Infrastructure Privatization and Changes in Corruption Patterns:

The Roots of Public Discontent

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Abstract

This paper offers a theory of how the degree of corruption that prevails in a society responds to changes in the ownership structure of major public service providers. We show that there are cases in which privatization, even though it fosters investments in infrastructure, also opens the door to more corruption. The public dissatisfaction towards privatization is then crucially affected by the changes in the degree and pattern of corruption. Our model thus helps understand the seemingly paradoxical situation prevailing in Latin America, where most studies find that privatizations have been efficiency-enhancing and have fostered investments and, at the same time, popular dissatisfaction with the process is extremely high, especially among the middle class. We show that this line of explanation is consistent with the evidence from surveys in the region.

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1 Introduction

This paper offers a theory of how the degree of corruption responds to changes in the ownership structure of major public service providers. Our main conclusion is that there are cases where private ownership, even though it fosters efficiency-enhancing investments also opens the door to more corruption. In doing so, we focus on one specific type of corruption especially relevant for privatized infrastructure sectors, namely the fact that soft ex post price regulation may have allowed both firms, through large profits, and governments, through increased tax revenues, to benefit from efficiency gains at the expense of consumers.[1]

How do the ownership structure and the kinds of control rights exerted by public officials affect both the patterns of investment and corruption? Since Kornai (1986), it is well known that public firms suffer from the so-called *soft-budget constraint.* As an owner, the government cannot refrain from siphoning the Treasury to cover the cost overruns of a public firm. Anticipating these extra subsidies, the managers of public firms have little incentives to cut on costs. Under-investment in cost-reducing measures prevails under public ownership. The other consequence of allowing direct transfers between the government and the public firms is that any kind of collusion between public officials and the manager of the public firm takes the form of inflated subsidies, which siphon the Treasury to please private interests. Those manipulations are thus perceived as a burden only by taxpayers and do not appear significant to consumers.

On the other hand, it has often been argued that a key benefit of private ownership comes from the fact that the government stays at arm's length with the private firm. By committing itself not to use lump-sum transfers to finance cost overruns, the government hardens the firm's budget constraint. This fosters cost-reducing investments and improves welfare. Indeed, in the absence of public funds, the manager of a private firm can only cover costs with the firm's revenues. However, raising price mark-ups to cover inefficient fixed costs also dampens demand. Under a hard-budget constraint, consumers discipline the firm. This increases incentives to realize cost-reducing investments. However, the hidden side of this *hard-budget constraint* is that collusion between public officials and the firm takes now the form of softened price regulation, to which consumers might be quite sensitive.

[1] To the best of our knowledge, this paper is the first to develop a formal theory of the link between ownership and corruption. Other channels through which corruption may destroy the benefits from privatizations are discussed in Rose-Ackerman (1999), Estache (2004) and Martimort and Straub (2005). These include the use of inside information at the pre-award stage, renegotiations (Guasch, Laffont and Straub, 2003 and 2005; Engel, Fischer and Galetovic, 2003), and obstacles to the introduction of competition. As argued below, these can be considered as complementary to the channel discussed in this paper.

Thus, we argue that there is a change in the type of corrupt practices during the process, from using SOEs as soft money transfer schemes to favored groups, to allowing greater prices to capture the benefits from increased efficiency, and that consequently the burden of corruption shifts from taxpayers under public ownership to consumers of specific services under private ownership.[2]

This links to the second point of the paper, namely the fact that public opinion of privatization is crucially affected by the degree of corruption and the extent to which society perceives that corruption changes with the ownership structure. More precisely, we shall argue that, although public and private ownerships are both subject to corruption, these corrupt deals are of different kinds, have different likelihoods in equilibrium, and might be perceived quite differently by the general public. The important point we stress is that corruption between non-benevolent public officials and the firm might emerge more easily, precisely for the very reasons that make privatization socially beneficial, namely *a harder budget constraint* due to restricted transfers between the State and the firm. A hardened budget constraint under private ownership fosters investments but also shifts the burden of corruption from taxpayers to consumers. Our model will thus explain a seemingly paradoxical situation where both efficiency and investments are fostered and, at the same time, corruption and dissatisfaction with privatization are more pronounced.

As stressed below when analyzing the model's results, this is more likely to happen for firms in sectors involving large fixed costs and requiring high mark-ups to break-even, which makes the water and transport (road, port and airport construction) sectors good candidates to fit our model.

It appears that this type of corruption can seriously undermine public support for privatizations by shifting the distribution of potential rents among different groups and is therefore likely to constitute an important explanation of the recent upsurge in dissatisfaction with privatizations, observed for example in Latin America.

This evolution has often been deemed some of a paradox, because to date, most studies have failed to find significant negative welfare effects of infrastructure privatization.[3] We argue that despite this, the mechanism unveiled in our model can explain the increase in dissatisfaction in two ways. First, as argued for example in Birdsall and Nellis (2005), it fuels the perception that the process is fundamentally unfair and deprived of equity concerns. This is in particular the case when an increase in income and wealth for all citizens is accompanied by an increased inequity in their distribution.

Second, a complementary line of explanation is found in recent contributions showing

[2] This point was already made by Shleifer and Vishny (1994), although they did not provide theoretical foundations for it.

[3] See a review of the relevant literature below.

that relative income concerns may be pivotal in shaping opinions on welfare comparisons or specific policy issues.[4] Indeed, with the modification in the ownership structure, different groups come to pay the cost of corruption or benefit from efficiency improvements. In the present case, middle class consumers tend to perceive that they have been the losers in this allocation of gains and losses and therefore that their relative position has worsened. We show in the discussion in Section 6 that this interpretation is consistent with stylized facts and econometric evidence from the Latinobarometro surveys.[5]

Note also that different groups have different levels of organization, homogeneity and costs of organizing themselves as active political actors. Following Olson's (1971) classical insights, this in turn may have an impact on how much they would invest in uncovering and controlling corruption or, alternatively, on how much political pressure they would exert as constituencies. As discussed in Section 6, this tends to reinforce the expression of discontent among middle class, urban consumers.

Finally, this line of explanation is also consistent with the common observation and the perception among the public that in many countries privatization programs have been plagued by cronyism, insider dealings and assets, sometimes the "crown jewels", being transferred to friends or members of the ruling elite. Indeed, as will become clear during the exposition of the model, these instances of collusion can be seen as facilitating factors to ex post price collusion between private owners and regulators or governments. Indeed, although we don't model formally the process through which assets are transferred to focus on our main purpose, namely the link between ownership regimes, efficiency and corruption, we stress in Section 2 that it is straightforward to link corruption in this process to a change in the distribution of the transaction cost of corruption, conducive to higher ex post equilibrium corruption in the model.

The paper is organized as follows. Next, we review the related literature. Section 2 presents our theoretical model. Section 3 analyzes the benchmark of a benevolent public official. We focus there on the benefits of private ownership in hardening the firm's budget constraint and its positive impact on investment. Section 4 introduces the possibility of corruption and derives its consequences both for public and private ownership. Section 5 discusses the incentives of consumers to react to an increase in their own perception of corruption. Section 6 presents the situation with private participation in infrastructure in Latin America and discusses stylized facts and estimations from Latinobarometro surveys supporting the analysis put forward in the theoretical model. Section 7 concludes. Proofs

[4] See Clark and Oswald (1996) and Senik (2004) for examples of empirical applications. Hopkins and Kornienko (2004) and Rayo and Becker (2007) provide theoretical foundations.

[5] Recent empirical analyses of the determinants of dissatisfaction with privatization include Bonnet et al. (2006) and Checchi et al. (2006) for Latin America, and Denisova et al. (2007) for 28 post-communist countries, who show that fairness considerations are an important motive of dissatisfaction with privatization.

are relegated to an Appendix.

Literature Review.

Our definition of ownership is standard. It relies on the unrestricted exercise of residual rights of control, which stems from the ability to use transfers to finance (or refinance) the firm under public ownership. This definition is thus the same as in Shleifer and Vishny (1994) and Bennedsen (2000). However, because it is based on *informational asymmetries* to justify first the existing information rent of firms, second, the discretion of public officials, our model provides solid micro-foundations for the stakes of corruption. It does not *a priori* distinguish between the kinds of corruption which respectively takes place between a private manager or a public one and a public official as those previous studies. Any such difference comes from the existing differences in incentives that arise under both governance modes.

Although the soft versus hard budget constraint debate has by-now been put on firmer theoretical grounds,[6] no one has to the best of our knowledge analyzed the consequences of tightening the firm's budget on the stakes and degrees of corruption that may emerge. Our paper bears some similarity with Coate and Morris (1995), who argue that inefficient redistributive tools may be used to transfer resources towards private interests. A similar phenomenon arises here: because it suppresses direct transfers from taxpayers to the public firm, privatization may change the collusive stakes between the public official and the firm, sometimes increasing that stake and making corruption more likely. As we do in this paper, Laffont and Tirole (1993, Chapter 15) argued that average cost pricing triggers more reaction from consumers in a model where the firm's private information is on its fixed cost and where collusion is not an equilibrium phenomenon.

Finally, the literature on privatization in developing countries, our primary concern, has by large ignored the possibly positive relationship between investment, privatization and corruption unveiled in our paper. On the relationship between privatization and corruption, a few papers deal with different aspects of the process.

At the theoretical level, Laffont (2005, Chapter 3) stresses instead that the mere fact of privatizing may be a corrupt political act. Bjorvatn and Soreide (2005) model how corruption affects the acquisition price and the post-privatization market structure, predicting that higher corruption will result in greater market concentration. Boycko, Shleifer and Vishny (1996) develop a model in which privatization helps controlling political discretion, and introduce bribes between managers and politicians as a way to provide benefits to the latter more efficiently than through excess employment for example, thus arguing for a socially beneficial effect of corruption. Hoff and Stiglitz (2005) propose a model that

[6] See Dewatripont and Maskin (1995), Kornai, Maskin and Roland (2002) and Segal (1999) for more recent contributions.

explains how the privatization process in transition countries, because it was plagued with corruption, failed to generate a high level of demand for the establishment of the rule of law and led to an inefficient path of institutional change.

At the empirical level, Kaufman and Siegelbaum (1997) consider the privatization process that took place in the former Soviet Union and Central and Eastern Europe, and discuss how the scope and different methods employed to carry out privatization affected the likelihood of subsequent corruption. Clarke and Xu (2004) document how petty corruption in eastern European and central Asian utilities depends on the characteristics of bribe payers and takers, arguing in particular that corruption is lower with privatized and competitive utilities. Finally, anecdotal evidence and case studies on the link between privatization and corruption can be found in Manzetti (1999), Rose-Ackerman (1999) and Tulchin and Espach (2000) *inter alia*.

As for the link between privatization and efficiency, a distinction must be made between general privatizations and the specific case of infrastructure services. As for generic evidence, evaluations of the impact of privatization point to improvements in financial and operating performance[7] and wages,[8] while some negative effects are observed for prices and employment.[9]

As for infrastructure sectors, on which we specifically focus, more specific evidence is found in McKenzie and Mookherjee (2003), Harris (2003), Coelli and Lawrence (2006) and Andres et al. (2007) *inter alia*.[10] Especially relevant to our purpose, Andres et al. (2007) offers the more encompassing and methodologically sound review of privatization and infrastructure performance in Latin America to date, looking at 181 firms in 3 sectors (telecommunications, electricity distribution, water and sewerage) across 15 countries. Controlling for existing pre-privatization and transition-period trends, they conclude that overall there are consistent improvements in operating performance and quality, reduction in the workforce, a tendency to price increases but with a lot of variability, and no significant impacts on output and coverage. In most cases, productivity improvements were due to sizable cutoffs in the amount of labor, but quality indicators such as distributional losses in water and electricity, and percentage of incomplete calls in telecoms showed substantial improvements.

[7] Standard indicators include profitability (net income to sales, operating income to sales), operating efficiency (cost per unit, sales to assets and sales to employee ratio), and output. See La Porta and Lopéz-de-Silanes (1999), Megginson and Netter (2001), Kikeri and Nellis (2002), Bortolotti and Siniscalco (2003) and Chong and Lopéz-de-Silanes (2004) *inter alia*. These papers are summarized and discussed in more details in Martimort and Straub (2005) and Megginson (2005).

[8] Kikeri and Nellis (2002), López-Calva and Rosellón (2002), and La Porta and López-de-Silanes (1999).

[9] Lora and Panizza (2002), Kikeri and Nellis (2002).

[10] Jamasb, Mota, Newbery and Pollitt (2005) is a survey of electricity sector reform in developing countries. Dal Bo and Rossi (2007) show that Latin American electricity distribution firms in more corrupt countries are more inefficient. Lobina and Hall (2003) provide a critical view of water privatization.

As for prices, evidence from other studies shows that they have increased in about half of the privatization cases[11], an evolution sometimes justified by the need to bring heavily subsidized prices in line with marginal costs, attract much needed investments and finance quality improvements, as well as allow tariff changes when cross-subsidies were eliminated. Moreover, price increases were sometimes partly due to indirect tax premia on basic prices, so that infrastructure services have been used as tax handle by governments.[12] As for employment, substantial initial job losses in the privatized firms were limited as a percentage of the total workforce and tended to be (at least partially) reversed in the medium run.[13]

In a nutshell, it appears that to date, and despite a relatively adverse economic phase in the late 90s, infrastructure privatization improved fiscal stability,[14] had mostly neutral to positive effects on welfare and social outcomes[15], and some negative but limited effects on prices and employment. Given this, there is little discussion that the strict welfare impact of infrastructure privatizations is unlikely by itself to explain the surge in discontent observed in particular in Latin America. This suggests either a massive communication failure regarding the positive effects of reforms, or that some of the negative effects that shape the public disapproval have gone unnoticed. We argue here that a dimension of the problem that has been largely overlooked when trying to understand public perceptions of privatizations involves corruption and the perceived transparency of the privatization process on the one hand, and the way resulting gains and losses have been distributed among different social groups. We now introduce the model and return to the analysis of perceptions in the Latin American case in Section 6.

2 The Model

We investigate the impact of the ownership structure in monopolistic industries involving major infrastructure investment (water, transport and electricity distribution are leading examples) on the degree of corruption that prevails in these sectors.[16] To distinguish between the objectives of society as a whole and those of the potentially corrupt politician or public official (decision-maker) in charge of designing the firm's regulation, we shall use a three-tier model of incentive regulation, general public/government/firm, along the

[11] McKenzie and Mookherjee (2003).

[12] Estache (2004)

[13] Kikeri and Nellis (2002) report that significant labor reductions are mainly observed in the sub-group of non-competitive firms, i.e. water and electricity transmission and distribution.

[14] See Davis, Ossowski, Richardson and Barnett (2000).

[15] Such as infant mortality in the case of water (Galiani, Gertler and Schargrodsky, 2005). More confirming evidence on welfare effects is however still necessary.

[16] By considering the case of monopolistic industries, we depart from investigating how competition may interact with corruption and ownership patterns.

lines of Laffont and Tirole (1993, Chapters 13 and following).

♦ **Ownership structures:** We shall analyze two different ownership structures:

- **Public ownership:** The general Treasury can be used to transfer money directly to the public firm.[17] An incentive regulation of such a public firm stipulates both the value of these transfers and the firm's output.
- **Private ownership:** No direct transfers can be used. The private firm must cover its costs only with its revenue. Although private, the firm is still subject to some regulation in the form of quantity/price restrictions. This regulation affects the firm's revenue and thus its ability to cover the fixed-cost.

Considering that private firms are regulated still leaves an active role to public officials under privatization. However, regulation amounts then to fixing a simple cap on prices.[18] This assumption reduces the difference between the two ownership structures to the minimum. The basic difference between public and private ownerships comes thus from the government's inability to make direct transfers to the firm under private ownership. This view is consistent with the host of evidence on the so-called soft-budget constraint faced by public firms. As an owner, the government cannot refrain from siphoning the general budget to cover cost overruns of public firms. Instead, the government, when its sole role consists in regulating a private firm, can no longer use the Treasury to increase the firm's revenues.[19] Of course, this difference in the firm's budget constraint also has implications on its ex ante incentives to reduce fixed-cost. We shall address the implications of different ownership structures on investments in Section 3.

♦ **Preferences:** Let us turn to a description of the objective functions of each player in a three-tier hierarchy where the top level is the constitutional level, the middle tier is meant for the politician or public official who may be corrupt, the lower tier represents the regulated firm, be it private or public.

The political decision-maker's payoff V can be written as:

$$V = s \geq 0, \tag{1}$$

[17] See Shleifer and Vishny (1994) for a similar assumption.

[18] Readers who feel more comfortable thinking of the privatized firm as being unregulated can view this cap as a threat of re-regulating the firm in case it charges too high a price in the current period or the limit price that those unregulated firms charge in face of potential competitors.

[19] Kaufmann and Siegelbaum (1997) provide evidence of such a hardening of the budget constraint of privatized firms in transition economies. Although ex post renegotiation of regulatory contracts, which has been widespread in Latin America (Guasch, Laffont and Straub, 2007a and 2007b), may to some extent soften the budget constraint of the firms, the lags involved in the process still imply that private firms face harder budget constraints than their public counterpart. See more on this below.

where, to simplify the analysis, s is the share of the overall budget that this decision-maker can grasp for himself. This can be viewed as the size of the budget that this corruptible decision-maker directly controls if we adopt a Niskanean perspective. Alternatively, s can be viewed as a proxy for the private benefit in terms of reputation, prestige and perquisites that the official withdraws from holding office. This interpretation can be particularly relevant if the politician has reelection concerns. One might then write $s = pB$ where B is the private benefit of holding office and p is the probability of reelection when the official is thought as being incorruptible. Finally, note that we normalize the public official's reservation payoff so that he must of course withdraw a positive payoff from holding office.

The firm's profit includes any direct transfer from the government, but also the firm's revenue net of the production cost. This cost entails a marginal cost θ and a fixed-cost related to the size of an ex ante investment I performed by the firm. This fixed-cost may for instance be viewed as the cost of operating an electricity or water network. We will assume that $K'(I) < 0$ with $K''(I) > 0$, so that a greater investment reduces the operating fixed-cost and does so at a decreasing rate. Once its investment I has already been sunk, the firm's ex post profit U, whether private or public, i.e. whether transfers are available or not, can thus be written as:

$$U = t + P(q)q - \theta q - K(I) \geq 0, \tag{2}$$

where t is the transfer made to the firm from the general budget. We normalize again at zero the firm's ex post outside opportunities.[20]

In many privatization cases for infrastructure industries, operators face well defined investment obligations, linked for example to the extension of the physical network. Without loss of generality, we normalize the size of this contractible and verifiable investment to zero. The investment I must therefore be understood as an additional "efficiency investment", which we assume is non-verifiable although observable by both parties.[21] For instance, the government does not have the ability to commit beforehand to any regulatory scheme rewarding this investment. The non-verifiable part of the firm's investment is thus under the threat of regulatory hold-up.[22]

Finally, once an ownership structure has been chosen and the firm's investment has

[20] The model could account for the possibility that the investment affects marginal costs at the cost of an increased complexity. For instance, marginal cost could become $\theta - K(I)$ with some investment I. In that case, a change in ownership which affects the investment level would still have an impact on prices, equilibrium corruption and thus on the perception of corruption.

[21] This observability is a standard assumption in the incomplete contract literature, see Hart (1995).

[22] If part of the investment was verifiable, the public official could use it in the regulatory contract to promote other political objectives, for instance to please some constituencies and secure reelections or favors. Such effects could be appended to our analysis but introducing them would somewhat blur one of our message: the fact that privatization fosters investment by hardening the firm's budget constraint.

been made, the social welfare function which is maximized at the constitutional level through the design of an incentive regulation and institutions incorporates the utilities of consumers, taxpayers and shareholders of the firm.[23] It writes as:

$$W = S(q) - P(q)q - (1+\lambda)(t+s) + U + V - I. \tag{3}$$

The expression $S(q) - P(q)q$ is the consumers' net surplus from consuming q units of the good where $S'(\cdot) = P(\cdot)$ is the inverse demand function, which is decreasing. As in most models of incentive regulation, the cost of public funds λ plays an important role in the forthcoming analysis. It measures the extend of the government's budgetary problems and any inefficiency in the taxation system it might face.

Note also that including the public official's utility into the social objective function may be warranted even though the public official by himself is negligible. For instance, he may represent a group (tribe, interest group, family with large economic stakes, etc.), whose interests follow closely his own and are, at large, not negligible.

For further references, it may be useful to rewrite social welfare once the firm's transfer has been substituted by their expression in terms of the firm's overall profit as:

$$W = S(q) + \lambda P(q)q - (1+\lambda)(\theta q + K(I)) - \lambda(U+V) - I.$$

Following again the framework of the New Regulatory Economics (Laffont and Tirole 1993), we assume that the constitutional level maximizes welfare. So overall regulatory institutions and contracts are designed "optimally", but those who run the State (be they elected public officials or regulators) are driven by their own objectives, which differ to some extent from welfare maximization. This is of course an extreme assumption which can be relaxed. First, introducing a bias towards the private sector in the welfare function by for instance having the constitutional level itself maximize a welfare function giving a weight $\alpha > 1$ to the private sector would not modify our analysis as long as the information rent of this sector remains costly, i.e., $1 + \lambda > \alpha$. This assumption is likely to hold for developing countries facing large inefficiencies in their taxation system. With this alternative formulation, our model can be reinterpreted as modelling the hierarchical relationship between top principals being themselves influenced to some extent by the private sector and intermediate officials and bureaucrats whose corruption is also a concern.

At an even broader level, the analysis below relies only on the compounding of two ingredients: a nested information structure between the different layers of the hierarchy and the existing conflicts of interest between those layers. As such, the lessons of our

[23] In the case of a public firm, one can assume that shares are equally distributed among the public, whereas only owners hold such shares in the case of private ownership. In both cases, the expression of social welfare remains of course the same.

model carry over to less optimistic models of the top level of the hierarchy. Qualitative results of much the same nature both in terms of output distortions, rent extraction and corruption patterns would also hold if top principals were Leviathan, or they were biased towards specific groups in society rather than caring for the whole set of customers, etc...[24]

Finally, it is worth noticing that our model can also be reinterpreted as a model of quality provision. In many sectors, regulation may impose service obligations which fix the overall quantity supplied, the variable q should then be interpreted as a verifiable quality index for the service without any change in the analysis. Distortions due to asymmetric information and corruption carry over to that quality index.

♦ **Information structure:** Asymmetric information is a key-ingredient of our modelling in two respects. First, it will justify the existence of information rents that the firm may get from holding private information. These rents are the key engine of investment under private ownership.[25] Second, the desire to keep those rents also creates a motive for capturing the public official and having him exert discretion to favor the firm at the expense of the general public.

Following the framework of the New Regulatory Economics,[26] we assume that the firm has private information on its marginal cost parameter θ. For simplicity, we adopt a simple discrete framework. This efficiency parameter may only take two values, $\theta \in \Theta = \{\underline{\theta}, \bar{\theta}\}$, with respective probabilities ν and $1-\nu$. Private information on marginal cost is a key ingredient of our model. It ensures that outside parties like customers and taxpayers face some uncertainty when they try to infer whether the high unit price paid for the service comes from high marginal cost or from hidden manipulations by the firm and/or by a corrupted official.

Bridging this information gap between the firm and the rest of society, which remains uninformed, the public official observes a hard information signal $\sigma \in \Sigma = \{\underline{\theta}, \emptyset\}$ with respective probabilities $\nu\varepsilon$ and $1-\nu\varepsilon$. The firm and the public official both know σ. By hiding evidence that the firm is efficient, the public official may thus let the firm enjoy some information rent. This discretion opens the door to the possibility that the public official gets corrupted.

♦ **Corruption:** When the firm offers x dollars of bribes to the public official, the latter enjoys only a fraction kx of this amount. The non-negative parameter $k \leq 1$ thus reflects the efficiency of collusive side-deals and $1-k$ is meant for the (marginal) transaction costs of collusion. This parameter captures the ease with which norms of collusive behavior can

[24] See Dixit (2006) on this issue.
[25] Riordan (1990) and Schmidt (1996) have developed similar arguments.
[26] Laffont (1994).

be sustained, the degree of "corruption culture" that prevails in a given society, the more or less important psychological costs that public officials might incur when being corrupted, the inefficiency that may be associated to non-monetary means of bribes between collusive partners, etc.[27]

The parameter k is randomly drawn according to a cumulative distribution function $F(\cdot)$ which has everywhere positive density $f(\cdot)$ on $[0,1]$. Moreover, the following monotone hazard rate property holds:

$$\frac{d}{dk}\left(\frac{F(k)}{f(k)}\right) > 0.$$

This condition ensures that the optimization problems considered below are well-behaved.

Note that different institutional environments may reflect different distributions of the efficiency of collusive deals. One expects more democratic systems with various checks on officials misconduct, either through electoral discipline, through direct monitoring or by means of a more efficient judicial system, to correspond to distributions $F(\cdot)$ which would be more front-loaded and conducive to less equilibrium corruption. Instead, more autocratic systems without much checks on collusion might certainly leave more scope for corruption and the corresponding cumulative distributions might lead to more equilibrium corruption.

Similarly, institutional environments more prone to ex ante corruption such as favoritism in the transfer of assets can be characterize by distributions leading to more ex post corruption. In that sense, ex ante and ex post corruption, although they occur through different mechanisms, can be seen as two sides of the same coin as argued in the introduction.

The collusion technology is known to both the firm and the public official but not to the general public at the time of making a side-deal. However, regulatory contracts are decided ex ante, under the veil of ignorance over the kind of collusive technology that will actually prevail.

Because, k is unknown at the time regulatory contracts and institutions are designed, it is certainly not optimal to always fight collusion between public officials and the private sector. Doing so would require setting up very large wage for behaving, wages corresponding to the most efficient collusive technology.[28] For a given regulatory contract, which

[27] Faure-Grimaud, Laffont and Martimort (2002) give some background motivations behind this parameter.

[28] From a more theoretical perspective, the Collusion-Proofness Principle does not hold in our context. Tirole (1986) proved this Principle when the technology for side-contracting is common knowledge. However, Tirole (1992) also analyzed a model where the collusion technology k is unknown but may take only two possible values, and showed that collusion may be an equilibrium phenomenon when the efficient technology of collusion is unlikely. An example with a continuous support is developed in Auriol (2006) with a different focus.

determines the possible stake of collusion between the public official and the firm, collusion may or may not happen depending on the prevailing technology. If the wage received when behaving and reporting socially valuable information exceeds the benefits of colluding, collusion does not occur and vice-versa. With the technology for side-contracting being common knowledge, raising the public official's wage above these collusive benefits would be enough to always prevent collusion.[29] However, when the benefits from colluding are uncertain as assumed here, raising that wage above the maximal benefit corresponding to the extreme value $k = 1$ is certainly too costly. When $k = 1$, society finds it as costly to give up an information rent to the regulated firm than to pay an official to bridge the informational gap. Instead, slightly reducing this wage induces some equilibrium corruption for the most efficient collusive technologies while corruption is still prevented for the least efficient ones. Moreover, doing so also reduces the budgetary burden of those wages. Hence, allowing some corruption in equilibrium is always optimal.

♦ **Timing:** The timing of the game unfolds as follows:

1. A given ownership structure is chosen. The firm decides on the size of its investment, which reduces its fixed-cost.

2. The firm learns its cost parameter. The public official learns his signal on the firm's cost, which may be informative or not.

3. The regulatory contract is designed under asymmetric information on the firm's cost and the official's signal, and under ignorance of the efficiency of collusive deals.

4. The efficiency parameter for a collusive deal between the public official and the firm is realized. These agents possibly exchange bribes and evidence on the firm's efficiency is hidden if collusion takes place. If collusion does not take place, the public official reports any informative signal he may have gotten on the firm's cost and gets paid a positive wage accordingly. If the official's report is uninformative, the official's wage is zero and the firm is subject to incentive regulation. Its choice of output and transfers reveals its efficiency parameter.

From the Revelation Principle,[30] the most general class of contracts, which are feasible given the information structure, is of the form

$$\left\{ s(\hat{\theta}, \hat{\sigma});\ t(\hat{\theta}, \hat{\sigma});\ q(\hat{\theta}, \hat{\sigma}) \right\}_{\hat{\theta} \in \Theta,\, \hat{\sigma} \in \Sigma},$$

[29] See again Tirole (1986 and 1992).

[30] Green and Laffont (1977), Myerson (1979) and Laffont and Martimort (2002) among others.

where $\hat{\theta}$ is the firm's report on its cost and $\hat{\sigma}$ is the public official's report on the signal he has learned on the firm's cost. For the sake of simplifying notations, we will denote such a contract

$$\left\{(\underline{s}^*, \underline{t}^*, \underline{q}^*);\ (\underline{s}, \underline{t}, \underline{q});\ (\bar{s}, \bar{t}, \bar{q})\right\},$$

where $(\underline{s}^*, \underline{t}^*, \underline{q}^*)$ are respectively the public official benefits from holding office, the firm's transfer and its output when $\underline{\sigma} = \underline{\theta}$ (and thus $\theta = \underline{\theta}$). $(\underline{s}, \underline{t}, \underline{q})$ and $(\bar{s}, \bar{t}, \bar{q})$ are the same variables when $\sigma = \emptyset$ and respectively $\theta = \underline{\theta}$ and $\theta = \bar{\theta}$. Similar notations are used for the firm's profit $\underline{U}^*, \underline{U}$ and $\bar{U}$ in each state of nature.

Finally, it is worth noticing that, once the ownership structure has been chosen, there is full commitment to the contracts described above. We will comment below on the possibility of renegotiation and its impact on the degree of corruption that arises in equilibrium.

3 Benchmark: Benevolent Public Official

A benevolent public official uses any piece of private information he may have learned on the firm to maximize social welfare and does not need to be paid any positive wage for doing so. Alternatively, with a benevolent public official, everything happens as if the efficiency of collusive deals k was identically null.

♦ **Public Ownership:** When $\sigma = \underline{\theta}$ is observed and reported by the public official, the firm enjoys a profit

$$\underline{U}^* = \underline{t}^* + (P(\underline{q}^*) - \underline{\theta})\underline{q}^* - K(I) \geq 0. \tag{4}$$

When the uninformative signal $\sigma = \emptyset$ is instead observed by the public official, a regulatory mechanism is incentive-feasible when it satisfies the following incentive and participation constraints:

$$\underline{U} = \underline{t} + (P(\underline{q}) - \underline{\theta})\underline{q} - K(I) \geq \bar{t} + (P(\bar{q}) - \underline{\theta})\bar{q} - K(I) = \bar{U} + \Delta\theta\bar{q}, \tag{5}$$

$$\bar{U} = \bar{t} + (P(\bar{q}) - \bar{\theta})\bar{q} - K(I) \geq 0. \tag{6}$$

In two-type adverse selection problems as the present one where transfers are allowed, it is standard to show that only the efficient firm's incentive constraint and the inefficient one's participation constraint are relevant.[31]

[31] Laffont and Martimort (2002, Chapter 2). In particular, incentive constraints imply the standard monotonicity conditions $\underline{q} \geq \bar{q}$. We will see below that, when transfers are not allowed (i.e., the firm is private), even the inefficient firm's incentive constraint matters since only pooling mechanisms are possible ($\underline{q} = \bar{q}$).

The optimal regulation with a benevolent public official under public ownership is summarized in the next proposition:

Proposition 1 *: Under public ownership and with a benevolent public official, the optimal outputs are respectively given by the following Ramsey formula:*

⋆ *For an efficient firm,* $\underline{q}_{Pu}^{B} = \underline{q}_{Pu}^{*B}$*, such that*

$$P\left(\underline{q}_{Pu}^{B}\right) - \underline{\theta} = -\frac{\lambda}{1+\lambda} P'\left(\underline{q}_{Pu}^{B}\right) \underline{q}_{Pu}^{B}; \tag{7}$$

⋆ *For an inefficient firm,*

$$P\left(\underline{q}_{Pu}^{B}\right) - \left(\bar{\theta} + \frac{\nu(1-\varepsilon)}{1-\nu}\frac{\lambda}{1+\lambda}\Delta\theta\right) = -\frac{\lambda}{1+\lambda} P'\left(\bar{q}_{Pu}^{B}\right) \bar{q}_{Pu}^{B}. \tag{8}$$

Only the efficient firm gets an information rent when $\sigma = \emptyset$*. This rent does not depend on its ex ante investment:*

$$\underline{U}_{Pu}^{B} = \Delta\theta \bar{q}_{Pu}^{B} > 0, \quad \text{and} \quad \bar{U}_{Pu}^{B} = \underline{U}_{Pu}^{*B} = 0. \tag{9}$$

The public firm does not invest, $I_{Pu}^{B} = 0$*.*

The optimal outputs follow traditional Ramsey rules. Because of costly public funds, covering the public firm's cost has a budgetary impact that is reduced by distorting outputs. However, in these Ramsey formula under asymmetric information, the true cost of an inefficient firm $\bar{\theta}$ must now be replaced by its virtual cost $\bar{\theta} + \frac{\nu(1-\varepsilon)}{1-\nu}\frac{\lambda}{1+\lambda}\Delta\theta$, which is obviously greater. This reduces the output of an inefficient firm but also, and this is the benefit of doing so, the information rent that an efficient one gets.

Importantly, under public ownership the rent of the efficient firm does not depend on its investment. Indeed, in this case any reduction in the fixed-cost that such investment would trigger is passed on to the taxpayers. Those taxpayers reduce by the same amount the taxes they would pay to cover the firm's cost and have the firm at least break even. This cost reduction is not passed on the firm itself, which thus does not internalize any of its investment. There is a complete dichotomy between outputs, which depend only on variable costs, and investment. In other words, under public ownership the source of the firm's information rent lies in its marginal cost only and, the firm's incentives to invest being unrelated to its rent, no investment arises at equilibrium.

Because he cannot refrain from using those transfers and cannot commit to reward the investment, which is non-verifiable even though it is observable, the public official is unable to induce any investment from the public firm.[32]

[32] This accords with general empirical findings, mentioned in the Introduction, that privatized firms become more efficient than their initial public counterparts.

♦ **Private ownership:** Under private ownership, direct transfers to the firm out of the Treasury are no longer feasible. The number of instruments, which can be used for screening purposes is thus reduced. This significantly undermines the ability of an optimal regulation to screen the different firms according to their costs. Indeed, under complete information, the optimal outputs $\underline{q}^{*B}_{Pr}(I)$ and $\bar{q}^{*B}_{Pr}(I)$ requested by both types of firm would be set so that those firms break even:

$$(P\left(\underline{q}^{*B}_{Pr}(I)\right) - \underline{\theta})\underline{q}^{*B}_{Pr}(I) = (P\left(\bar{q}^{*B}_{Pr}(I)\right) - \bar{\theta})\bar{q}^{*B}_{Pr}(I) = K(I). \tag{10}$$

Clearly that output scheme is no longer incentive compatible under asymmetric information since the efficient firm can gain a rent $\Delta\theta\bar{q}^{*B}_{Pr}(I)$ by pretending being inefficient. As a result, only pooling mechanisms stipulating a constant output $\bar{q} = \underline{q}$ are available when the public official remains uninformed, i.e., when $\sigma = \emptyset$. Of course, an optimal regulation can still set a different output $\underline{q}^*$ when the latter is instead informed ($\sigma = \underline{\theta}$).

Proposition 2 *: Under private ownership and a benevolent public official, the optimal outputs depend on the investment I and are respectively given by the following formula:*

⋆ *For $\sigma = \underline{\theta}$,*

$$P\left(\underline{q}^{*B}_{Pr}(I)\right) - \underline{\theta} = -\frac{\lambda^*(I)}{1+\lambda^*(I)}P'\left(\underline{q}^{*B}_{Pr}(I)\right)\underline{q}^{*B}_{Pr}(I), \tag{11}$$

where $\lambda^*(I)$ is strictly decreasing in I and determined by the zero-profit condition

$$P\left(\underline{q}^{*B}_{Pr}(I)\right) = \underline{\theta} + \frac{K(I)}{\underline{q}^{*B}_{Pr}(I)}; \tag{12}$$

⋆ *For $\sigma = \emptyset$, $\bar{q}^B_{Pr} = \underline{q}^B_{Pr}$ such that*

$$P\left(\bar{q}^B_{Pr}(I)\right) - \bar{\theta} = -\frac{\tilde{\lambda}(I)}{1+\tilde{\lambda}(I)}P'\left(\bar{q}^B_{Pr}(I)\right)\bar{q}^B_{Pr}(I), \tag{13}$$

where $\tilde{\lambda}(I)$ is strictly decreasing in I and determined by the zero-profit condition for an inefficient firm

$$P\left(\bar{q}^B_{Pr}(I)\right) - \bar{\theta} = \frac{K(I)}{\bar{q}^B_{Pr}(I)}. \tag{14}$$

Only the efficient firm gets an information rent

$$\underline{U}^B_{Pr} = \Delta\theta\bar{q}^B_{Pr}(I), \quad \text{and} \quad \underline{U}^{*B}_{Pr} = \bar{U}^B_{Pr} = 0. \tag{15}$$

The firm invests a positive amount I^B_{Pr} given by:

$$\nu(1-\varepsilon)\Delta\theta\frac{\partial\bar{q}^B}{\partial I}(I^B_{Pr}) = 1. \tag{16}$$

The intuition behind this Proposition is straightforward. When regulatory transfers are banned, the only way that the firm's budget constraint can be satisfied is by decreasing output, raising the price mark-up (equations (11) and (13)) so that revenues cover the fixed-cost. Of course, doing so is easier and requires less output distortion when the fixed-cost itself is small enough.[33] Output distortions, and thus the rent that an efficient firm gets, are now directly linked to the size of the investment. This desire for securing enough rent ex post whenever the benevolent public official remains uninformed creates the firm's ex ante incentives to invest. Private ownership comes with a harder budget constraint and induces some ex ante investment.[34]

One may wonder how robust this result is to the threat of renegotiation or re-nationalization. Indeed, given the commitment not to use transfers under private ownership, such renegotiation could make it possible to use transfers ex post. To be acceptable, such renegotiation making explicit use of transfers should give to the firm at least its rent under private ownership, i.e., renegotiation should lead to an output $\bar{q}$ for an inefficient firm, which satisfies:

$$\Delta\theta\bar{q} \geq \Delta\theta\bar{q}^{Pr}.$$

When this inequality holds for $\bar{q}^{Pu}$, the optimal contract under privatization is renegotiated and re-nationalization takes place with the firm strictly gaining from this change in ownership pattern. The fact that the firm has been private has no impact on its final rent and thus, its incentives to invest are null exactly as in the case of a public firm. This case is likely to occur when $\tilde{\lambda}(I)$ is small with respect to λ, which means that inefficiency due to the fact that the firm has to cover its fixed-cost from revenues in the sector is small compared to the inefficiency of the tax system. This case is unlikely for infrastructure sectors whose fixed-costs are large and economies whose taxation is highly inefficient.

More likely is the case $\Delta\theta\bar{q}^{Pu} \leq \Delta\theta\bar{q}^{Pr}$, which means that renegotiation is constrained by the level of rent that the firm gets under privatization. When this constraint is binding, the firm's final rent again depends on its initial investment and the firm keeps all its incentives to invest. In that case, our results are robust to the threat of renegotiation and will remain so when corruption is introduced below. However, note that the renegotiation considered in this discussion is not a political hold-up in the sense that assets and profits are not expropriated, they have to be bought at fair price whenever a

[33] From a technical viewpoint the multipliers of the binding zero-profit constraints decrease in I.

[34] Although this result has the flavor of those found in Riordan (1990), Schmidt (1996) and Faure-Grimaud (2001), it should also be contrasted with those papers along several lines. In our model, the difference between the two ownership structures comes from the different contracting abilities of the government as an owner and the government as a simple regulator, not from differences in the information structures as is assumed (in the first two pieces) or derived (in the last one) in these works. Although our analysis could be put on the firmer foundations used in those models, it does not seem useful for our current purposes. Also, investment in the previous literature affects the distribution of marginal cost, not the fixed-cost as here.

re-nationalization takes place. This requires an institutional environment where property rights are sufficiently secure. Otherwise, re-nationalization may just be unconstrained by previous commitments. In that case, incentives to invest cannot be carried on with changes in the ownership structure.

4 Corruption

Let us now consider the case of a non-benevolent public official who can thus be corrupted by the industry. Contrary to most of the existing literature on capture,[35] we assume that there exists a whole distribution of non-benevolent public officials, who differ in terms of their willingness to collude with private interests, or to put it differently, in terms of the transaction costs of collusive behavior that they face when engaging in side-deals. This assumption ensures that corruption is always an *equilibrium phenomenon*; i.e., at the social optimum, there is always some positive probability that the public official is corrupted, i.e., prefers accepting bribes and manipulating information.

To see that point formally, observe that the stake of corruption in our model is the rent $\Delta\theta\bar{q}_i \quad (i \in \{Pu, Pr\})$ that the firm can secure whenever the informed public official ($\sigma = \underline{\theta}$) reports instead having observed nothing ($\hat{\sigma} = \emptyset$). Whenever his benefits of doing so exceed the gains $\Delta\theta\bar{q}_i$ from being corrupted, the public official reports publicly the hard information signal that the firm is efficient. By doing so, he pockets the corresponding reward s_i^*. This occurs with probability

$$\Pr\left\{\tilde{k}\Delta\theta\bar{q}_i \leq s_i^*\right\} = F\left(\frac{s_i^*}{\Delta\theta\bar{q}_i}\right).$$

Instead, when transaction costs of collusion are small enough, namely when $\tilde{k}\Delta\theta\bar{q}_i > s_i^*$, the public official hides evidence on the firm being efficient, and accepts bribes rather than behaving.

When corruption is possible, we may write expected welfare under any ownership regime i ($i \in \{Pu, Pr\}$) as:

$$\begin{aligned}
\underset{(\theta,\sigma)}{E}(W_i) &= \nu\varepsilon F\left(\frac{s_i^*}{\Delta\theta\bar{q}_i}\right)\left(S(\underline{q}_i^*) - \underline{\theta}\underline{q}_i^* - \lambda(\underline{t}_i^* + s_i^*)\right) \\
&\quad + \nu\varepsilon \int_{\frac{s_i^*}{\Delta\theta\bar{q}_i}}^{1} \left(S(\underline{q}_i) - \underline{\theta}\underline{q}_i - \lambda\underline{t}_i + (\tilde{k}-1)\Delta\theta\bar{q}_i\right) f(\tilde{k})dk \\
&\quad + \nu(1-\varepsilon)\left(S(\underline{q}_i) - \underline{\theta}\underline{q}_i - \lambda\underline{t}_i\right) \\
&\quad + (1-\nu)\left(S(\bar{q}_i) - \bar{\theta}\bar{q}_i - \lambda\bar{t}_i\right) - K(I_i) - I_i, \qquad (17)
\end{aligned}$$

[35] See Laffont and Tirole (1993, Chapter 15) for instance but a noticeable exception is Auriol (2006).

where $\underset{(\theta,\sigma)}{E}(\cdot)$ is the expectation operator and I_i represents the investment under the corresponding ownership structure.

The different terms on the right-hand side of (17) can be readily interpreted. The first term represents the expected welfare given that the public official is informed but corruption does not take place because the transaction technology is inefficient enough (k low). Because of the cost of public funds λ, transferring money either to the public official or to the firm is costly. The second term represents expected social welfare when collusion does occur on the equilibrium path. The public official gives up any wage he may receive and prefers taking bribes. Because bribes are inefficient ways of transferring wealth, there is a dead-weight loss of corruption (the term $(\tilde{k}-1)\Delta\theta\bar{q}_i < 0$), which is a cost of corruption. The third and fourth terms are easily interpreted as the expected welfare when the public official remains uninformed.

This expression shows that, whenever corruption occurs, the public official enjoys the benefits $\tilde{k}\Delta\theta\bar{q}_i$ and the firm, when public, receives a transfer $\underline{t}_i$ from the general budget even though the signal σ learned by the public official is informative. In that case, we assume that the public official has all the bargaining power in negotiating bribes with the firm, which therefore gets no rent.[36] Note also that, when corruption is an equilibrium phenomenon, the regulatory scheme is still designed to induce information revelation from the firm, but of course, this is costly in terms of information rent left to the firm and finally pocketed (at least partially) by the public official.

The optimal incentive regulation with corruption must maximize (17) subject to the incentive and participation constraints (4) to (6). Of particular importance is the optimization with respect to s_i^*, the public official's wage. To understand the corresponding first-order condition, it is useful to stress two different effects of raising s_i^*. On the one hand, raising s_i^* indeed increases the probability that the public official prefers not to be corrupted. On the other hand, doing so is of course socially costly.

To better understand this optimization, let us define $k_i^* = \frac{s_i^*}{\Delta\theta\bar{q}_i}$ as a new optimization variable, which replaces s_i^*. k_i^* is a threshold in the efficiency of the collusive technologies, above which corruption occurs in equilibrium. The corresponding first-order condition with respect to k_i^* becomes:[37]

$$\left\{\left[S(\underline{q}_i^*) - \underline{\theta}\underline{q}_i^* - (S(\underline{q}_i) - \underline{\theta}\underline{q}_i)\right] + \Delta\theta\bar{q}_i - \lambda[\underline{t}_i^* - \underline{t}_i] - (1+\lambda)k_i^*\Delta\theta\bar{q}_i\right\} f(k_i^*) = \lambda F(k_i^*)\Delta\theta\bar{q}_i. \tag{18}$$

This condition can be simplified further by using the property of the optimal regulatory

[36] This assumption is without loss of generality and we could allow for a different distribution of the bargaining surplus.

[37] This condition is also sufficient thanks to the monotonicity of the hazard rate, which ensures quasi-concavity with respect to k_i^*.

contract in each ownership regime. This is the task to which we now turn.

4.1 Public Ownership

Consider first the case of public ownership. Two remarks are in order. First, Proposition 1 shows that production is first-best, i.e., $\underline{q}_{Pu} = \underline{q}^*_{Pu}$ at the optimal contract if the public official is benevolent. However, this condition still holds if he is corruptible.[38] Second, still using the fact that (4) and (5) are binding at the optimal contract, the difference between the firm's transfers when its type is reported by the public official and when it is not is given by:

$$\underline{t}_{Pu} - \underline{t}^*_{Pu} = \Delta\theta \bar{q}_{Pu}.$$

Intuitively, when the public official is not corrupted but remains informed, he helps society to extract the efficient firm's rent $\Delta\theta\bar{q}_{Pu}$. This reduces the burden of incentive regulation on taxpayers by the same amount.

Finally, using the two remarks above helps simplifying (18) to get that k^*_{Pu} solves:

$$k^*_{Pu} + \frac{\lambda}{1+\lambda}\frac{F}{f}\frac{(k^*_{Pu})}{(k^*_{Pu})} = 1. \tag{19}$$

Because the monotone hazard rate property holds, the left-hand side of (19) is strictly increasing and this equation admits a unique solution in $]0,1[$ so that corruption is *always* an equilibrium phenomenon.

Proposition 3 *: The probability of corruption* $1 - F(k^*_{Pu})$ *is always positive with public ownership and it increases with the cost of public funds* λ*.*

As λ increases, fighting corruption by raising s^*_{Pu} becomes increasingly costly from a social viewpoint. It is then preferable to let more corruption occur at equilibrium. This comparative statics points to an interesting aspect of the analysis. Developing countries, which are characterized by a large cost of public funds, because of large public deficits or highly distortionary and inefficient tax systems, are also likely to face a high level of equilibrium corruption under public ownership. International agencies have often pushed the view that such countries should rely more on the private sector to undertake major investments in infrastructure. As we will point out below in more details, this may not be warranted, as corruption will still be present under private ownership and its scope will depend on the economic characteristics of the privatized sector under scrutiny.

The other impact of corruption is that it changes the firm's output and the distribution of rents, without nevertheless affecting the incentives to invest.

[38] See the Appendix for details.

Proposition 4 *: Under public ownership and corruption, the efficient firm always produces efficiently* $\underline{q}^c_{Pu} = \underline{q}^{*c} = \underline{q}^B_{Pu}$*, whereas the inefficient firm output becomes:*

$$P(\bar{q}^c_{Pu}) - \left(\bar{\theta} + \frac{\lambda\nu}{(1+\lambda)(1-\nu)}\left(1+\varepsilon\left(\frac{1}{\lambda}\int_{k^*}^{1}(1-\tilde{k})f(\tilde{k})d\tilde{k} - F(k^*)(1-k^*)\right)\right)\right) = \frac{-\lambda}{1+\lambda}P'(\bar{q}^c_{Pu})\bar{q}^c_{Pu}. \quad (20)$$

Only the efficient firm obtains a rent $\underline{U}^c_{Pu} = \Delta\theta\bar{q}^c_{pu}$*, which does not depend on the investment level, so that the public firm still has no incentives to invest and* $I^c_{Pu} = 0$*.*

Everything happens as if the virtual cost parameter of an inefficient firm were now given by the following expression

$$\bar{\theta} + \frac{\lambda}{(1+\lambda)}\frac{\nu}{(1-\nu)}\left(1+\varepsilon\left(\frac{1}{\lambda}\int_{k^*}^{1}(1-\tilde{k})f(\tilde{k})d\tilde{k} - F(k^*)(1-k^*)\right)\right)\Delta\theta.$$

Compared with the case of a benevolent public official, this virtual cost is of course greater. This captures the fact that now distortions are also necessary to reduce the cost for society of having an informed but non-benevolent public official. Those additional distortions have two sources. First, they come from the fact that a non-negative and socially costly wage ($s^* = k^*\Delta\theta\bar{q}^c_{Pu}$) is given to the public official to ensure that he behaves at least when the technology of collusion is sufficiently inefficient, i.e., with probability $F(k^*)$; a greater output increases the firm's information rent and would require to raise the wage of the public official beyond the efficient level. Second, these distortions are also necessary when the technology of collusion is efficient enough. In that case, the informed public official is corrupted so that he does not reveal information. Society has to give up some information rent to the firm for inducing this information revelation. However, and this is a side-effect of corruption being an equilibrium phenomenon, this rent ends up being pocketed by the corrupted official and this brings an extra cost under the form of a deadweight loss of collusion (the term $\int_{k^*}^{1}(1-\tilde{k})f(\tilde{k})d\tilde{k}$ in the expression of the virtual cost parameter).

Finally note that, even with corruption, the public firm's expected rent does not depend on its investment, so that again public ownership goes hand in hand with some underinvestment.

4.2 Private Ownership

With private ownership, transfers can no longer be used to better regulate the sector under scrutiny. The optimal regulation entails some pooling when no informative signal is revealed by the public official ($\sigma = \emptyset$), namely $\underline{q}^* > \underline{q} = \bar{q}$.

Condition (18) can now be simplified to get the new expression of the cut-off:

$$k^*_{Pr} + \frac{\lambda}{1+\lambda}\frac{F(k^*_{Pr})}{f(k^*_{Pr})} = \frac{S(\underline{q}^*_{Pr}) - \underline{\theta}\underline{q}^*_{Pr} - [S(\bar{q}_{Pr}) - \bar{\theta}\bar{q}_{Pr}]}{(1+\lambda)\Delta\theta\bar{q}_{Pr}}. \tag{21}$$

Again $\underline{q}^*_{Pr}$ and $\bar{q}_{Pr}$ take the same values defined in (11) to (14), i.e. just helping the firm to cover its fixed-cost in each state of nature.

To better understand (21) and compare it with (19), let us assume that $\Delta\theta$ is small enough. In that case, the multipliers of the firm's break-even constraints $\lambda^*(I)$ and $\tilde{\lambda}(I)$, when the public official is informed and when he is not respectively, are close to each other. The following approximation holds:[39]

$$k^*_{Pr} + \frac{\lambda}{1+\lambda}\frac{F(k^*_{Pr})}{f(k^*_{Pr})} \approx \frac{1+\tilde{\lambda}(I)}{1+\lambda} < 1 \quad \Leftrightarrow \quad \tilde{\lambda}(I) < \lambda. \tag{22}$$

This gives immediately:

Proposition 5 *: Assume that $\Delta\theta$ is small enough, then the probability of corruption $1-F(k^*_{Pr})$ under private ownership is larger than the probability of corruption $1-F(k^*_{Pu})$ under public ownership if and only if $\tilde{\lambda}(I) > \lambda$.*

To understand the intuition behind this proposition, note that, under private ownership, the gains from having a non-corrupted public official are no longer pocketed by taxpayers but by consumers, who pay a lower price for the firm's output when it is efficient and the public official is informed. For $\Delta\theta$ small enough this gain on the consumers' surplus can be approximated by $(1+\tilde{\lambda}(I))\Delta\theta\bar{q}_{Pr}$. This is nothing else that the information rent of an efficient firm conveniently weighted by a factor $1+\tilde{\lambda}(I)$ to capture the impact that a truthful report of the public official has in terms of hardening the efficient firm's break-even constraint.

As the firm's investment decreases, its fixed-cost increases so that breaking even becomes harder. The multiplier $\tilde{\lambda}(I)$ increases and so does the probability of corruption. Our model is therefore consistent with the possibility that increased investment under private ownership comes also with more corruption than under public ownership. Indeed, when the cost of public funds λ is not too large compared to the fixed-cost involved, the probability of corruption under public ownership is small, and it can be smaller than under private ownership. This case is more likely when the government's deficit is small, the taxation system is relatively efficient or when the sector under scrutiny entails large fixed-costs.

[39] See the Appendix for details.

To understand the impact of the ownership structure on corruption, first note that transferring one more dollar from society, and specifically taxpayers, towards a public official in order to prevent corruption has a cost $1+\lambda$ for the general budget of the State. This extra dollar prevents the public firm from siphoning public funds at the same rate. Instead, under private ownership, public funds can no longer be siphoned that way. Consumers now bear the cost of corruption in terms of higher prices. The transfer of wealth from society, and now more specifically from consumers, to the public official has a cost $1+\tilde{\lambda}(I)$ where $\tilde{\lambda}(I)$ is actually the shadow cost of the private firm's budget constraint, which, of course, depends on its investment I. However, fighting corruption by raising the wage of the public official still requires to withdraw $1+\lambda$ from the State's budget.

Comparisons between the two different ownership structures in terms of corruption follow immediately. When $\tilde{\lambda}(I) < \lambda$, there is less equilibrium corruption under private ownership than under public ownership. It becomes relatively difficult to transfer resources for corrupted activities and fighting them is comparatively easier. Instead, when $\tilde{\lambda}(I) > \lambda$, private ownership also generates more corruption.

A shift towards private ownership may thus increase corruption for regulated sectors which, when public, enjoyed large subsidies, or sectors which involve large fixed-costs and require significant output distortions and large mark-ups to help private firms break-even. This indicates when the paradoxical situation in which investment and increased corruption go hand in hand is more likely to prevail. Sectors like water and transport (especially the concessioning of hard infrastructure such as roads, ports and airports) are typical candidates for that paradox since they tend to be net recipients of transfers from the state[40] and involve large sunk investments. These are also sectors that typically remain non-competitive, making corruption through price manipulation easier in the absence of any kind of benchmarking.[41]

For completeness, let us analyze the impact of corruption on outputs and investment in the case of private ownership. At first glance, corruption of a public official could have a positive welfare impact since it allows to raise prices and better reward the firm for its investment. This view is of course only partial since a corrupted official set those prices too high and, given our allocation of bargaining power between officials and the firm, the extra rent generated from corrupted deals is captured by the public official and so has no positive welfare effect expect that of paying those officials by very indirect and inefficient means (thanks to the existing frictions $1-k$ in side-contracting).

Looking at (17) in the case where transfers are banned and outputs $\underline{q}$ and $\bar{q}$ are pooled

[40] See Guasch, Laffont and Straub (2007a).

[41] Of course, the speed at which competition is introduced is then determined simultaneously with corruption, as argued on the basis of case studies by Manzetti (1999) and Rose-Ackerman (1999).

together, we observe that outputs and investments are unchanged. The only role of corruption is to make it more likely that an efficient firm produces $\bar{q}^B_{Pr}(I)$ instead of $\underline{q}^{*B}_{Pr}(I)$. This makes it more likely that average output is somewhat distorted downwards, but the magnitude of this distortion is difficult to compare with the case of public ownership.

Both when the public official is not corrupted and reports publicly this information and when he is corrupted and pockets the rent for himself, the private firm is expropriated from the rent it may get in state $\sigma = \underline{\theta}$. This reduces the benefits of investing for the private firm (term $1-\varepsilon$) and yields the same investment level as with a benevolent public official.

Summarizing, we get:

Proposition 6 *: Under private ownership and corruption, outputs are again only defined by the firm's break-even conditions, so that formula (11) to (14) still hold. The investment remains unchanged and is still equal to its value with a benevolent public official:*

$$I^c_{Pr} = I^B_{Pr}.$$

5 The Perception of Corruption

We have established so far conditions under which a shift to private ownership of a major public service provider may increase the incidence of corruption. In this section, we discuss how the cost of this corruption affects different social groups and how this may shape their evaluation of the process. Interest groups may form as effective watchdogs and reduce the likelihood of corruption through different channels. They may themselves gather information and make it available to the general public. They may also induce more coverage by medias of instances of misbehavior by public officials. Individuals can react to what they think are instances of corruption by voting against tenured politicians if they expect higher utility levels under alternative and uncorrupted political regimes.[42]

We will argue that the firm's ownership structure has important implications for the political reactions of both individuals and interest groups faced with the threat of corrupt activities.

Both individuals' and groups' incentives to react to corruption are of course related to the per-capita stake of doing so as well as to various transaction or psychological costs. Following an insight due to Olson (1971), corruption might become less likely when small, homogeneous, less disperse interest groups facing lower transaction costs of organizing

[42] However, although privatization issues sometimes have high visibility, they are unlikely to be pivotal issues in elections.

themselves intervene. For individuals, acting politically against the threat of corruption might require investing in education and information to understand the terms of the political debate and the basic trends at play. In any case, various factors may influence the incentives of both interest groups and individuals to have a disciplinary effect on presumed corrupted public officials.

For the purpose of our discussion, it is useful to distinguish the exogenous versus endogenous determinants of these incentives. On the one hand, individuals in a given population might be differentiated according to a number of exogenous aspects, including in particular their income level and their geographical location. On the other hand, the economic stakes of different individuals are endogenously determined in our model by the difference in ownership structures and thus regulatory policies.

To capture more formally the role of groups and individuals (excluded consumers, served consumers, taxpayers) as disciplinary devices for corrupted public officials, we will assume that they may react ex post, i.e., once the public official has already reported $\hat{\sigma} = \emptyset$, to check whether that report is truthful or not. Depending on whether unorganized individuals or better organized interest groups are concerned, this reaction might take different forms, from not voting for incumbents to a greater involvement in political life and lobbying campaigns against corruption. All these political actions represent the actual level of discontent that society may face in front of the presumption of a corrupted economic life. At this stage, we do not need to be too explicit about the disciplinary role that individuals/interest groups may exert on corruptible public officials.[43] Formally, let us denote by x_i^j the probability that a group/individual j gets concerned about the likelihood of corruption in ownership regime i. This probability should be a function of its stake S_i^j in correcting the public official's misbehavior, namely:

$$x_i^j = G^j(S_i^j).$$

with $G_S^j > 0$ and $G^j(0) = 0$. This function $G^j(\cdot)$ itself depends on the group/individual j to capture some fundamental heterogeneity across them.

As a change in ownership occurs, the probability that different groups/individuals react to corruption changes. For instance, taxpayers are by definition inactive under private ownership since regulated transfers are banned. Instead, they might perceive corruption under public ownership since such corruption increases the burden of taxation for taxpayers. The reverse is true for consumers, who are more prone to perceive corruption when they face a high price for the service. The respective assessment of the benefits of the privatization process for those different groups can then be viewed as the difference $\Delta x^j = x_{Pu}^j - x_{Pr}^j$, which encapsulates how the privatization process affects the incen-

[43] See nevertheless the Appendix where we develop a bare-boned model of such a disciplinary role in the case where consumers are organized as efficient watchdogs.

tives to react of the concerned constituency (maybe through an impact on access, prices, quality, etc.).

Let us now illustrate in more details how taxpayers and consumers may perceive differently the shift from public to private ownership. First, observe that, under public ownership, only taxpayers may suffer from the possible corruption of the public official, which takes the form of increased transfers and thus a higher tax burden. On the other hand, whether officials are corrupted or not, an efficient firm must be paid enough transfer to reveal information but its output remains efficient, so consumers have no incentives to react to corruption because their net surplus remains the same whether $\hat{\sigma} = \underline{\theta}$, or $\hat{\sigma} = \emptyset$ and $\hat{\theta} = \underline{\theta}$. As such, corruption is not perceived by consumers.

More precisely, under public ownership, the taxpayers' stake $S_{Pu}^{taxpayers}$ for intervening and checking potential corrupt behavior is given by the difference between what they pay in case the public official is corrupted and information revelation has to be induced from the firm itself and what they would pay in terms of wages to the public official if he chooses not to be corrupted. This yields the following expression:

$$S_{Pu}^{taxpayers} = \nu\varepsilon \int_{k_{Pu}^*}^{1} (\underline{t}_{Pu} - (t_{Pu}^* + s_{Pu}^*)) f(\tilde{k}) d\tilde{k} = \nu\varepsilon \Delta\theta \bar{q}_{Pu}(1 - k_{Pu}^*)(1 - F(k_{Pu}^*)).$$

Note that this stake increases with the probability of corruption under public ownership, i.e., when the taxation system is sufficiently inefficient. Taxpayers are more likely to perceive the cost of corruption under public ownership when the cost of public funds is large. To the extent that an increase in the tax burden due to corruption can be easily disguised as coming from deteriorating macroeconomic conditions (Shleifer and Vishny, 1994), the quantity $\Delta x^{taxpayers} = G^{taxpayers}(S_{Pu}^{taxpayer})$ is likely to be small. Even if it is significant, this quantity remains positive, showing that taxpayers enjoy a shift towards private ownership and, as such, are not likely to express any discontent.[44]

Under private ownership, corruption is more easily readable by the general public, who, as consumers, might observe a significant price increase and may suspect from that the existing corruption. The consumer's expected stake for reacting to the threat of corruption under private ownership is now given by:

$$S_{Pr}^{consumers} = \nu\varepsilon(1 - F(k_{Pr}^*))(S(\underline{q}_{Pr}^*) - P(\underline{q}_{Pr}^*)\underline{q}_{Pr}^* - (S(\bar{q}_{Pr}) - P(\bar{q}_{Pr})\bar{q}_{Pr}))$$

where $1 - F(k_{Pr}^*)$ is the probability of corruption under private ownership and $\bar{q}_{Pr}$ is the output level given this level of corruption.

[44] Since $G^{taxpayers}(S_{\mathrm{Pr}}^{taxpayers}) = 0$. Note that they still might express some discontent to the extent that they are consumers as well.

Corruption is likely to weight heavily on the public's perception of the privatization process when consumers of the public service represents a sizeable share of society. Specifically, the quantity $\Delta x^{consumers} = -G^{consumers}(S_{Pr}^{taxpayer})$ is more likely to be significant and, in any case, is negative.[45] This points to the fact that consumers are more likely to express their discontent as ownership shifts to the private sector.

Our model thus shows that while the increase in corruption is likely to be linked to a general increase in dissatisfaction, the changing pattern of corruption implies that this increase will be stronger among consumers, and among these among middle class urban ones, both because of their exogenous characteristics making them more likely to organize themselves and express dissatisfaction and because they are the big losers in the biased distribution of efficiency gains.

6 Stylized Facts and Discussion

We have shown that a shift towards private ownership of some key regulated industries is likely to result in a situation characterized by both increased efficiency and more corruption, and by a higher level of discontent among (middle class) consumers. In what follows, we present supportive stylized facts documenting the link between corruption, the perception thereof, and the public expressions of distrust toward the benefits of privatization.[46] We then discuss related empirical papers that analyze the general determinants of dissatisfaction with privatizations.

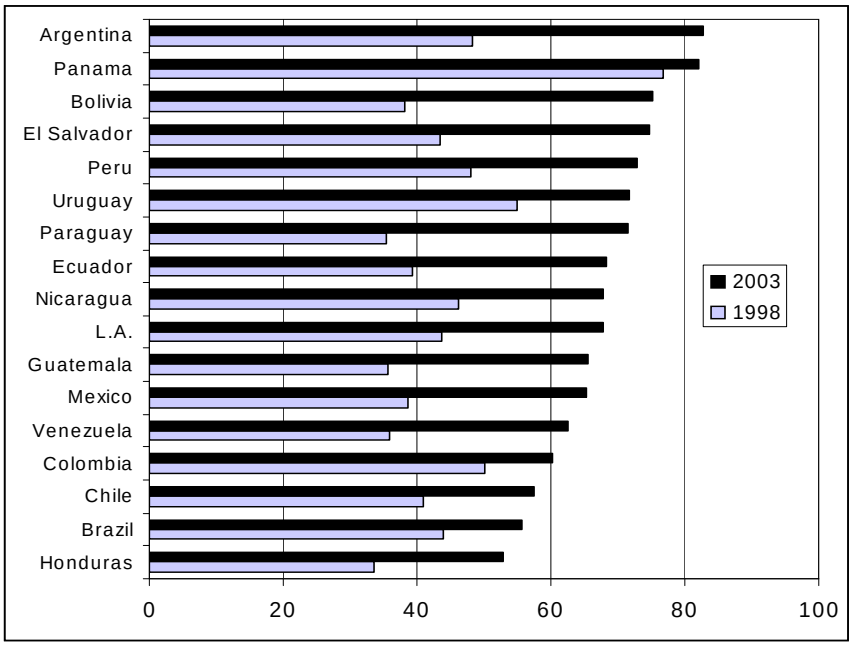
Since the second half of the 1980s, Latin America has been the leading region in attracting private participation in infrastructure projects, from telecommunication and energy (electricity and natural gas) to transport (roads, railways, ports and airports) and water (potable water and sewage). Between 1990 and 2004, the Latin American and Caribbean region was home to approximately 36% of the total number of projects and 45% of the total investments in developing countries.[47] Strikingly, by the early 2000s there was in most Latin American countries a strong and rising public discontent with the outcome of privatization, a decline in private investors' interest and an often open defiance from newly elected governments. By now, the optimistic mood of the 1990s is largely forgotten, and some even question the validity of the privatization paradigm that once was a cornerstone of reforms in the region. In some countries, renationalization is again on the agenda.

[45] Here again, $G^{consumers}(S_{Pu}^{consumers}) = 0$.

[46] Note that the robustness of the insights presented here is limited by the fact that neither set of indicators are specific to infrastructure. Unfortunately, such specific indicators do not exist.

[47] Figures are from the World Bank Private Participation in Infrastructure database. Note that investment figures generally report commitments, and that effective investments end up being substantially lower (Estache, 2004). Still, infrastructure represents the majority of privatization revenues.

Figure 1: Percentage of respondents who (strongly) disagree that privatization has been beneficial for their country



Source: Latinobarometro 2001 and 2003.

As far as public perceptions are concerned, the main evidence comes from Latinobarometro, a survey of public opinion conducted yearly in several Latin American countries since 1995.[48] As of 2003, in the 17 countries surveyed, negative views of privatization ranged from 53% in Honduras to 83% in Argentina, for a Latin American average above 67%. Furthermore, negative opinions had increased significantly since 1998, going for example from below 50% to 83% in Argentina, from 38% to 75% in Bolivia and from 48% to almost 73% in Peru (see Figure 1).[49]

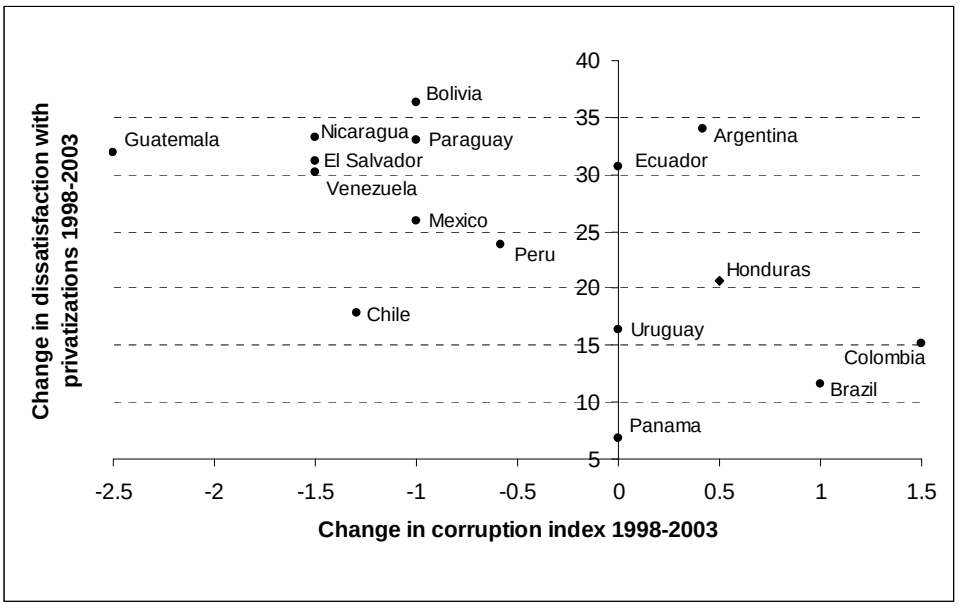
Figures 2 and 3 present simple scatter plots of changes in the degree of dissatisfaction with privatization over the period 1998-2003 versus either the change or the absolute level of a corruption index.[50] The correlation coefficients are -0.58 and -0.51 respectively.

[48] See www.latinobarometro.org (last visited 13/02/06). Hall et al. (2005) discuss the shape and impact of the opposition to privatization in water and energy.

[49] Dissatisfaction is computed as the sum of the shares of respondents who declare that they disagree or strongly disagree with the statement "Privatizations of state enterprises have been beneficial to the country". Unfortunately, the questions' wording regarding satisfaction with privatizations was changed in 2004, making comparisons difficult. Data for 2005 show a slight improvement in satisfaction, but figures remain much higher than in the late 1990s.

[50] Dissatisfaction figures are from Latinobarometro (see footnote 4). The corruption index used is from Political Risk Service. The scale goes from 0 to 6, with a higher score denoting less corruption. Note that in the Latin American sample, between 1998 and 2003, average corruption actually increased by two thirds of the 1998 standard deviation.

Figure 2: Correlation between changes in dissatisfaction with privatizations and changes in corruption, 1998-2003.

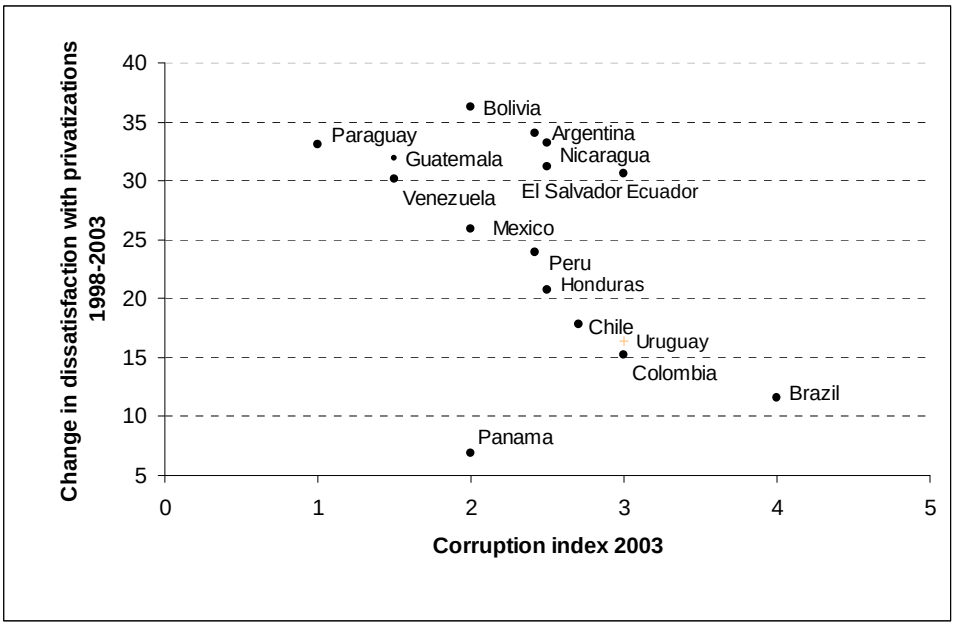


Sources: Latinobarometro and International Country Risk Guide

These correlations are consistent with a wealth of anecdotal evidence on the long tradition of corruption that has plagued Latin American economic policy making, especially when it comes to the sale of public firms.[51] In many cases, like the corruption scandal that resulted in the eviction of the Brazilian president Fernando Collor de Mello in 1992 or the revelation on some of the deals made under the Menem presidency in Argentina, the whole privatization process came under suspicion and this created a deep public distrust in this type of policy intervention and in market reforms more generally. Moreover, anti-privatization lobbies often capitalized on such cases, thus giving high visibility to the issue.

Figure 3: Correlation between changes in dissatisfaction with privatizations, 1998-2003, and corruption, 2003.

[51] See for example Manzetti (1999) and Tulchin and Espach (2000).



Sources: Latinobarometro and International Country Risk Guide

Although these correlations do of course not establish a causal link between the feeling that corruption has increased, or has not been addressed properly, and the dissatisfaction with privatization, it is possible to further document the relationship between both in the respondents' answer to the successive surveys. First, note that corruption is consistently perceived as a major issue by respondents across Latin America. In 1998, 94.9% overall (96% in 2000) consider it to be a serious or very serious problem.[52]

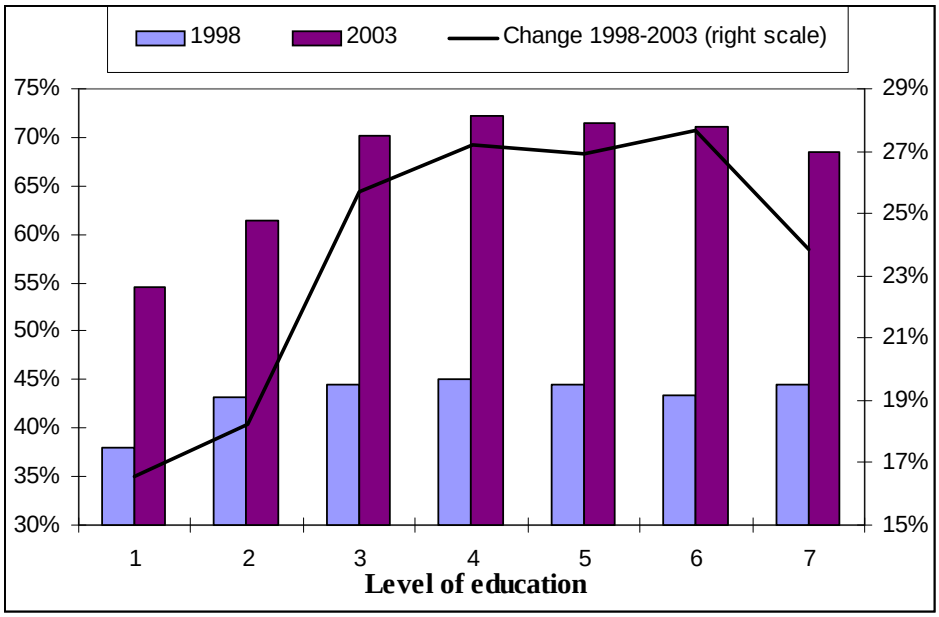
As for the link between perceptions, in 2003, people were asked whether they considered that progress was made in reducing corruption.[53] Dissatisfaction with privatization is higher among those answering that no or little progress was made (71.2% and 69.5% respectively), than among more optimistic respondents considering that some or a lot of progress was made (60.3% and 58.5% respectively). Thus, a similar pattern is obtained using individual survey answers on corruption rather than country level subjective indices.

Moreover, perceptions of corruption are linked to the political economy of the process and the shifts that privatizations induce in the distribution of costs and benefits. Indeed, another striking figure coming out of opinion polls is the fact that the middle class is in general more critical of privatization than any other group. Looking at education levels, Latinobarometro data show that dissatisfaction is stronger among those with some secondary or technical education and higher than among the groups with either no or little education and that, from 1998 to 2003, the biggest increase in dissatisfaction with privatizations was recorded for groups with intermediate education levels (Figure 5).

[52] The question was not included again in this form in later surveys.

[53] People were asked whether there had been a lot/some/little or no progress.

Figure 5: Dissatisfaction with privatizations by level of education

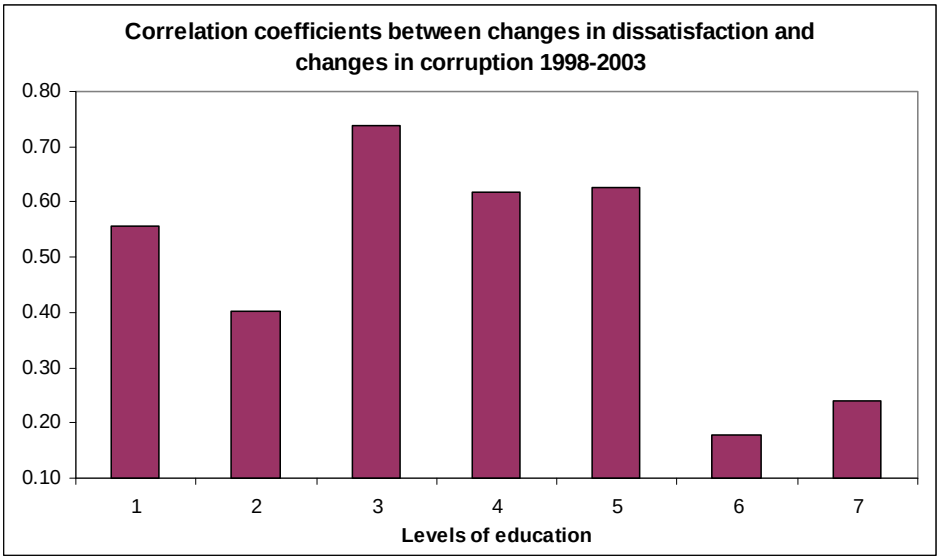


Levels of education: 1.= illiterate; 2 Basic incomplete; 3 = Basic complete; 4 = Secondary, medium, technical incomplete; 5 = Secondary, media, technical complete; 6 = Superior incomplete; 7 = Superior complete.

Source: Latinobarometro 1998 and 2003.

Finally, for the groups that express the highest levels of dissatisfaction and have increased their criticisms the most, we also observe strong correlation coefficients across countries between these changes in dissatisfaction and the changes in corruption, meaning again that the correlation observed in Figures 3 and 4 above are mainly driven by dissatisfaction among the middle class (Figure 6).

Figure 6: Correlation coefficients between changes in dissatisfaction and in corruption



Source: Latinobarometro 1998 and 2003

One limitation of these stylized facts is that the available measures of corruption are only imperfect proxies for the specific type of misbehavior stressed in our theoretical model. We have argued in the introduction that different aspects of corruption are likely to be highly correlated and that they may actually act in a complementary way, for example if the fact that assets from public firms are transferred to insiders becomes a facilitating factor for ex post regulatory capture. Still, some measure of price changes in privatized industries would capture the underlying regulatory failure better. Unfortunately, while some authors have estimated price evolutions for specific sectors at some point in time, systematic measures across countries, sectors and time do not exist.[54] Moreover, the satisfaction question included in Latinobarometro does not discriminate by sectors, making the connection between overall satisfaction and sectorial prices difficult. Another potential measure that could relate to the type of corruption discussed here is regulatory quality. Indeed, Chisari, Estache and Romero (1999) conclude, using a computable general equilibrium model fitted to Argentinean data, that the positive macroeconomic effects of privatization are likely to increase considerably under effective regulation. But again, systematic measures of regulatory quality are not available, and if they were, it is unclear how to aggregate them across sectors.

Considering now the more general context, Bonnet et al. (2006) perform a systematic empirical analysis of the determinants of dissatisfaction with privatization in Latin America, using data from the Latinobarometro surveys between 1998 and 2005. Their results can be related to our analysis in several respects.

[54] See McKenzie and Mookherjee (2003), as well as Torero and Pasco-Font (2001) for Peru, Delfino and Casarin (2001) for Argentina and Barja and Urquiola (2001) for Bolivia.

First of all, considering two variables that proxy for the income distribution, namely the education level of the survey respondent and an evaluation of its socioeconomic condition by the person carrying out the survey, they show a robust inverse U-shaped pattern, indicating that the strongest discontent is indeed expressed by the middle class. This insight is confirmed by the results from variables capturing individual asset holdings and access to basic services, which show that both the very poor and the richer individuals are significantly more satisfied than their middle class counterpart. These results constitute the main empirical regularity as far as individual characteristics are concerned and are robust to a variety of specification, including the use of fixed effects in a pseudo panel.[55]

As for country level aspects, dissatisfaction appears to strive in contexts characterized by adverse macroeconomic shocks and poor governance. The significance of these variables, however, is not robust to the introduction of a time trend that seems to capture most of the country level relevant effects. On the other hand, governance related beliefs appear to be very significant. In particular, after instrumenting it to control for potential endogeneity, the respondents' degree of trust in the judicial institution appears to have a strong positive impact on the satisfaction with privatizations.[56]

These facts can be related straightforwardly to our theoretical framework. Indeed, we expect individuals' incentives to form groups and actively engage in watchdog activities, and therefore their awareness of the level of corruption, to be related to the per-capita stake as well as to their transaction costs of doing so. First, individuals have exogenous characteristics, which are unlikely to be substantially modified by the occurrence of privatizations.

A pervasive characteristic of infrastructure services is the fact that some geographical areas are more expensive to serve for a variety of reasons, including distance to the existing network, low population density and low levels of consumption. Consumers in these areas also have a lower likelihood to engage in monitoring activities and express concerns about privatizations. Moreover, under public ownership, electricity, telecommunication or water networks in Latin America have typically failed to provide universal service to such less profitable categories of consumers, generally located in poor rural communities as well as some less developed urban areas. The fact that many of them have gained access to the service after the change in ownership is likely to exert an important and positive effect on their perception of the benefits of the process.[57]

[55] A similar non linear relationship between socioeconomic status and satisfaction with privatizations is found by Checchi et al. (2005), who perform a similar exercise using only three waves (1998, 2000, 2002) of the Latinobarometro survey.

[56] Birdsall and Nellis (2005) mention the legal/judiciary system as one of the key aspects of a country's institutional framework relevant to privatization.

[57] Empirically, access by new customers makes up the bulk of the positive welfare impact observed in most sectors (McKenzie and Mookherjee, 2003). Note, however, that in many countries and sectors significant affordability problems remain for poor households, in particular in terms of connection costs

On the other hand, middle class consumers have higher incentives to care about corruption, both for exogenous reasons linked to their characteristics and tradition, and because they face higher stakes of doing so, as shown in the model. As they interpret any evidence of corruption as operating a transfer, through higher prices, of a chunk of the efficiency gains from them to corrupt politicians and firm managers, they indeed express stronger dissatisfaction with the privatization process.[58]

In terms of the relative burden of higher taxes versus that of higher utilities prices, we unfortunately don't have relevant data by income groups in the Latin American case to assess it precisely. We do know, however, that tax systems there have historically been based mostly on indirect taxes and as such tend to be quite regressive. Moreover, as stressed by Birdsall and Nellis (2002), the poorest part of the population is also likely to have benefited relatively more from the end of soft money transfers to inefficient public firms, because these subsidies often amounted to a highly regressive inflationary tax. This is summarized in Kessides (2004), who stresses that: "Higher prices generally fall on those benefiting from services–in many developing countries, the middle and upper classes–while higher taxes are likely to occur partly through inflation taxes that hurt poor people and other vulnerable groups". These factors are likely to support our conclusions, in the sense that the intensity of discontent is inversely related to education/income levels, possibly with a peak among the middle class.

Finally, an additional potential channel involves quality effects, as there is a presumption that virtual price increases could in practice also have taken place through hidden quality reductions (Estache, 2004). Indeed, quality concerns are a well known aspect of high-powered regulatory schemes such as price caps that were extensively used in the region. Again, insufficient quality improvements in the face of well publicized efficiency gains may have lead to the perception of an unfair distribution of these gains, although more evidence is still due on this aspect.

7 Conclusion

It is a well admitted point that the ownership pattern of firms has strong impact on the hardness of their budget constraints, and thus has significant effects on cost-reducing investments. However, ownership has also a significant impact on the incentives of corrupt public officials to engage in informed side-deals and on the stakes involved in these side-deals. Far from always reducing corruption, privatization only changes the pattern of corruption deals and the identity of the groups most likely to suffer from it. Taxpayers

(Estache, 2004).

[58] See further evidence on the biased distribution of efficiency gains in Estache, Guasch and Trujillo (2003).

suffer from corruption when firms are public, while consumers are the first group harmed in the case of private firms.

How the likelihood of corruption changes as sectors get privatized depends on fine details like the cost of public funds of the economy under scrutiny, or the size of the investment undertaken in the privatized sector at hands. There is therefore no apparent contradiction between the fact that, in given sectors such as water and transport, privatization triggers efficiency-enhancing investments by hardening the firm's budget constraint, and at the same time results in an increased likelihood of corruption and more aggregate dissatisfaction. For that argument to be complete, it must be that dissatisfaction is monotonically linked with the likelihood of corruption, an idea on which we built our empirical analysis. This relationship between perception and equilibrium corruption has been viewed to a large extent as an exogenous black-box of our analysis but certainly more research should be devoted to the psychological aspect of those perceptions and how feelings about the privatization process can be bundled with other related grand-issue such as globalization.

Various stylized facts suggest that the absolute welfare impact of changes in ownership in infrastructure sectors is unlikely to explain by itself the extremely high level of discontent observed throughout Latin America. They rather indicate that the political economy of the process may matter, in the sense that a fraction of the population, mostly the middle class, appears to be much more critical of privatization, probably on the ground that they perceive the reforms as opening possibilities for corrupt deals that they can only guess as consumers and, for this reason, consider themselves as the big losers in this occasion.

As the theoretical model shows, one channel for this is the fact that the hardening of the soft-budget constraint of public firms consecutive to the move to private ownership has shifted the burden of corruption from the general budget and therefore taxpayers, to the price of services, affecting (middle class) consumers directly and, above all, more visibly. So, the mixed results in terms of prices have fuelled discontent among the middle class, not so much because of a huge impact on these households' budget, but because their failure to decrease to reflect much publicized efficiency gains was interpreted as evidence of a corrupt allocation of efficiency gains in favor of firms and politicians. Perceptions of unfairness and relative income concerns therefore drive dissatisfaction.

Our model helps understand the skyrocketing discontent with privatizations expressed by citizens all over Latin America and the Caribbean region in Latinobarometro opinion surveys. As a matter of fact, this discontent appears to be strongly correlated with both changes and absolute levels of corruption perceptions at the country level. Moreover, this correlation is mostly driven by middle class groups, consistently with a framework

in which they are both directly affected by corrupt deals that deprive them of potential efficiency gains and they are the more likely to organize and try to control wrongdoings in the privatization process.

One possible restriction of our analysis is that it focuses on corruption *once* a given ownership structure has been chosen and it neglects the fact that ownership transfers from the public to the private sector may itself be corrupted acts favoring groups, elites and close-friends of the power. However, one may suspect that environments where such undue transfers have taken place will also be more conducive of the kind of day-to-day corruption in price fixing or subsidy channelling that we have uncovered in this paper. In other words, more corrupted economies at the ex ante stage are also the most likely to have efficient side-deals ex post.

Subsequent research should investigate further the structure of the dynamic political equilibrium that may emerge from the repeated interactions between corrupted politicians, individuals and interest groups, who might express their discontent towards privatization through political actions. Far from being taken as exogenous as we did in our above analysis, the degree of privatization and the nature of the sectors, which are actually privatized, might then reflect the tension that corruptible politicians feel when torn between cajoling private interests and securing political support from middle classes. In that respect, one major lesson of our findings is that, beyond the ownership structure in itself, the transparency of the relationship between the State and infrastructure service providers, in particular the quality of the regulatory process, is a key ingredient to minimize the threat of corruption.

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Appendix

• **Proof of Proposition 1:** Let us first rewrite expected welfare with a benevolent politician and public ownership as:

$$\begin{aligned} \underset{(\theta,\sigma)}{E}(W) &= \nu\varepsilon(S(\underline{q}^*)+\lambda P(\underline{q}^*)\underline{q}^*-(1+\lambda)\underline{\theta}\underline{q}^*-\lambda\underline{U}^*-\lambda\underline{V}^*) \\ &\quad +\nu(1-\varepsilon)(S(\underline{q})+\lambda P(\underline{q})\underline{q}-(1+\lambda)\underline{\theta}\underline{q}-\lambda\underline{U}-\lambda\underline{V}) \\ &\quad +(1-\nu)(S(\bar{q})+\lambda P(\bar{q})\bar{q}-(1+\lambda)\bar{\theta}\bar{q}-\lambda\bar{U}-\lambda\bar{V}) \\ &\quad -(1+\lambda)K(I)-I, \end{aligned} \tag{A1}$$

where I is the observable investment choice made by the firm.

The optimal contract maximizes (A1) subject to (4), (5), (6) and the following binding participation constraints of the public official

$$\underline{V}^*=\underline{V}=\bar{V}=0, \tag{A2}$$

since there is no need to pay the benevolent politician in any state of nature. All those constraints are of course binding at the optimum. Hence, we get (9).

Inserting the corresponding values of the firm's information rent in the different states of nature into the objective function and optimizing with respect to outputs yields (7) and (8).

Finally, the firm chooses to invest to maximize its expected return. Given that the only state of nature where the firm gets some information rent occurs with probability $\nu(1-\varepsilon)$, but that in this case the rent does not depend on the firm's investment, we trivially get:

$$I^e=\arg\max_{I\geq 0}\nu(1-\varepsilon)\Delta\theta\bar{q}^B_{Pu}-I=0. \tag{A3}$$

■

• **Proof of Proposition 2:** Expected social welfare with a benevolent politician who does not need to be paid to report information can now be written as:

$$\underset{(\theta,\sigma)}{E}(W)=\nu\varepsilon(S(\underline{q}^*)-\underline{\theta}\underline{q}^*)+\nu(1-\varepsilon)(S(\underline{q})-\underline{\theta}\underline{q})+(1-\nu)(S(\bar{q})-\bar{\theta}\bar{q})-K(I)-I. \tag{A4}$$

Under private ownership, the optimal regulatory contract maximizes (A4) subject to (5), the incentive constraint of an inefficient firm and the participation constraints of both types of firm:

$$\underline{U}^* = (P(\underline{q}^*)-\underline{\theta})\underline{q}^*-K(I)\geq 0, \tag{A5}$$

$$\bar{U} = (P(\bar{q})-\bar{\theta})\bar{q}-K(I)\geq 0, \tag{A6}$$

where (A5) now replaces (4) and (A6) replaces (6).

Finally, (5) implies that, when $\sigma = \emptyset$, a $\underline{\theta}$-firm makes a positive profit.

To simplify the analysis we also assume that $K(I)$ is not too large so that (A5) and (A6) define non-empty constrained sets.

Of course, (A5) and (A6) are necessarily binding at the optimum. We denote $\lambda^*(I)$ and $\tilde{\lambda}(I)$ the corresponding multipliers and note that increasing I reduces $K(I)$ and relaxes the constraints so that $\lambda^*(\cdot)$ and $\tilde{\lambda}(\cdot)$ decrease with I.

Similarly, setting $\underline{q}$ such that the efficient firm breaks even (i.e., $(P(\underline{q}) - \underline{\theta})\underline{q} = K(I)$) also violates the incentive constraint (5), which is thus again binding so that

$$(P(\underline{q}) - \bar{\theta})\underline{q} = (P(\bar{q}) - \bar{\theta})\bar{q}, \tag{A7}$$

and thus $\underline{q} = \bar{q}$ (ruling out the sub-optimal choices consisting in choosing outputs on opposite sides of the revenue's curve). Without transfer, the best that can be done is to offer a pooling contract.[59]

Note that $\bar{q}^B_{Pr}$ is lower when $K(I)$ increases, i.e., when I decreases.

The firm chooses ex ante an investment level I_{Pr} such that

$$I_{Pr} = \max_{I \geq 0} \ \nu(1-\varepsilon)\Delta\theta\bar{q}^B_{Pr}(I) - I,$$

where we make explicit the dependence of $\bar{q}^B_{Pr}$ on I. This yields (16). ■

• **Proof of Proposition 3:** Note from (19) that $k^*_{Pu} \in]0,1[$. Moreover making explicit the dependence on λ:

$$\frac{dk^*_{Pu}}{d\lambda} = -\frac{1}{(1+\lambda^2)} \frac{F(k_{Pu})}{f(k^*_{Pu})\left[1 + \frac{\lambda}{1+\lambda}\frac{d}{dk}\left(\frac{F}{f}\right)\Big|_{k^*_{Pu}}\right]} < 0$$

and thus $1 - F(k^*_{Pu})$ increases with λ. ■

• **Proof of Proposition 4:** We optimize (18) subject to (4) and (5).Those constraints are obviously binding, inserting their expression as function of outputs and optimizing with respect to outputs yields the result. ■

[59] Indeed, since we have $\bar{q}^B_{Pr} > \bar{q}^M$ where $\bar{q}^M$ is the monopoly output such that $P(\bar{q}^M) - \bar{\theta} = -P'(\bar{q}^M)\bar{q}^M$, from $\tilde{\lambda}(I) > 0$, we may have a solution $\tilde{\underline{q}} < \bar{q}^M$ to (A7). However, this solution is always dominated from a social welfare point of view since, when $\bar{q}^M < \underline{q}^{FB}$ (where $(P(\underline{q}^{FB}) = \underline{\theta})$), we have:

$$S(\bar{q}^B_{Pr}) - \underline{\theta}\bar{q}^B_{Pr} > S(\bar{q}^M) - \underline{\theta}\bar{q}^M > S(\tilde{\underline{q}}) - \underline{\theta}\tilde{\underline{q}}.$$

• **Approximation for (21):** When $\Delta\theta$ is small enough, the right-hand side of (21) can be approximated by:

$$\begin{aligned}
&\frac{1}{(1+\lambda)\Delta\theta\bar{q}_{Pr}}\left\{\Delta\theta\bar{q}_{Pr}+(P(\underline{q}^*_{Pr}-\underline{\theta})(\bar{q}_{Pr}-\underline{q}^*_{Pr})\right\}=\frac{1}{(1+\lambda)\Delta\theta}\left\{\Delta\theta+\frac{K(I_{Pr})}{\underline{q}^*_{Pr}\bar{q}_{Pr}}(\bar{q}_{Pr}-\underline{q}^*_{Pr})\right\}\\
&=\frac{1}{(1+\lambda)\Delta\theta}\{P(\underline{q}^*_{Pr})-P(\bar{q}_{Pr})\}=-\frac{P'(\underline{q}^*_{Pr})(\underline{q}^*_{Pr}-\bar{q}_{Pr})}{(1+\lambda)\Delta\theta}\\
&=\frac{P'(\underline{q}^*_{Pr})}{(1+\lambda)\left(P'(\underline{q}^*_{Pr})+\frac{K(I_{Pr})}{\underline{q}^*_{Pr}\bar{q}_{Pr}}\right)}=\frac{1+\tilde{\lambda}(I)}{1+\lambda},
\end{aligned}\tag{A8}$$

where the last equality uses (11) and (12). Finally, we obtain (22). ■

• **Proof of Proposition 5:** Direct from the text. ■

• **Proof of Proposition 6:** Taking again (18) as the objective function and optimizing subject to (A5) and (A6) gives the result. ■

• **The Consequences of Countervailing Power and the Role of Watchdogs**: Suppose that an interest group hurt by the threat of corruption may intervene as an effective watchdog, providing information on the politician's misbehavior.[60] This may be by acquiring ex post information on σ conditionally on $\hat{\sigma}$ being uninformative. We will assume that, if this interest group successfully reacts, it learns $\sigma=\underline{\theta}$ with probability one.

Let us derive the outcome of the model when consumers are active watchdogs under private ownership. A politician when caught corrupted loses both the benefit of the bribe he would have received otherwise and the benefits of holding office s^* (because he may not be reelected or he may be put in jail and lose his reputation and prestige). Under private ownership, as consumers are the only checks on politician misbehavior, (17) becomes thus:

$$\begin{aligned}
\underset{(\theta,\sigma)}{E}(W_{Pr}) \;=\;& \nu\varepsilon F\left[\frac{s^*_{Pr}}{\Delta\theta\bar{q}_{Pr}}\right]\left(S(\underline{q}^*_{Pr})-\underline{\theta}\underline{q}^*_{Pr}-\lambda s^*_{Pr}\right)\\
&+\nu\varepsilon(1-x^{cons}_{Pr})\int_{\frac{s^*_{Pr}}{\Delta\theta\bar{q}_{Pr}}}^{1}(S(\bar{q}_{Pr})-\underline{\theta}\bar{q}_{Pr}-(1-\tilde{k})\Delta\theta\bar{q}_{Pr})f(\tilde{k})d\tilde{k}\\
&+\nu\varepsilon x^{cons}_{Pr}\int_{\frac{s^*_{Pr}}{\Delta\theta\bar{q}_{Pr}}}^{1}(S(\underline{q}^*_{Pr})-\underline{\theta}\underline{q}^*_{Pr})f(\tilde{k})d\tilde{k}\\
&+\nu(1-\varepsilon)(S(\bar{q}_{Pr})-\underline{\theta}\bar{q}_{Pr})+(1-\nu)(S(\bar{q}_{Pr})-\bar{\theta}\bar{q}_{Pr})-K(I_{Pr})-I_{Pr}.
\end{aligned}$$

[60] For a model along these lines see Laffont and Tirole (1993, Chapter 15).

In optimizing social welfare, we will assume that $\underline{q}^*_{Pr}$ and $\bar{q}_{Pr}$ are still given by the zero profit constraints of the firm (12) and (14),[61] so that the probability x that corruption is detected and does not occur is taken as fixed.

The cut-off value k^*_{Pr} now solves the following equation:

$$k^*_{Pr} + \frac{\lambda}{1+\lambda}\frac{F(k^*_{Pr})}{f(k^*_{Pr})} = \frac{(1-x^{cons}_{Pr})(S(\underline{q}^*_{Pr}) - \underline{\theta}\underline{q}^*_{Pr} - [S(\bar{q}_{Pr}) - \bar{\theta}\bar{q}_{Pr}]) - x^{cons}_{Pr}k_{Pr}\Delta\theta\bar{q}_{Pr}}{(1+\lambda)\Delta\theta\bar{q}_{Pr}}, \tag{A9}$$

with the following approximation when $\Delta\theta$ is small enough

$$\left(1 + \frac{x}{1+\lambda}\right)k^*_{Pr} + \frac{\lambda}{1+\lambda}\frac{F(k^*_{Pr})}{f(k^*_{Pr})} = \left(\frac{1+\tilde{\lambda}(I_{Pr})}{1+\lambda}\right)(1-x). \tag{A10}$$

The impact of consumers' ex post check is straightforwardly seen from (A10). It unambiguously reduces the threat of corruption. Two effects are nevertheless at work. On the one hand, output is raised from $\bar{q}_{Pr}$ to $\underline{q}_{Pr}$ in case corruption is detected. This increases welfare and makes it more attractive to reduce the probability of corruption. On the other hand, there is no longer any need to reward indirectly the politician through bribes. ■

[61] This will typically be the case when x is small enough.