Political Corruption in the Execution of Public Contracts: A Principal-Agent Analysis

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Abstract

This paper provides a novel economic explanation of why embezzlement may occur in the execution of public contracts. It is argued that at the core of the phenomenon is an agency problem where the room for the contracting firm to embezzle money is created by the opportunism of its principal, a partially selfish politician who may gain from designing perverse incentives. The politician, who is responsible for the design of both contracts and auditing policy, can decide whether to enter a corrupt transaction with the firm upon detection - i.e., to hide evidence in exchange of a share of embezzled money. It is found that while a moderately selfish politician (by choosing a relatively aggressive auditing policy) prevents the firm from embezzling money, an enough selfish politician (by choosing a relatively weak auditing policy) creates an incentive for embezzlement in optimal contracts, in order to engage in corruption. Also, an improvement in the efficiency of the fiscal system, by lowering the social cost of cost-padding, makes embezzlement easier to occur, since also less opportunist politicians are willing to engage in corruption.

Keywords: Cost-padding; Principal-agent model; Selfish regulator; Optimal contracts; Endogenous auditing; Corruption in procurement.

JEL Classification: D73; D82; L51.

1 Introduction

In June 2014 a huge corruption scandal burst in Italy concerning the public works for the MOSE, the ambitious project of underwater barriers designed to protect Venice from flooding. The inquiry led to the arrest of 35 people among entrepreneurs, bureaucrats and politicians (including the mayor of Venice and the former governor of Veneto), and to the investigation of other 100 people, with the charges of fiscal fraud, corruption, extortion and money laundering. The inquiry unveiled a well-established system where contracting and sub-contracting firms in the consortium in charge of the MOSE works, systematically embezzled public funds, mainly via inflated and false billings. The embezzled money was then allocated to managers’ private use and to buy the favoritism of national-level politicians (e.g., to unblock extra funding to
the project) and the connivance of the authorities in charge of the monitoring of work. Authorities reported that the money embezzled since the beginning of works in 2003 amounts to 1 billion euros, i.e. 20 percent of the current cost of the MOSE (now at 80 percent of completion).

The MOSE case, as well as other similar episodes, highlights two fundamental aspects about how corruption may affect public procurement that have been neglected by the literature. First, although it is well acknowledged that corruption may be a major source of cost-overruns in public procurement (see e.g., Auriol (2006), OECD (2007), Transparency International (2006)), most contributions focus on corruption at the award stage, notably on the case that the auctioneer can manipulate the tender in favor of a participant in exchange of a bribe (see e.g., Laffont and Tirole (1991), Celentani and Ganuza (2002), Burguet and Che (2004), Compte et al. (2005), Lengwiler and Wolfstetter (2006), Burguet and Perry (2007), Arozamena and Weinschelbaum (2009)). However, the most severe overruns may rather follow from corruption at the implementation stage of the contract (see e.g., Piga (2011), Boehm and Olaya (2006)).

Corruption at the post-tendering stage of procurement is widespread and significant, and can occur under many different forms (e.g., see Søreide (2005) and Ware et al. (2007)). Most notably, the contracting firm can, with the connivance of some corrupt public official in charge of monitoring the execution of the contract, engage in cost-padding, namely accounting manipulations that allow it to inflate reimbursable costs and divert public money to private uses.

Despite the practical relevance of corruption at the execution stage of public contracts, to the best of our knowledge only two works have provided an economic analysis of this issue. The former is a paper by Laffont and Tirole (1993, Ch. 12), who analyzed cost-padding in an extension of the standard regulatory problem with unobserved firm’s productivity (see Laffont and Tirole (1986)), and allowed for the possibility that the firm bribes the supervisor - a bureaucrat who audits the firm on behalf of a benevolent regulator. They found first, that even in absence of corruption, cost-padding can emerge in optimal contracts due to informational asymmetry, since the principal may prefer to let the firm engage in cost-padding rather than paying a higher rent to prevent it; and, second, that the effect of corruption on optimal contracts is ambiguous, since on one hand high-powered schemes reduce the incentive for cost-padding and hence are less affected by corruption, but on the other hand they yield higher rents, hence enhancing the stakes of and the incentive for corruption. More recently, Iossa and Martimort (2013) have studied how the procurement contract (and in particular the allocation of risk between parties) should be designed in order to minimize the scope for

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1 Authorities reported that the consortium paid real “annual wages”- ranging from 100.000 to 1 million euros per person per year - to regional and national level top politicians (both right and left-wing and also as electoral funding), as well as to regional officers, judges, intelligence officers, one high official of the Italian Financial Police and one judge of the Court of Accounts. In addition to monetary “wages”, substantial favors were paid in in-kind utilities (e.g., holidays, private flights). The president of the consortium, which was also nicknamed by people in the system as the “Doge”, used diverted money to increase his own salary by one million per year, to benefit relatives and even to build an image of himself as a philanthropist of Venice - creating job positions, funding the university, sponsoring public events and even funding for 5 million the Italy stage of the America’s cup (for more details see (in Italian) http://www.repubblica.it/cronaca/2014/06/07/news/mose_tangenti_e_sprechi_per_un_miliardo-88272959/?ref=search).

2 Notice that not all causes of cost overruns are driven by opportunistic behavior (of either the contracting firm or the purchasing authority). For example, inadequate planning (due to complexity and uncertainty), honest mistakes, and even political bias in choosing “wrong” projects and underestimating costs (like in the case of “white elephant” projects), may all be sources of severe cost-overruns but are driven by mostly unintentional behavior (e.g., see Flyvbjerg (2007)).

3 There are many ways contracting firms can pad costs, among which increasing expense claims for materials and supplies (via over-billing), charging advertising and other unallowable expenses to project costs, increasing managerial compensation, not reporting cost-reducing improvements (see e.g., Ware et al. (2007)).
post-tender corruption, finding that the solution depends on a country’s quality of auditing institutions and levels of corruption.

In the works just mentioned, the only kind of corruption which is allowed for is bureaucratic corruption, namely the case that the firm bribes the bureaucrat in charge of the monitoring of contract execution, since it needs its connivance to engage in illegal activities. In the spirit of the very first economic models that analyzed the issue (see e.g., Becker and Stigler (1974), Banfield (1975), Rose-Ackerman (1975) and Klitgaard (1988)), corruption is therefore treated as an agency problem where the bureaucrat is a corruptible agent of the government, which is instead regarded as a benevolent regulator. The same is true for the literature on corruption at the award stage of procurement.

However, big corruption scandals like the MOSE, show that corruption may not be limited to minor bureaucratic levels, but rather involve higher levels of the political hierarchy, namely top-level politicians, who may as well have to gain from large-scale corruption. Therefore, a second main aspect of the relationship between procurement and corruption that was neglected by the literature is that beside bureaucratic corruption, also political corruption can arise: when the potential gains from a corrupt deal are large, bureaucratic malfeasance can be often sustained by dishonesty at the top-level of the political hierarchy.

While the general issue that all levels of government are rent-seeking and hence corruptible has a long-standing tradition in the “Public Choice” and political economy research agendas (see e.g., Buchanan and Tullock (1962), Barro (1973), Ferejohn (1986), Shleifer and Vishny (1993), Persson and Tabellini (2000), Grossman and Helpman (2002), Besley (2007)), the problem has not been analyzed for public procurement in particular. To the best of our knowledge, the only exceptions are two recent empirical studies. The former is a work by Coviello and Gagliarducci (2010), who investigate the relationship between the time politicians stay in office and the functioning of procurement, finding that more time in office is associated with a worsening of procurement performance. The latter is by Goldman et al. (2013) who analyze the effect of political connections of publicly traded corporations in the US on the allocation of procurement contracts, and find that companies that are connected to the winning (losing) party are significantly more likely to experience an increase (decrease) in procurement contracts.

The contribution of this work is therefore to provide a theoretical framework which explains the occurrence of cost-padding in the execution of public contracts as a problem of political corruption. We argue that at the core of the phenomenon is an agency problem where the incentive for the contracting firm to engage in cost-padding does not arise from post-contractual informational asymmetries, but is rather created by the opportunism of the principal - a top-tier politician, who can be self-interested and corruptible and have a gain from designing perverse incentive schemes in order to induce the firm to embezzle money.

In particular, we extend the contract-theoretic cost-padding model by Laffont and Tirole (1993, Ch. 12) to allow for the political principal to be partially selfish - i.e., he is no longer a benevolent regulator but he rather maximizes a weighted average between social welfare and his own personal benefit - and for both the auditing technology and the stakes of corruption to be endogenous and dependent on his selfishness. In our model the principal/politician

4See Aidt (2003) for a survey on economic models of corruption.
5Other examples, beside the MOSE case, are the Italian corruption scandals concerning the Milan world’s fair EXPO 2015 (see e.g. (in Italian), http://www.repubblica.it/argomenti/tangenti_expo), and the recent case “Sistema Incalza” (see e.g. (in Italian), http://espresso.repubblica.it/plus/articoli/2015/03/20/news/grandi-opere-i-nomi-del-sistema-ercole-incalza-1.205042). In both cases corruption was found to involve top level politicians and former politicians.
6The “mixed” view of the government was introduced by Grossman and Helpman (1994) in the context of lobbying and special interest politics, and can be found in other research agendas as well, e.g., in law
is responsible not only for the design of procurement contracts, but also for the auditing of the contracting firm. Depending on his degree of selfishness, the politician decides both the level of auditing technology and, in case evidence of cost-padding is found, whether to enter a corrupt transaction with the firm, i.e., hide evidence in exchange of a share of the embezzled money. This framework allows to develop a theory of endogenous political corruption: while in Laffont and Tirole cost-padding could emerge in optimal contracts only due to costly informational problems, in this model cost-padding and, consequently, corruption, are ultimately choices of the politician, which depend on his degree of selfishness.

We find that while a moderate politician (by choosing a relatively aggressive auditing policy) prevents the firm from engaging in cost-padding, an enough opportunist politician (by choosing a relatively weak auditing policy) creates an incentive to pad costs in optimal contracts and, conditional upon detection, enters in a corrupt transaction with the firm. This result is consistent with the “mixed” nature of the politician, who cares both about social welfare and private utility. Since cost-padding implies a higher cost for consumers in terms of distortionary taxation, only a politician who is eager enough is willing to allow for cost-padding to occur. Interestingly, opportunist politicians face a trade-off when choosing the optimal level of auditing, for an increase in auditing leads on one hand to a higher probability to get a bribe (due to more frequent detection of cost-padding), but at the same time reduces the firm’s incentive to engage in cost-padding.

Moreover, we find that an improvement in the efficiency of the fiscal system makes cost-padding easier to occur. This happens since a decrease in the social cost of cost-padding (in terms of less distortionary taxation) induces also less opportunist politicians to engage in corruption. Therefore, since politicians induce cost-padding by reducing auditing, the model also predicts endogenous substitutability between the level of auditing and the efficiency of the state. This result can be interpreted in light of the recent debate on State capacity (Besley and Persson (2010), Acemoglu (2010); Acemoglu et al. (2011)): by increasing the stakes from staying in power, a more efficient fiscal system increases the politician’s incentive to misuse public office. Therefore, without a coincident increase in political accountability, an increase in State capacity can be detrimental. Also, we find that elections can hold an opportunist politician (more) accountable.

The rest of the paper is structured as follows: Section 2 presents the model; Section 3 analyzes the auditing subgame; Section 4 characterizes optimal contracts; Section 5 analyzes the optimal choice of auditing technology for the politician; Section 6 considers the effect of voting on the politician’s accountability; Section 7 concludes. All proofs are gathered in the Appendix.

2 The Model

2.1 Setting

A politician (principal) wants to contract the realization of a single and indivisible project of public utility from a monopolistic firm (agent).

The politician is partially selfish, i.e. rather than being a purely benevolent social welfare enforcement and economics of crime (e.g., Garoupa and Klerman (2002) and Dittmann (2006))

Dhami and Al-Nowaihi (2007) also have an agency problem where the principal (a politician) can be partially self-interested and audit himself the agent (a corruptible bureaucrat). However, the auditing technology is exogenous in their case.

The firm might be the winner of a procurement tender or a concessionaire for that project (like in the MOSE case).
maximizer as in Laffont and Tirole (1993, Ch. 12) (LT in the following), he maximizes a weighted average between social welfare (SW) and some measure of private utility (PU), which will be both defined shortly. Therefore, his objective function has the form:

\[ U = SW + \mu PU \]

where \( \mu \in [0, \infty) \) is a selfishness parameter measuring the weight placed by the politician on private utility relative to social welfare (see e.g., Grossman and Helpman (1994), Grossman and Helpman (2002), Dhami and Al-Nowaihi (2007)).

According to the value of \( \mu \), politicians can be categorized as follows:

**Definition 1.** If \( \mu > 1 \) the politician is “opportunist”, i.e., he cares relatively more about his private utility; if \( \mu \leq 1 \) the politician is “moderate”, i.e., he cares relatively more about social welfare.

The LT purely benevolent politician and the “Public Choice” purely selfish politician are limit cases of this modelization, where, respectively, \( \mu = 0 \) and \( \mu \to \infty \).

As in LT, the firm’s technology is represented by the following linear cost function

\[ C(\beta, e, a) = \beta - e + a \]

where \( \beta \) is a parameter which measures the technological efficiency (or “intrinsic productivity”) of the firm, with \( C_\beta > 0 \) (a high \( \beta \) corresponds to an inefficient technology), \( e \) is the level of cost-reducing effort (\( C_e < 0 \)) and \( a \) is the level of cost-padding activity (\( C_a > 0 \)), which in this model amounts to the quantity of project money embezzled by the firm. The realized cost of the project \( C \) is therefore equal to actual cost (\( \beta - e \)) plus cost-padding: if the firm exerts effort level \( e \) it reduces realized cost \( C \) by \( e \), and if it pads costs for an amount of \( a \) it increases \( C \) by \( a \).

The efficiency parameter \( \beta \) is private information to the firm. The politician only knows that there are two possible types of firms, a low-cost (efficient) type \( L \), and a high-cost (inefficient) type \( H \), i.e., \( \beta \in \{\beta_L, \beta_H\} \), with \( \beta_L < \beta_H \), and has a prior distribution over the two types i.e., \( \nu = P(\beta = \beta_L) \in (0, 1) \). Moreover, cost-reducing effort \( e \) and cost-padding activity \( a \) are firm’s post-contractual actions which are both unobservable for the politician. Only the realized cost \( C \) is observable and verifiable by the politician. Therefore, this setting is an extension of the standard regulatory problem in Laffont and Tirole (1986) where the moral-hazard problem becomes two-dimensional: the firm can try to inflate observed costs (and hence the reimbursement it receives from the regulator) not only by exerting a suboptimal level of effort, but also by embezzling public money. Notice that despite both adverse selection and moral-hazard are present in this model, the key informational issue is adverse selection (on the efficiency parameter) since both moral-hazard variables (i.e., cost-reducing effort and cost-padding) result deterministically in a level of cost realization.

We adopt the accounting convention that the politician reimburses the realized cost \( C \) to the firm, and then pay a net monetary transfer \( t \) (it is assumed that otherwise the firm does not accept the project), such that \( t \geq 0 \) (the firm has limited-liability). A contract

\[ t = k - bC \]

where \( k \) is a fixed fee and \( b \) represents the fraction of costs borne by the firm (i.e., the so called incentive power of the contract).
between the politician and the firm is therefore based on observables \( C \) and \( t \), and specifies a cost-transfer pair \((C, t)\). If the firm does not accept the contract, it gets its reservation utility, which is normalized to zero.

Notice that due to the linearity of the cost function, when the firm commits to a contractual cost level \( C \), optimizing on the level of either variable among \( e \) and \( a \) will imply that the level of the other variable is determined residually. The focus of this model is on cost-padding, so that the relevant choice variable for the firm will be cost-padding, while effort will be determined residually. Following LT, for simplicity we assume that equilibrium effort is always positive. Also, exerting an effort level \( e \) brings disutility \((\psi(e))\) to the firm. The disutility increases with effort \( \psi_e > 0 \) for \( e > 0 \), it is convex \( \psi_{ee} > 0 \), and satisfies \( \psi(0) = 0 \) and \( \lim_{e \to \beta} \psi(e) = +\infty \).

The project has constant value \( S > 0 \) for consumers, and to finance its cost \((C + t)\) the politician levies distortionary taxation: for each dollar raised by taxation, consumers bear disutility \( $(1 + \lambda)$, with \( \lambda > 0 \), where \( \lambda \) denotes the shadow cost of public funds. We also assume that for the politician it is worth realizing the project even with an inefficient firm \((\beta = \beta_H)\).

Finally, we assume that all agents (i.e., politician, firm and consumers) are risk-neutral, and we rule out any issue of political accountability or of contractual renegotiation. In particular, we assume that there is an implicit mechanism that enforces all legal and illegal contracts and ensures credibility of political announcements.

### 2.2 Audit of Cost-padding and Corruption

After the firm has selected and implemented the contract, i.e., it has chosen the level of cost-padding (and residually the level of effort), it undergoes auditing about cost-padding. We assume that the auditing is responsibility of the politician, that is in this model the politician is not only in charge of contract design, but also of the auditing policy. Albeit we are not explicitly introducing a supervisor in the model, so that our agency problem has a two-tier structure, we interpret that while the politician is responsible for the auditing policy, he is not the material executor of the auditing, the latter being assigned to some implicit subordinate bureaucrat whose motives are perfectly in line with those of the politician, like a “blind executor”.

The politician will choose and announce the auditing policy before offering contracts to the firm. The auditing choice is credible and binding, implying that after contract implementation the blind executor will simply audit the firm according to the predetermined auditing policy. Therefore, in this model the auditing choice is endogenous and will depend on the degree of selfishness of the politician.

We assume that the auditing policy simply amounts to a level of detection probability \( \rho(\mu) \in (0, 1) \). Moreover, the auditing technology is costless and produces hard-information, namely for a given level of cost-padding \( a \geq 0 \), the auditing will detect the true (and verifiable) level of cost-padding \((\hat{a} = a)\) with probability \( \rho(\mu) \) and nothing \((\hat{a} = \emptyset)\) with probability

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13LT show that it is worth to keep the inefficient type active (rather than shutting it down) as long as \( S \) is sufficiently high.

14Dhami and Al-Nowaihi (2007) have the same two-tier modelization of auditing, albeit in their case the detection probability is exogenous. This simplification is justifiable on the basis that the role of a corruptible supervisor in a model where the principal is himself corruptible seems redundant. For three-tier models of auditing and regulation see e.g., LT, Tirole (1992), Laffont and Tirole (1993), Mookherjee and Png (1995) and Kofman and Lawarree (1996).

15Some models in the law enforcement and economics of crime research agendas also endogenize the detection policy (see e.g., Dittmann (2006)).
If no hard evidence of cost-padding is found, the firm keeps the entire amount of diverted money\(^{16}\) if instead hard evidence is found, the politician has two possible choices: either he confiscates the money and returns it to consumers as a lump-sum transfer, or he enters a corrupt transaction with the firm where he suppresses evidence if the firm agrees to share the embezzled money\(^{18}\). The politician’s decision is *endogenous* and depends on his degree of selfishness. If the firm agrees with the sharing, the politician and the firm divide the money and nothing is returned to consumers. If instead the firm refuses to share the money, the amount of embezzled money is confiscated and returned back to consumers\(^{19}\). We assume that the corrupt sharing is determined by the Nash-bargaining solution\(^{20}\). We believe that this is the appropriate modelization in our context, since what we have in mind is the world of big projects where the gains from cost-padding are potentially large and contractors and politicians are likely to have even bargaining powers.

Importantly, the stakes of corruption, which amount to the level of money embezzled by firm, are endogenous in this model and depend on the politician’s behavior.

The timing of the game is summarized in Figure 1.

### 2.3 Agents’ Preferences

On the basis of the setting described above we can now define agents’ preferences, which are represented by expected payoffs.

#### 2.3.1 Firm

The profit of a firm of type \(\beta\) who accepts contract \((C, t)\) and engages in a level of cost-padding \(a \geq 0\) is:

\[
\Pi(\mu) = \begin{cases} 
  t + a - \psi(\beta - C + a), & \text{if } \hat{a} = \emptyset \\
  t + a^F(\mu) - \psi(\beta - C + a), & \text{if } \hat{a} = a
\end{cases}
\]  

(3)

That is, in case hard evidence of cost-padding is not found (\(\hat{a} = \emptyset\)) the firm keeps the full amount of embezzled money \(a\). If instead hard evidence of cost-padding is found (\(\hat{a} = a\)), the share of embezzled money accruing to the firm, \(a^F\), will depend on whether the politician will be willing to enter Nash-bargaining with the firm, which, as said, is an endogenous decision dependent on his selfishness \(\mu\). Notice that \(a\) represents both the level of cost-padding chosen by the firm and the gains from cost-padding, and hence also amounts to the endogenous stakes of corruption. Further, differently from LT, we assume that the transfer \(t\) paid by the politician is not dependent on the outcome of the auditing: the firm is not punished above

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\(^{16}\)Dhami and Al-Nowaihi (2007) also adopt hard information auditing technology. LT instead assume a different auditing technology which produces soft-information i.e., the signals of the true level of cost-padding are always imperfect and errors can occur.

\(^{17}\)Differently from LT, we assume that there is no deadweight loss associated with the diversion of funds that is, the firm derives utility $1 from padding cost by $1. On the other hand LT consider that accounting manipulations may be costly in expertise, time and need of secrecy and hence create a deadweight loss.

\(^{18}\)Differently from LT, we assume that the money diverted by cost-padding can be fully recouped by the politician in case of detection, whereas LT assume that cost-padding is fully consumed by the firm before the audit. The fact that successful auditing can end up in a refund to consumers is also present in Baron and Besanko (1984).

\(^{19}\)One may ask why in case of unsuccessful bargaining the politician does not keep all the money for himself. A possible explanation is that the politician then fears that the firm may report something to the police, while he is safe if he returns money back to consumers. Hence, the politician tries to pocket money only in case an agreement with the firm is reached. For more on the modelization of a judicial authority, see Section 7.

\(^{20}\)This also is borrowed by Dhami and Al-Nowaihi (2007).
The politician offers contracts to the firm
The firm accepts or rejects the contract
The firm chooses the level of cost-padding
The firm undergoes audit about cost-padding
The politician returns money to consumers
The politician shares money w firm

Figure 1: The timing of the game

The expected profit of the firm can therefore be written as:

$$\mathbb{E}[\Pi(\mu)] = t + \mathbb{E}[a^F(\mu)] - \psi(\beta - C + a)$$  (4)

where $0 \leq \mathbb{E}[a^F(\mu)] \leq a$.

2.3.2 Consumers

Analogously, the expected welfare of consumers when the contracting firm is of type $\beta$, accepts contract $(C, t)$ and engages in cost-padding level $a \geq 0$ is:

$$\mathbb{E}[W(\mu)] = S + \mathbb{E}[a^C(\mu)] - (1 + \lambda)(C + t)$$  (5)

where $C = \beta - e + a$ and $\mathbb{E}[a^C(\mu)]$ is the expected amount of embezzled money that will be returned back to the consumers as a lump-sum transfer.

2.3.3 Politician

In this model the private utility of the politician will merely amount to the share of embezzled money accruing to the politician, $a^P$. Therefore, the objective function of a politician with self interest $\mu$ when the contracting firm is of type $\beta$, accepts contract $(C, t)$ and engages in cost-padding level $a \geq 0$ is:

$$\mathbb{E}[U(\mu)] = \mathbb{E}[SW(\mu)] + \mu \mathbb{E}[a^P(\mu)]$$  (6)

In LT, who assume that cost-padding cannot be confiscated because it is consumed by the firm before auditing, the penalty in case of detection is the retention of transfer ($t_a = 0$).
Now we turn to defining social welfare $SW$ in our model\textsuperscript{22}. While some authors in the literature (see e.g., Dhani and Al-Nowaihi (2007), Garoupa and Klerman (2002)) argue that including profits in social welfare is questionable because of the inclusion of the proceeds of corruption (and so they adopt consumer surplus as the measure of social welfare), we rather believe that the utilitarian view, as adopted by LT, is more realistic, insofar real world regulators need to take into account the interest of the private sector even if it may engage in illegal activities. However, we go a step further with respect to LT. Since the preferences of the politician are separable and additive, we assume that conditional upon detection, the politician will, regardless of his type, include in social welfare only the “socially efficient” level of profits, $\Pi_{SW}, \text{i.e., profits net of the firm’s gain from cost-padding (which after detection is observable and measurable)}\textsuperscript{23}. More formally,

\textbf{Assumption 1.} If $a = a, \Pi_{SW}(\mu) \equiv t - \psi(\beta - C + a) \quad \forall \mu$.

Accordingly, we will distinguish between the expected profit of the firm $E[\Pi(\mu)]$, which was defined in \textsuperscript{4} and using Assumption \textsuperscript{1} can be written as

$$E[\Pi(\mu)] = \Pi_{SW} + E[a^F(\mu)] \quad (7)$$

and the part of expected profit to be included in social welfare,

$$E[\Pi_{SW}(\mu)] = \Pi_{SW} + E[a^F_{SW}(\mu)] \quad (8)$$

where $E[a^F_{SW}(\mu)] = [1 - \rho(\mu)]a$ is the fraction of expected firm’s share of embezzled money to be included in the social welfare, such that $E[a^F_{SW}(\mu)] \leq E[a^F(\mu)]$.

Therefore, the politician’s objective function will be $E[U(\mu)] = E[W(\mu)] + E[\Pi_{SW}(\mu)] + \mu E[a^P(\mu)],$ or extensively

$$E[U(\mu)] = S + E[a^C(\mu)] - (1 + \lambda)(C + t) + t + E[a^F_{SW}(\mu)] - \psi(\beta - C + a) + \mu E[a^P(\mu)] \quad (9)$$

Using the fact that $E[\Pi_{SW}(\mu)] = E[\Pi(\mu)] + E[a^F_{SW}(\mu)] - E[a^F(\mu)]$ we can obtain a more meaningful expression for the social welfare component of the objective function, namely

$$E[SW(\mu)] = S + E[a^C(\mu)] + \lambda(\Delta E[a^F(\mu)]) - (1 + \lambda)(C - E[a^F_{SW}(\mu)] + \psi(\beta - C + a)) - \lambda E[\Pi(\mu)] \quad (10)$$

which tells us that social welfare is the difference between the consumer surplus attached to the project $S$ (increased by the expected transfer to consumers $E[a^C(\mu)]$) and by the social gain from not including cost-padding in the profits conditional upon detection $\lambda \Delta E[a^F(\mu)]$, where $\Delta E[a^F(\mu)] \equiv E[a^F(\mu)] - E[a^F_{SW}(\mu)]$ and the sum of (i) the total cost of the project as perceived by taxpayers $(1 + \lambda)(C - E[a^F_{SW}(\mu)] + \psi(\beta - C + a))$ and (ii) the social cost of giving the firm a rent above its reservation utility $\lambda E[\Pi(\mu)]$. This expression also shows that, due to distortionary taxation, the politician - to the extent he cares about social welfare - dislikes leaving a rent to the firm.

\textsuperscript{22}SW is to be interpreted in monetary terms in order for the weighted average to be meaningful.

\textsuperscript{23}The increased disutility in effort remains the same since effort has already been exerted.
2.4 Strategies and Equilibrium Concept

A strategy for the politician defines a level of detection probability, a pair of procurement contract offers, one for each type of firm, and a decision about whether entering into corrupt bargaining with the firm upon detection of cost-padding. The strategy depends on the degree of selfishness, formally \( s_P(\mu) = \{\rho; (C_i, t_i); \text{enter/not enter} \}, \quad i \in \{L, H\} \). A strategy for (each type of) the firm defines a contract choice (including the possibility of rejection of all offers), a level of cost-padding \( a \), and a decision about whether entering into corrupt bargaining with the politician upon detection, formally \( s_i = \{(C_k, t_k); a; \text{enter/not enter} \}, \quad i, k \in \{L, H\} \).

The relevant equilibrium concept is Perfect Bayesian Equilibrium (PBE), since the politician chooses the auditing technology and offers contracts under incomplete information about the type of the firm he is facing. Notice that while the politician will update his beliefs after the firm has chosen a contract (since the firm may reveal some information about its type through the contract choice), however he will not use this information in the auditing subgame, since we assumed that he can credibly commit to the announcement about the auditing policy (the blind executor will simply audit the firm according to the announced detection probability \( \rho \)). Also, notice that a successful audit does not add any new information about the firm’s type which has not already been revealed by the firm’s contract choice.

We solve the game by backward induction, looking for the complete set of PBE, i.e. of sets of triples of mutually optimal strategies \( S^* = (s_P^*(\mu), s_I^*, s_H^*) \) and beliefs \( B^*(\mu) \) for the politician at information sets where he has the move (i.e., after Nature’s move and after the firm’s contractual choice). Therefore we will first characterize the equilibrium of the auditing subgame and derive the equilibrium expected shares of embezzled money \( \mathbb{E}[a^{F^*}(\mu)], \mathbb{E}[a^{P^*}(\mu)] \) and \( \mathbb{E}[a^{C^*}(\mu)] \); then, on the basis of continuation payoffs we will analyze optimal contracts for the politician \((C^*(\mu), t^*(\mu))\), \( i \in \{L, H\} \) (which, since the politician as usual acts as a Stackelberg leader, take into account the firm’s optimal choices of cost-padding and cost-reducing effort); last, on the basis of optimal contracts, we will analyze the optimal choice of detection probability for the politician, \( \rho^*(\mu) \). Notice that until the last stage (Section 5), the detection probability is considered as a parameter, \( \rho \in (0, 1) \).

3 The auditing subgame

If hard evidence of cost-padding is not found (\( \hat{a} = \emptyset \)) the equilibrium shares of embezzled money are trivially \( a^{F^*}(\mu) = a, a^{P^*}(\mu) = 0, a^{C^*}(\mu) = 0 \) \( \forall \mu \). Instead, if hard evidence of cost-padding is found (\( \hat{a} = a \)) the politician will choose the most profitable between the two options of entering Nash-bargaining with the firm or returning money to consumers. This decision will depend on the Nash-bargaining solution, which we now derive.

If we let \( a^P \in [0, a] \) be the politician’s share of the embezzled money, we have that if the politician and the firm manage to reach an agreement on the sharing of the cake, their respective payoffs are\(^{25}\)

\[
U_A = S - (1 + \lambda)(t + C) + \Pi_{SW} + \mu a^P
\]

\[
\Pi_A = \Pi_{SW} + (a - a^P)
\]

\(^{24}\)Our conjecture is that nothing substantial would change in equilibrium in case he had the possibility to change the level of auditing, at least as long as auditing is costless. We will get back on this in Section 5.

\(^{25}\)Notice that without Assumption 1 we would have a problem in implementing Nash-bargaining, since the utility of one bargaining party - the politician - would have included the utility of the other bargaining party - the firm. The interpretation of Assumption 1 is that the politician temporarily confiscates the money and invites the firm to Nash-bargain over it.
If instead they do not manage to reach an agreement, the politician returns money to consumers as a lump-sum transfer. Therefore, the disagreement payoffs are:

\[ U_D = S + a - (1 + \lambda)(t + C) + \Pi_{SW} \]  

\[ \Pi_D = \Pi_{SW} \]

The equilibrium shares will be given by the solution to the following problem:

\[ \max_{a^P, (U_A, \Pi_A) \geq (U_D, \Pi_D)} (U_A - U_D)(\Pi_A - \Pi_D) \]

The Nash-Bargaining solution is:

\[ a^P_* = \frac{1 + \mu}{2\mu} a, \quad a^F_* = \frac{\mu - 1}{2\mu} a \]

It is immediate to check that \( U_A \geq U_D \) holds iff the politician is opportunist, i.e., \( \mu > 1 \) (while the firm always find it profitable to enter bargaining). As we expected, we have that Nash Bargaining will occur only if the politician is selfish enough. Otherwise (\( \mu \leq 1 \)), he will return money to consumers. Importantly, notice that the politician does not need to be fully benevolent (\( \mu = 0 \)) to decide not to enter the corrupt deal. This is an interesting aspect of this result, since it allows for the realistic interpretation that a politician may well be self-interested but not enough to engage in corruption.

Therefore, if the politician is opportunist (indicated with subscript \( O \)) the optimal shares of embezzled money will be: \( a^P_* = \frac{1 + \mu}{2\mu} a, \quad a^F_* = \frac{\mu - 1}{2\mu} a, \quad a^C_* = 0 \), where \( a^P_* \) and \( a^F_* \) are given by the bargaining solution. Notice that \( \frac{\partial a^P_*}{\partial \mu} < 0 \) (with \( \lim_{\mu \to \infty} \frac{1 + \mu}{2\mu} a = \frac{a}{2} \), \( \lim_{\mu \to 1} \frac{1 + \mu}{2\mu} a = a \)). Interpretation is that a more eager politician is easier to bribe: like impatience, selfishness reduces bargaining power. Instead, if the politician is moderate (indicated with subscript \( M \)) the optimal shares are: \( a^P_* = 0, \quad a^F_* = 0, \quad a^C_* = \rho a \).

From the results above we can derive the optimal expected shares of embezzled money (which take into account the case that hard evidence is not found) and state the following result:

**Proposition 1.** (Expected equilibrium shares of \( a \)) The expected equilibrium shares of embezzled money depend on the type of politician and are as follows:

\[
E[a^P_j] = \begin{cases} 
0, & j = M \\
\rho\frac{1 + \mu}{2\mu} a, & j = O 
\end{cases}, \quad E[a^F_j] = \begin{cases} 
(1 - \rho)a, & j = M \\
(1 - \rho\frac{1 + \mu}{2\mu})a, & j = O 
\end{cases}, \quad E[a^C_j] = \begin{cases} 
\rho a, & j = M \\
0, & j = O 
\end{cases}
\]

The expected continuation payoffs for the politician and the firm from the auditing subgame are simply the expressions in (6) and (7) where money shares are at their equilibrium levels i.e.,

\[
E[U^*_j] = E[SW^*_j] + \mu E[a^P^*_j], \quad E[\Pi^*_j] = \Pi_{SW} + E[a^F^*_j] \quad j \in \{M, O\}
\]

Notice that so far we have just determined the optimal shares of embezzled money, but the optimal level of cost-padding is yet to be determined and will be an optimal choice of the firm.

Notice that there is a discontinuity at \( \mu = 1 \): \( \lim_{\mu \to 1+} a^P_* = a \) but for \( \mu \leq 1 \) \( a^P_* = 0 \).
4 Optimal Contracts

4.1 Benchmark: No Cost-padding

As a benchmark, we first consider the case where cost-padding is unfeasible. First, notice that in this case there is no possibility for the politician to pursue his personal interest, since in our model this is uniquely represented by his share of embezzled money. Therefore, regardless of his type, the politician’s objective function reduces to social welfare $U_j = SW \quad \forall j \in \{M, O\}$ as if he were benevolent. Also, the cost function of the firm in this case is $C(\beta, e) = \beta - e$.

In this case the model is identical to the basic regulatory model in Laffont and Tirole (1986), which is a standard model in contract theory. While referring to this work for the complete analysis, here we just briefly summarize (in our notation) relevant results and intuitions.

4.1.1 Complete information

Under complete information, i.e. when the principal knows $\beta$ and observes the cost-reducing effort $e$, the firm cannot misrepresent its type and the politician can directly contract on the level of effort to be taken by each type of firm. The politician will offer contracts $(e_i, t_i)$ (or equivalently, $(e_i, \Pi_i)$) that maximize $SW$ under Individual Rationality constraints i.e., $\Pi_i = t_i - \psi(e_i) \geq 0 \quad i \in \{L, H\}$.

The solution of this problem (indicated with superscript $BC$) is $e_{BC} = e^* : \psi'(e^*) = 1; \quad \Pi_{BC} = \Pi^* = 0 : t^*_i = \psi(e^*) \quad i \in \{L, H\}$ (18)

namely, for both types: (i) the optimal level of effort is the first best one, namely the one which equates marginal social cost (i.e., marginal disutility of effort) and marginal social benefit (i.e., marginal cost savings), and (ii) the firm receives no rent, since distortionary taxation is socially costly. Both types receive the same transfer but the inefficient type is allowed to produce at a higher realized cost, $C_H^* > C_L^*$. The politician can implement this first-best optimum by offering both types a fixed-price contract, such as e.g., $t(C_i) = k - (C_i - C_i^*)$, where $C_i^* = \beta_i - e^* \quad i \in \{L, H\}$. The value function of the politician in this case, which amounts to social welfare under complete information, is

$$U_{BC} = S - (1 + \lambda) (\beta_i - e^* + \psi(e^*))$$ (19)

4.1.2 Incomplete information

Under incomplete information the politician can still observe the realized cost $C$ but does not know the true value of the efficiency parameter $\beta$ and does not observe the effort level $e$. In

$^{27}$ Also notice that in absence of cost-padding $E[\Pi_{SW,j}] = t - \psi(\beta - C) \quad \forall j \in \{M, O\}$, so that the regulator is purely utilitarian.

$^{28}$ More exactly, is identical to the model in Ch.1 of Laffont and Tirole (1993), which is the two-type version of Laffont and Tirole (1986).

$^{29}$ This is the definition of complete information in Laffont and Tirole (1993) (Ch 1). However, notice that in this case the principal does not need to observe effort, since, knowing $\beta$, he can infer its level from observing costs $e = \beta - C$.

$^{30}$ It is straightforward to check that level of effort that maximizes the firm’s utility $\{k - (\beta - \psi(e_i) - C_i^{FB})\} \psi(e_i)$ is exactly $e^{FB}$.  


this case we have a standard screening problem where the principal offers a menu of type-
contingent contracts based on contractibles \((C_i, t_i)\) (or equivalently, \((C_i, \Pi_i)\)) which maximize 
expected SW under Individual Rationality (IR) and Incentive Compatibility (IC) constraints: 
\(IR_i : t_i - \psi(\beta_i - C_i) \geq 0, \; IC_i : t_i - \psi(\beta_i - C_i) \geq t_k - \psi(\beta_i - C_k), \; i \neq k, \; i, k \in \{L, H\}.\) 
This problem has the following well-known solution (indicated with superscript \(BI\)):

\[
\begin{cases}
C^*_{L} = C^*_{H} = \beta_{L} - e^* \quad C^B_{L} = \beta_{H} - e^B_{L} \\
\text{where } e^* > e^B_{L} : (1 - \nu)(1 + \lambda)[1 - \psi(e^B_{L})] = \nu \lambda \Phi' (e^B_{L}) \\
\Pi^B_{L} = \Phi(e^B_{L}) \left( t^B_{L} = \psi(e^* + \Phi(e^B_{L})) \right), \quad \Pi^B_{H} = 0 \left( t^B_{H} = \psi(e^B_{H}) \right)
\end{cases}
\]  

(20)

where \(\Phi(e_H) = \psi(e_H) - \psi(e_H - \Delta \beta), \quad \Phi'(e_H) > 0\) and \(\Delta \beta = \beta_{H} - \beta_{L}\).

The interpretation is as standard in these kind of screening problems. The efficient type can profitably mimic the inefficient type (since thanks to its higher efficiency he enjoys a rent in terms of economy in disutility of effort), so the principal needs to give him a positive rent if he wants to have both types active. This rent is an increasing function of the effort level required from the inefficient type, so that the principal reduces the rent by distorting downward the effort required from the inefficient type, while still requiring the first-best effort from the efficient type (“efficiency at the top” is preserved). The optimal value of \(e_H\) balances the trade-off between the two regulatory goals of efficiency, which calls for high-powered incentive schemes (i.e., fixed-price contracts), and rent extraction, which calls for low-powered incentive schemes (i.e., cost-sharing contracts\(^{31}\)).

The value function of the politician in this case, which amounts to social welfare under incomplete information, is:

\[
U^B = \nu[S - (1 + \lambda)(\beta_{L} - e^{FB} + \psi(e^{FB})) - \lambda \Phi(e^B_{H})] + (1 - \nu)[S - (1 + \lambda)(\beta_{H} - e^{FB} + \psi(e^{FB}))]
\]  

(21)

4.2 Optimal contracts under cost-padding

Now we let the firm engage in cost-padding, so that the cost function of the firm is \(C(\beta, e, a) = \beta - e + a\). After accepting contract \((C, t)\) the firm decides its optimal level of cost-padding \(a\) by solving the problem

\[
\max_{a \geq 0} \mathbb{E}[\Pi^H_j] = t + \mathbb{E}[a^*] - \psi(\beta - C + a) \quad j \in \{M, O\}
\]  

(22)

Remember that due to the linearity of the cost function, when the firm commits to a contractual cost level \(C\), choosing a level of cost-padding \(a\) will imply that the level of cost-reducing effort \(e\) it needs to exert is determined residually, \(e = \beta - C + a\). In particular, for a given \(C\), an increase in \(a\) needs to be counterbalanced by an equal increase \(e\). This suggests that, since the marginal disutility of increasing effort is lower for the efficient type \(\psi_{\beta} > 0\), for a given cost level a more efficient type will engage in more cost-padding than a less efficient type.\(^{32}\) This result is proved to be true and is stated as follows,

**Proposition 2. (Proposition 1 LT)** If for a given cost level \(C \) \(a^*_L\) and \(a^*_H\) are the optimal levels of cost-padding for, respectively, \(\beta_{L}\) and \(\beta_{H}\), then it must be the case that \(a^*_L \geq a^*_H\).

\(^{31}\)A marginal decrease \(e_H\) has a marginal cost in terms of an increase by \(1 - \psi(\epsilon_H)\) in the production cost of type \(H\), but also a marginal benefit in terms of a decrease by \(\Phi'(\epsilon_H)\) of the rent we need to give to type \(L\). As shown by the FOC, the optimal level of \(e_H\) equates expected marginal cost \((1 - \nu)(1 + \lambda)[1 - \psi(\epsilon_H)]\) and expected marginal benefit \(\nu \lambda \Phi'(\epsilon_H)\).

\(^{32}\)Condition \(\psi_{\beta} > 0\) amounts to the Spence-Mirrless Single-crossing condition in our case, which will ensure the sustainability of a separating equilibrium in optimal contracts (see e.g., Bolton and Dewatripont (2005)). Notice that \(\psi_{\beta} > 0\) also holds, namely the efficient type has a lower disutility from effort.
Proof. In the Appendix (8.1).

It is important to remark that Proposition 2 asserts that the more efficient type engages in more cost-padding than the less efficient type for a given cost level, not that the more efficient type will engage in more cost padding in equilibrium, since in general different types will produce at different costs. We analyze first the case with complete information and then the case with informational asymmetries.

4.2.1 Complete information

Knowing the true value of the efficiency parameter $\beta$ and observing the level of effort $e$, the politician can infer the level of cost-padding $a = C - \beta + e$, as if the auditing technology were perfect, i.e., $\rho = 1$. Cost-padding will be always detected if the firm does it. Therefore, the politician can directly contract on the level of cost-padding exerted by the firm, and offer type-contingent contracts $(t_i, e_i, a_i)$ or - in our notation - $(\Pi_i, e_i, a_i)$.

\[
\max_{\Pi_i, e_i, a_i} \{ S + a_{ij}^C - (1 + \lambda)[\beta_i - e_i + a_i + \psi(e_i)] - \lambda \Pi_i + \lambda a_{ij}^F + \mu a_{ij}^P \}
\]
\[
s.t. \quad IR_i : \Pi_i = t_i + a_{ij}^F - \psi(e_i) \geq 0 \quad i \in \{L, H\} \quad j \in \{M, O\}
\]

As usual, the individual rationality constraints $IR_i$ will be binding in equilibrium\(^{33}\). Therefore, the politician will solve a relaxed maximization problem in $a$ and $e$. It is immediate to check that the maximization with respect to $e$ requires, regardless of the politician’s type, that both firm types exert the first-best level of effort ($\psi'(e^*) = 1$), while the maximization with respect to $a$ brings a corner solution which depends on the selfishness of the politician and is as follows:

\[
a_i^* = \begin{cases} 
0, & \text{if } \mu \leq 1 + D(\lambda) \\
\overline{a}_i, & \text{if } \mu > 1 + D(\lambda)
\end{cases}
\]

where $D(\lambda) = \frac{\lambda - 1 + \sqrt{\lambda^2 + 6\lambda}}{2} > \lambda > 0$ and $\overline{a}_i$ is the maximum amount of cost-padding that can be exerted (e.g., suppose that the politician cannot allow for the cost of the project to exceed a given value $C$; then, $\overline{a}_i = C - \beta_i + e^*)$.

Our result is consistent with the “mixed” nature of the politician, who cares both about social welfare and private utility. Since cost-padding implies a higher cost for consumers in terms of distortionary taxation, only a politician who is eager enough will be willing to allow for cost-padding to occur. In particular, for the politician to prefer cost-padding, it must be the case that the marginal benefit from increasing his private utility ($\mu$) is higher than its marginal cost in terms of distortionary taxation ($1 + D(\lambda)$). Notice that the marginal cost is higher than the pure marginal cost of distortionary taxation ($1 + \lambda$), since the politician does not always get the total of embezzled money (due to bargaining)\(^{34}\). Also, notice that the level of selfishness needed for the politician to induce cost-padding is higher than the level required

\[^{33}\text{Notice that in this case the expectation operator disappears, and } \mathbb{E}[a_{ij}^F] = 0 \text{ and } \Delta \mathbb{E}[a_{ij}^F] = a_{ij}^F \forall i, j.\]

\[^{34}\text{The fact that in the auditing subgame both the firm and the politician have bargaining power while in contracting all the bargaining power is in the hands of the politician (i.e., he offers a take-it-or-leave-it offer to the firm) may seem an incongruence, but can be meaningfully justified as follows: in legal transactions (such as contracting) the politician, as a regulator, has all the bargaining power; in illegal transactions instead (such as taking bribes) he needs to bargain to obtain a good deal.}\]

\[^{35}\text{Due to distortionary taxation, a moderate politician is not tolerant about cost-padding even in the most favorable case where he could return all embezzled money to consumers, since the cost exceeds the benefit anyway } ((1 + \lambda)a > a \quad \forall \lambda > 0).\]
for him to find it convenient to enter corrupt Nash Bargaining upon detection. This result is nice insofar it captures in a simple and clear way the realistic case that a politician can well be selfish, but only particularly selfish ones- the ones who let private cause substantially exceed public interest - will damage the public by engaging in corruption.

Therefore, the contractual solution under complete information (indicated with superscript CC) is as follows:

**Proposition 3. (Optimal contracts under complete information)** A moderately opportunist politician (indicated with subscript MO) \((\mu \leq 1 + D(\lambda))\) the will offer the first-best contracts: \(C_i^{CC} = \beta_i - e^*\), \(\Pi_i^{CC} = 0\) \((t_i = \psi(e^*))\). A very opportunist politician (indicated with subscript VO) \((\mu > 1 + D(\lambda))\) will offer the suboptimal contracts that allow to embezzle the highest amount of money consistent with the firm exerting the first-best effort: \(C_i^{CC} = \beta_i - e^* + \pi_i\), \(\Pi_i^{CC} = 0\) \((t_i = \psi(e^*) - \frac{\mu - 1}{2\mu}\pi_i)\).

The value function of the politician in this case depends on his type, as follows:

\[
U_j^{CC} = \begin{cases} 
U_{BC}, & \text{if } j = \text{MO} \\
S - (1 + \lambda)[\beta_i - e^* + \pi_i + \psi(e^*)] + \lambda \frac{\mu - 1}{2\mu}\pi_i + \mu \frac{\mu + 1}{2\mu}\pi_i, & \text{if } j = \text{VO}
\end{cases}
\]  

\[(25)\]

**4.2.2 Incomplete information**

We suppose now that the politician does not know \(\beta\) and does not observe \(e\), but only observes \(C\).

In this case the politician would in principle want to proceed as usual in standard screening problems, namely choose type-contingent contracts \((C_i, t_i)\) (or, \((C_i, E[\Pi_i])\)) to maximize

\[
\mathbb{E}[U_j] = \mathbb{E}\{S + \mathbb{E}[a_{ij}^C] - (1 + \lambda)[C_i - \mathbb{E}[a_{ij}^F] + \psi(\beta_i - C_i + a_i)] - \lambda\mathbb{E}[\Pi_i] + \lambda\Delta\mathbb{E}[a_{ij}^F] + \mu\mathbb{E}[a_{ij}^P]\}
\]  

\[(26)\]

(where the \(\mathbb{E}\) accounts for the uncertainty over the firm’s type) under constraints \(IR_i\) and \(IC_i\), with \(i \in \{L, H\}, \ j \in \{M, O\}\). However, differently from the standard screening problem, here \(IC_i\) are more problematic to characterize, since we do not know which level of cost-padding will a given type choose when mimicking the other type, so that the rents from mimicking are undetermined.

In order to derive optimal contracts, we will analyze the simple case where cost-padding can take only two levels \(a \in \{0, \alpha\}\) \((\alpha > 0)\) and consider different possible solutions, and then check for which conditions on parameters, and in particular on the detection probability \(\rho\), can each of these optimizations arise in equilibrium. Depending on which are the optimal levels of cost-padding for each type of firm, in principle four types of optimia are possible:

**Type1** Only the inefficient type engages in cost-padding: \(a_H^* = \alpha, a_L^* = 0\);

**Type2** Only the efficient type engages in cost-padding: \(a_H^* = 0, a_L^* = \alpha\);

**Type3** Both types engage in cost-padding: \(a_H^* = \alpha, a_L^* = \alpha\);

**Type4** Neither type engages in cost-padding: \(a_H^* = 0, a_L^* = 0\).

Notice that when we style cost-padding as a binary choice, the maximization problem for the firm states in \[(22)\] reduces to the following: after accepting contract \((C, t)\), the firm will engage in cost-padding (i.e., \(a = \alpha\)) iff \(\mathbb{E}[\Pi_j^*(a = \alpha)] \geq \mathbb{E}[\Pi_j^*(a = 0)]\), which implies

\[
\mathbb{E}[a_j^F] \geq \psi(\beta - C + \alpha) - \psi(\beta - C)
\]  

\[(27)\]
where \( \mathbb{E}[\alpha_j^F] \) with \( j \in \{ M, O \} \) is the firm’s equilibrium share of cost-padding from Proposition 1\(^{[30]} \). This condition simply tells that the firm will engage in cost-padding iff the gain from engaging in cost-padding (i.e., the firm’s expected share of embezzled money) outweighs its cost (i.e., the extra disutility of effort due to cost-padding).

Moreover, the following holds:

**Proposition 4.** In each type of optimum, the efficient type is always required to exert the first-best level of effort \( e^*_L = e^* \).

Proposition 4 is due to the fact that the politician is affected by incomplete information only through the rent to be given to the efficient type, which depends on the effort of the inefficient type. The maximization with respect to the effort of the efficient type is hence the same as when cost-padding is unfeasible (Equation (20)).

In the whole section it will be exploited the fact that constraints \( I_R^L \) and \( I_C^H \) can be ignored, since the former is implied by \( I_C^L \) and \( I_R^H \), and the latter holds at the solution (See Appendix 8.4).

**Type1 optima: cost-padding by the inefficient type**

Suppose the case \( a_H^* \alpha, a_L^* \alpha = 0 \) is an optimum. The cost level of the inefficient type is then \( C_H = \beta_H - \epsilon_H + \alpha \).

Let us denote with \( a_L^m \) the optimal level of cost-padding for the efficient type when it mimics the inefficient type (i.e., chooses contract \((C_H, t_H)\)). Then, we know by Proposition 2 that \( a_L^m = \alpha \). Therefore, relevant constraints \( I_C^L \) and \( I_R^H \) are respectively:

\[
\mathbb{E}[\Pi_L] = t_L - \psi(\beta_L - C_L) \geq t_H + \mathbb{E}[\alpha_j^F] - \psi(\beta_L - C_L + \alpha), \tag{28}
\]

\[
\mathbb{E}[\Pi_H] = t_H + \mathbb{E}[\alpha_j^F] - \psi(\beta_H - C_H + \alpha) \geq 0. \tag{29}
\]

Using Proposition 4 and the fact the constraints above will be binding at the optimum, which implies that \( \mathbb{E}[\Pi_H] = 0 \) and \( \mathbb{E}[\Pi_L] = \psi(e_H) - \psi(e_H - \Delta \beta) = \Phi(e_H) \), we can reduce the maximization problem of politician \( j \) to the following unconstrained problem in \( e_H \):

\[
\max_{e_H} \{ \nu[S - (1 + \lambda)](\beta_L - e^* + \psi(e^*)) - \lambda \Phi(e_H) + (1 - \nu)[S - (1 + \lambda)](\beta_H - \epsilon_H + \psi(e_H)) + (1 - \nu) G(\alpha_j) \} \tag{30}
\]

where

\[
G(\alpha_j) = \mathbb{E}[\alpha_j^C] - (1 + \lambda) \mathbb{E}[\alpha - \alpha_{SW,j}^F] + \lambda \Delta \mathbb{E}[\alpha_j^F] + \mu \mathbb{E}[\alpha_j^F], \tag{31}
\]

is a constant which adds to expected social welfare insofar the inefficient type engages in cost-padding. Importantly, notice that the value of the constant depends on the type of the politician.

The solution is stated in the following proposition:

**Proposition 5.** (Type1 optima: cost-padding by type H only) There is a unique type1 optimum (indicated with superscript \( CPH \)) which is as follows:

\[
\begin{align*}
C_H^{CPH} & = \beta_H - \epsilon_H^R + \alpha, \quad E[I_H^{CPH} = 0 \ (t_H^{CPH} = \psi(\epsilon_H^R) - \mathbb{E}[\alpha_j^F]) & \\
C_L^{CPH} & = \beta_L - e^*, \quad \Pi_L^{CPH} = \Phi(\epsilon_H^R) (t_L^{CPH} = \psi(e^*) + \Phi(\epsilon_H^R))
\end{align*}
\]

\(^{30}\)In the following optimal contract analysis we will use the generic notation for the subgame equilibrium shares of embezzled money \( \mathbb{E}[\alpha_j^F], \mathbb{E}[\alpha_j^F], \mathbb{E}[\alpha_j^F] \), and will make them explicit only later when needed. Also, we will omit the star superscript.

\(^{37}\)Notice that \( a_H^* = a_L^m \geq \alpha_0 \) respects Proposition 2 for a given cost \( C = C_H, a_L^m \geq \alpha_0 \).
The value function of the politician will therefore be $U_j^{CPH} = U_j^{BI} + (1 - \nu)G(\alpha_j)$

The type 1 optimum occurs in equilibrium iff two conditions are satisfied namely that 1) the inefficient type does find it profitable to engage in cost-padding when accepting contract $(C_H^{CPH}, t_H^{CPH})$, and 2) the efficient type does not want to deviate to cost-padding when accepting $(C_L^{CPH}, t_L^{CPH})$. Therefore, using condition (27) and $\beta_H - C_H^{CPH} + \alpha = e_H^{BI}$ and $\beta_L - C_L^{CPH} = e^* - \alpha$ iff

$$
\psi(e^* + \alpha) - \psi(e^*) > \mathbb{E}[\alpha_j^F] \geq \psi(e_H^{BI}) - \psi(e_H^{BI} - \alpha) \tag{33}
$$

Expliciting condition (33) with respect to the detection technology $\rho$, yields the following result:

**Proposition 6.** (Occurrence of the type 1 optimum (CPH)) Under politician $j \in \{M, O\}$, the type 1 optimum occurs iff $\rho_j < \rho \leq \rho_j$ where

$$
\rho_j = \begin{cases} 
\frac{\alpha - [\psi(e_H^{BI} + \alpha) - \psi(e_H^{BI})]}{\alpha}, & \text{if } j = M \\
\frac{2\mu}{\mu + 1}, & \text{if } j = O
\end{cases} \tag{34}
$$

$$
\rho_j = \begin{cases} 
\frac{\alpha - [\psi(e_H^{BI} + \alpha) - \psi(e_H^{BI} + \alpha)]}{\alpha}, & \text{if } j = M \\
\frac{2\mu}{\mu + 1}, & \text{if } j = O
\end{cases} \tag{35}
$$

Notice that since $e^* > e_H^{BI}$ and $\psi'(e) - \psi'(e - \alpha) > 0$, $\rho_j < \rho_j$. The intuition is that each type of firm has a relatively high (low) incentive to engage in cost-padding if the probability of being discovered is relatively low (high), i.e., cost-padding is difficult (easy) to detect.

**Type 2 optima: cost-padding by the efficient type**

Suppose now that the case $a_H = 0$, $a_L = \alpha$ is an optimum. The cost level of the inefficient type therefore is $C_H = \beta_H - e_H$.

In this case, if type $L$ chooses contract $(C_H, t_H)$, both $a_H = 0$ and $a_L = \alpha$ are admissible by Proposition 2. Therefore, the IC is less trivial to define than before, insofar we want that the rent of the efficient type is such that he does not want to mimic the inefficient type neither without engaging in cost-padding:

$$
IC_L(a_L^m = 0) : E[\Pi_L] = t_L + E[\alpha_j^F] - \psi(\beta_L - C_L + \alpha) \geq t_H - \psi(\beta_L - C_H) \tag{36}
$$

nor with engaging in cost-padding

$$
IC_L(a_L^m = \alpha) : E[\Pi_L] \geq t_H + E[\alpha_j^F] - \psi(\beta_L - C_H + \alpha) \tag{37}
$$

By using the fact that constraint $\text{IR}_H$ will bind at the optimum as usual i.e., $\Pi_H = t_H - \psi(e_H) = 0$, we can rewrite (36) and (37) respectively as

$$
E[\Pi_L] \geq \Phi(e_H) \tag{38}
$$

and

$$
E[\Pi_L] \geq \Gamma(e_H) \tag{39}
$$
where $\Gamma(e_H) \equiv \psi(e_H) - \psi(e_H - \Delta \beta + \alpha) + E[\alpha^F]$.  

Depending on which of the constraints (38) and (39) binds at the optimum, different solutions can emerge. To consider all possibilities we set the following maximization problem:

$$
\max_{e_H, E[\Pi_L]} \quad U(e_H, E[\Pi_L]) = \nu[S - (1 + \lambda)[\beta_L - e^* + \psi(e^*)] - \lambda E[\Pi_L]] \\
+ (1 - \nu)[S - (1 + \lambda)[\beta_H - e_H + \psi(e_H)]] + \nu G(\alpha_j)
$$

s.t. (38), (39)

where $G(\alpha_j)$ is the constant defined in (31), which yields the following result:

**Proposition 7.** (Type2 optima: cost-padding by type $L$ only) Two type2 optima are possible. The solution where $a^n_L = 0$ (indicated by superscript CPL1) is: $C_{H}^{CPL1} = \beta_H - e_H^{BI}$, $\Pi_{H}^{CPL1} = 0$ ($t_{H}^{CPL1} = \psi(e_H^{BI})$); $C_{L}^{CPL1} = \beta_L - e^* + \alpha$, $\Pi_{L}^{CPL1} = \Phi(e_H^{BI})$ (i.e., when choosing $t_{L}^{CPL1}$) = $\psi(e^*) - E[\alpha^F] + \Phi(e_H^{BI})$. The solution where $a^n_L = \alpha$ (indicated by superscript CPL2) is: $C_{H}^{CPL2} = \beta_H - e_{H}^{CPL2}$, where $e^* > e_{H}^{CPL2} > e_{H}^{BI}$ : $\psi'(e_{H}^{CPL2}) = 1 - \frac{\lambda}{\alpha + \lambda} \frac{\nu}{1 - \nu} \Gamma'(e_{H}^{RC})$, $\Pi_{H}^{CPL2} = 0$ ($t_{H}^{CPL2} = \psi(e_{H}^{CPL2})$); $C_{L}^{CPL2} = \beta_L - e^* + \alpha$, $\Pi_{L}^{CPL2} = \Gamma(e_H^{CPL2}) > \Phi(e_H^{BI})$ (i.e., when choosing $t_{L}^{CPL2}$) = $\psi(e^*) - E[\alpha^F] + \Gamma(e_{H}^{CPL2})$. The two contracting solutions are mutually exclusive. Further, given the concavity of the maximization problem in (40) the objective function $U(e_H, E[\Pi_L])$ has a unique global maximum, so that $C_{H}^{CPL1} = U_{CPL1} = U^{BI} + \nu G(\alpha_j)$. 

**Proof.** In the Appendix (8.2).  

The intuition why the optimal effort required from the inefficient type (i.e., the power of incentives) is higher in the CPL2 solution than in CPL1 (and in the benchmark case), and, consequently, is higher the rent to be given to the inefficient type, is as follows (see LT). Increasing $e_H$ is more attractive when the efficient type would like to engage in cost-padding when mimicking the inefficient type, due to the fact that cost-padding increases the marginal disutility $\psi'(e_H - \Delta \beta + \alpha)$ of the efficient type of mimicking the inefficient type with respect to the case without cost-padding, $\psi'(e_H - \Delta \beta)$. This implies that a marginal increase in $e_H$ increases the rent of the efficient type by less than when the efficient type does not want to pad costs ($\Gamma'(e_H) < \Phi'(e_H)$).  

The solution CPL1 occurs in equilibrium iff the efficient type finds it profitable to pad costs when choosing her contract ($C_{L}^{CPL1}, t_{L}^{CPL1}$), but not when mimicking the inefficient type (i.e., when choosing ($C_{H}^{CPL1}, t_{H}^{CPL1}$)). From Proposition 2 we know that the inefficient type will not deviate to cost-padding, so that no condition on this type need to be checked in this case. On the other hand, the solution CPL2 occurs iff 1) the efficient type does finds it profitable to do cost-padding both when choosing her contract and when mimicking the inefficient type, and 2) the inefficient type does not want to deviate to cost-padding (in this case Proposition 2 does not help).  

However, it can be proved that no type2 optima can occur in equilibrium, or more exactly,

**Proposition 8.** (Occurrence of type2 optima) If $\Delta \beta \geq 2\alpha$ neither CPL1 nor CPL2 solutions can ever occur in equilibrium. If $\alpha \leq \Delta \beta < 2\alpha$ solution CPL1 never occurs in equilibrium, while nothing unambiguous can be said for solution CPL2. If $\Delta \beta < \alpha$ nothing unambiguous can be concluded for either case.

38The optimal level of $e_H$ is the one that equates the expected marginal benefit of increasing $e_H$, in terms of a reduction by $[1 - \psi'(e_H)]$ in the production cost of type $H$, and the expected marginal cost, in terms of an increase by $\Gamma'(e_H)$ of the rent for type $L$: $(1 - \nu)(1 + \lambda)[1 - \psi'(e_H^{RC})] = \nu \lambda \Gamma'(e_H^{RC})$, which corresponds to the F.O.C.
Proof. In the Appendix \[8.3\]

To avoid ambiguities, we will assume in the following that

Assumption 2. $\Delta \beta \geq 2\alpha$

and hence that no type 2 optima can occur in equilibrium.

Type 3 optima: cost-padding by both types

Now suppose that $a^*_H = \alpha = a^*_L$ is an optimum. The cost level of the inefficient type is therefore $C_H = \beta_H - e_H + \alpha$. Again, we know from Proposition 2 that $a^*_H = \alpha$. Therefore, the relevant $IC_L$ and $IR_H$ constraints are respectively:

$$E[\Pi_L] = t_L + E[\alpha_j] - \psi(\beta_L - C_L + \alpha) \geq t_H + E[\alpha_j] - \psi(\beta_L - C_H + \alpha) \quad (41)$$

$$E[\Pi_H] = t_H + E[\alpha_j] - \psi(\beta_H - C_H + \alpha) \geq 0 \quad (42)$$

Using the fact that these constraints will be binding at the optimum, which implies that $E[\Pi_H] = 0$ and $E[\Pi_L] = \Phi(e_H)$, it is immediate to check that the relaxed maximization problem for the politician is identical to the type 1 case (equation (30)), with the only difference that now the constant $G(\alpha_j)$ (defined in (41)) enters in the politician’s objective function with probability 1, since both types engage in cost-padding. Therefore the equilibrium effort for the inefficient type will be the same, and the solution as follows:

Proposition 9. (Type 3 optima: cost-padding by both types) There is a unique type 3 optimum (indicated with superscript CP) which is as follows: $C^CP_H = \beta_H - e_H^B + \alpha$, $E[\Pi^CP_H] = 0$ ($E[\Pi^CP_L] = \psi(e_H^B) - E[\alpha^L_H]$); $C^CP_L = \beta_L - e^* + \alpha$, $E[\Pi^CP_L] = \Phi(e_H^B)$ ($E[t^CP_L] = \psi(e^*) - E[\alpha^L_F] + \Phi(e_H^B)$). The value function of the politician will therefore be $U^{CP_H} = U^{B_H} + G(\alpha_j)$.

The type 3 optimum occurs in equilibrium iff both types find it profitable to do cost-padding when accepting their own contracts. Therefore, the following two conditions need to hold (using $\beta_L - C_L + \alpha = e^*$ and $\beta_H - C_H + \alpha = e_H^B$):

$$E[\alpha_j] \geq \psi(e^*) - \psi(e^* - \alpha) \quad (43)$$

$$E[\alpha_j] \geq \psi(e_H^B) - \psi(e_H^B - \alpha) \quad (44)$$

which, since the RHS of (43) is larger than the RHS of (44), implies that

Proposition 10. (Occurrence of the type 3 optimum (CP)) Under politician $j \in \{M, O\}$ the type 1 optimum occurs in equilibrium iff $\rho \leq \hat{\rho}_j$, where

$$\hat{\rho}_j = \begin{cases} \frac{\alpha - \psi(e^*) - \psi(e^* - \alpha)}{\alpha}, & \text{if } j = M \\ \frac{\alpha - \psi(e^*) - \psi(e^* - \alpha)}{2\alpha (2\alpha + 1)}, & \text{if } j = O \end{cases} \quad (45)$$

Type 4 optima: no cost-padding

Suppose now that the case $a^*_H = 0 = a^*_L$ is an optimum. The cost level of the inefficient type is therefore $C_H = \beta_H - e_H$.

As for type 2 optima, if type $L$ chooses contract $(C_H, t_H)$, both $a^*_H = 0$ and $a^*_L = \alpha$
are admissible by Proposition 2. The two $IC_L$ are the same as (38) and (39). Also the maximization problem is the same as in 10, apart from constant $G(\alpha_j)$ which here is missing since type $L$ is not cost-padding at the optimum. The solution is stated in the following proposition:

**Proposition 11.** (Type4 optima: no cost-padding) Two type 4 optima are possible. The solution where $a_P^H = 0$ (indicated by superscript $NC_1$) is: $C_H^{NC_1} = \beta_H - e_H^{BI}$, $\Pi_H^{NC_1} = 0$ ($t_H^{NC_1} = \psi(e_H^{BI})$); $C_L^{NC_1} = \beta_L - e^*, \Pi_L^{NC_1} = \Phi(e_H^{BI})$ ($t_L^{NC_1} = \psi(e^*) + \Phi(e_H^{BI})$). The solution where $a_P^H = \alpha$ (indicated by superscript $NC_2$) is: $C_H^{NC_2} = \beta_H - e_H^{NC_2}$, where $e_H^{NC_2} = \epsilon^{CPL2} > e_H^{BI}$, $\Pi_H^{NC_2} = 0$ ($t_H^{NC_2} = \psi(e_H^{NC_2})$); $C_L^{NC_2} = \beta_L - e^*$, $\Pi_L^{NC_2} = \Gamma(e_H^{NC_2})$. The two contracting solutions are mutually exclusive. Further, given the concavity of the maximization problem in (40) the objective function $U(e_H, \Pi_L)$ has a unique global maximum, so that $U^{NC_1} = U^{NC_2} = U^{BI}$.

**Proof.** Identical to the proof of Proposition 7 (see Appendix 8.2).

Solution $NC_1$ occurs in equilibrium iff the efficient type does not find it profitable to engage in cost-padding neither when mimicking the inefficient type nor when not mimicking, i.e., if the two following conditions (where use was made of $\beta_H - C_H^{NC_1} = e_H^{BI}$ and $\beta_L - C_L^{NC_1} = e^*$) hold:

$$E[\alpha_j^F] < \psi(e_H^{BI} - \Delta \beta + \alpha) - \psi(e_H^{BI} - \Delta \beta)$$  \hspace{1cm} (46)

$$E[\alpha_j^F] < \psi(e^* + \alpha) - \psi(e^*)$$  \hspace{1cm} (47)

Notice that by virtue of Proposition 2, condition (46) guarantees that the inefficient type neither will deviate to cost-padding when accepting $(t_H^{NC_1}, t_H^{NC_1})$.

Since the RHS of condition (46) is smaller than the RHS of condition (47), the former is necessary and sufficient for the solution $NC_1$ to occur in equilibrium. Expliciting this condition with respect to $\rho$ we obtain:

**Proposition 12.** (Occurrence of NC1 optimum) Under politician $j \in \{M, O\}$ the NC1 solution occurs in equilibrium iff $\rho > \rho_j'$ where

$$\rho_j' = \begin{cases} \frac{\alpha - \psi(e_H^{BI} - \Delta \beta + \alpha) - \psi(e_H^{BI} - \Delta \beta)}{\alpha} & \text{if } j = M \\ \frac{\alpha - \psi(e_H^{BI} - \Delta \beta + \alpha) - \psi(e_H^{BI} - \Delta \beta)}{\alpha} \left( \frac{2\mu}{\mu + 1} \right) & \text{if } j = O \end{cases}$$  \hspace{1cm} (48)

On the other hand, solution $NC_2$ occurs in equilibrium iff the efficient type does want to engage in cost-padding when mimicking the inefficient type but not when not mimicking and the inefficient type does not want to engage in cost-padding (Proposition 2 does not help in this case). Therefore the following system of conditions must hold

$$E[\alpha_j^F] \geq \psi(e_H^{NC_2} - \Delta \beta + \alpha) - \psi(e_H^{NC_2} - \Delta \beta)$$  \hspace{1cm} (49)

$$E[\alpha_j^F] < \psi(e^* + \alpha) - \psi(e^*)$$  \hspace{1cm} (50)

$$E[\alpha_j^F] < \psi(e_H^{NC_2} + \alpha) - \psi(e_H^{NC_2})$$  \hspace{1cm} (51)

Notice that condition (51) implies condition (50), so that, by expliciting the relevant conditions with respect to $\rho$, the following holds:
Proposition 13. (Occurrence of NC2 optimum) Under politician \( j \in \{M, O\} \) the NC2 solution occurs in equilibrium iff \( \bar{\rho}_j < \rho \leq \tilde{\rho}_j \) where:

\[
\tilde{\rho}_j = \begin{cases} 
\frac{\alpha - \psi(e_H^{NC2} + \alpha) - \psi(e_H^{NC1})}{\alpha}, & \text{if } j = M \\
\frac{2\mu}{\mu + 1}, & \text{if } j = O
\end{cases}
\]  

\[ (52) \]

\[
\bar{\rho}_j = \begin{cases} 
\frac{\alpha - \psi(e_H^{NC2} - \Delta \beta + \alpha) - \psi(e_H^{NC1} - \Delta \beta)}{\alpha}, & \text{if } j = M \\
\frac{\alpha - \psi(e_H^{NC2} - \Delta \beta + \alpha) - \psi(e_H^{NC1} - \Delta \beta)}{\alpha} \left( \frac{2\mu}{\mu + 1} \right), & \text{if } j = O
\end{cases}
\]  

\[ (53) \]

We are now able to gather results of this section in the following proposition

Proposition 14. (Optimal contracts under incomplete information) Under incomplete information, three different optima and seven different cases can occur, depending on the value of the detection probability \( \rho \): (i) for \( 0 < \rho \leq \tilde{\rho}_j \) only the CP solution occurs; (ii) for \( \rho_j < \rho \leq \tilde{\rho}_j \) both the CP and the CPH solutions can occur; (iii) for \( \tilde{\rho}_j < \rho \leq \bar{\rho}_j \) only the CPH solution occurs; (iv) for \( \rho_j < \rho \leq \bar{\rho}_j \) both the CPH and the NC2 solutions can occur; (v) for \( \rho_j < \rho \leq \bar{\rho}_j \) only the NC2 solution can occur; (vi) for \( \rho_j < \rho \leq \bar{\rho}_j \) no solution can occur; (vii) for \( \rho_j < \rho \leq 1 \) only the NC1 solution can occur.

The relevant interpretation of Proposition 14 is as follows: when the probability of detecting cost-padding is low, both types find it profitable to engage in cost-padding when accepting equilibrium contracts (CP optimum occurs). When the detection probability increases a bit, the inefficient type still finds it profitable to do cost-padding, but the efficient type may not, since it is asked to exert a higher equilibrium effort which makes cost-padding more costly in terms of extra disutility of effort (however, the inefficient type would pad costs were it to mimic the inefficient type, since it could finance the extra effort by means of the economy in disutility which it gains from mimicking) (CPH optimum occurs); when the detection probability rises further, neither the inefficient type wants to do equilibrium cost-padding, but the efficient type would still have an incentive to pad costs when mimicking (NC2 optimum occurs); when the detection probability becomes even higher, neither the efficient type finds it profitable to pad costs when mimicking the inefficient type (NC1 optimum occurs). Proposition 14 is represented in Figure 2 below

![Figure 2: Regime Transition](image)

5 The politician’s optimal choice

The last step is to analyze the politician’s optimal auditing policy on the basis of optimal contracts derived in last section. Therefore, while in the previous sections the detection probability \( \rho \) was regarded as a parameter, in this section we endogenize it.

\[ 39 \] The gap is due to the fact that \( e_H^{NC2} \neq e_H^{BI} \) and shrinks as \( e_H^{NC2} \to e_H^{BI} \).
5.1 Optimal auditing technology

The politician will choose the detection probability that induces the contractual optimum which gives him the highest continuation payoff (i.e., the highest value of the objective function).

From Proposition 11 we know that the two cost-padding free solutions (NC1 and NC2) yield the same value function to the politician, regardless of his type, which in turn is identical to the value that the politician can obtain in the benchmark solution, \( U^{NC1} = U^{NC2} = U^{BI} \) where \( U^{BI} \) is given in (21). On the other hand, from Proposition 5 and 9 we know, respectively, that in the solution where only the inefficient type pad costs (CPH) the politician gets \( U^{CPH} = U^{BI} + (1 - \nu)G(\alpha_j) \) while in the solution where both types pad costs (CP) he gets \( U^{CP} = U^{BI} + G(\alpha_j) \), where \( G(\alpha_j) \) is the constant defined in (31). Clearly, the choice for a politician of type \( j \in \{M,O\} \) will merely depend on the sign of the constant \( G(\alpha_j) \).

By straightforward calculation we get that \( G(\alpha_j) > 0 \) if and only if \( \mu > 1 + D(\lambda) \), where \( D(\lambda) = \frac{\lambda - 1 + \sqrt{1 + 2\lambda - 6\lambda^2}}{2} > \lambda > 0 \), which confirms the results obtained in section 4.2.1 under complete information:

**Proposition 15.** (Politician’s preferred regime) a) A moderate politician (\( \mu \leq 1 \)) never prefers a solution with cost-padding (CP and CPH), while he is indifferent between the cost-padding free solutions (NC1 and NC2); b) An opportunist politician will prefer a solution with cost-padding (and strictly prefer the solution where both types do cost-padding) iff he is opportunist enough i.e., iff \( \mu > 1 + D(\lambda) \). Otherwise (if \( 1 < \mu \leq 1 + D(\lambda) \)) he behaves as a moderate one.

As said in section 4.2.1 since cost-padding implies a higher cost for consumers in terms of distortionary taxation, only a politician who is eager enough will be willing to allow for cost-padding to occur. In particular, for the politician to prefer cost-padding, it must be the case that the marginal benefit from increasing his private utility (\( \mu \)) is higher than the marginal cost in terms of distortionary taxation (\( 1 + D(\lambda) \)). Notice that the marginal cost is higher than the pure marginal cost of distortionary taxation (\( 1 + \lambda \)), since the politician does not always get the total of embezzled money (due to both imperfect auditing and bargaining). We remark that the level of selfishness needed for the politician to induce cost-padding is higher than the level required for him to find it convenient to enter corrupt Nash Bargaining upon detection. This capture in a simple way the fact that politicians can well be selfish, but only particularly selfish ones- the ones who let private cause substantially exceed public interest - will damage the public by engaging in corruption.

On the basis of Proposition 14 and Proposition 15 we can now easily conclude about the optimal detection probability for each type of politician. First notice that according to Proposition 14 the politician has strict type-contingent preferences over the regimes: a moderately opportunist politician strictly prefers the cost-padding-free solutions, while a very opportunist strictly prefers the solution where both types pad costs. Therefore, neither type of politician will choose values of \( \rho \) that sustain the overlapping between cost-padding and cost-padding free solutions. Therefore, cases (iv) and (trivially) (vi) in Proposition 14 can be disregarded. Moreover, since the very opportunist politician can have a strictly higher expected payoff by inducing both types of firm to engage in cost-padding, he will avoid the overlapping between the cases where both types and only the inefficient type pad cost, so that also case (ii) and (iii) can be disregarded. Therefore,

**Proposition 16.** (Politician’s optimal choice of detection probability) Moderately opportunist politicians (\( \mu \leq 1 + D(\lambda) \)) will optimally choose any value of \( \rho \) in the interval \( M = \)
\( (\bar{\rho}_j, \hat{\rho}_j) \cup (\rho_j', 1) \), where \( j = \begin{cases} M, & \text{if } \mu \leq 1 \\ O, & \text{if } 1 < \mu \leq 1 + D(\lambda) \end{cases} \). Therefore, \( \rho^*_{MO} = \forall \rho \in M \).

Very opportunist politicians (\( \mu > 1 + D(\lambda) \)) will choose \( \rho^*_{VO} = \rho_O = \arg \max_{\rho \in (0, \rho_O]} U_{CP}^O(\rho) \).

Notice that while \( U_{BI} \) is constant with respect to \( \rho \), so that the moderately opportunist politician is optimally indifferent between all the values that sustain either of the cost-padding free solutions (cases (v) and (vii)), on the other hand \( U_{CP}^O \) depends on \( \rho \) and hence the politician further maximizes with respect to it.

The intuition beyond the optimal choice of the very opportunist politician is that he faces a trade-off when choosing the detection technology: on one hand a higher detection probability allows him to detect cost-padding more often, which increases his expected share of embezzled money; on the other hand a higher detection probability deters the firm from engaging in cost-padding (i.e., makes the cost-padding optima relatively less likely to occur), which decreases his expected share. Therefore he optimally chooses the highest level of detection probability such that both types of firm still find it profitable to engage in cost-padding, namely \( \rho^*_{VO} = \rho_O \).

The possible PBE of the game therefore depend on the selfishness of the politician. Under a very opportunist politician a unique PBE can arise, where the politician chooses \( \rho^*_{VO} = \rho_O \) and induces the solution where both types engage in cost-padding. Under a moderately opportunist politician, infinite PBE can arise since the politician is indifferent between infinite values of \( \rho \). Auditing choices in the interval \( (\bar{\rho}_j, \hat{\rho}_j] \) will induce PBE with the \( NC2 \) solution, where the efficient type has an incentive to pad costs when mimicking, while choices in the interval \( (\rho_j', 1) \) will induce PBE with the \( NC1 \) solution. The formal characterization of the full set of PBE is provided in Appendix 8.5.

Propositions 15 and 16 summarize the result we wanted to show, namely that the occurrence of cost-padding in the execution of public projects can be explained as a problem of political corruption. In LT - where the politician is benevolent and the auditing technology is exogenous - cost-padding can emerge in optimal contracts only due to incomplete information (i.e., when preventing cost-padding is too costly in terms of the extra-rents the politicians need to pay), and (bureaucratic) corruption can never occur in equilibrium, since the principal always makes a take-it-or-leave-it offer to the corruptible bureaucrat. On the other hand, in this model, due to the endogenization of the detection technology, cost-padding and (political) corruption can occur in equilibrium and are ultimately choices of the politician: particularly opportunist politicians, who are eager to get a share of the gains from illegal activities, will misuse public office to allow for cost-padding to occur (via choosing a relatively low detection probability and hence leaving an incentive to pad costs in optimal contracts) and will enter in corrupt transaction with the firm whenever they have the chance to do so.

### 5.2 A State Capacity interpretation

Closer inspection of condition \( \mu \geq 1 + D(\lambda) \) yields two additional interesting results. First, we have that an improvement in the efficiency of taxation (i.e., a decrease in \( \lambda \)) makes the cost-padding regime easier to occur, insofar a lower degree of selfishness is needed for the politician to induce cost-padding. In the limit case of a perfectly efficient fiscal system (i.e., \( \lambda = 0 \)) all opportunist politicians (i.e., \( \forall \mu > 1 \)) will allow cost-padding to occur. The intuition is that a decrease in the distortion of taxation reduces the social cost of cost-padding, which implies that also moderately opportunist politicians will have an incentive to let cost-padding occur. Therefore, since politicians need to weaken the auditing technology in order to induce

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\[40^a\] A similar trade-off occurs in Dittmann (2006).
cost-padding, the model predicts an endogenous substitutability between auditing and state capacity: if the state works well the politician will choose poor auditing, while if the state works bad he will choose strong auditing. An interesting extension to implement in this direction, is to endogenize $\lambda$ in order to check whether a more selfish politician would invest more in state capacity, in order to steal more, while a more benevolent ruler would invest less.

Also, notice that the extent to which the politician is able to pursue his private agenda rather than social welfare depends on the effectiveness of the political system, in terms of the political accountability it manages to create. Therefore $\mu$ can be interpreted as a measure of (exogenous) political accountability: the more efficient is the political system, i.e., the more accountable are politicians, the lower is $\mu$ (see e.g., Shapiro and Willig (1990)). If we do so, we also have a second result, namely that a decrease in $\lambda$ must be more than counterbalanced by a decrease in $\mu$ in order to make cost-padding less easier to occur. This result can be explained in the light of the Acemoglu (2010) discussion about state capacity. A reduction in the distortion of taxation has ambiguous effects on welfare: on one hand it has a direct positive effect insofar it improves redistribution and allocation of resources. On the other hand however, it has an indirect negative effect insofar it increases the potential benefits of ruling the state, so that pursuing personal interest becomes more attractive for the politician: the higher the improvement in efficiency the lower degree of selfishness is needed to find it convenient for the politician to prefer the cost-padding regime.

Therefore, our results confirm Acemoglu (2010) insight that an improvement in State capacity (like a more efficient fiscal system) is not good per se (as instead argued by Besley and Persson (2010) - who neglected the impact that an increase in State capacity has on political equilibrium) but it is beneficial only if it comes from or is coincident to an increase in the political accountability of politicians.

## 6 Political Accountability

In the previous sections we worked under the implicit assumption that there are no checks or constraints on the conduct of the politician. Under this hypothesis, we showed that a sufficiently opportunist politician induces cost-padding and enters a corrupt transaction with the firm, at the expense of consumers welfare.

In this section we aim to relax this important assumption and to assess how the politician’s optimal behavior would change when some form of political accountability is introduced. In particular, we consider the role of elections as a disciplining device, i.e., how consumers can exploit voting to achieve that politicians deliver something closer to what they would like, namely lower cost-padding.

To address this issue, we adopt a simple static political agency model, based on first-generation electoral accountability models à la Barro (1973) and Ferejohn (1986). The setting is as follows. The voters (we assume that only consumers vote) are able to announce - and commit to - an incentive-based re-election rule before the politician contracts with the firm. Voters are able to coordinate on the same voting strategy, punishing the incumbent for bad behavior and rewarding him for good behavior. The stakes of re-election for the politician are measured by the expected present value of holding office from the next period onward. Then, after the incumbent politician has contracted with the firm, elections are held in which the voters choose between the incumbent and an opponent. If the contractual policy of the
incumbent satisfied the voters, he is re-elected. If the incumbent did not satisfy voters, they
punish him by electing the opponent. As usual in these models, for the voters the opponent
is identical in all respects to the incumbent. Elections are merely a disciplining device, and
the only reason for not reappointing the incumbent is to punish him ex-post.

To keep the exposition clear and focus on what interests us the most now, we adopt
some simplifications with respect to the previous sections. First, since the focus here is on
the interaction between the politician and the voters, we regard the interaction between
the politician and firm, as analyzed in the previous sections, as given. In particular, we assume
that the politician has complete information about the type and the operating of the firm, as
in the case analyzed in section 4.2.1 and will contract optimally with the firm as explained
there (in particular, he will impose $\Pi_i = 0$). On the other hand, voters do not know the
"state of the world" i.e., the level of efficiency of the firm. What they observe is 1) the level
of total amount of taxation they have to bear $X$, which is needed to cover the entire cost of
the project, i.e., the sum of true project cost, cost-padding, and the transfer to be paid to the
firm; and 2) the value of the project $G$, i.e., the amount of project spending that the voters
value. Given that we treat the problem of the firm as given, we will disregard in the following
the composition of $G$, and simply assume that $X_i = \beta_iG_i + a_i$. Therefore, the politician
chooses $G$ and $a$ (determining $X$ residually), but voters only observe $X$ and $G$. Also, given
the importance of consumers/voters at this stage, we will no longer regard the surplus they
enjoy from the project as a constant, but we allow for $S(G_i)$, where $S(.)$ is increasing and
concave. Therefore, when the politician provides a project of value $G$ and rise taxation of $X$,
the welfare of voters is $W(G,X) = S(G) - (1 + \lambda)X$.

The voting strategy simply amounts to choosing a reservation utility $\overline{w}$ and a probability
of re-election $P_r$ such that:

$$P_r = \begin{cases} 
1, & \text{if } W \geq \overline{w} \\
0, & \text{otherwise}
\end{cases}$$

(54)

Notice that the cutoff $\overline{w}$ cannot be state-contingent since the voters do not observe the
state of the world.

When determining the optimal cutoff, voters need to take into account the incentives of the
politician. The politician has two alternatives when choosing contracts. Either he pleases
the voters, earns re-election and gains expected rents from office $R$, or he does not please them
and forgo re-election. In the latter case, he finds it profitable to induce the highest possible
level of cost-padding. Letting $\overline{X}$ be the (exogenous) maximum feasible level of tax collection
(hence $X \in [0, \overline{X}]$), we assume that he will choose $a = \overline{X}$, namely he will impose maximum
tax collection and embezzle all the revenue. In this case the project will not be built but the
politician and firm will still share embezzled money according to Proposition 45. Also, in the
simplification of this section, $\overline{X}$ is also the amount of cost-padding that the politician would
induce in absence of elections.

Therefore, when the voters choose their reservation utility for re-election, they need to
consider that, since the incumbent can always extract $\overline{X}$ today and forgo re-election, he must
be offered at least the same utility if they want to hold him accountable. Second, voters need
to ensure that the incumbent does not pretend that the state of the world is "bad" (i.e., the
firm is inefficient) when in fact it is good just in order to gain additional rents from mimicking.

Therefore, the problem of voters is to induce levels of spending and taxation $(G_L, X_L)$ and

---

44 According to the analysis in the previous section, we would have $G_i = \beta_i - e_i^* + t_i^*$ and $X_i = G_i + a_i$.
45 Obviously this is an approximation, since typically there will always be some positive spending on the project, even in the most severe cases of embezzlement and corruption. The same assumption is adopted by Besley (2007) in the context of public finance.
\((G_H, X_H)\) to maximize expected welfare

\[
\nu[S(G_L) - (1 + \lambda)X_L] + (1 - \nu)[S(G_H) - (1 + \lambda)X_H]
\]

subject to the \(IR_H\) guaranteeing that when the firm is inefficient, the politician prefers to implement \((G_H, X_H)\) and be re-elected rather than extracting \(X\), not accomplishing the project and foregoing re-election, and the \(IC_L\) guaranteeing that when the firm is efficient, the politician prefers to implement \((G_L, X_L)\) rather than \((G_H, X_H)\) and gain from mimicking.\(^{46}\)

Therefore, relevant \(IR_H\) and \(IC_L\) constraints are as follows

\[
U_H = S(G_H) - (1 + \lambda)X_H + \mu[R + k_1(X_H - \beta H G_H)] \geq -(1 + \lambda)\bar{X} + \mu(k_2\bar{X})
\]

\[
U_L = S(G_L) - (1 + \lambda)L + \mu[R + k_1(X_L - \beta L G_H)] \geq S(G_H) - (1 + \lambda)X_H + \mu[R + k_1(X_H - \beta H G_H)]
\]

where i) \(X_i - \beta_i G_i = a_i\) \(i \in \{L, H\}\), ii) \(X_H - \beta_L G_H = a_H + \Delta \beta G_H\), where \(\Delta \beta G_H\) is the extra rent, equal to the true cost difference, that the politician can gain when lying about the state; and iii) \(k_1 \) and \(k_2\) are the constants that characterize the share of the politician when he bargains with the firm, respectively when he cares about being re-elected and when he does not. Notice that these amounts will typically be different, and typically \(k_2 < k_1\), since the expected discounted value of future office \(R\) increases the reservation utility and hence the bargaining power of the politician.\(^{47}\)

The problem is solved as usual, namely after substituting in (55) the expressions for \(X_H\) and \(X_L\) obtained from the binding constraints, the relaxed problem in \((G_H, G_L)\) is solved. The solution to the problem is as follows:

\[
G_H^* : S'(G_L^*) = (1 + \lambda)\beta L
\]

and

\[
G_L^* : S'(G_H^*) = (1 + \lambda)\beta_H + (1 + \lambda) \frac{\nu}{1 - \nu} \Delta \beta
\]

with \(G_L^* > G_H^*\) and \(X_L^* > X_H^*\) (see Appendix 8.4.3).\(^{48}\)

The solution tells that in the efficient state the politician is induced to invest the first-best spending in the project (the one which equates the marginal benefit of spending and its marginal tax cost), while in the inefficient state the investment is distorted downward (clearly \(S'(G_H^*) > (1 + \lambda)\beta_H\)), in order to limit the rents from mimicking. As usual in this kind of political agency models, it is suggested that agency problems may lead to smaller government, in order to limit the rents politicians can extract through cost-padding.

More interestingly for our purposes, we would like to assess the optimal levels of cost-padding. Considering for ease of exposition the case that the politician is purely selfish, these are as follows:

\[
a_H^* = \frac{k_2}{k_1} \bar{X} - \frac{R}{k_1}
\]

\[
a_L^* = \frac{k_2}{k_1} \bar{X} - \frac{R + \Delta \beta G_H^*}{k_1}
\]

\(^{46}\)Again, use is made of the fact that \(IR_L\) and \(IC_H\) can be omitted since they hold at the solution (see Appendix 8.4.3 for checks).

\(^{47}\)We have checked that this is in fact the case. Calculations are available upon request.
which shows that elections do make politicians (more) accountable. While in state $H$ the politician always embezzle less with respect to the case without elections ($\overline{X}$), in state $L$ this is granted to be true if $R \geq k_1 \Delta \beta G^*_H$, i.e., in case the value the politician gives to remaining in office in the future is larger than the share of the information rent that the politician can gain now, which is plausible. Notice, that the more the politicians care about staying in office in the future, the less they will embezzle today.

The optimal reservation utility that voters will require from the incumbent in exchange for re-election will therefore be the value welfare function:

$$\overline{w} = \nu[S(G^*_L) - (1 + \lambda)X^*_L] + (1 - \nu)[S(G^*_H) - (1 + \lambda)X^*_H]$$

(62)

7 Conclusion

In this paper we have provided a theoretical framework to explain why cost-padding and corruption are so widespread in the execution of public contracts. To do so, we have extended the contract-theoretic cost-padding model in Laffont and Tirole (1993), to allow for the principal to be partially selfish and for the auditing of cost-padding to be endogenous. In our model the principal (a top-level politician) is responsible not only for the design of procurement contracts but also for the auditing policy. Depending on his selfishness, he decides both the level of auditing technology and whether to enter (upon detection of cost-padding) a corrupt bargaining with the firm to share embezzled money. The stakes of corruption are hence endogenous and depend on the politician’s motives.

This framework enabled us to argue that the occurrence of cost-padding can be explained as a problem of political corruption: opportunist political principals can gain a personal benefit from allowing contracting firms to embezzle public money. While in Laffont and Tirole (1993) cost-padding and, consequently, (bureaucratic) corruption, could emerge in optimal contracts only due to asymmetric information, in this model cost-padding and corruption are ultimately choices of the politician, which depend on his degree of selfishness.

We found that while a moderate politician (by choosing a relatively aggressive auditing technology) prevents the firm from engaging in cost-padding, a very opportunist politician (via choosing a relatively weak auditing technology) leaves in optimal contracts an incentive to pad costs and, upon detection, shares embezzled money with the firm. Moreover, an improvement in the efficiency of the fiscal system makes cost-padding easier to occur, due to the fact that since the social cost of cost-padding (in terms of distortionary taxation) is lower, also less opportunistic politicians will be tempted to engage in corruption. Consequently, since politicians need to reduce auditing in order to induce cost-padding, there is endogenous substitutability in the model between auditing and state capacity. We also show that elections would make the politician more accountable.

Despite its relative simplicity, our model is able to produce interesting results. Still, there is a number of dimensions along which this work could be further developed. First, it would be interesting to relax the assumption of automatic enforcement of contracts and announcements to see how issues of contract renegotiation and credibility problems add up to our results. In particular, this would allow for the information revelation issues to have more bite in the model, and to analyze the problem of credibility underlying the politician’s auditing choice. Notably, an opportunist politician could announce a strong auditing to look good to the public, but then implement a weak one to induce cost-padding.

Also it could be interesting to assume that auditing is costly. This would make the modelization of the auditing technology more realistic and may enrich the results about the politician’s optimal choice. In particular, the optimal level of auditing for an opportunist
politician will no longer depend only on the trade-off between favoring cost-padding (which calls for weak auditing) and detecting cost-padding (which calls for strong auditing), but also on the fact that auditing is costly. This would also likely produce interesting implications in combination with the issue of time-consistency highlighted above.

To further enhance the descriptive power of the modelization of auditing, it would be possible to explicitly separate the roles of the politician and of the supervising bureaucrat. This could be done by adopting the three-tier agency structure of classical auditing models, but still allowing for both the bureaucrat and the politician to be corruptible.

Moreover, it would be interesting to see what happens when the politician’s type is private information. In particular, a possible relevant extension would be to analyze the combined effect of this informational assumption and the introduction in the model of a third “benevolent” player (like the constituency - as we already considered - or the Media or the political opposition). In this case, the third player could use the information that is revealed by the contract type and the auditing technology chosen by the politician to make inference about the politician’s honesty. This could have interesting implications on the results.

Also, it would be interesting to endogenize the efficiency of the fiscal system $\lambda$ with respect to the selfishness $\mu$, to see how the quality of institutions is influenced by the motives of politicians designing them. It would be also interesting to study the problem from the opposite viewpoint, namely to endogenize $\mu$ with respect to the institutions that constrain the politician’s behavior. This could be implemented either by introducing a judicial system which could detect and punish corrupt politicians, or further elaborating on electoral accountability (notice that in our short analysis $\mu$ was still regarded as exogenous). A second possible way to endogenize the politician’s self-interest would be “motivational” and would consider the role of psychological and social factors on the intrinsic motivation and self-regulation of the politician.

8 Appendix

8.1 Proof of Proposition 2

The proof is analogous to that in LT (p. 520) and exploit a simple revealed preferences argument. Revealed preferences imply that if $a^*_L$ is optimal for $\beta_L$, then it must hold that:

$$t + \mathbb{E}[a^*_L F] - \psi(\beta_L - C + a^*_L) \geq t + \mathbb{E}[a^*_H F] - \psi(\beta_L - C + a^*_H)$$

(63)

Analogously, if $a^*_H$ is optimal for $\beta_H$, it must hold that:

$$t + \mathbb{E}[a^*_H F] - \psi(\beta_H - C + a^*_H) \geq t + \mathbb{E}[a^*_L F] - \psi(\beta_H - C + a^*_L)$$

(64)

Adding up (63) and (64), one obtains:

$$\psi(\beta_L - C + a^*_H) + \psi(\beta_H - C + a^*_L) - \psi(\beta_L - C + a^*_L) - \psi(\beta_H - C + a^*_H) \geq 0$$

(65)

or

$$\int_{a^*_L}^{a^*_H} \int_{\beta_L}^{\beta_H} \psi''(\beta - C + a) \, d\beta \, da \geq 0$$

(66)

For example, after the firm reveals its type through the choice of the contract, the politician may decide not to audit an efficient firm since it would never engage in cost-padding.

This alternative way may refer to the recent literature about more sophisticated behavior of economic agents (see e.g., Bénabou and Tirole (2002), Bénabou and Tirole (2003) and Bénabou and Tirole (2006)).

Subscript $j$ indicating the type of the politician is omitted here.
which, together with \(\psi''(.) > 0\) and \(\beta_L < \beta_H\) implies \(a^*_L \geq a^*_H\) Q.E.D.

### 8.2 Proof of Proposition 7

Writing constraints (38) and (39) in the form

\[
\Phi(e_H) - E[\Pi_L] \leq 0 \quad (67)
\]

\[
\Gamma(e_H) - E[\Pi_L] \leq 0 \quad (68)
\]

we have that the Lagrangian for problem (40) is:

\[
\mathcal{L} = \nu[S - (1 + \lambda)[\beta_L - e^* + \psi(e^*)]] - \lambda E[\Pi_L] + (1 - \nu)[S - (1 + \lambda)[\beta_H - e_H + \psi(e_H)]] + \xi[E[\Pi_L] - \Phi(e_H)] + \zeta[E[\Pi_L] - \Gamma(e_H)]
\]

where the constant \(\nu G(\alpha_j)\) is omitted and \(\xi\) and \(\zeta\) are the Lagrange multipliers of constraints (67) and (68) respectively.

**Lemma 1.** Constraints (67) and (68) are qualified.

**Proof.** The gradients of constraints (67) and (68) are respectively

\[
\nabla = (\Phi'(e_H); -1) \neq (0; 0) \quad \forall e_H
\]

\[
\nabla = (\Gamma'(e_H); -1) \neq (0; 0) \quad \forall e_H
\]

Further,

\[
\left| \begin{array}{c}
\Phi'(e_H)
\Gamma'(e_H)
\end{array} \right| -1 = -\Phi'(e_H) + \Gamma'(e_H) \neq 0 \quad \forall e_H \geq 0
\]

Therefore constraints are qualified Q.E.D.

**Lemma 2.** The objective function \(U(e_H, E[\Pi_L])\) is concave and both constraints (67) and (68) are convex, so that, given constraint qualification, the Khun-Tucker necessary conditions for a maximum are also sufficient, and each maximizer is a global maximizer (e.g., see Chiang and Wainwright (2005)).

**Proof.** The Hessian matrix of the objective function is:

\[
H = \begin{bmatrix}
-(1 - \nu)(1 + \lambda)\psi''(e_H) & 0 \\
0 & 0
\end{bmatrix}
\]

Since \(U_{e_H,e_H} = (1 - \nu)(1 + \lambda)(-\psi''(e_H)) < 0\), \(U_{E[\Pi_L],E[\Pi_L]} = 0\) and \(|H| = 0\) we can conclude that \(H\) is semi-definite negative everywhere and hence the objective function is concave. Similarly, it is straightforward to check that the Hessian matrices of, respectively, constraints (67) and (68)

\[
H = \begin{bmatrix}
\Phi''(e_H) & 0 \\
0 & 0
\end{bmatrix}
\quad H = \begin{bmatrix}
\Gamma''(e_H) & 0 \\
0 & 0
\end{bmatrix}
\]

are semi-definite positive everywhere, so that both constraints are convex Q.E.D.

Applying the Khun-Tucker necessary conditions, we need to consider four possible cases according to which of the constraints is binding:

**Case 1** no constraint is binding: \(\xi = 0, \zeta = 0\)
Case 2: binding, not binding: $\xi > 0, \zeta = 0$

Case 3: binding, not binding: $\xi = 0, \zeta > 0$

Case 4: both constraints are binding: $\xi > 0, \zeta > 0$

Lemma 3. Only Case 2 and Case 3 yield a solution.

Proof.

Case 1: $\xi = 0, \zeta = 0$

The FOC relative to the variable $E[\Pi_L]$ gives $-\nu \lambda = 0$, which is clearly impossible (as we expected, since the incentive compatibility constraint for the efficient type should be binding in equilibrium).

Case 2: $\xi > 0, \zeta = 0$ ("CPL1")

Provided that the following condition

$$\Phi(e_{CPL1}^H) \geq \Gamma(e_{CPL1}^H)$$

holds, the unique solution for this case is: \{e_{CPL1}^H, E[\Pi_{CPL1}^L]\} = \Phi(e_{CPL1}^H); \zeta^{CPL1} = \nu \lambda$, where

$$e_{CPL1}^H: \psi(e_{CPL1}^H) = 1 - \frac{\lambda}{1 + \lambda} \frac{\nu}{1 - \nu} \Phi'(e_{CPL1}^H)$$

i.e., $e_{CPL1}^H = e_{H}^I$ (74)

Case 3: $\xi = 0, \zeta > 0$ ("CPL2")

Provided that the following condition

$$\Gamma(e_{CPL2}^H) \geq \Phi(e_{CPL2}^H)$$

holds, the unique solution for this case is \{e_{CPL2}^H, E[\Pi_{CPL2}^L]\} = \Gamma(e_{CPL2}^H); \zeta^{CPL2} = \nu \lambda$, where

$$e_{CPL2}^H: \psi(e_{CPL2}^H) = 1 - \frac{\lambda}{1 + \lambda} \frac{\nu}{1 - \nu} \Gamma'(e_{CPL2}^H)$$

(76)

Case 4: $\xi > 0, \zeta > 0$

The FOCs imply $\zeta^4 < 0$, impossible.

Therefore only Case 2 and Case 3 give solutions Q.E.D.

Lemma 4. $e_{CPL2}^H > e_{CPL1}^H$.

Proof. Since $\Phi'(e) > \Gamma'(e) \forall \epsilon \geq 0$, the result follows by inspection of the FOCs in (74) and (76).

Lemma 5. The solutions found in Case 2 and Case 3 are mutually exclusive. Therefore for each regime there is a unique solution, which by virtue of Lemma 2 is global.

Proof. Given Lemma 4, it must be the case that if (73) holds for $e_{CPL1}^H$, it must hold also for $e_{CPL2}^H > e_{CPL1}^H$. Therefore, when (73) holds, (75) cannot hold. With a similar reasoning one can conclude that when (75) holds, (73) cannot hold. When (73) holds, $(e_{CPL1}^H, \Phi(e_{CPL1}^H))$ is the only maximizer, while when (75) holds, $(e_{CPL2}^H, \Gamma(e_{CPL2}^H))$ is the only maximizer Q.E.D.
8.3 Proof of Proposition

Let us start with the CPL1 solution. Using (27) and \( \beta_L - C_{CPL1}^L + \alpha = e^* \) and \( \beta_H - C_{CPL1}^H = e^H \), we have that this solution occurs in equilibrium iff \( L \) wants to engage in cost-padding when not mimicking and does not want to engage in cost-padding when mimicking, i.e., iff this double condition is met:

\[
\psi(e^*) - \psi(e^* - \alpha) \leq \mathbb{E}[\alpha_j] < \psi(e^H - \Delta \beta + \alpha) - \psi(e^H - \Delta \beta)
\]

Notice that for this condition to ever hold, we need that

\[
\psi(e^*) - \psi(e^* - \alpha) < \psi(e^H - \Delta \beta + \alpha) - \psi(e^H - \Delta \beta)
\]

By using the fact that the difference \( \psi(e) - \psi(e - \Delta \beta) \) is increasing, it can be assessed that this condition is never verified for \( \Delta \beta \geq \alpha \). If \( \Delta \beta < \alpha \) is impossible to determine unambiguously which side of (78) is greater.

On the other hand, for solution CPL2 to occur we need the three following conditions to hold simultaneously (using \( \beta_L - C_{CPL2}^L + \alpha = e^* \) and \( \beta_H - C_{CPL2}^H = e_{CPL2}^H \))

\[
\mathbb{E}[\alpha_j] \geq \psi(e^*) - \psi(e^* - \alpha)
\]

(i.e., \( L \) wants to engage in cost-padding when not mimicking)

\[
\mathbb{E}[\alpha_j] \geq \psi(e_{CPL2}^H - \Delta \beta + \alpha) - \psi(e_{CPL2}^H - \Delta \beta)
\]

(80)

(i.e., \( L \) wants to engage in cost-padding when mimicking)

\[
\mathbb{E}[\alpha_j] < \psi(e_{CPL2}^H + \alpha) - \psi(e_{CPL2}^H)
\]

(81)

(i.e., \( H \) does not want to engage in cost-padding)

Again, by using the fact that the difference \( \psi(e) - \psi(e - \Delta \beta) \) is increasing, it can be established that the three conditions cannot hold simultaneously for \( \Delta \beta \geq 2\alpha \), since for that configuration of parameters it is the case that the RHS of condition (79) is bigger than the RHS of condition (80), but is smaller than the RHS of (81). On the other hand, for \( \Delta \beta < 2\alpha \) nothing unambiguous can be said Q.E.D.

8.4 Checks on the \( IR_L \) and \( IC_H \) constraints

8.4.1 Type1 Optima

Check on \( IR_L \):

\[
\mathbb{E}[\Pi_L] \geq t_H + \mathbb{E}[\alpha_j^L] - \psi(\beta_L - C_H + \alpha) > t_H + \mathbb{E}[\alpha_j^L] - \psi(\beta_H - C_H + \alpha) \geq 0
\]

where the first inequality comes from \( IC_L \), the second from the fact that \( \beta_H > \beta_L \) and the third from \( IR_H \), Q.E.D.

Check on \( IC_H \):

51 Notice that the condition on the right corresponds to condition (73).

52 Notice that condition (80) corresponds to (75).
In this case $IC_H$ is:

$$E[\Pi_H] \geq t_L + E[\alpha_f^L] - \psi(\beta_H - C_L + \alpha)$$  \hspace{1cm} (83)

Combining the fact that $IC_L$ is binding at the optimum:

$$t_{CPH}^L - \psi(\beta_L - C_{CPH}^L) = t_{CPH}^H + E[\alpha_f] - \psi(\beta_L - C_{CPH}^H + \alpha)$$  \hspace{1cm} (84)

with the facts that $\beta_H > \beta_L$ and $C_{CPH}^H > C_{CPH}^L$ (since $e_{CPH}^H < e_{CPH}^L$) yields:

$$t_{CPH}^H + E[\alpha_f] - \psi(\beta_H - C_{CPH}^H + \alpha) \geq t_{CPH}^L + E[\alpha_f] - \psi(\beta_H - C_{CPH}^L + \alpha)$$  \hspace{1cm} (85)

Q.E.D.

8.4.2 Type2 Optima

The checks on type 2 optima are omitted since it has been proved that these never occur in equilibrium.

8.4.3 Type3 Optima

Check on $IR_L$:

$$E[\Pi_L] = t_L + E[\alpha_f] - \psi(\beta_L - C_L + \alpha) \geq t_H + E[\alpha_f^H] - \psi(\beta_L - C_H + \alpha) > t_H + E[\alpha_f^H] - \psi(\beta_H - C_H + \alpha) \geq 0$$  \hspace{1cm} (86)

where the first inequality comes from $IC_L$, the second from the fact that $\beta_H > \beta_L$ and the third from $IR_H$, Q.E.D.

Check on $IC_H$:

$IC_H$ in this case is

$$E[\Pi_H] = t_H + E[\alpha_f^H] - \psi(\beta_H - C_H + \alpha) \geq t_L + E[\alpha_f^L] - \psi(\beta_H - C_L + \alpha)$$  \hspace{1cm} (87)

Adding and subtracting $\psi(\beta_L - C_L + \alpha)$ to the RHS we can rewrite (87) as

$$E[\Pi_H] \geq E[\Pi_L] + \psi(\beta_L - C_L + \alpha) - \psi(\beta_H - C_L + \alpha)$$  \hspace{1cm} (88)

Using the facts that $E[\Pi_{CPH}^H] = 0$, $E[\Pi_{CPH}^L] = \Phi(\beta_H - C_{CPH}^L + \alpha)$ (where $\beta_H - C_{CPH}^L + \alpha = e_{BI}^H$) and the definition of $\Phi(\cdot)$, yields

$$0 \geq \Phi(\beta_H - C_{CPH}^L + \alpha) - \Phi(\beta_H - C_{CPH}^L + \alpha)$$  \hspace{1cm} (89)

which is true since $C_{CPH}^H > C_{CPH}^L$ Q.E.D.

8.4.4 Type4 Optima

We need to distinguish between the two cases a) $a_L^m = 0$ and b) $a_L^m = \alpha$.

Case a) Check on $IR_L$:

$$\Pi_L \geq t_H - \psi(\beta_L - C_H) > t_H - \psi(\beta_H - C_H) \geq 0$$  \hspace{1cm} (90)
where the first inequality comes from $IC_L$, the second from the fact that $\beta_H > \beta_L$ and the third from $IR_H$, Q.E.D.

Case a) Check on $IC_H$:

The relevant solution is the $NC1$ solution, so

$$t^NC1_H - \psi(\beta_H - C^NC1_H) > t^NC1_H - \psi(\beta_H - C^NC1_L) = t^NC1_L - \psi(\beta_L - C^NC1_H) - \psi(\beta_L - C^NC1_L) > t_L - \psi(\beta_H - C^NC1_L)$$

(91)

where the first inequality comes from the fact that $C^NC1_H > C^NC1_L$ (since $e^NC1_H < e^NC1_L$), the equality comes from the fact that $IC_L$ is binding at the optimum (i.e., $t^NC1_L - \psi(\beta_L - C^NC1_L) = t^NC1_H - \psi(\beta_L - C^NC1_L)$) and the third inequality from $\beta_H > \beta_L$, Q.E.D.

Case b) Check on $IR_L$:

$$E[\Pi_L] \geq t_H + E[\alpha^F] - \psi(e_H - \Delta\beta + \alpha) > t_H + E[\alpha^F] - \psi(e_H) > t_H - \psi(e_H) \geq 0$$

(92)

where the first inequality comes from $IC_L$ (and using $\beta_L - C_H + \alpha = e_H - \Delta\beta + \alpha$), the second from the fact that $\Delta\beta > \alpha$ by Assumption 2 (and using $\beta_H - C_H = e_H$), and the last from $IR_H$, Q.E.D.

Case b) Check on $IC_H$:

In this case $IC_H$ is:

$$\Pi_H = t_H - \psi(\beta_H - C_H) \geq t_L - \psi(\beta_H - C_L)$$

(93)

or, in terms of $e_H$ and $e_L$

$$\Pi_H = t_H - \psi(e_H) \geq t_L - \psi(e_L + \Delta\beta)$$

(94)

Using the fact that $IC_L$ is binding at the optimum:

$$t^NC2_L - \psi(\beta_L - C^NC2_L) = t^NC2_H + E[\alpha^F] - \psi(\beta_H - C^NC2_H + \alpha)$$

(95)

or, in terms of $e^NC2_H$ and $e^NC2_L$

$$t^NC2_L - \psi(e^NC2_L) = t^NC2_H + E[\alpha^F] - \psi(e^NC2_H - \Delta\beta + \alpha)$$

(96)

and the fact that $\Delta\beta > \alpha$ (by Assumption 2), we get

$$t^NC2_H - \psi(e^NC2_H) \geq t^NC2_L - \psi(e^NC2_L + \Delta\beta)$$

(97)

8.4.5 Checks on politician’s constraints

Check on $IR_L$:

$$U_L \geq S(G_H) - (1+\lambda)X_H + \mu[R + k_1(X_H - \beta_L G_H)] > S(G_H) - (1+\lambda)X_H + \mu[R + k_1(X_H - \beta_H G_H)] \geq \overline{X}[\mu k_2 - (1+\lambda)]$$

(98)

where the first inequality comes from $IC_L$, the second from the fact that $\beta_H > \beta_L$ and the third from $IR_H$, Q.E.D.
Check on $IC_H$:

In this case the $IC_H$ is

$$U_H = S(G_H) - (1+\lambda)X_H + \mu[R + k_1(X_H - \beta_H G_H)] \geq S(G_L) - (1+\lambda)X_L + \mu[R + k_1(X_L - \beta_H G_L)]$$

(99)

By adding and subtracting $\mu k_1 \beta_L G_L$ to the RHS, the constraint can be rewritten as:

$$U_H \geq U_L - \mu k_1 G_L \Delta \beta$$

(100)

Using the facts that $IR_H$ and $IC_L$ are binding at the equilibrium, the constraint reduces to

$$0 \geq \mu k_1 (G_H - G_L) \Delta \beta$$

(101)

or simply $G_L \geq G_H$. By inverting the FOCs in [58]-[59] and using the fact that $S'$ is decreasing, it is straightforward to check that $G^*_L \geq G^*_H$, Q.E.D.

By substituting the optimal values of $G^*_i$ in the expressions of $X_i$ obtained by the binding constraints

$$X_H = \frac{1}{\mu k_1 - (1+\lambda)}[\mu k_1 \beta_H G_H - S(G_H) - \mu R + \lambda \mu k_2 - (1+\lambda)]$$

(102)

$$X_L = \frac{1}{\mu k_1 - (1+\lambda)}[\mu k_1 \beta_L G_L - S(G_L) - \mu R + \lambda \mu k_2 - (1+\lambda) + \mu k_1 G_H \Delta \beta]$$

(103)

it is possible to establish that $X^*_H > X^*_L$ iff $\mu k_1 \beta_L (\Delta G) > S(G^*_H) - S(G^*_L - \Delta G)$, where $\Delta G = G^*_L - G^*_H$. By the Mean Value Theorem, this condition can be written as $S'(x) < \mu k_1 \beta_L$, where $G^*_H < x < G^*_L$. Using [58] and [59]:

$$(1+\lambda)(\beta_H + \frac{\nu \Delta \beta}{1-\nu}) < S'(x) < (1+\lambda)\beta_L < \mu k_1 \beta_L$$

(104)

where the last inequality is due to $\mu > 1+\lambda$, Q.E.D.

8.5 Perfect Bayesian Equilibria of the Game

Under a very opportunist politician (VO) ($\mu > 1 + D(\lambda)$), there is an unique PBE:

$$s_{VO} = \{\rho_{VO} = \varrho^j; \quad (C^*_j, t^*_j) = (C^{CP}_j, t^{CP}_j); \text{ enter}\}$$

$$s^*_H = \{(C^*_H, t^*_H) = (C^{CP}_H, t^{CP}_H); \quad \alpha^*_H = \alpha; \text{ enter}\}$$

$$s^*_L = \{(C^*_L, t^*_L) = (C^{CP}_L, t^{CP}_L); \quad \alpha^*_L = 0; \text{ enter}\}$$

$$B^*_i = \{\text{Prob}(\beta = \beta_L) = \nu; \quad \text{Prob}(\beta = \beta_L) = \nu; \text{ Prob}(\beta = \beta_L) (C^*_L, t^*_L) = (C^{CP}_L, t^{CP}_L) = 1\}$$

(105)

Under a moderately opportunist politician (MO) ($\mu \leq 1 + D(\lambda)$), two set of infinite possible PBE can arise, depending on which between the $NC1$ and the $NC2$ optima is induced:

$$s^*_{MO} = \{\rho_{MO} = \forall \rho \in \{\varrho_j, \hat{\varrho}_j\}; \quad (C^{NC}_j, t^{NC}_j) = (C^{NC}_j, t^{NC}_j); \text{ enter if } j = O, \text{ not enter if } j = M\}$$

$$s^*_H = \{(C^*_H, t^*_H) = (C^{NC}_H, t^{NC}_H); \quad \alpha^*_H = 0; \text{ enter}\}$$

$$s^*_L = \{(C^*_L, t^*_L) = (C^{NC}_L, t^{NC}_L); \quad \alpha^*_L = 0; \text{ enter}\}$$

$$B^*_i = \{\text{Prob}(\beta = \beta_L) = \nu; \quad \text{Prob}(\beta = \beta_L) = \nu; \text{ Prob}(\beta = \beta_L) (C^*_L, t^*_L) = (C^{NC}_L, t^{NC}_L) = 1\}$$

(106)
\[
\begin{align*}
\mathcal{S}_{\text{MO}} &= \{ \rho_\text{MO}^* \in \{ \rho'_j, 1 \}, (j \in \{ M, O \}); (C_\text{MO}^*, t_\text{MO}^*) = (C_\text{MO}^{NC1}, t_\text{MO}^{NC1}); \text{enter if } j = O, \text{not enter if } j = M \} \\
\mathcal{S}_H &= \{ (C_H^*, t_H^*) = (C_H^{NC1}, t_H^{NC1}); a_H = 0; \text{enter} \} \\
\mathcal{S}_L &= \{ (C_L^*, t_L^*) = (C_L^{NC1}, t_L^{NC1}); a_L = 0; \text{enter} \} \\
\mathcal{B}_{\text{MO}} &= \{ \text{Prob}(\beta = \beta_L) = \nu; \text{Prob}(\beta = \beta_L | (C_L^*, t_L^*) = (C_L^{NC1}, t_L^{NC1})) = 1 \} \\
\end{align*}
\]  
(107)

References


