beta) - Q^r(\beta)] d\beta + \Pi^m(\beta)$$  \hspace{1cm} (20)

Proof. See Appendix 2.

Expression (20) includes the profit of the private firm $\Pi^m(\beta_0)$, which decreases with fixed costs, and the rent of the public manager $\Pi^r(\beta_0)$, which is independent of fixed costs. Hence, larger fixed costs decrease the level of transfers under ex-post contracting compared to regulation. Also, because $Q^m(\beta) > Q^r(\beta)$ for all $\beta > \beta_0$ (see Figure 1), the constant $\Delta t$ is positive if $\Pi^m(\beta) > 0$. In this case the government pays larger transfers under ex-post contracting than it would under regulation. Also, some firms receive positive transfers whereas they would pay a tax under regulation (i.e., $t^c(\beta_0) = 0 > t^r(\beta_0)$). However, $\Delta t$ can also be negative if $\Pi^m(\beta)$ is sufficiently negative. The government then pays smaller transfers under ex-post contracting and some firms receive no transfers whereas they would be subsidized under regulation (i.e., $t^c(\beta_0) = 0 < t^r(\beta_0)$).

4.4 Welfare

By Lemma 1, expected welfare under ex-post contracting writes as

$$EW^c(\lambda) = \int_{\beta}^{\beta_0} W(\beta, Q^r(\beta), t^c(\beta), F, \lambda) dG(\beta) + \int_{\beta_0}^{\beta} W(\beta, Q^m(\beta), 0, F, \lambda) dG(\beta) + \lambda F$$  \hspace{1cm} (21)

Using expression (20), the linearity of the welfare function $W(\cdot)$ in $t(\beta)$ and $F$, and Proposition (3), we rewrite the expected welfare function as

$$EW^c(\lambda) = \int_{\beta}^{\beta_0} W(\beta, Q^m(\beta), 0, 0, \lambda) dG(\beta) + \int_{\beta_0}^{\beta} W(\beta, Q^r(\beta), t^r(\beta), 0, \lambda) dG(\beta) - \lambda \Delta t G(\beta_0) + \lambda F$$  \hspace{1cm} (22)
The ex-ante welfare consists of four elements: the welfare accrued to private firms with high cost $\beta$ receiving no ex-post contract, the welfare accrued to private firms with low cost $\beta$ that contract with the government to produce the regulated level output, the social cost of leaving the additional rent $\Delta t$ to the fraction $G(\beta_0)$ of firms under ex-post contracting and finally the social value of the franchise fee.

The following section discusses the government’s choice between regulation to outsourcing. Because ex-post contracting always dominates laisser-faire, ex-post contracting is the unique outsourcing regime that we need to compare with regulation.

5 Regulation Versus Outsourcing

Outsourcing is preferred to regulation if and only if $EW^c(\lambda) > EW^r(\lambda)$. To facilitate the welfare comparison we change the integration boundaries in (22). We obtain

$$EW^c(\lambda) = EW^r(\lambda) - \lambda \Delta t G(\beta_0) + \lambda F$$

$$- \int_{\beta_0}^{\beta} [W(\beta, Q_r(\beta), t_r(\beta), 0, \lambda) - W(\beta, Q^m(\beta), 0, 0, \lambda)] dG(\beta)$$

Using the welfare function linearity w.r.t. transfer $t_r(\beta)$, we obtain the following result.

Proposition 4 Outsourcing is preferred to regulation if and only if

$$-\lambda \Delta t G(\beta_0) + \lambda F + \lambda \int_{\beta_0}^{\beta} t_r(\beta) dG(\beta)$$

$$+ \int_{\beta_0}^{\beta} [W(\beta, Q^m(\beta), 0, 0, \lambda) - W(\beta, Q^r(\beta), 0, 0, \lambda)] dG(\beta) > 0$$

The difference in welfare between outsourcing and regulation is decomposed into four terms: the social cost of additional rents $\Delta t$, the social value of the franchise fee $F$, the social value of the transfers recouped from the regulated firm (the first integral), and the increase in consumers’ surplus due
to a larger production by high cost firms’ when they are unregulated (the second integral).

In what follows we show that the range of the parameters where outsourcing dominates regulation is not empty. We focus on three situations: small shadow costs of public funds, large shadow cost of public funds and high franchise fees.

5.1 Small shadow costs of public funds: $\lambda \leq \lambda_0$

According to Proposition 2, the government offers ex-post contracts to all firms when $\lambda \leq \lambda_0$. By (18), this amounts to set the cut-off cost $\beta_0$ to its largest value $\bar{\beta}$. Because $\Pi^r (\bar{\beta}) = 0$, we deduce that $\Delta t = \Pi^m (\bar{\beta}) - \Pi^r (\bar{\beta}) = \Pi^m (\bar{\beta})$. Hence, transfers under outsourcing are larger than under regulation by an amount that is equal to the \textit{laissez-faire} profit in the worst cost realization. On the one hand, when the latter profit is positive, all subsidized firms receive larger rents under outsourcing. To participate to the ex-post contracts, private firms must at least keep the lowest profits they get under \textit{laissez-faire}. By contrast a public manager receive nothing in the worst cost realization. On the other hand, firms receive lower transfers when they make losses in the worst case realization. The government indeed avoids the social cost of subsidizing firms in this cost realization.

Finally, since $\beta_0 = \bar{\beta}$, the second integral in expression (23) cancels out. The ex-ante welfare can hence be written as

$$EW^c (\lambda) = EW^r (\lambda) - \lambda \Pi^m (\bar{\beta}) + \lambda F$$

At $\lambda = 0$, outsourcing is equivalent to regulation: $EW^c (0) = EW^r (0)$. For larger $\lambda$, we get the following result.

\textbf{Proposition 5} For $\lambda \leq \lambda_0$ outsourcing is preferred to monopoly regulation if and only if $F > \Pi^m (\bar{\beta})$.

When $\lambda \leq \lambda_0$, each private firm accepts an ex-post contract. Because the ex-post contracts specify the same output levels as under regulation (see
Lemma 1), regulation and outsourcing yield the same consumer and producer surpluses. The choice between the two structures then depends on the levels of expected transfers. Outsourcing is preferred to regulation if the social cost of additional transfers to private firms is balanced against the social benefit of franchise fees. The attractiveness of the outsourcing regime hence depends on the government ability to recoup the expected monopoly profits through franchise fees.

Proposition 5 offers a sharp characterization of the optimal public policy: it only requires to know the franchise fee cashed in by the government and the worst profit realization of the monopoly. For low values of shadow cost of public funds, the government should outsource as soon as it recoups the smallest monopoly’s *laissez-faire* profit through a franchise fee. Because $E \Pi^m > \Pi^m (\beta)$, it should necessarily do so when it sells the firm at its expected market price, $F = E \Pi^m$. One would expect this to be the case in countries with efficient financial markets. Furthermore, when the government is not able/allowed to raise a franchise fee (i.e., when $F = 0$), it should also outsource as long as firms make losses with positive probability (i.e., $\Pi^m (\beta) < 0$). Industries with large uncertainties, such as pharmaceutical industries or more generally R&D industries, are good candidates for such ex-post contractual arrangement with zero franchise fees. Proposition 5 presumably applies for developed economies where shadow costs of public funds take low values\(^{12}\). Yet, in many developing countries, shadow costs of public funds are likely to be larger and one may wonder whether outsourcing is also preferred for large shadow costs of public funds.

### 5.2 Large shadow costs of public funds: $\lambda \to \infty$

When $\lambda \to \infty$ the government puts no weight on consumer’s surplus so that it focuses on collecting funds. In the outsourcing regime, it sells the business to

\(^{12}\)For instance, shadow costs of public funds are assessed to about 0.3 in OECD countries while the threshold $\lambda_0$ is equal to 0.5 in the linear demand and uniform distribution example.
a private entrepreneur and does not intervene any longer. Indeed, according to Proposition 2, no private firm is offered an ex-post contract when \( \lambda \rightarrow \infty \) (i.e., \( \beta_0 \rightarrow \beta \)). Production under outsourcing is the same as under *laissez-faire*.

When \( \lambda \rightarrow \infty \), welfare objective functions tend to infinity. To compare outsourcing and regulation, we need to consider the slopes of those functions. Under outsourcing, the ex-ante welfare tends to infinity with the following slope:

\[
\lim_{\lambda \to \infty} EW_c(\lambda)/\lambda = \int_{\beta} \lim_{\lambda \to \infty} \left[ W(\beta, Q^m(\beta), 0, 0, \lambda)/\lambda \right] dG(\beta) + F = F
\]

Under regulation, the ex-ante welfare tends to infinity with a slope that reflects the transfers that the government expects to collect or pay. When \( \lambda \rightarrow \infty \), the first order condition (9) yields an output level \( Q^r(\beta) \) that is equal to \( Q^m[v(\beta)] \) where \( v(\beta) \equiv \beta + G(\beta)/g(\beta) > \beta \) is called ‘virtual cost’. Then, we successively get

\[
\lim_{\lambda \to \infty} EW^r/\lambda = \int_{\beta} \lim_{\lambda \to \infty} \left[ -t^r(\beta) \right] dG(\beta)
\]

\[
= \int_{\beta} \left[ \int_{\beta} \lim_{\lambda \to \infty} -Q^r(\beta) d\beta + \lim_{\lambda \to \infty} \pi(\beta, Q^r(\beta)) \right] dG(\beta)
\]

\[
= \int_{\beta} \left[ \int_{\beta} -Q^m[v(\beta)] d\beta + \pi(\beta, Q^m[v(\beta)]) \right] dG(\beta)
\]

(25)

The ex-ante welfare under regulation includes the cost of information rent to the public manager (the first term in last equality of this expression) and the average profit tapped from the public firm (the second term). Therefore, we can write the following proposition.

**Proposition 6** *For very large shadow cost public funds \((\lambda \to \infty)\), outsourcing is preferred to regulation if and only if \( F > \lim_{\lambda \to \infty} EW^r/\lambda \).*

The condition in this proposition involves more information than the condition presented in Proposition 5. It requires to know the exact distribution of
cost as well as the profit and output functions for all cost values. In practice, the government lacks such information. Some conditions based on a smaller set of statistics is welcome. The following corollary provides a sufficient and a necessary condition based on smaller information requirements.

**Corollary 7** Suppose $\lambda \to \infty$. Then,

(i) outsourcing is preferred to regulation if $F \geq E\Pi^m - Q^m[v(\beta)] (\bar{\beta} - E\beta)$;
(ii) regulation is preferred to outsourcing if $F \leq \pi(\bar{\beta}, Q^m[v(\bar{\beta})]) \leq \Pi^m(\bar{\beta})$.

**Proof.** See Appendix 3. ■

Part (i) of this corollary confirms the result of the previous section: outsourcing is preferred as soon as the franchise fee recoups the laissez-faire profit. For instance, the latter profit can be assessed by using estimates of firms’ values in similar markets. The conclusion remains true if the government does not extract the full market value of the firm as long as cost uncertainty is large (i.e., $E\beta < \bar{\beta}$). Part (ii) of the corollary states that, to prefer regulation, the government must cash a franchise fee that is sufficiently smaller than the smallest profit realization. Part (ii) is probably more meaningful when we inverse the implication as it follows: regulation is certainly not the preferred option when firms possibly make losses under laissez-faire and when the government cannot extract any franchise fee.

Propositions 5 and 6 show that outsourcing is preferred to regulation for small or large shadow costs of public funds when large franchise fees are sufficiently large. The next section discusses the role of franchise fee for any shadow costs of public funds.

### 5.3 High franchise fees

In this section, we show that outsourcing is preferred by the government when the latter is able to tap a sufficiently large share of the firm’s expected profit through the ex-ante franchise fee, independently of the value of $\lambda$. Since fees are bounded by private firms’ gains, we also study the fees that entrepreneurs are likely to pay when they bargain with the government. We show that the
government always prefers outsourcing to regulation when franchise fees are determined in a efficient bargaining process.

Let us first consider exogenous franchise fees. We compute the value of the maximal franchise fee, i.e., the monopoly’s expected profit when no franchise fee is asked. Using (17) and (19), we know that the profit under outsourcing is equal to the profit under laissez-faire plus a positive information rent that is equal to \( \int_{\beta_0}^{\beta} [Q^r(z) - Q^m(z)]dz \) for each firm with \( \beta < \beta_0 \). Using (8) and (9), this information rent can be written as \( \Pi^r(\beta) - \Pi^r(\beta_0) - [\Pi^m(\beta) - \Pi^m(\beta_0)] \), which by (20) is equal to \( \Pi^r(\beta) - \Pi^m(\beta) + \Delta t \). Hence, the ex-ante profit with zero franchise fee is equal to

\[
E\Pi^c_0 = E\Pi^m + \int_{\beta}^{\beta_0} \int_{\beta}^{\beta_0} [Q^r(z) - Q^m(z)]dz dG(\beta)
= E\Pi^m + G(\beta_0)\Delta t + \int_{\beta}^{\beta_0} [\Pi^r(\beta) - \Pi^m(\beta)]dG(\beta) \tag{26}
\]

We now show that outsourcing is preferred when franchise fees are sufficiently close to the latter value of ex-ante private profits. To do this, we add \( \lambda E\Pi^c_0 \) on both sides of condition (24). After some substitutions and simplifications (see Appendix 4), condition (24) becomes

\[
\lambda [E\Pi^c_0 - F] < \begin{cases} 
\lambda \int_{\beta_0}^{\beta} \Pi^r(\beta) dG(\beta) \\
+ \lambda \int_{\beta_0}^{\beta} [\Pi^m(\beta) - \pi(\beta, Q^r(\beta))]dG(\beta) \\
+ \int_{\beta_0}^{\beta} [W(\beta, Q^m(\beta), 0, 0, \lambda) - W(\beta, Q^r(\beta), 0, 0, \lambda)]dG(\beta).
\end{cases} \tag{27}
\]

The RHS of this condition includes three terms: the expected value of the public manager’s information rent, the additional profit and the additional (gross) surplus that high cost firms generate under outsourcing. It is straightforward to check that each term is positive. We indeed have that \( E\Pi^r(\beta) \geq 0 \) and that \( \Pi^m(\beta) = \max_Q \pi(\beta, Q) \geq \pi(\beta, Q^r(\beta)) \). Also, we have that \( Q^m(\beta) \geq Q^r(\beta) \) for \( \beta > \beta_0 \) and welfare increases at \( Q^m(\beta) \) and \( Q^r(\beta) \) because both \( Q^m(\beta) \) and \( Q^r(\beta) \) are lower than the first best production level \( Q^*(\beta) \).
We deduce the following result.

**Proposition 8** *If the franchise fee $F$ is sufficiently close to $E\Pi_c^0$, outsourcing is preferred to monopoly regulation for any shadow cost of public funds $\lambda > 0$.*

Clearly outsourcing is preferred to regulation for any shadow cost of public funds if the government is able to tap the whole ex-ante profit through the franchise fee. This is likely to occur when the number of investors is large, when they do not collude and when there exist no information asymmetry at the ex-ante stage. These conditions correspond to perfectly competitive financial and/or procurement markets. Moreover the possibility to successfully auction public projects to private investors and entrepreneurs strongly depends on the government’s ability to commit not to expropriate them once the investments are sunk. This ultimately depends on the credibility and on the stability of the political and judicial institutions. Efficient procurement markets, strong legal system and credible governments are found in advanced economies. Such institutions lack in developing countries where attracting private investors is difficult. In such countries, governments might be unable to tap a large amount of private firms’ ex-ante profits and they might ultimately prefer regulation.\(^{13}\)

We finally note that whereas the LHS of (27) decrease with fixed costs (through the term $E\Pi^m$ in $E\Pi^m_c$), the RHS is independent of them. Higher fixed cost diminishes the franchise fee that makes the government indifferent between regulation and outsourcing. Hence, when the ex-ante profit is sufficiently small, the franchise fees need not be positive. The government may indeed pay the entrepreneur to take the business risk.

In the above discussion, we have considered exogenous franchise fees. Yet Proposition 8 offers an important implication when franchise fees are

\(^{13} \text{In contrast, strong moral hazard issues, time inconsistency and lack of governments’ economic focus can be rationales for privatization in least developed countries (see Kornai et al. 2002).} \)
endogenously negotiated between the government and a (single) private entrepreneur: there is always room for negotiation as there always exists a franchise fee that is accepted by the private entrepreneur and that makes the government prefer outsourcing. The negotiation should nevertheless be efficient in the sense that no economic opportunities are lost during the bargaining process. To clarify this statement, assume that the franchise fee is the result of the efficient bargaining process yielding the Nash bargaining solution. The entrepreneur’s payoff is equal to $E\Pi_0^c - F$ and its fallback position is equal to zero. The government’s welfare is equal to the ex-ante welfare without franchise fees, $EW_0^c (\lambda) \equiv EW^c (\lambda) - \lambda F$. Its fallback position is given by $EW^r (\lambda)$. The Nash bargaining allocation solves

$$\max_\phi [EW_0^c (\lambda) + \lambda F - EW^r (\lambda)]^\phi (E\Pi_0^c - F)^{1-\phi}$$

where $\phi \in [0, 1]$ is the government’s bargaining power. Since the payoff functions are linear in $F$, the Nash bargaining solution readily writes as

$$F^c = \phi E\Pi_0^c - (1 - \phi) [EW_0^c (\lambda) - EW^r (\lambda)] / \lambda$$

The franchise fee can be positive or negative. It will be negative for instance when the government has weak bargaining power (i.e., $\phi$ is close to zero) and when expected profits are negative. Because the market is not profitable the government is willing to help a firm to enter and propose ex-post contracts. The franchise fee will also be negative when the welfare level under regulation is sufficiently small compared to the welfare level under outsourcing and no franchise fee. In this situation the firm is able to extract an ex-ante rent from the government because it knows that the option of regulation yield no better welfare.

We deduce the following result.

**Corollary 9** Outsourcing is always preferred to regulation when the franchise fee $F$ is endogenously determined by an efficient bargaining process.
The results of the paper rest on two key assumptions: first, risk neutral entrepreneurs have access to efficient financial markets and second, government does not auction the right to run the regulated firm to potential public managers. This last assumption is usually justified by the fact that information rents take the form of in-kind benefits that are difficult to value. But, for the sake of the argument, suppose that the government is able to perfectly auction the right to operate a private-regulated firm to some risk neutral manager. The government is then able to recoup the manager’s expected rents,

\[ \int_{\beta}^{\bar{\beta}} \Pi' (\beta) \, dG (\beta). \]

The ex-ante welfare with the regulated firm is increased by this amount. This is equivalent to cancel the first term in (27). Proposition 8 is still valid. Outsourcing is preferred to regulation for any franchise fee \( F \) that is sufficiently close to \( E \Pi_0^c \). The crucial assumption of the paper is the existence of efficient financial market for private entrepreneurs. Policy implications are thus more likely to fit advanced economies.

### 5.3.1 Numerical example

We consider a linear inverse demand function \( P(Q) = a - bQ \) and a uniform distribution of cost \( \beta \in [0, \bar{\beta}] \) so that \( G(\beta)/g(\beta) = \beta \). Assumption A1 writes \( a \geq 2\bar{\beta} \). To meet this requirement we index the spread of the distribution cost by \( \alpha \in [0, 1] \) so that \( \bar{\beta} = a\alpha/2 \). Under these assumptions it is straightforward to check that equation (15) yields \( \beta_0 = a/ (1 + 2\lambda) \) and equation (18) yields \( \lambda_0 = (2 - \alpha) / (2\alpha) \) so that \( \lambda_0 \in [0.5, +\infty) \). Moreover let \( V \) be the ex-ante variable profit of a laissez-faire monopoly (i.e., \( E \Pi^m = V - K - F \)). One can check that \( V = (12 - 6\alpha + \alpha^2) a^2 / (48b) \). Appendix 5 shows that \( EW^r \) and \( EW^c \) are both fully characterized by \( V, \lambda, \alpha, F \) and \( K \).

\[^{14}\text{Because what really matters is the net surplus from consumption by the first consumer (i.e., } a - \beta, \text{ we can normalize } \bar{\beta} = 0 \text{ without loss of generality.}\]
We normalize the fixed cost to its share in the *ex-ante* variable profit of the *laissez-faire* monopoly. That is, let $k \equiv K/V$. Obviously, a *laissez-faire* firm makes zero *ex-ante* profit when $k = 1$ and it makes $E\Pi^m = (1 - k)V$ when $0 < k < 1$. Figure 2 shows the normalized levels of fixed costs, $k$, above which outsourcing is preferred in the case of a zero franchise fee and in the case of a franchise fee equal to half the *ex-ante laissez-faire* profit ($F = E\Pi^m/2$). Each curve is drawn for a cost spread varying between $\alpha = 0.05$ and 0.5. It is readily observed that outsourcing is preferred for smaller shadow costs of public funds. Still, the latter effect is not too much marked. Also, outsourcing is preferred for larger cost spreads, i.e., for larger business risk. Finally, outsourcing is preferred when the government is able to tap larger franchise fees from the monopoly.

**6 Conclusion**

This paper studies the effect of soft-budget constraints in a pure adverse selection model of monopoly regulation. We consider a government maximizing total surplus but incurring some cost of public funds à la Baron and Myerson (1982) and Laffont and Tirole (1993). We compare two regimes. First, in the regulation regime, the government delegates the firm’s operation to a public manager who reports cost realization. Because of information rents, the government is not able to impose first best production level. It therefore induces the second best, incentive compatible production levels. Second, in the outsourcing regime, the government delegates the firm’s operation to a private entrepreneur or investor who enter the natural monopoly market. The private firm is allowed to freely choose the price and output levels as in the *laissez-faire*. Still, the government can propose ex-post contracts to firms in order to increase production levels. Such ex-post contracts leave private firms with at least their *laissez-faire* profits.
In this paper outsourcing correspond to the privatization of a natural monopoly. Under outsourcing the government does not take any responsibility over firms’ cash flows. Private investor and entrepreneurs pay for their losses and they cash in their profits. In fact, privatization alleviate the information rents that takes place under regulation where public firms’ managers are able to tap revenues from the government in exchange for the information they disclose about their firms.

In the outsourcing regime, ex-post contracting is obviously welfare improving compared to laissez-faire. Indeed, the government can always implement laissez-faire within the outsourcing regime by setting ex-post contracts to zero. The issue is then whether ex-post contracting is preferred to regulation. Ex-post contracting indeed allows the government to avoid high subsidies to high cost firms. This relaxes the incentive constraint and permits to reduce output distortions within high cost firms. However, ex-post contracting forbids the government to tap revenues from low cost, profitable firms, as it does under regulation.

In this paper, we show that, under outsourcing, the government offers ex-post contracts to a group of low cost firms only. These firms are asked output and price schedules that are similar to those under regulation. By contrast, high cost firms do not receive any ex-post contracts and they operate exactly as under laissez-faire. The set of such high cost firms grow with larger shadow cost of public funds. We also show that transfers under ex-post contracting and regulation are equal up to a constant. Still, transfers may be smaller or larger under outsourcing.

Obviously, the benefit of outsourcing depends on the value of the shadow cost of public funds and on the size of the franchise fees that the government is able to extract ex-ante. We show that liberal regulation is clearly preferred by the government in three distinct situations. When shadow costs of public funds are small, all private firms receive ex-post contracts and outsourcing is always preferred when the franchise fee is larger than the laissez-faire profit in the worst cost realization. We show that when shadow costs of public

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funds are large enough, outsourcing is also preferred if the franchise fee is larger than expected laissez-faire profits. Finally, outsourcing is also the best option when the government is able to set a franchise fee that is sufficiently large but, still acceptable for the private entrepreneur. These results suggest that governments’ financial constraints and asymmetric information are good rationales for privatization as well as moral hazard issues, time inconsistency and governments’ lack of economic focus on which the literature has focused. The lack of government’s ability to franchise natural monopoly markets and the importance of cost uncertainties favor private ownership to public ownership and/or to traditional regulation.

References


JULLIEN B. (2000), "Participation Constraints in Adverse Selection Mod-


Appendix 1: Proof of Lemma 1

The proof is an application of Jullien (2000) in the particular case of common
value adverse selection. We make it here explicit the dynamic programming
approach. The program can be written as

$$\max_{Q(.),\Pi(.),\mu(.),\gamma(.)} \int H_1 (\beta, Q, \Pi, \mu, \gamma) \, d\beta$$

where

$$H_1 (\beta, Q, \Pi, \mu, \gamma) = [S(Q) + \lambda P(Q) Q - (1 + \lambda) \beta Q - \lambda \Pi] g(\beta) + \mu (\Pi + Q) + \lambda \gamma (\beta) (\Pi - \Pi^m(\beta))$$

where \(\Pi^m(\beta) \equiv \pi(\beta, Q^m(\beta))\), where \(\mu(\beta) \in \mathbb{R}\) is the co-state variable of the
incentive constraint and where \(\gamma(\beta) \geq 0\) is the Lagrange multiplier of the
participation constraint. After integrating by part, this program is equivalent
to \(\max_{Q(.),\Pi(.),\mu(.),\gamma(.)} \int H_2 (\beta, Q, \Pi, \mu, \gamma) \, d\beta\) where

$$H_2 (\beta, Q(.), \Pi(.), \mu(.), \gamma(.)) = [S(Q) + \lambda P(Q) Q - (1 + \lambda) \beta Q - \lambda \Pi] g(\beta) - \mu(\beta) \Pi + \mu(\beta) Q + \lambda \gamma (\beta) (\Pi - \Pi^m(\beta))$$

with transversality conditions: \(\Pi (\beta) \mu (\beta) = \Pi (\beta) \mu (\beta) = 0\). It is easy to
check that concavity conditions are respected. So, the following necessary
condition is also sufficient:

$$P(Q) + \frac{\lambda}{1 + \lambda} P'(Q)Q = \beta + \frac{\lambda}{1 + \lambda} \frac{G(\beta) - \Gamma(\beta)}{g(\beta)}$$  \hspace{1cm} (28)$$

where \(\Gamma(\beta) = \int_0^\beta \gamma(\beta) \, d\beta\) is an increasing function such that, by the transversality conditions, \(\Gamma(\beta) = 0\) and \(\Gamma(\beta) = 1\). Let us denote the solution of
(28) by the function \(l(\beta, \Gamma)\). By assumption A3, \(l(\beta, \Gamma)\) is a non increasing
function of $\beta$ and a non decreasing function of $\Gamma$ (see ‘potential separation’ in Jullien (2000)). The solution is displayed as the bold curve of Figure 3.

Consider the binding participation constraint: $\Pi(\beta) = \Pi^m(\beta)$ and $\gamma(\beta) > 0$. A necessary condition is that $\Pi(\beta) = \Pi^m(\beta)$ or, by the envelop theorem, $Q(\beta) = Q^m(\beta)$, which is equivalent to $l(\beta, \Gamma) = Q^m(\beta)$.

We study the intersection of $Q^m(\beta)$ with $l(\beta, \Gamma)$ successively for $\Gamma = 1$ and for $\Gamma = 0$. On the one hand, using expression (11), we find that $l(\beta, 1) > Q^m(\beta)$. So, $l(\beta, 1)$ never intersects $Q^m(\beta)$ and, thus, $\Gamma(\beta)$ is never equal to 1. On the other hand, if $l(\beta, 0)$ intersects $Q^m(\beta)$, it must intersect at some $\beta_0$ that satisfies both conditions (11) and (28), which yields the expression (15) that we write again here:

$$P(Q^m(\beta_0)) - \beta_0 = \lambda \frac{G(\beta_0)}{g(\beta_0)} \tag{29}$$

Under Assumptions A2 and A3, this equality accepts a unique solution $\beta = \beta_0$. Indeed, by Assumption A2, the RHS of (29) increases in $\beta_0$. Also, note that the LHS of (29) is positive and decreases in $\beta_0$ iff $P(Q^m(\beta)) - \beta$ is a decreasing function, or by (11), iff $P'(Q^m(\beta))Q^m(\beta)$ is an increasing function. Since $Q^m$ is non increasing in $\beta$, this is true under Assumption A3: $P''Q + P' < 0$.

We thus have that, for $\beta < \beta_0$, the solution of the program is $Q^c(\beta) = l(\beta, 1) = Q^r(\beta)$ and $\gamma(\beta) = 0$, and that, for $\beta \geq \beta_0$, $Q^c(\beta) = Q^m(\beta) = l(\beta, \gamma(\beta))$ and $\gamma(\beta) > 0$. Also, one can check that $Q^m(\beta) > Q^r(\beta)$ iff $\beta > \beta_0$. 

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Appendix 2: Proof of Lemma 3

For any $\beta < \beta_0$,

$$\Delta t = t^c(\beta) - t^r(\beta)$$

$$= \int_\beta^{\beta_0} [Q^r(\beta) - Q^m(\beta)] d\beta + \pi(\beta, Q^m(\beta)) - \pi(\beta, Q^r(\beta))$$

$$\quad - \left[ \int_\beta^{\bar{\beta}} Q^r(\beta) d\beta - \pi(\beta, Q^r(\beta)) \right]$$

$$= \int_\beta^{\beta_0} [Q^r(\beta) - Q^m(\beta)] d\beta + \pi(\beta, Q^m(\beta)) - \int_\beta^{\bar{\beta}} Q^r(\beta) d\beta$$

$$= \int_\beta^{\beta_0} Q^r(\beta) d\beta + \Pi^m(\beta_0) - \int_\beta^{\bar{\beta}} Q^r(\beta) d\beta$$

$$= \int_{\beta_0}^{\bar{\beta}} Q^r(\beta) d\beta + \Pi^m(\beta_0) = \Pi^m(\beta_0) - \Pi^r(\beta_0)$$

where we used (19) in the third and fourth equalities and (8) in the last equality. This expression can be re-written as $\int_{\beta_0}^{\bar{\beta}} [Q^m(\beta) - Q^r(\beta)] d\beta + \Pi^m(\bar{\beta})$ where the first term is positive because $Q^m(\beta) > Q^r(\beta)$ for all $\beta > \beta_0$ (see proof of the Lemma 1).

Appendix 3: Proof of Corollary 7

For the sake of clarity, let us denote $v(\beta)$ and $v(\bar{\beta})$ by $v$ and $\bar{v}$.

(i) Note that $E\Pi^m = \int_{\beta}^{\bar{\beta}} \pi[\beta, Q^m(\beta)] dG(\beta)$. Adding the LHS and subtracting the RHS of this equality in (25) as well as adding and subtracting
\[
\int_{\beta}^{\bar{\beta}} \int_{\beta}^{\bar{\beta}} Q^m(\bar{v})d\beta dG(\beta) \text{ successively yield}
\]

\[
\lim_{\lambda \to \infty} \frac{EW^r}{\lambda} = E\Pi^m + \int_{\beta}^{\bar{\beta}} \left[ \int_{\beta}^{\bar{\beta}} -Q^m(v)d\beta + \pi[\beta, Q^m(v)] - \pi[\beta, Q^m(\beta)] \right] dG(\beta)
\]

\[
= E\Pi^m + \int_{\beta}^{\bar{\beta}} \int_{\beta}^{\bar{\beta}} -Q^m(\bar{v})d\beta + \int_{\beta}^{\bar{\beta}} [Q^m(\bar{v}) - Q^m(v)] d\beta dG(\beta)
\]

\[
+ \int_{\beta}^{\bar{\beta}} \pi[\beta, Q^m(v)] - \pi[\beta, Q^m(\beta)] dG(\beta)
\]

\[
= E\Pi^m - Q^m(\bar{v}) \int_{\beta}^{\bar{\beta}} \left( \bar{\beta} - \beta \right) d\beta
\]

\[
+ \int_{\beta}^{\bar{\beta}} \left[ \int_{\beta}^{\bar{\beta}} [Q^m(\bar{v}) - Q^m(v)] d\beta + \pi[\beta, Q^m(v)] - \pi[\beta, Q^m(\beta)] \right] dG(\beta)
\]

where the last integral in the RHS of the last equality is negative because \(\bar{v} \geq v\) and thus \(Q^m(\bar{v}) < Q^m(v)\) and because \(\pi[\beta, Q^m(v)] \leq \pi[\beta, \bar{Q}(\beta)] = \max_{Q} \pi(\beta, Q)\). Hence, \(\lim_{\lambda \to \infty} \frac{EW^r}{\lambda} > E\Pi^m + Q^m(\bar{v}) \int_{\beta}^{\bar{\beta}} (\bar{\beta} - \beta) d\beta = E\Pi^m - Q^m \left[ v(\bar{\beta}) \right] (\bar{\beta} - E\beta)\).

(ii) Note that \(\pi(\beta, Q^m(v)) = \pi(\bar{\beta}, Q^m(\bar{v})) - \int_{\beta}^{\bar{\beta}} \{ \pi_{\beta}[\beta, Q^m(v)] + \pi_{Q}[\beta, Q^m(v)]Q^m(v)Q^m(v)\} d\beta\)

where \(\pi_{\beta}[\beta, Q^m(v)] = -Q^m(v)\). Adding the RHS of this equality in (25), subtracting the LHS and simplifying yield

\[
\lim_{\lambda \to \infty} \frac{EW^r}{\lambda} = \int_{\beta}^{\bar{\beta}} \left[ \pi[\bar{\beta}, Q^m(\bar{v})] + \int_{\beta}^{\bar{\beta}} \pi_Q[\beta, Q^m(v)][-Q^m(v)Q^m(v)] d\beta \right] dG(\beta)
\]

where the last term in the integral is positive because \(Q^m(v) < 0\), \(v' = 1 + (G(\beta))/g(\beta)\) > 0, \(Q^m(v) < Q^m(\beta)\) and thus \(\pi_{\beta}[\beta, Q^m(v)] > \pi_{\beta}[\beta, Q^m(\beta)] = 0\). Hence, \(\lim_{\lambda \to \infty} \frac{EW^r}{\lambda} > \pi[\bar{\beta}, Q^m(\bar{v})]\). Since \(Q^m(v) < Q^m(\beta)\), \(\pi(\bar{\beta}, Q^m \left[ v(\bar{\beta}) \right]) \leq \Pi^m(\bar{\beta})\).
Appendix 4: Proof of Proposition 8

We here detail the proof of condition (27). Adding $\lambda (E\Pi_0 - F)$ on both sides of condition (24) we get

\[-\lambda \Delta t G (\beta_0) + \lambda E\Pi_0 + \lambda \int_{\beta_0}^{\beta} tr (\beta) dG(\beta) + \int_{\beta_0}^{\beta} [W(\beta, Q^m (\beta), 0, 0, \lambda) - W (\beta, Q^r (\beta), 0, 0, \lambda)] dG(\beta) \}

\[> \lambda (E\Pi_0 - F)\]

Replacing $E\Pi_0$ by its value in (26) and using the identity $\int_{\beta_0}^{\beta} tr (\beta) dG(\beta) = \int_{\beta_0}^{\beta} [\Pi^r (\beta) - \pi (\beta, Q^r (\beta))] dG(\beta)$, the first line on the LHS becomes

\[\lambda E\Pi^m + \lambda \int_{\beta_0}^{\beta} [\Pi^r (\beta) - \Pi^m (\beta)] dG(\beta) + \lambda \int_{\beta_0}^{\beta} [\Pi^r (\beta) - \pi (\beta, Q^r (\beta))] dG(\beta)\]

Adding the term $\lambda E\Pi^r - \lambda E\Pi^m - \lambda \int_{\beta}^{\beta_0} [\Pi^r (\beta) - \Pi^m (\beta)] dG(\beta) (= 0)$, this expression becomes

\[\lambda E\Pi^r + \lambda \int_{\beta_0}^{\beta} [\Pi^m (\beta) - \pi (\beta, Q^r (\beta))] dG(\beta)\]

which yields the condition (27).

Appendix 5: Linear Example

We consider the linear inverse demand function $P = a - bQ$ a uniform distribution of cost $\beta$. Without loss of generality, we normalize $\beta = 0$ and we set $\beta = \alpha a/2$ where $\alpha \in [0, 1]$ is a parameter that indexes the spread of cost distribution. Under linear utility function, profits and welfare are proportional to $a^2/b$. This allows to normalize the fixed cost and the franchise fee such that $K = kV$ and $F = fV$ where $V = [P(Q^m (\beta)) - \beta] Q^m (\beta) = (12 - 6\alpha + \alpha^2) a^2/(48b)$. So, $E\Pi^m = 0$ $\iff$ $K = V$ $\iff$ $k = 1$. We can compute that $E\Pi^m / V = (1 - k)$, that $\lambda_0 = \frac{2 - \alpha}{2\alpha}$ and that welfare under regulation is equal to

\[EW^r / V = 2 \frac{12 (1 + \lambda)^2 + \alpha^2 (1 + 2\lambda)^2 - 6\alpha (\lambda + 1) (2\lambda + 1)}{(12 - 6\alpha + \alpha^2) (1 + 2\lambda)} - (1 + \lambda) k\]
Welfare under outsourcing is equal to

\[
EW^c/V = \begin{cases} 
\frac{24+36\lambda-12\alpha(1+2\lambda)+\alpha^2(\lambda+2)(1+2\lambda)}{(12-6\alpha+\alpha^2)(1+2\lambda)} - k + \lambda f & \text{if } \lambda < \lambda_0 \\
\frac{8+3\alpha^2(1+2\lambda)^2-\alpha^2(1+2\lambda)(2\lambda+1)}{2\alpha(12-6\alpha+\alpha^2)(1+2\lambda)^2} - k + \lambda f & \text{if } \lambda > \lambda_0
\end{cases}
\]

Note first the case in which the franchise fee extracts the whole laissez-faire profit: \( f = (1 - k) \). Then

\[
EW^c/V - EW^r/V = \begin{cases} 
\frac{2(3-\alpha)^2}{12-6\alpha+\alpha^2} > 0 & \text{if } \lambda < \lambda_0 \\
\frac{8-12\alpha(1+2\lambda)+6\alpha^2(1+2\lambda)^2-\alpha^2(1+2\lambda)(2\lambda+1)}{2\alpha(12-6\alpha+\alpha^2)(1+2\lambda)^2} & \text{if } \lambda > \lambda_0
\end{cases}
\]

where the numerator of the second item in this expression is a cubic function of \( \lambda \). It can be readily be numerically shown that the latter is always positive. Hence outsourcing is always preferred when the franchise fee extracts the whole laissez-faire profit.

Comparing welfare under regulation and outsourcing yields the following normalized level of fixed cost above which outsourcing is preferred:

\[
k(\lambda, f, \alpha) = \begin{cases} 
\frac{3(2-\alpha)^2}{(12-6\alpha+\alpha^2)} - f & \text{if } \lambda < \lambda_0 \\
\frac{8+\alpha^2(1+2\lambda)^2(1+8\lambda)-6(1+4\lambda)\alpha^2(1+2\lambda)^2+12\alpha(2\lambda+1)(4\lambda^2+2\lambda+1)}{2\alpha(12-6\alpha+\alpha^2)(1+2\lambda)^2} - f & \text{if } \lambda > \lambda_0
\end{cases}
\]

When the franchise fee is set to zero we get

\[
k(\lambda, 0, \alpha) = \begin{cases} 
\frac{3(2-\alpha)^2}{(12-6\alpha+\alpha^2)} - f & \text{if } \lambda < \lambda_0 = \frac{1}{2} \\
\frac{8+\alpha^2(1+2\lambda)^2(1+8\lambda)-6(1+4\lambda)\alpha^2(1+2\lambda)^2+12\alpha(2\lambda+1)(4\lambda^2+2\lambda+1)}{2\alpha(12-6\alpha+\alpha^2)(1+2\lambda)^2} & \text{if } \lambda > \lambda_0 = \frac{1}{2}
\end{cases}
\]

This yields the curves displayed in the figure.
Figure 1. Output and Profit under Regulation, Laissez-Faire and Outsourcing.
Figure 2: Outsourcing v/s Regulation for Linear Demand Functions (P=a-bQ) and Uniform Cost Distributions (0, β); k=K/V.
Figure 3: Output levels and shadow value of participation constraint $\Gamma(\beta)$