# Capture, Politics and Antitrust Effectiveness*

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**Abstract**

We study a three-tier hierarchy *Political Principal - Competition Authority - Firms* in which the Principal chooses the Authority's *(i)* budget, *(ii)* percentage of the fine (bonus), and *(iii)* preferences in presence of moral hazard. Collusion between the Authority and firms may arise in order to avoid fines. For high efficiency levels of the bribing technology, the collusion-proof contract induces the Authority to exert more effort: the Principal trades-off the benefits from allowing the Authority to exert the desidered level of effort by devoting it an increasing budget, with the cost of leaving it an increasing expected rent, thus making the budget non-monotone in the bribing technology efficiency's level. We find that, ceteris paribus, both the optimal budget and the bonus are non-increasing in *(a)* the Principal's degree of internalization of firms' profits, non-monotone in *(b)* firms' anti-competitive profits, and ambiguous in *(c)* the fine. Firms can also bribe the Principal for a reduced budget. In this setting, both the budget and the bonus are non-increasing in *(a)*, *(b)*, and in the bribing technology efficiency's level, and ambiguous in *(c)*.

Instances in which the Authority is allocated a zero budget and/or a zero bonus are characterized. Finally we show that the Principal prefers a consumers' surplus maximizer Competition Authority.

**Keywords**: Three-tier Hierarchy, Moral Hazard, Collusion-Proofness, Endogenous Budget, Antitrust Enforcement.

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# 1 Introduction

Most of the theoretical models present in the literature treat the Competition Authority's budget as exogenous. Even if most of the Authorities in developed countries are said to be independent from governments, their monitoring effectiveness still depends on the budget allocated to them by the latter.[1] Weingast and Moran (1983) point out how in a system in which several agencies compete among them for budgetary favors, then the Congress could use its budgetary process in order to provide incentives to agencies to benefit a congressional clientele.

Our paper deals with a political economy determinant of the Competition Authority's budget, i.e. the presence of an industry interest group bribing *(i)* the policymaker in charge of devoting resources to the Competition Authority, or *(ii)* the Competition Authority in charge of reporting violations of law.

We show how the optimal budget and the optimal bonus devoted to the Competition Authority may vary according to variations in the bribing thechnology's efficiency level (i.e. bureacurats/politicians degree of proneness to corruption and/or industry lobby's strenght), and we endogenouly derive the case in which it may be profitable not to set-up a Competition Authority. It is indeed well-known that several industrialized countries set up a national Competition Authority only several decades after the appearance of the Sherman Act in 1890.[2]

Stigler (1971) was the first to emphasize how the industry is able to influence regulatory outcomes in its favor. In contrast, consumers are generally too dispersed in order to be able to overcome the free-riding problem among them and to organize themselves as an interest group.

Batra, Kaufmann and Stone (2003) employ data provided by the World Bank's investment climate studies in order to show the presence of a positive correlation between antitrust institutions functioning poorly and the level of corruption in the business climate. Søreide (2006) builds on this correlation and studies the firms' incentive in reacting against cases of bribery conducted by competitors and negatively affecting their profits.[3]

Our model is closely related to the literature on regulatory capture as in Laffont and Tirole (1991). More specifically a Political Principal is in charge of devoting resources to the Competition Authority that in turn monitors firms' behavior. This is a three-tier hierarchy in which the Political Principal relies

[1]See Berti and Pezzoli (2010). Faure-Grimaud and Martimort (2003) analyze in a dynamic setting the effect of regulatory independence on both capture of the regulatory agency by interest groups and constraints on future majority's preferred policy implementation. The authors endogenize the choice of the regulatory agency's independence status and how it generates a stabilization policy effect.

[2]For instance Italy set up a national Competition Authority in 1990, one century later than USA.

[3]The author points out that firms might refrain from speaking out about corruption since this might jeopardize the possibility of cooperating with competitors (for instance entering into a cartel agreement) in future periods. If antitrust institutions function poorly, the possibility of entering into cartel agreement is higher, thus firms have a lower incentive in blowing the whistle against cases of bribery.

on the Competition Authority's report about the firms' behavior whenever economic variables (prices or quantities) in a given industry suggest the presence of an anticompetitive behavior by firms. The Competition Authority possesses time, resources and expertise in order to monitor firms.

Unlike Laffont and Tirole (1991), we endogenize the Competition Authority's investigative resources. The presence of moral hazard affects the Political Principal-Competition Authority relation. The Political Principal chooses both the budget and the bonus to devote to the Competition Authority, thus controlling both the Authority's strategic space *via* budget (i.e. it determines the maximal amount of effort that the Authority can exert), and the amount of budget spent (i.e. the effective amount of effort exerted) *via* bonus.

The budget and the bonus devoted to the Competition Authority thus directly affects the probability of the firms being uncovered in case of misbehavior, giving rise to a stake in influencing the Political Principal's decision by firms.[4] In fact a lower budget entails a lower probability of the Competition Authority uncovering firms misbehaving, then it also entails higher expected returns from misbehaving to firms.

As in Laffont and Tirole (1991) the presence of asymmetric information about the firms' behavior gives rise to a stake in colluding between the Competition Authority and firms. In case the Competition Authority uncovers a misbehavior by firms, a side-contract between them could be signed in order to induce the former to hide information from an external Court of Law in charge of imposing fines.

Firms in the industry can employ different means in influencing the policymaker or the law enforcer. For the sake of simplicity we assume that side-transfers by means of monetary bribes are feasible and enforceable, however other means are avalaible, like hoped-for future employment in the industry or monetary contributions to political campaigns of the politician.[5]

Other two relevant features differentiate our model from Laffont and Tirole (1991). First we do not explicitly deal with a classical regulatory framework in which the Political Principal delegates the production of a public good to a firm having private information about its efficiency. In our framework firms just decide to act competitively or not based on the observation of the budget for investigation and the bonus devoted to the Competition Authority. Second, we consider not only the situation in which the interest group signs a side-contract with the Competition Authority, but we also consider the possible side-contract between the firms' interest group and the Political Principal.[6]

Our model is also related to the literature on collusion between law enforcers

[4]For instance a higher budget allows the Competition Authority to hire a higher number of officials, or to hire officials with higher investigative skills.

[5]With respect to the enforceability of side-contracts see Laffont and Tirole (1991).

[6]Tirole (1986) shows that in a three-tier hierachy Principal/Supervisor/Agent, the only coalition to be considered is the Supervisor/Agent one, since a relevant coalition occurs within parties that can manipulate the information. In terms of our model, this result would entail that the only relevant coalition would be the one involving Competition Authority and firms, whilst we show that a coalition between Political Principal and firms might also arise. However the framework we analyze is not the classical regulatory one.

and criminals. Becker and Stigler (1974) propose paying rewards to law enforcers in order to control bribery. Polinsky and Shavell (2001) analyze corruption in law enforcement in a framework in which the law enforcer can take bribes from wrongdoers in order not to report violations of the law, or it can frame and extort innocent individuals. They emphasize how bribery, extortion and framing dilute deterrence, thus they are worth being discouraged. They derive optimal penalties for bribing and framing, and they also derive the rewards that have to be paid to the law enforcer in order to induce him to report violations. Our framework abstracts from framing and extortion of innocent firms by the Competition Authority, and it focuses on deriving a mechanism of rewards for the Competition Authority based on devoting to the latter a percentage of the fine imposed on misbehaving firms, such that collusion among Authority and firms is deterred.[7]

Sabbatini (2009) notices that only few Competition Authorities in the world are allowed to finance their budget by means of part of the fines imposed on firms for anticompetitive behavior. We find the optimal reward (bonus) as it is related to the efficiency of the bribing technology, and we show that it might be optimal not to devote any reward to the Authority both when no bribing is profitable (i.e. low efficiency values of the bribing technology) and when bribing of the Political Principal is highly profitable (i.e. high efficiency values of the bribing technology).

We analyse how both the equilibrium budget and bonus are affected by *(a)* the Political Principal's degree of internalization of firms' profits, *(b)* the extra-profits deriving from anti-competitive behavior, and *(c)* the fine.

When the Competition Authority-Firms coalition is considered, all else equal, the budget is unambiguosly non-increasing in *(a)*, since the Political Principal internalizes more the effect of the budget on producers' surplus. On the other hand the budget is a non-monotone function of *(b)*. In the latter case, another effect is at work: anti-competitive extra-profits positively affect the stake in collusion between Firms and the Competition Authority, that in turn positively affects the effort exerted by the Authority *via* a higher bonus devoted to the latter. We show how this effect may induce a higher budget devoted in equilibrium to the Authority for a given range of the bribing technology's efficiency level.[8]The budget is also ambiguous in *(c)*. In fact, like *(b)*, the fine also positively affects the stake in collusion. However, contrary to *(b)*, a higher fine induces a Principal giving more weight to consumers' surplus with respect to producers' one, to invest more in the Competition Auhtority's budget, since this entails a profitable redistribution of the fine from consumers to producers.

[7]A similar mechanism of law enforcers being rewarded for reporting violations is already observable. In 2000 the Italian Corte Costituzionale declared constitutionally valid the art. 208 D.lgs 285/92, according to which the member of the State and municipal police get a percentage of the fine imposed on wrongdoers.

[8]Faure-Grimaud et al. (2000) endogenize the transaction cost arising from the Supervisor-Agent coalition (i.e. high transaction costs are equivalent to low efficiency level of the bribing technology) and show that it is negatively related to the size of the collusive stake among the players. Unlike Faure-Grimaud et al. (2000), and as in Laffont and Tirole (1991), we treat transaction costs as exogenous.

When the Political Principal-Firms coalition is considered, both the budget and the bonus are unambiguosly decreasing in both *(a)* and *(b),* and ambiguous in *(c).*

Compte et al. (2002) show a link between corruption and collusion in a procurement framework. More specifically the authors show that corruption facilitates implicit collusion in prices between competing firms. The idea that corruption and collusion are strategic complements is confirmed in our model also. However the causality is an inverse one, i.e. higher profits deriving from collusion between competing firms foster corruption of both the Competition Authority and the Political Principal.

Finally, the budget choice is not the only mean by which the Political Principal can affect the Authority's effectiveness and independence. We also let the Political Principal affecting the Competition Authority's preferences by choosing the standard the Competition Authority is held accountable for. This might refer to situations that are common in many developed countries where the president of the national Competition Authority is directly appointed by the government. Calvert, McCubbins and Weingast (1989) analyze the government's choice of agency's preferences. Neven and Röller (2002) analyze the performance of the consumers' surplus standard with respect to the welfare standard in a merger control framework in which the Competition Authority may receive bribes. The authors show that neither standard always dominates in terms of welfare. We show that the Principal prefers a consumers' surplus maximizer Authority since it is the least costly to incentivize exerting a given effort and it is the least corruptible one.

The paper proceeds as follows. Section 2 presents the model setting. Section 3 deals with the benchmark model, that is the model with both a benevolent Political Principal and a benevolent Competition Authority.[9] Section 4 first considers the case in which the Competition Authority is non-benevolent, that is the situation in which a side-contract between the Authority and firms can be signed. Section 5 deals with the industry interest group directly influencing the Political Principal's budget choice. Section 6 concludes. In Appendix 1 we present the solution to the problem analyzed in Section 4 when the Competition Authority's Limited-Liability Constraint is binding. Proofs of the main propositions are relegated to Appendix 2, graphs are relegated to Appendix 3.

## 2 The Model Setting

Our economy is populated by a Political Principal (from hereby $PP$), a Competition Authority (from hereby $CA$) and a representative industry with $N$ homogenous firms. All the players are assumed to be risk neutral. $PP$ chooses the budget for investigation $\overline{s}$ for $CA$ to monitor firms' competitive behavior, the fraction $\gamma$ of the overall exogenous fine $F$ imposed on firms in case the for-

[9] Alternatively the benchmark model could be interpreted as the model in absence of any interest group.

mer finds evidence of firms' misbehavior and reports it to the Court of Law.[10] Finally $PP$ also chooses the standard $CA$ is held accountable for.

## 2.1 The Industry

Firms in the industry choose to engage in an anti-competitive action or not, i.e. firms choose to enter into a cartel agreement or to compete.[11] We assume that the industry is concentrated enough so a cartel agreement is stable.

If firms in the industry compete (from hereby $C$) they jointly get:

$$U^C = \pi^C \left(q^C\right) \tag{1}$$

where $\pi^C$ is the industry joint profit from producing the competition quantity $q^C$ (i.e. from engaging in $(C)$).

On the other hand, if the industry runs a cartel agreement (from hereby $M$) it gets:[12]

$$U^M = \rho(s)\left(\pi^C \left(q^C\right) - F\right) + (1-\rho(s))\,\pi^M \left(q^M\right) \tag{2}$$

where $\pi^M$ is the industry joint profit from producing the cartel quantity $q^M$ (i.e. from engaging in $(M)$), $\rho(s)$ is the probability of $M$ being uncovered and convicted by $CA$ when the latter spends a budget $s$.[13] $F$ is the exogenous aggregate fine imposed on $M$ by the Court of Law.[14]

In case $M$ is uncovered we assume that $CA$ can impose remedies such that both consumers and producers' surplus under competition are restored.[15]

## 2.2 The Competition Authority

Unlike in the Laffont-Tirole framework, we do not treat $CA$ as a mere agency in charge of supervising firms' behavior by mobilizing its material welfare, but we explicitely assign a welfare function to $CA$.

[10] As far as we know, only in Bulgaria, Portugal and Perù the Competition Authorities can use fines imposed in case of anticompetitive behaviors in order to finance their budgets. See Sabbatini (2009). See Polinsky and Shavell (2001) for a theoretical model in which the law enforcer gets a reward for reporting the offense.

[11] In this model we focus on firms choosing to enter or not to enter into a cartel agreement as one example of firms' anti-competitive behavior. However the model can also account for firms engaging in other kinds of anti-competitive practices.

[12] We denote the firms running a cartel agreement by $M$ since a cartel is run for the purpose of monopolizing the market. $M$ also refers to members of the industry interest group in charge of lobbying $PP$ or $CA$. See Section 4 and 5.

[13] $s$ can also be thought as the effort exerted by CA.

[14] We are implicitly assuming that whenever $M$ is detected it is also convicted. See Spagnolo (2003) for a model in which detection and conviction are identified with a single probability. See also Aubert et al. (2006). Moreover we have to distinguish between the European continental antitrust institutional framework in which the Competition Authority can directly impose fines (even if those fines can be revised by a court), and the American framework in which fines are imposed by a Court of Law. See also Sabbatini (2009).

[15] For a similar assumption see Motta and Polo (2003).

$CA$'s utility function is the following:

$$V^C(\bar{s}) = S\left(q^C\right) + \alpha_{CA}\pi^C + \bar{s} \tag{3}$$

where we normalize to zero $CA$'s reservation utility. $S\left(q^C\right)$ ($S\left(q^M\right)$ resp.) is the consumers' surplus in case in case firms compete (run a cartel resp.). $\alpha_{CA} \in [0,1]$ is the weight of firms' profts in $CA$'s objective function: if $\alpha_{CA} = 1$ $CA$ maximizes social welfare, whilst if $\alpha_{CA} = 0$ $CA$ maximizes consumers' surplus. $CA$ is also allocated a budget $\bar{s}$ and, given $q^C$, it does not open any investigation.[16]

On the other hand, in case $q^M$ is observed on the market, $CA$ gets:

$$V^M(s,\gamma) = \rho(s)\left[S\left(q^C\right) + \alpha_{CA}\left(\pi^C - F\right) + \gamma F\right] + \tag{4}$$

$$+ (1-\rho(s))\left[S\left(q^M\right) + \alpha_{CA}\left(\pi^M\right)\right] + (\bar{s} - s)$$

since it is allocated a budget $\bar{s}$, and it opens an investigation that costs $s$. With probability $\rho(s)$, $CA$ finds evidence of collusion, restores competition and gets a percentage $\gamma$ of the fine $F$ imposed on $M$. Otherwise, with probability $1-\rho(s)$, $M$ is not uncovered and the social welfare under monopoly realizes. We consider $F$ as exogenous.

We assume that the probability function $\rho(s)$ is a continuous increasing concave function with respect to the budget $s$, i.e. $\rho'(s) > 0$, and $\rho''(s) < 0$. For instance a higher budget spent by $CA$ simply allows the latter to hire a higher number of officials or to hire higher skilled officials that in turn lead to a higher probability of uncovering a cartel.[17]

## 2.3 The Political Principal

$PP$ maximizes a social welfare function that depends on whether the industry engages in $M$ or not. If $M$ does not form $PP$'s objective function is the following:

$$W^C(\bar{s}, s) = S\left(q^C\right) + \alpha_{PP}U^C - \bar{s} + \beta(\bar{s} - s) \tag{5}$$

where $(\bar{s} - s)$ represents $CA$'s rent.[18] $\alpha_{PP}$ and $\beta$ are two exogenous non-

[16] $CA$ can also prefer a high budget since, for instance, it induces more prestige for the Agency or simply because it implies a more relaxed working environment within the Agency. Weingast and Moran (1983) point out how several Agencies compete for budgetary favors from the Congress.

[17] $s$ can be thought as materially spent in hiring officials before an investigation is open. The higher $s$, the higher the investigative skills of the officials hired by $CA$, thus the higher the probability $\rho(s)$ that firms will be found guilty of anti-competitive behavior. In this case when $q^C$ is realized, officials can spend their time in leisure. Then $s$ can be thought as the monetary equivalent of the leisure-time lost by officials when $q^M$ is observed and they open an investigation in order to find evidence of firms' anti-competitive behavior.

negative parameters representing the degree of internalization of firms' profits and $CA$'s rent in $PP$'s objective function respectively. We assume $\alpha_{PP} \in [0,1]$ and $\beta < 1$.

On the other hand if $M$ forms $PP$'s objective function is the following:

$$W^M(\bar{s}, s, \gamma) = \rho(s)\left[S\left(q^C\right) + (1-\gamma)F\right] + (1-\rho(s))S\left(q^M\right) + \alpha_{PP}U^M +$$
$$+\beta\left[\rho(s)(\bar{s} - s + \gamma F) + (1-\rho(s))(\bar{s} - s)\right] - \bar{s}$$

With probability $\rho(s)$ $M$ is uncovered and fined, and competition is restored.[19]

In this case $CA$'s rent is constituted by both $(\bar{s} - s)$ and $\gamma F$. Otherwise, with probability $1 - \rho(s)$ $CA$ does not uncover $M$, thus the latter gets monopoly profits without being fined, $CA$ does not get any bonus and $PP$ does not collect any fine. Then, $CA$'s rent is constituted by $(\bar{s} - s)$ only. $PP$'s objective function rewrites as:

$$W^M(\bar{s}, s, \gamma) = \rho(s)\left[\underbrace{S\left(q^C\right) + \alpha_{PP}\left(\pi^C - F\right) + F}_{\overline{S}} - \gamma F\right] + \tag{6}$$
$$+(1-\rho(s))\left[\underbrace{S\left(q^M\right) + \alpha_{PP}\pi^M}_{\underline{S}}\right] + \beta\left[(\bar{s} - s) + \rho(s)\gamma F\right] - \bar{s}$$

We abstract from the deadweight burden of taxes needed for $CA$'s budget fnancing.[20]

## 2.4 The Timing

This is a game of imperfect information, since all the players' payoffs are common knowledge, but neither $CA$ nor $PP$ observe with certainty if $M$ forms or not. The timing of the game in absence of side-contracting neither between $CA$ and $M$, nor between $PP$ and $M$, is the following:

1. $PP$ chooses a budget $\bar{s}$ to devote to $CA$. $PP$ also chooses the fraction $\gamma$ of the fine $F$ (i.e. bonus) to allocate to $CA$ in case firms are uncovered running a cartel, and the $CA$'s parameter $\alpha_{CA}$;

2. given $\{\bar{s}, \gamma, \alpha_{CA}\}$, firms simultaneously decide to engage in $M$ or $C$;

[18] If $s$ is interpreted as the effort exerted by $CA$ in finding evidence, then $(\bar{s} - s)$ might be interpreted as the monetary value of the time spent by $CA$'s officials in leasure.

[19] We assume that the fine $F$ is redistributed to tax-payers.

[20] For a similar assumption see Polinsky and Shavell (2001).

3. the quantity $q$ is realized on the market. $q$ is perfectly observed by both $PP$ and $CA$;

4. If the competitive output $q^C$ is realized the game ends. If the monopoly output $q^M$ is realized, $CA$ opens an investigation deciding the optimal level of budget $s$ to spend. With probability $1 - \rho(s)$ $CA$ does not find any evidence against $M$ and the game ends. Otherwise with probability $\rho(s)$, $CA$ uncovers $M$ and reports it to the Court of Law, thus an exogenous fine $F$ is imposed on $M$.[21]

5. Players get their payoffs.

The modified timing taking into account side-contracting will be presented at the beginning of the relevant sections. Section 3 deals with the benchmark game in which side-contracting is not allowed.

# 3 The No-bribing Game

## 3.1 Industry's Choice

We first investigate the case in which $M$ forms. Firms compare the expected utility from engaging in $M$ to the utility from engaging in $C$. From (1) and (2), $M$ forms if the following inequality holds:

$$\rho(s) < \frac{\triangle\pi}{\triangle\pi + F} \tag{7}$$

where $\triangle\pi = \pi^M - \pi^C$.

The interpretation of (7) is straightforward: $M$ forms if the probability of being uncovered is low enough, that is if $s$ is low enough. To summarize, if (7) holds $M$ forms and the $PP$'s objective function to consider is given by (6), otherwise the relevant objective function is given by (5).

[21] Motta (2004) lists several reasons concerning why it would be very difficult to consider market outcomes in order to decide if antitrust-laws have been infringed or not. First, price data may not be avalaible, and when they are avalaible they might refer to list prices rather than to effective ones (the author refers to effective prices as the ones that are privately negotiated between buyers and sellers). Second, even if reliable data are avalaible, it could be difficult to infer which would be the monopoly quantity (or price) in a given industry. Finally, even if there is agreement about the theoretical monopoly quantity (or price), a last issue arises concerning how close to the theoretical monopoly quantity (resp. price) should the effective quantity (resp. price) be in order to establish an infringement of antitrust-laws.

Moreover Aubert et al. (2006) highlight that Competition Authorities are powerless in front of tacit collusion. Indeed a coordinated outcome can also derive from firms acting non-cooperatively. See Werden (2004). On this ground also refer to the *Woodpulp* case.

### 3.2 CA's Effort Choice

$CA$ faces a budget $\bar{s}$ and it optimally chooses the amount of budget to invest in investigation effort if $q^M$ realizes on the market. Formally $CA$ solves the following problem:

$$s = \underset{\tilde{s}\in[0,\bar{s}]}{arg\max}\ \rho(\tilde{s})\left[S\left(q^C\right) + \alpha_{CA}\left(\pi^C - F\right) + \gamma F\right] + \tag{8}$$

$$+\left(1-\rho(\tilde{s})\right)\left[S\left(q^M\right) + \alpha_{CA}\pi^M\right] - \tilde{s}$$

since with probability $\rho(s)$ $CA$ finds evidence of cartel behavior, competition is restored, $M$ is fined and $CA$ gets the bonus $\gamma F$. Otherwise, with probability $1-\rho(s)$, $CA$ does not find evidence, no fine is imposed on $M$, and $CA$ does not collect any bonus.

The solution to (8) constitutes the Incentive Compatible Constraint (from hereby **ICC**) arising from the moral hazard problem affecting the relationship between $PP$ and $CA$. The First-Order-Condition (from hereby FOC) of the problem in (8) gives us the optimal level of effort exerted by $CA$:

$$\rho'(s) = \frac{1}{S(q^C) - S(q^M) - \alpha_{CA}(\triangle\pi + F) + \gamma F} \tag{9}$$

The Second-Order-Condition (from hereby SOC) holds if $S\left(q^C\right) - S\left(q^M\right) - \alpha_{CA}(\triangle\pi + F) + \gamma F > 0$.

Given $\rho''(s) < 0$, *ceteris paribus* the higher $\gamma$ (the higher $\alpha_{CA}$ resp.), the higher (the lower resp.) the effort $s$ exerted by $CA$. Both a higher bonus and an objective function biased toward a consumers' surplus standard incentivize $CA$ to exerts more effort.

### 3.3 PP's Enforcement Choice

$PP$ has two options: *(i)* inducing a probability $\rho(s)$ such that $M$ does not form, or *(ii)* inducing a probability $\rho(s)$ such that $M$ forms. In the latter case $PP$ might devote to $CA$ a budget $\bar{s} = 0$, or she can devote to $CA$ a positive budget that allows her to collect the fine $F$ with a positive probability, even if it is not sufficient to deter $M$ from forming.

We first analyze the situation in which $s$, as it is given by (9), is such that (7) does not hold. We define $s^C$ as the level of budget such that (7) holds as an equality, i.e.

$$s^C = \rho^{-1}\left(\frac{\triangle\pi}{\triangle\pi + F}\right) \tag{10}$$

In this case $PP$ solves the following maximization problem:

$$\max_{\{\bar{s},s,\alpha_{CA}\}} W^C(\bar{s},s) \tag{11}$$

$$s.t.\quad \gamma \geq \frac{1}{\rho'(s^C)F} - \frac{S(q^C)-S(q^M)-\alpha_{CA}(\triangle\pi+F)}{F}$$

$$\gamma \geq 0$$

$$\bar{s} \geq s \geq s^C$$

where $W^C(\bar{s},s)$ is given by (5). The first constraint derives from the **ICC** in (9), and it establishes the percentage $\gamma$ of $F$ needed to induce $CA$ to exerts an effort at least equal to $s^C$. The second constrain just establishes that the bonus allocated to $CA$ cannot be negative.[22] The third constraint tells us that the budget $\bar{s}$ allocated to $CA$ should be high enough to finance the effort $s$, that in turn has to be at least equal to the effort level $s^C$ needed to deter cartel behavior.

Since the objective function is strictly decreasing in both $\bar{s}$ and $s$, the solution is given by setting $\bar{s}^* = s^* = s^C$.

From (5), $PP$'s objective function takes the following value:

$$W^C(s^C) = S(q^C) + \alpha_{PP}\pi^C - s^C \tag{12}$$

As an important remark, note that competition is a feasible outcome if and only if the Right-hand-side (RHS from now on) in the constraint for $\gamma$ in (11) is lower or equal to one. This observation gives us the hint for the result that $\alpha_{CA}^* = 0$.[23] Indeed, even if $CA$ never collects the bonus $\gamma F$ when $M$ does not form, such that $PP$ is indifferent with respect to $\alpha_{CA}$, still lowering $\alpha_{CA}$ makes it more likely that competition is an achievable outcome.

We now analyze the case in which $PP$ chooses $\bar{s}$ and/or $\gamma$ such that $M$ forms. $PP$ solves the following maximization problem:

$$\max_{\{\bar{s},s,\alpha_{CA},\gamma\}} W^M(\bar{s},s,\gamma) \tag{13}$$

$$s.t.\quad \gamma \geq \frac{1}{\rho'(s)F} - \frac{S(q^C)-S(q^M)-\alpha_{CA}(\triangle\pi+F)}{F}$$

$$\gamma \geq 0$$

$$\bar{s} \geq s$$

$$s < s^C$$

where the first constraint is the **ICC**, the second constraint is the **LLC**, the

[22]This constraint might be interpreted as a *Limited-Liability Constraint* (**LLC**).

[23]Moreover note that if $\alpha_{CA} = 0$, then the problem in (8) is concave.

third one states that the budget allocated to $CA$ has to be at least equal to the budget $s$ spent by the latter, and where the last constraint states that the effort exerted by $CA$ is not enugh to deter $M$ from forming. Since the objective function is decreasing in $\bar{s}$ till the second constraint holds as an equality. Moreover we assume throughout the paper that the last constraint holds.

For the sake of crispness we disregard **LLC**, i.e. we assume that parameters values are such that **LCC** holds. The solution to the constrained maximization problem when **LLC** binds is relegated to Appendix 1. The implication of this assumption is that **ICC** is now an equality.[24]

By substituting the first and the second constraint in the objective function, and by disregarding the last constraint we get the following system of FOCs:

$$\frac{\partial L}{\partial s} = 0 \Longleftrightarrow \rho'(s)\left[\triangle S + (1-\beta)\left(S\left(q^C\right) - S\left(q^M\right) - \alpha_{CA}\left(\triangle\pi + F\right)\right)\right] + \qquad (14)$$

$$+ (1-\beta)\underbrace{\frac{\rho(s)\rho''(s)}{\left[\rho'(s)\right]^2}}_{\varphi(s)} = 2-\beta$$

$$\frac{\partial L}{\partial \alpha_{CA}} = 0 \Longleftrightarrow -(1-\beta)\rho(s)\left(\triangle\pi + F\right) = 0 \qquad (15)$$

where $\triangle S = \bar{S} - \underline{S}$.

The SOC holds if:

$$\rho''(s)\left[\triangle S + (1-\beta)\left(S\left(q^C\right) - S\left(q^M\right) - \alpha_{CA}\left(\triangle\pi + F\right)\right)\right] +$$

$$+\underbrace{\frac{\left[\rho'(s)\right]^2\left[\rho'(s)\rho''(s) + \rho(s)\rho'''(s)\right] - 2\rho'(s)\left[\rho''(s)\right]^2\rho(s)}{\left[\rho'(s)\right]^4}}_{B(s)}(1-\beta) < 0$$

From (15) we get $\alpha_{CA}^M = 0$, i.e. $PP$ prefers a consumers' surplus maximizer $CA$. The intuition for this result is straightforward: when the budget allocated to $CA$ is such that $M$ can profitably arise, then $CA$ collects the bonus $\gamma F$ in case it uncovers and fines $M$. For any given value of $s$ (i.e. effort), setting $\alpha_{CA} = 0$ reduces $\gamma$, thus it reduces the cost of incentivizing $CA$ to exert a given level of effort.

The solution to (14) gives us $s^M$, i.e. both the optimal budget level devoted by $PP$ to $CA$, and the optimal effort level exerted by the latter as a function of parameters' values. $PP$ equates the marginal benefit from increasing the budget allocated to $CA$ (deriving form the higher probability of re-establishing competition and collecting $F$, i.e. $\triangle S$), with the marginal cost of doing it,

[24] This statement is intuitive: since $\gamma$ is costly to $PP$, whenever she allocates to $CA$ a strictly positive $\gamma$, then it finds it profitable to also allocate a budget $\bar{s}$ such that $s(\gamma) = \bar{s}$.

deriving from *(i)* the higher budget, *(ii)* the higher probability of paying the bonus, and *(iii)* the higher bonus itself (captured by $\varphi(s)$ in (14)).

We also get

$$\gamma^M\left(s^M\right) = \frac{1}{\rho'\left(s^M\right)F} - \frac{S\left(q^C\right) - S\left(q^M\right)}{F} \tag{16}$$

i.e. the bonus associated to each level of budget devoted to $CA$. Intutively $\gamma^M$ is increasing in $s^M$, since a higher bonus is associated to a higher budget in order to induce $CA$ to effectively spend it.

We state the following assumption:

*Assumption 1*: either *(i)* $s^C$ in (10) is such that *(i)* $\frac{1}{\rho'(s^C)F} - \frac{S(q^C)-S(q^M)}{F}$ is greater than one, either/or *(ii)* $s^C$ is not achievable due to $PP$'s exogenous budget constraint, i.e. competition is not an achievable outocome for $PP$, either/or *(iii)* $W^C\left(s^C\right) < W^M\left(s^M\right)$.

Given Assumption 1, the following Proposition holds:

**Proposition 1**: *if Assumption 1 holds, in the benchmark game the Political Principal sets* $\bar{s} = s^M$ *and* $\gamma^M$ *as in* (16) *such that* $s = s^M$*, where* $s^M$ *is given by the solution to* (14).

**Proof**: See above.■

The comparitive statics of $s^M$ (and thus $\gamma^M\left(s^M\right)$) with respect to $\alpha_{PP}$, $\triangle\pi$ and $F$ can be performed. From (14), it is straightforward to note that $\alpha_{PP}$, $\triangle\pi$ and $F$ affect the marginal benefit from devoting a higher budget to $CA$ *via* its impact on $\triangle S$. More specifically we have:

**Proposition 2**: $s^M$*, and the associated* $\gamma^M\left(s^M\right)$*, are:*

1. *both decreasing in* $\alpha_{PP}$*,*
2. *both decreasing in* $\triangle\pi$*, and*
3. *increasing and ambiguous in* $F$ *respectively.*

**Proof**: first note that, from (15), $\gamma^M\left(s^M\right)$ is monotonically increasing in $s^M$. *Ceteris paribus*, from (14), given that $\pi^C - F - \pi^M < 0$ holds, the marginal benefit from increasing $s^M$ is decreasing in $\alpha_{PP}$, therefore point 1 in Proposition 2 follows. Moreover, *ceteris paribus*, the marginal benefit from increasing $s^M$ is decreasing in $\triangle\pi$, that establishes point 2 in Proposition 2.

Finally from (14), $F$ positively affects $s^M$, whilst from (15), the partial derivative $\gamma^M$ with respect to $F$ is ambiguous. ■

The intuition for the ambiguity of $\gamma^M$ with respect to $F$ is the following: $F$ positively affects $s^M$. Moreover, from **ICC** $CA$ is also incentivized to exert more effort. Therefore, all else equal, if $PP$'s desired new level of effort is higher then the new effort that $CA$ is willing to exert, then $\gamma^M$ increases with $F$, and viceversa.[25]

# 4 Non-benevolent Authority

We now analyze the case in which $CA$ is non-benevolent, i.e. $M$ is allowed offering a side-contract to $CA$ in order to induce the latter not to report evidence of cartel behavior to the Court of Law.

We assume that transferring \$1 to $CA$ costs to $M$ $\$(1+\mu)$, where $\mu$ is the shadow price of transfers. Indeed transfers are not fully efficient due to organizational costs and to other exogenous variables that can affect the relative importance of interest groups.[26]

With respect to the timing of the benchmark game, we divide stage 4 into three intermediate stages:

- 4a: if $q^M$ is realized, $CA$ opens an investigation that costs $s$. With probability $\rho(s)$ $CA$ finds evidence $(e)$ regarding $M$, whilst with probability $1-\rho(s)$ it is not able to find any evidence $(\emptyset)$.
- 4b: $M$ observes if $CA$ observed $e$ or $\emptyset$, and in case $CA$ observed $e$, $M$ decides to propose or not to propose a side-contract to $CA$ in order to induce the latter not to report $e$ to the Court of Law.[27]
- 4c: $CA$ makes a report $r \in \{e, \emptyset\}$ to the Court of Law and, in case $r = e$, $M$ incurs a fine $F$.

We highlight that $e$ is "hard" information, that is in case $CA$ finds $e$ regarding $M$, it can hide $e$ from the Court of Law but it cannot manipulate $e$. This implies that in case $CA$ observes $e$, then it can make a report $r \in \{e, \emptyset\}$. On the other hand in case $CA$ observes $\emptyset$, it can just report $r = \emptyset$.

We solve the game backward. Assume first that $\emptyset$ has been observed by $CA$ in stage 4a. Since $M$ anticipates that in stage 4c $CA$ makes the report $r = \emptyset$, in stage 4b it does not propose any side-contract to $CA$.

On the other hand, assume that $e$ has been observed by $CA$ in stage 4a and that in stage 4b $M$ proposes a side-contract to $CA$ consisting of a transfer $t(r) \in \{t(e), t(\emptyset)\}$.

In stage 4c $CA$ accepts to make a report $r = \emptyset$ if the following inequality holds:

[25] Note that, in a framework where industries are differentiated with respect to anti-competitive profits, increasing $F$ will have the further effect of increasing the rate of deterrence of anti-competitive behavior.

[26] See Laffont and Tirole (1991). Side transfers are not efficient due to the presence of legal sanctions for bribing public officials also (Polinsky and Shavell (2001)).

[27] Clearly there is no motivation for $M$ offering a side-contract to $CA$ in case the latter does not find any evidence.

$$t(\emptyset) \geq S\left(q^{C}\right) - S\left(q^{M}\right) - \alpha_{CA}(\triangle\pi + F) + \gamma F$$

$(\triangle\pi + F)$ represents the "stake in collusion" between *CA* and *M*, i.e. the difference between *M*'s profits in case *CA* observes $e$ and does not report it to the Court of Law ($r = \emptyset$), and *M*'s profits in case *CA* observes $e$ and reports it to the Court of Law ($r = e$):

$$\pi^{M} - \left(\pi^{C} - F\right) = \triangle\pi + F$$

The stake of collusion represents the maximal amount that *M* is willing to pay to *CA* in order to induce the latter not to make a report $r = e$. Collusion between *M* and *CA* arises if the following inequality holds:

$$\underbrace{\triangle\pi + F}_{stake\ in\ collusion} > \underbrace{\left[S\left(q^{C}\right) - S\left(q^{M}\right) - \alpha_{CA}(\triangle\pi + F) + \gamma F\right]}_{t(\emptyset)}(1+\mu) \tag{17}$$

i.e. the stake in collusion has to be greater or equal to the cost of the transfer $(1+\mu)\,t(\emptyset)$. (17) rewrites as:

$$\gamma < \underbrace{\frac{(\triangle\pi + F)}{F}(k + \alpha_{CA}) - \frac{S\left(q^{C}\right) - S\left(q^{M}\right)}{F}}_{\gamma^{B}(k)} \tag{18}$$

where $k = \frac{1}{1+\mu} \in [0,1]$ is the efficiency of the bribing technology, and where $\gamma^{B}(k)$ is increasing in $k$. We define the reversed inequality in (18) (i.e. $\gamma \geq \gamma^{B}(k)$) as the Collusion Proofness Constraint (from hereby **CPC**).

## 4.1 Case 1: Unprofitable Bribing

If the bribing technology is not efficient enough, bribing *CA* is too costly to *M* and a profitable bribing agreement does not exist. We have:

**Proposition 3**: *assume* $\gamma^{M}\left(s^{M}\right) > 0$, *then if* $k \leq \frac{1}{\rho'(s^{M})(\triangle\pi+F)} = \underline{k}$ *PP does not distort her choice with respect to the benchmark game.*[28]

**Proof**: if $k \leq \underline{k}$ then $\gamma^{M}\left(s^{M}\right) \geq \gamma^{B}(\underline{k})$, i.e. the bonus paid to *CA* in order to incentivize it to find evidence, it is high enough to make **CPC** hold.$\blacksquare$

[28] The result for the case in which $\gamma^{M}\left(s^{M}\right) = 0$ is analyzed in Appendix 2.

This result goes against the common wisdom according to which bribing makes deterrence harder. If $k \leq \underline{k}$, i.e if lobbying technology is inefficient enough, the incentive contract paid to $CA$ is high enough to deter bribing.[29]

## 4.2 Case 2: Profitable Bribing

We now analyze the case in which bribing technology is efficient enough to make the incentive scheme designed by $PP$ not generous enough to deter collusion between $M$ and $CA$.

The intuition is the following: when bribing technology is efficient enough, **CPC** does not hold, i.e. a profitable side-contract might be signed between $M$ and $CA$. In this case, absent any intervention by $PP$, dilution of cartel deterrence arises. In order to avoid this outcome, $PP$ designs a collusion-proof mechanism by devoting to $CA$ a higher bonus that is increasing in the bribing technology's efficiency level.

At first, the budget allocated to $CA$ is increasing in the bribing technology efficiency parameter ($k$). This movement is driven by the willingness to exert a higher effort by $CA$ given the higher bonus. When the bonus gets costly enough, $PP$ finds it profitable to restrict $CA$'s action space by devoting a lower budget with respect to the maximal one that the latter would be willing to spend. The rational for this choice consists in the bonus being so costly that $PP$ finds it profitable to pay it with a lower probability. Therefore, in this range of $k$'s values, the budget is decreasing in $k$.

Finally, for very high values of $k$, the budget reaches the level of zero, i.e. $PP$ does not find it profitable to set up $CA$.

The following result holds:

**Proposition 4**: *if* $k > \underline{k}$ *PP sets* $\alpha_{CA}^{B} = 0$ *and* $\bar{s}^{B}(k) = s^{B}(k)$, *such that:*

1. $s^{B}(k) = \rho'^{-1}\left(\frac{1}{k(\triangle\pi+F)}\right)$ *is increasing in* $k$ *for* $\underline{k} < k \leq \hat{k}$, *where* $\hat{k} = \frac{\triangle S+(1-\beta)\left[S\left(q^{C}\right)-S\left(q^{M}\right)\right]}{(2-\beta)(\triangle\pi+F)}$,
2. $s^{B}(k) = \rho'^{-1}\left(\frac{1}{\triangle S-(1-\beta)[k(\triangle\pi+F)-S(q^{C})+S(q^{M})]}\right)$ *is decreasing in* $k$ *for* $\hat{k} < k \leq \bar{k}$, *where* $\bar{k} \mid \frac{\partial s^{B}(k)}{\partial k} = 0$,
3. $s^{B}(k) = 0$ *for* $\bar{k} < k \leq 1$.

**Proof**: see Appendix 2. ■

Clearly it might be the case that for some parameter values one or more of the thresholds on $k$ is higher than one. In this case, it is straightforward to derive the equilibrium budget behavior.

When collusion between $CA$ and $M$ matters (i.e. for $k \in (\underline{k}, 1]$), the movement in $s$ and $\gamma$ are not anymore positively correlated. For high enough levels

[29] For a similar result in a three-tier hierarchy *Principal-Supervisor-Agent* with moral hazard and adverse selection see Angelucci, Mattera and Meraglia (2010).

of the bribing technology, $PP$ lowers the budget devoted to $CA$ while increasing the bonus $\gamma$.

Figure 1 plots the equilibrium budget $s^B$ as a function of the bribing efficiency technology *k:*

[Insert Figure 1 here]

### 4.3 Comparative Statics

The same comparitive statics exercise as in Section 3.3 can be performed here. This analysis is performed for different values of $k$, since the equations determining both $s^B$ and $\gamma^B$ vary as $k$ varies. We have:

**Proposition 5**: *The following comparative statics hold:*

1. *all else equal, the thresholds* $\left\{\underline{k}, \hat{k}, \bar{k}\right\}$ *and* $s^B$ *are respectively decreasing and non-increasing in* $\alpha_{PP}$*;*
2. *all else equal, the thresholds* $\left\{\underline{k}, \hat{k}, \bar{k}\right\}$ *and* $s^B$ *are respectively decreasing and non-monotone in* $\triangle\pi$*;*
3. *all else equal, the thresholds* $\left\{\underline{k}, \hat{k}, \bar{k}\right\}$ *and* $s^B$ *are ambiguous in F.*

**Proof**: See Appendix 2. ■

An upward movement in $\alpha_{PP}$ triggers a downward movement in all the thresholds $\underline{k}$, $\hat{k}$ and $\bar{k}$. Thus a higher $\alpha_{PP}$ causes a reduction of the range of values for $k$ such that Proposition 3 holds (i.e.$\swarrow \underline{k}$), given the lower budget $s^M$ and the consequential lower $\gamma^M$. This result emphasizes the role played by $PP$'s degree of internalization of firms' profits in making bribing profitable for relatively inefficient values of the bribing technology.

An upward movement in $\alpha_{PP}$ also triggers a lower $\hat{k}$ *via* its effect on $PP$'s lower willigness to invest in $CA$'s budget. This also explains why a higher $\alpha_{PP}$ causes a reduction of the range of values for $k$ such that $PP$ finds it profitable devoting a non-zero budget to $CA$ (i.e.$\swarrow \bar{k}$). More generally, all else equal, the higher $\alpha_{PP}$, the lower $s^B$.

An upward movement in $\triangle\pi$ also makes all the thresholds for $k$ moving downward. Intuitively, as $\triangle\pi$ increases, $\underline{k}$ decreases because *(i)* $\gamma^M\left(s^M\right)$ decreases, *(ii)* the stake in collusion between $CA$ and $M$ increases. Both effects imply that, all else equal, higher anti-competitive profits make bribing matter for a higher range of the bribing technology's efficiency values.

The effect in *(ii)* also accounts for the downward movement in $\hat{k}$, jointly with the effect deriving from $PP$ preferring devoting a lower budget to $CA$ as $\triangle\pi$ increases.[30] Finally the impact of $\triangle\pi$ on $PP$'s willingness to invest in $s$ is responsible for the downward movement in $\bar{k}$.

[30] $\triangle\pi$ negatively affects $PP$'s willingness to invest in $s$ in two ways: the first is the one pointed out in Proposition 2, the second one comes from a higher $\triangle\pi$ implying a higher $\gamma$ to be devoted to $CA$.

The effect in *(ii)* differentiates this comparative static analysis from the one performed with respect to $\alpha_{PP}$ and points out the role played by the stake in collusion between *CA* and *M*. Therefore it is also responsible for an increment in $s^B$ for a moderate range of values of $k$.[31]

Finally we analyze the effect of an upward movement in $F$. Two contrasting effects affect $\underline{k}$. On one side a higher $F$ makes $s^M$ higher, thus $\nearrow \underline{k}$; on the other side $F$ positively affects the stake in collusion, thus inducing $\swarrow \underline{k}$.

This last effect derives from a higher stake in collusion inducing *CA* to exert a higher effort $\forall k$, and it is also responsible for a partial downward movement in $\hat{k}$. However $\hat{k}$ is also affected by the movement in *PP*'s desired level of budget. Here the effect of a higher $F$ is ambiguos since, when choosing to invest in $s$, *PP* trades-off the positive effect deriving from the profitable redistribution of $F$ from producers to consumers ($\forall \alpha_{PP} < 1$) and the cost related to the increasing bonus left to *CA*. The final effect is an ambiguity in the movement in both $\hat{k}$ and $\bar{k}$ and, generally, an ambiguity in the movement in $s^B$. It is possible to show that for low enough values of $\alpha_{PP}$ (and/or high enough values of $\beta$) such that the positive redistribution effect dominates, then the budget $s^B$ is unambiguously non-decreasing in $F$ (even if the movement in $\hat{k}$ may remain ambiguous).

When we turn to the bonus devoted to the Competition Authority, we have:

**Proposition 6**: *The following comparative statics for the equilibrium bonus* $\gamma^B$ *hold:*[32]

1. *all else equal,* $\gamma^B$ *is non-increasing with respect to* $\alpha_{PP}$*;*
2. *all else equal,* $\gamma^B$ *is non-monotonic in* $\triangle\pi$.

**Proof**: See Appendix 2. ■

The analysis is not straightforward since the thresholds in $k$ move with respect to movements in both $\alpha_{PP}$ and $\triangle\pi$.

The first point in Proposition 6 is intuitive. $\alpha_{PP}$ negatively affects the budget devoted to *CA*, that in turn negatively affects the bonus $\gamma$ for values of $k$ such that the coalition *CA-M* does not form. When $k$ is high enough to make collusion between *CA* and *M* matter, then $\gamma^B = \gamma^B(k)$ is not affected by $\alpha_{PP}$.

When $\triangle\pi$ moves, the effect is as in the comparative statics with respect to $\alpha_{PP}$ for values of $k$ such that the coalition *CA-M* does not form. However, when collusion matters, $\triangle\pi$ also positively affects the stake in collusion between *CA* and *M*. This effect makes $\gamma^B$ being increasing in $\triangle\pi$ in this range of values for $k$. A full analysis based on discrete movement in $\triangle\pi$ is contained in the proof of the Proposition.

Proposition 6 does not deal with the comparative static with respect to $F$ due to the ambiguity in the movement in $\underline{k}$. However, the general rule is that the bonus is increasing in $F$ due to its effect on the stake in collusion.

[31] For technical details see Appendix 2.

[32] Clearly, given that $\bar{k} \leq 1$, for $k \in [\bar{k}, 1]$ the bonus is equal to zero since *CA* is not set up.

# 5 Non-benevolent Political-Principal

In this section we characterize the equilibrium in a game in which $M$ can propose a take-it-or-leave-it offer to $PP$, that is $M$ proposes a transfer schedule $t(s)$ to $PP$ in order to induce the preferred level of budget to be allocated to the benevolent $CA$.

With respect to the timing of the benchmark game, we add a preliminary stage 0 in which $M$ proposes a side-contract to $PP$.

As in the case of side-contracting between $M$ and $CA$, making side-transfers is costly to the former. More specifically we assume that transferring \$1 to $PP$ costs to $M$ $\$(1+\zeta)$, where $\zeta$ is the shadow price of transfers.[33]

Given Assumption 1, we know that in absence of any side-contract proposed by $M$, $PP$ maximizes its objective function for a value $s = s^M$ and $\alpha_{CA}^M = 0$. In presence of a side-contract between $M$ and $PP$, it might be the case that the latter would be willing to allocate to $CA$ a budget $s_{PP}^B < s^M$. We assume that $M$ cannot lobby for $\alpha_{CA}$, thus we still know that the parameter is set to zero.[34]

Let us define $\nu = \frac{1}{1+\zeta} \in [0,1]$. Moreover assume the following specific functional form for $\rho(s)$:

$$\rho(s) = \left(\frac{s}{\hat{s}}\right)^{\tau} \tag{19}$$

where $\tau < 1$, and where $\hat{s}$ represents an exogenous cap on $s$.[35]

For the sake of semplicity, we assume $\tau = \frac{1}{2}$, but the following result holds $\forall \tau \in (0,1)$.[36]

We have:

**Proposition 7**: *Given* (19)*, the following result holds:*

1. *for* $\nu = 0$ $s_{PP}^B(0) = s^M$,
2. *for* $0 < \nu \leq \bar{\nu}$, $s_{PP}^B(\nu) < s^M$ *is decreasing in* $\nu$,
3. *for* $\bar{\nu} \leq \nu \leq 1$, $s_{PP}^B(\nu) = 0$,

*where* $\bar{\nu}$ *is the threshold for* $\nu$ *below which* $M$*'s optimization problem is concave.*

**Proof**: See Appendix 2. ■

Clearly it might be the case that $\bar{\nu} > 1$; in this case the budget $s_{PP}^B(\nu)$ is decreasing in $\nu$ and never reaches the zero level.

[33] The shadow price of transfers depends on who $M$ is targeting. Bribing $PP$ entails different costs with respect to bribing $CA$. For instance $M$ might bribe a politician by contributing to political campaigns (Political Action Committees).

[34] The same reasoning as in Section 3 applies. The computation throughout the Section takes $\alpha_{CA} = 0$ as given.

[35] For instance $\hat{s}$ may derive from $PP$'s exogenous budget constraint.

[36] The proofs are avalaible from the authors on request.

The result in Proposition 7 highlights how bribing the policymaker in charge of allocating a budget to $CA$ might also explain the absence of the latter (i.e. $s_{PP}^{B}=0$) and relates it to the efficiency of the bribing technology.

Recall that, from $CA$'s **ICC**, we also have that the bonus $\gamma$ is a decreasing function of $s$, thus bribing of $PP$ may also explain the evidence related to the absence of countries allocating a bonus to $CA$.

Figure 2 plots the equilibrium budget $s_{PP}^{B}$ as a function of the bribing efficiency technology $\nu$*:*

[Insert Figure 2 here]

### 5.1 Comparative Statics

As a comparative statics exercise, we analyze the effect of a variation in $\alpha_{PP}$, $\triangle\pi$ and $F$ on the equilibrium result.

**Proposition 8**: *The following comparative statics hold:*

1. *all else equal, the thresholds $\underline{\nu}$ and $s_{PP}^{B}$ are respectively decreasing and non-increasing in $\alpha_{PP}$;*

2. *all else equal, the thresholds $\underline{\nu}$ and $s_{PP}^{B}$ are respectively decreasing and non-increasing in $\triangle\pi$;*

3. *all else equal, the thresholds $\underline{\nu}$ and $s_{PP}^{B}$ are both ambiguous in $F$.*

**Proof**: See Appendix 2. ■

As we might expect, an upward movement in $\alpha_{PP}$ makes the threshold $\bar{\nu}$ move downward, since $PP$ attaches a higher value to industry's profits.[37]

Moreover the very same result holds when we perform a comparative static exercise with respect to $\triangle\pi$. However in this case two separated and mutual reinforcing effects are at work: all else equal, *(i)* the higher $\triangle\pi$, the lower the marginal cost to $PP$ from decreasing $s$, thus the lower the marginal transfer from $M$ to $CA$, and *(ii)* the higher $\triangle\pi$, the higher the marginal benefit to $M$ from inducing a budget $s_{PP}^{B}<s^{M}$. Both effects accounts for the movement in $s_{PP}^{B}$ (and the associated $\gamma^{B}\left(s_{PP}^{B}\right)$) and $\bar{\nu}$.

Finally, when we analyze the effect of an increase in $F$. As in the comparative statics with respect to $\triangle\pi$, still two effects are at work, but they go in opposite directions: all else equal, *(i)* the higher $F$, the higher the marginal cost to $PP$ from decreasing $s$, thus the higher the marginal transfer from $M$ to $CA$, and *(ii)* the higher $F$, the higher the marginal benefit to $M$ from inducing a budget $s_{PP}^{B}<s^{M}$. This gives rise to the ambiguity in the movement in both $\underline{\nu}$ and $s_{PP}^{B}$.

[37]For instance the parameter $\alpha_{PP}$ can capture changes in the yearly budget devoted to the national Competition Authority due to switches in political parties in power. See Bittlingmayer (2001) for empirical budget allocation to Federal Trade Commission and Department of Justice-Antitrust Division due to switches in the US administration.

If we assume that the bribing technology is the same whoever the bribes' receiver, i.e. if we assume $k = \nu$, then we can compare $\bar{k}$ to $\bar{\nu}$. Since $\bar{\nu} < \bar{k}$, then this comparison allows us to state that corruption of $PP$ is more likely to be responsible for the absence of $CA$ in a given country.

# 6 Concluding Comments

The three-tier model presented in this paper fits well many of the developed countries institutional structures, where a Competition Authority gets its funding from the Government in order to monitor firms' competitive behavior. Notwithstanding Competition Authorities are considered independent from Government interventions, this constitutes a mean by which a Government is able to influence the Antitrust effectiveness within a country.

Given this institutional framework, we show that a sub-optimal level of budget may derive from two sources: *(i)* bribing of the law enforcement agency (the Competition Authority), or *(ii)* bribing of the Political Principal.

In the former case, a movement in the budget is due to potential collusion between Competition Authority and misbehaving firms. We show that for high enough levels of the bribing technology, the budget moves non-monotonically in the bribing technology's efficiency parameter. Potential corruption of the Competition Authority first induces a higher budget *via* a higher bonus allocated to the Authority. When bribing technology becomes very efficient, the high bonus paid to the Authority makes setting up the latter very costly to the Political Principal, inducing her to cut the budget and to constraint the effort of the Authority, until the latter is devoted a zero budget.

In the latter case (i.e. Political Principal - Firms collusion), the budget devoted to the Authority is monotonically decreasing in the bribing efficiency technology, until the Authority is again not allowed to exist. Compared to the previous case, here the bonus allocated to the Authority is positively correlated to the budget.

Our model provides two explanations for the observation of a zero bonus (in terms of a percentage of the fine) devoted to Competition Authorities around the world.[38] First, a zero bonus may be optimal even in presence of benevolent Authority and Political Principal. Second, it may be the consequence of bribing of the Political Principal. Interestingly, the analysis of the two cases suggest that a zero bonus might be observed for both low and high values of the bribing technology efficiency parameter.

Moreover we emphasize the importance of the Government's internalization of industry profits with respect to consumers' welfare, as it is given by the parameter $\alpha_{PP}$. The higher $\alpha_{PP}$, the lower the budget level in equilibrium.

[38]However recall that paying rewards for catching cartels may create a distortion in the allocation of the Authority's effort among different tasks. See also Polinsky and Shavell (2001). In their model giving high rewards to law enforcers in order to induce them to report violations of law could not be optimal since this would also give them an incentive to frame or extort innocent individuals.

Fluctuations in the yearly budget devoted to national Competition Authorities are not uncommon. Our model is able to explain those fluctuations and to link them to changes in the Governments' degree of internalization of industry profits.[39]

Extra-profits deriving from anti-competitive behavior and the fine also play an important role. Generally speaking, higher extra-profits foster corruption, thus confirming the idea according to which collusion and corruption are strategic complements *via* the effect on the stake in collusion between Firms and either the Competition Authority, either the Political Principal. On the other hand, the fine as an ambiguous effect on the budget devoted to the Authority in equilibrium. In fact, on one side it positively affects the stake in collusion between Authority and Firms, thus fostering corruption; on the other side it makes the Principal more willing to invest in financing the Auhtority's budget, thus hampering corruption.

Finally, we show that the Political Principal prefers a consumers' surplus maximizer Competition Authority. An Authority more focused on consumers' surplus is more willing to exert monitoring effort. This is always optimal for the Principal, since the latter is able to control the optimal amount of effort through the budget.

To the best of our knowledge the Competition Authority's budget has always been considered as exogenous. In this paper we propose a first attempt in trying to endogenize it. Moreover, by analyzing a mean by which bureaucrats' corruption could be discouraged, we hope that our model could also constitute a step forward in the understanding of the issue related to the Competition Authority financing.

Finally, our paper's result - that colluding agents may be able to affect the budget devoted to the law enforcement agency *via* corruption of the latter or of the Political Principal - may hold in a different framework - i.e. firms as mafia families. It is well known how, in areas where the power is concentrated among few powerful mafia families, the latter jointly exert influence over both law enforcers in charge of providing punishments for violations, and politicians in charge of designing and passing anti-mafia laws and of devoting the budget to law enforcement agencies.[40]

As a matter of future research, endogenizing the Political Principal's choice of the fine seems to be an interesting topic to explore.

[39] Note that even other exogenous contingencies could affect the yearly budget devoted to a national Competition Authority. For instance during war-periods Governments could prefer restraining the antitrust enforcement by dedicating a lower budget to the Competition Authority in exchange for firms exerting a war effort. This would explain variations in the budget within the same administration. See Bittlingmayer (2001).

[40] See Gratteri and Nicaso (2009) for instances of mafia families jointly lobbying the policy-maker. On the same topic see also Anderson (1995), and the related discussion to the paper (Franzini (1995)).

## References


[1] Anderson, A. (1995) "Organised Crime, Mafia and Governments", in Fiorentini, G. and S. Peltzman, eds., *The Economics of Organized Crime*, Cambridge University Press, pp. 33-54.

[2] Angelucci, C. - Mattera, G. - Meraglia, S. (2010) "Endogenous Information Gathering and Collusion in Hierarchies", Mimeo.

[3] Aubert, C. - Kovacic, W. - Rey, P. (2006) "The Impact of Leniency and Whistleblowing Programs on Cartels", in *International Journal of Industrial Organization*, Vol. 24, No. 6, pp. 1241-1266.

[4] Batra, G. - Kaufmann, D. - Stone, A.H.W. (2003) "Investment Climate Around the World: Voices of the Firms in the World Business Environment Survey", *The World Bank IBRD*.

[5] Becker, G. S. - Stigler, G. J. (1974) "Law Enforcement, Malfeasance, and Compensation of Enforcers", in *Journal of Legal Studies*, Vol. 3, No. 1, pp. 1-18.

[6] Berti, L. - Pezzoli, A. (2010) "Stagioni dell' Antitrust. Dalla Tutela della Concorrenza alla Tutela del Consumatore", Università Bocconi Edizioni.

[7] Bittlingmayer, G. (2001) "Regulatory Uncertainty and Investment: Evidence from Antitrust Enforcement", in *Cato Journal*, Vol. 20, No. 3, pp. 295-325.

[8] Calvert, R.L. - McCubbins, M.D. - Weingast, B.R. (1989) "A Theory of Political Control and Agnecy Discretion", in *American Journal of Political Science*, Vol. 33, pp. 588-611.

[9] Compte, O. - Lambert-Mogiliansky, A. - Verdier, T. (2005) "Corruption and Competition in Procurement", in *The RAND Journal of Economics*, Vol. 36, No. 1, pp. 1-15.

[10] Faure-Grimaud, A. - Laffont, J.J. - Martimort, D. (2000) "A Theory of Supervision with Endogenous Transaction Costs", in *Annals of Economics and Finance*, Vol. 1, pp. 231-263.

[11] Faure-Grimaud, A. - Martimort, D. (2003) "Regulatory Inertia", in *The RAND Journal of Economics*, Vol. 34, No. 3, pp. 413-437.

[12] Franzini, M. (1995) Discussion on "Organised Crime, Mafia and Governments" by Anderson, A., in Fiorentini, G. and S. Peltzman, eds., *The Economics of Organized Crime*, Cambridge University Press, pp. 54-60.

[13] Gratteri, N. - Nicaso, A. (2009) "La Malapianta. La mia lotta contro la 'ndrangheta", *Collezione strade blu*, Arnoldo Mondadori Editore S.p.a., Milano.

[14] Laffont, JJ. - Tirole, J. (1991) "The Politics of Government Decision-Making: A Theory of Regulatory Capture", in *The Quarterly Journal of Economics*, Vol. 106, No. 4, pp. 1089-1127.

[15] Moran, M. J. - Weingast, B. R. (1983) "Bureaucratic Discretion or Congressional Control? Regulatory Policymaking by the Federal Trade Commission", in *The Journal of Political Economy*, Vol. 91, No. 5, pp. 765-800.

[16] Motta, M. (2004) "Competition Policy. Theory and Practice", *Cambridge University Press.*

[17] Motta, M. - Polo, M. (2003) "Leniency Programs and Cartel Prosecution", in *International Journal of Industrial Organization*, Vol. 21, No. 3, pp. 347-379.

[18] Neven, D.J. - Röller, L.H. (2005) "Consumers Surplus vs Welfare Standard in a Political Economy Model of Merger Control", in *International Journal of Industrial Organization*, Vol. 23, Issue 9-10, pp. 829-848.

[19] Polinsky, A. M. - Shavell, S. (2001) "Corruption and Optimal Law Enforcement", in *Journal of Public Economics*, Vol. 81, Issue 1, pp. 1-24.

[20] Sabbatini, P. (2009) " Funding the Budget of a Competition Authority with Fines it Imposes" , Mimeo.

[21] Søreide, T. (2006) "Beaten by Bribery: Why not Blow the Whistle", in *CMI Working Papers.*

[22] Spagnolo, G. (2003) "Divide et Impera. Optimal Deterrence Mechanisms against Cartels and Organized Crime", Mimeo, Mannheim.

[23] Stigler, G. J. (1971) " The Theory of Economic Regulation", in *The Bell Journal of Economics and Management Science*, Vol. 2, No. 1, pp. 3-21.

[24] Tirole, J. (1986) "Hierachies and Bureaucracies: On the Role of Collusion in Organizations", in *Journal of Law, Economics, and Organization*, Vol. 2, No. 2, pp. 181-214.

[25] Werden, G. J. (2004) "Economic Evidence on the Existence of Collusion: Reconciling Antitrust Law with Oligopoly Theory", in *Antitrust Law Journal*, Vol. 71, No. 3, pp. 719-800.

# Appendix 1

In this Appendix we first solve for the constrained maximization problem in (13) when **LLC** is binding. This means that **ICC** now gives an upper bound for the effort exerted by $CA$, i.e. we have:

$$\rho'(s) \geq \frac{1}{S(q^C) - S(q^M) - \alpha_{CA}(\triangle\pi + F)}$$

Thus the Lagrangian writes as:[41]

$$L = \rho(s)[\triangle S] - \underline{S} - s + \xi \left[\rho'(s) - \frac{1}{S(q^C) - S(q^M)}\right]$$

where $\xi$ is the multiplier.

The complementary slackness conditions are given by:

$$\xi \geq 0$$
$$\xi \left[\rho'(s) - \frac{1}{S(q^C) - S(q^M)}\right] = 0$$

The FOC is given by:

$$\frac{\partial L}{\partial s} = 0 \Longleftrightarrow \rho'(s)\triangle S + \xi\rho''(s) = 1 \tag{20}$$

Thus either $\xi = 0$, i.e. $\rho'(s) > \frac{1}{S(q^C)-S(q^M)}$, and from (20) the solution is such that $\rho'(s) = \frac{1}{\triangle S}$, or $\xi > 0$ and the solution is such that $\rho'(s) = \frac{1}{S(q^C)-S(q^M)}$. In the latter case, from (20) it also clear that we have $\rho'(s) > \frac{1}{\triangle S}$.

By a comparison of this inequalities in both cases (i.e. for both $\xi = 0$ and $\xi > 0$), it is possible to conclude that *(i)* if $\alpha_{PP} < \frac{F}{\triangle\pi+F}$ then $\rho'\left(s^M\right) = \frac{1}{S(q^C)-S(q^M)}$, and *(ii)* if $\alpha_{PP} > \frac{F}{\triangle\pi+F}$ then $\rho'\left(s^M\right) = \frac{1}{\triangle S}$.

# Appendix 2

We first analyze the result in Proposition 3 for the case in which $\gamma^M\left(s^M\right) = 0$. Given that, we have that bribing does not affect the solution chosen by $PP$ if $0 \geq \gamma^B(k)$, i.e. if:

$$k \leq \frac{S\left(q^C\right) - S\left(q^M\right) - \alpha_{CA}(\triangle\pi + F)}{(\triangle\pi + F)} = \underline{k} \tag{21}$$

[41] We set $\alpha_{CA} = 0$, see Section 3.3.

that gives the new value for $\underline{k}$.

Note the impact of $\alpha_{CA}$. Intuitively it is still optimal for $PP$ to set $\alpha_{CA}=0$ since it allows a wider range of values of $k$ such that collusion between $CA$ and $M$ is deterred. Thus a consumers' maximizer $CA$ also has a value in terms of deterring corruption.

Finally, from the analysis in Appendix 1 we know that $\rho'\left(s^M\right) \leq \frac{1}{S(q^C)-S(q^M)}$ when $\gamma^M\left(s^M\right)>0$. Thus comparing $\underline{k}$ when $\gamma^M\left(s^M\right)=0$ to $\underline{k}$ when $\gamma^M\left(s^M\right)>0$ (see Proposition 3), it is straightforward to show that $\underline{k}_{|\gamma^M=0} \leq \underline{k}_{|\gamma^M>0}$.

**Proof of Proposition 4**: if $k>\underline{k}$, then **CPC** does not hold when $\gamma=\gamma^M\left(s^M\right)$. Since $PP$ sets $\gamma=\gamma^B(k)$ in order to make **CPC** hold, then the new maximal effort exerted by $CA$ is given by the solution to the following constrained maximization problem:

$$s = arg\max_{\tilde{s}\in[0,\bar{s}]} \ \rho(\tilde{s})\left[S\left(q^C\right)+\alpha_{CA}\left(\pi^C-F\right)+\gamma F\right]+$$

$$+\left(1-\rho(\tilde{s})\right)\left[S\left(q^M\right)+\alpha_{CA}\pi^M\right]-\tilde{s}$$

$$s.t. \ \ \gamma=\gamma^B(k)$$

The FOC is given by:

$$\rho'(s)=\frac{1}{k(\triangle\pi+F)} \tag{22}$$

Given $\rho''(s)<0$, the SOC holds. (22) gives us the maximal amount of budget spent by $CA$ when $\gamma=\gamma^B(k)$.

$PP$ solves the following constrained maximization problem:

$$\max_{\{\bar{s},s,\alpha_{CA}\}} W^M(\bar{s},s,\gamma) \tag{23}$$

$$s.t. \ \ \gamma=\gamma^B(k)$$

$$\bar{s}\geq s$$

$$\rho'(s)\geq\frac{1}{k(\triangle\pi+F)}$$

where the second constraint holds as an equality. The last constraint means that the effort required from $CA$ will not be higher than the one induced by $\gamma^B(k)$.

The Lagrangian of $PP$'s optimization problem writes as:

$$L=\rho(s)[\triangle S]-\underline{S}-\rho(s)(1-\beta)\left[(\triangle\pi+F)(k+\alpha_{CA})-\left(S\left(q^C\right)-S\left(q^M\right)\right)\right]+$$

$$-s+\lambda\left[\rho'(s)-\frac{1}{k(\triangle\pi+F)}\right]$$

The system of FOCs with respect to $\alpha_{CA}$, $s$ and $\lambda$ respectively, is given by:

$$\frac{\partial L}{\partial \alpha_{CA}}=0 \Longleftrightarrow -\rho(s)(1-\beta)(\triangle\pi+F)<0 \tag{24}$$

$$\frac{\partial L}{\partial s}=0 \Longleftrightarrow \rho'(s)\left[\triangle S-(1-\beta)\left((k+\alpha_{CA})(\triangle\pi+F)-S\left(q^{C}\right)+S\left(q^{M}\right)\right)\right]+\lambda\rho''(s)=1 \tag{25}$$

$$\rho'(s)\geq\frac{1}{k(\triangle\pi+F)}$$

and where we have the complementary slackness conditions:

$$\lambda\geq 0$$

$$\lambda\left[\rho'(s)-\frac{1}{k(\triangle\pi+F)}\right]=0$$

From (24) we have $\alpha_{CA}^{B}=0$.
From (25) and the complementary slackness conditions, if the last constraint in (22) is binding, thus the solution to $s$ is given by:

$$\rho'(s)=\frac{1}{k(\triangle\pi+F)} \tag{26}$$

otherwise, the constraint is not binding and $\lambda=0$, thus the solution to $s$ is given by:

$$\rho'(s)=\frac{1}{\triangle S-(1-\beta)\left[k(\triangle\pi+F)-S(q^{C})+S(q^{M})\right]} \tag{27}$$

The equality in (26) gives us the maximal budget that $CA$ is willing to spend as an increasing function of $k$. The intuition is straightforward: *ceteris paribus*, the higher $k$, the higher $\gamma^{B}(k)$, thus the higher the budget that $CA$ is willing to spend (i.e. the effort it is willing to exert).

The equality in (27) gives us the maximal budget $PP$ would like $CA$ to spend as a decreasing function of $k$. *Ceteris paribus*, the higher $k$, the higher $\gamma^{B}(k)$, the more costly to $PP$ the bonus allocated to $CA$ for each given level of budget devoted to it (i.e. the lower the fraction of $F$ collected).

The two functions cross in $k=\hat{k}=\frac{\triangle S+(1-\beta)\left[S\left(q^{C}\right)-S\left(q^{M}\right)\right]}{(2-\beta)(\triangle\pi+F)}$. By comparing the RHS in (26) and (27), $s^B$ is given by (26) for $\underline{k}<k\leq\hat{k}$, that establishes point 1 in Proposition 4.

Moreover note that, form (24), we have $s^B\left(\underline{k}\right)=s^M$, that also establishes continuity in $s$ when we pass from the "unprofitable collusion" case to the "profitable collusion" one.

Consider now values of $k>\hat{k}$, and let us define the denominator in (27) as $A\left(k\right)$, and $\bar{k}=\frac{\triangle S+(1-\beta)\left[S\left(q^{C}\right)-S\left(q^{M}\right)\right]}{(1-\beta)(\triangle\pi+F)}$.[42] Then we have:

$$A\left(k\right)>0,\;\;A'\left(k\right)<0\quad for\;\;k<\bar{k}$$

$$A\left(\bar{k}\right)=0$$

$$A\left(k\right)<0,\;\;A'\left(k\right)<0\quad for\;\;k>\bar{k}$$

From (27) we have:

$$s\left(k\right)=\rho'^{-1}\left(\frac{1}{A\left(k\right)}\right)\tag{28}$$

For $k<\bar{k}$, the following chain holds: $\nearrow k\rightarrow\nearrow A\left(k\right)^{-1}=\rho'\left(\cdot\right)\rightarrow\swarrow\rho'^{-1}\left(\cdot\right)$, thus, from (28), $\swarrow s\left(k\right)$.

For $k=\bar{k}$, then $A\left(\bar{k}\right)=0$, $A\left(\bar{k}\right)^{-1}=\rho'\left(\cdot\right)=\infty$, thus $\rho'^{-1}\left(\cdot\right)=s^B\left(\bar{k}\right)=0$.

Finally, for $k>\bar{k}$ we have $A\left(k\right)<0$. The following chain holds: $\nearrow k\rightarrow\swarrow A\left(k\right)$ and $\nearrow\left|A\left(k\right)\right|\rightarrow\swarrow\left|A\left(k\right)\right|^{-1}$, i.e $\rho'\left(\cdot\right)$ is becoming less and less negative, that implies $\nearrow s\left(k\right)$. This also establishes that $s\left(k\right)$ has a local minimum in $k=\bar{k}$.

Let us now analyze the SOC of *PP*'s objective function for $k>\hat{k}$. From (27), we have that the SOC is given by:

$$\rho''\left(s\right)\left[A\left(k\right)\right]<0$$

The SOC holds for $k<\bar{k}$, thus from (28) we get $s^B$ as a decreasing function of $k$, that establishes point 2 in Proposition 4.

The SOC does not hold for $k\geq\bar{k}$. This means that in this range of values for $k$ the solution to (27) gives us a minimum of *PP*'s objective function. From (27), for $k\geq\bar{k}$ *PP*'s objective function is decreasing in $s$, thus we have that *PP*'s objective function is maximized for $s^B=0$ for $k\geq\bar{k}$, that finally establishes point 3 in Proposition 4.■

[42] Note that we have $\hat{k}<\bar{k}$.

**Proof of Proposition 5**: It is straightforward to show that the thresholds $\left\{\underline{k}, \hat{k}, \bar{k}\right\}$ are all decresing in both $\alpha_{PP}$ and $\triangle\pi$.

Assume now two values of $\alpha_{PP}$, i.e. $(\alpha_{PP})_1 < (\alpha_{PP})_2$, such that we have $\left\{\underline{k}_i, \hat{k}_i, \bar{k}_i\right\}$ for $i = 1, 2$. Since $\alpha_{PP}$ does not affect (26), then $s^B(k)$ does not vary with respect to $\alpha_{PP}$ for $\underline{k}_1 \leq k \leq \hat{k}_2$ and for $\bar{k}_1 \leq k \leq 1$. On the other hand, from (14) and (27), both $s^M$ and $s^B$ are decreasing in $\alpha_{PP}$. This establishes Point 1 in Proposition 5.

We now analyze the impact of a movement in $\triangle\pi$ From both (26) and (27) it is straightforward to derive that $s^B$ is increasing in $\triangle\pi$ for $k \in [\underline{k}, \hat{k})$, and it is decreasing in $\triangle\pi$ for $k \in [\hat{k}, \bar{k}]$.

Since the thresholds for $k$ also move with $\triangle\pi$, assume two values of $\triangle\pi$, i.e. $\triangle\pi_1 < \triangle\pi_2$, such that we have $\left\{\underline{k}_i, \hat{k}_i, \bar{k}_i\right\}$ for $i = 1, 2$. First note that $\triangle\pi$ affects (14), (26) and (27). In order to analyze the movement in the budget we divide the analyzes based on different ranges of values for $k$:

1. $0 \leq k < \underline{k}_2$: in this range of values collusion between $CA$ and $M$ does not arise, and both $s^M(\triangle\pi_1)$ and $s^M(\triangle\pi_2)$ are given by (14). From Proposition 2 we have $s^M(\triangle\pi_2) < s^M(\triangle\pi_1)$.

2. $\underline{k}_2 \leq k < \underline{k}_1$: here $s^M(\triangle\pi_1)$ is till given by (14), whilst $s^B(\triangle\pi_2)$ is now given by (26), thus it is monotonically increasing in $k$. From continuity of the budget in $k$, we know that in $k = \underline{k}_2$ we have $s^B(\triangle\pi_2) < s^M(\triangle\pi_1)$. Moreover, in $k = \underline{k}_1$ the reverse inequality holds, since both $s^B(\triangle\pi_1)$ and $s^B(\triangle\pi_2)$ are given by (26). Jointly with the monotonicity of $s^B(\triangle\pi_2)$ in $k$, then there exists a unique threshold $\tilde{k} \in [\underline{k}_2, \underline{k}_1]$ such that $s^B(\triangle\pi_2) < s^M(\triangle\pi_1)$ for $\underline{k}_2 \leq k < \tilde{k}$, and $s^B(\triangle\pi_2) \geq s^M(\triangle\pi_1)$ for $\tilde{k} \leq k < \underline{k}_1$.

3. $\underline{k}_1 \leq k < \hat{k}_2$: here both $s^B(\triangle\pi_1)$ and $s^B(\triangle\pi_2)$ are given by (26). Therefore, it is straightforward to show that $s^B(\triangle\pi_2) > s^B(\triangle\pi_1)$ holds.

4. $\hat{k}_2 \leq k < \hat{k}_1$: $s^B(\triangle\pi_1)$ is still given by (26), and it is monotonically increasing in $k$. On the other hand, $s^B(\triangle\pi_2)$ is now given by (27), and it is monotonically decreasing in $k$. If we compare the two solutions for $s^B$, we have that there exists a threshold $\check{k} = \frac{\triangle S + (1-\beta)\left[S\left(q^C\right) - S\left(q^M\right)\right]}{\triangle\pi_1 + (1-\beta)\triangle\pi_2 + (2-\beta)F} \in \left[\hat{k}_2, \hat{k}_1\right]$, such that $s^B(\triangle\pi_2) > s^B(\triangle\pi_1)$ for $\hat{k}_2 \leq k < \check{k}$, and $s^B(\triangle\pi_2) \leq s^B(\triangle\pi_1)$ for $\check{k} \leq k < \hat{k}_1$.

5. $\hat{k}_1 \leq k < \bar{k}_2$: here both $s^B(\triangle\pi_1)$ and $s^B(\triangle\pi_2)$ are given by (27). It is straightforward to derive that $s^B(\triangle\pi_2) < s^B(\triangle\pi_1)$ holds.

6. $\bar{k}_2 \leq k < \bar{k}_1$: in this range of values for $k$, $s^B(\triangle\pi_1)$ is still given by (27), whilst $s^B(\triangle\pi_2) = 0$. Thus we still have $s^B(\triangle\pi_2) < s^B(\triangle\pi_1)$.

7. $\bar{k}_1 \leq k \leq 1$: finally in this range of values for $k$ we have $s^B(\triangle\pi_1) = s^B(\triangle\pi_2) = 0$.

Finally we analyze the effect of an upward movement in $F$ on $\left\{\underline{k}, \hat{k}, \bar{k}\right\}$. From the formulas defining the three thresholds it is straightforward to derive that their movement is ambiguos, and so it is the movement in $s^B$. ■

**Proof of Proposition 6**: from (18), it is straightfroward to show that $\gamma^B$ is not affected by $\alpha_{PP}$, and it is increasing in $\triangle\pi$ for $k \in [\hat{k}, \bar{k})$, so establishing point 1 in Proposition 6.

However recall that the thresholds $\left\{\underline{k}, \hat{k}, \bar{k}\right\}$ are all decresing in both $\alpha_{PP}$ and $\triangle\pi$. Thus a complete analysis of the movement $\gamma$ associated with movements in both $\alpha_{PP}$ and $\triangle\pi$ may be performed with respect to different ranges of values for $k$.

Assume now two values of $\alpha_{PP}$, i.e. $(\alpha_{PP})_1 < (\alpha_{PP})_2$, such that we have $\left\{\underline{k}_i, \hat{k}_i, \bar{k}_i\right\}$ for $i = 1, 2$. We have:

1. $0 \leq k < \underline{k}_2$: in this range of values for $k$, both $\gamma^M((\alpha_{PP})_1)$ and $\gamma^M((\alpha_{PP})_2)$ are given by (16). From Proposition 2, it is straightforward to derive that $\gamma^M((\alpha_{PP})_2) < \gamma^M((\alpha_{PP})_1)$.
2. $\underline{k}_2 \leq k < \underline{k}_1$: here $\gamma^M((\alpha_{PP})_1)$ is still given by (16) and it is constant in $k$. On the other hand, $\gamma^B$ is now given by (18), and it is monotonically increasing in $k$. From continuity of the budget in $k$, we know that in $k = \underline{k}_2$ we have $\gamma^B < \gamma^M((\alpha_{PP})_1)$. Moreover, in $k = \underline{k}_1$, we also know that $\gamma^B = \gamma^B$, since $\gamma^B$ in (18) is independent of $\alpha_{PP}$. Thus we still have that $\gamma^B < \gamma^M((\alpha_{PP})_1)$.
3. $\underline{k}_1 \leq k < \bar{k}_2$: here, for both values of $\alpha_{PP}$, $\gamma^B$ is given by (18), and it is independent of $\alpha_{PP}$. Therefore the two are equal.
4. $\bar{k}_2 \leq k < \bar{k}_1$: here $\gamma^B$ is still given by (18) for $(\alpha_{PP})_1$, whilst $\gamma^B = 0$ for $(\alpha_{PP})_2$. Therefore the former is higher than the latter.

We now analyze the impact of a movement in $\triangle\pi$. Assume two values of $\triangle\pi$, i.e. $\triangle\pi_1 < \triangle\pi_2$, such that we have $\left\{\underline{k}_i, \hat{k}_i, \bar{k}_i\right\}$ for $i = 1, 2$. We have:

1. $0 \leq k < \underline{k}_2$: in this range of values for $k$, both $\gamma^M(\triangle\pi_1)$ and $\gamma^M(\triangle\pi_2)$ are given by (16). From Proposition 2, it is straightforward to derive that $\gamma^M(\triangle\pi_2) < \gamma^M(\triangle\pi_1)$.
2. $\underline{k}_2 \leq k < \underline{k}_1$: here $\gamma^M(\triangle\pi_1)$ is still given by (16) and it is constant in $k$. On the other hand $\gamma^B(\triangle\pi_2)$ is now given by (18) that is monotonically increasing in $k$. From point 1 above, we know that $\gamma^B(\triangle\pi_2) < \gamma^M(\triangle\pi_1)$ holds in $k = \underline{k}_2$. However, from (18), we have $\gamma^B(\triangle\pi_2) > \gamma^B(\triangle\pi_1) = \gamma^M(\triangle\pi_1)$ in $k = \underline{k}_1$. Therefore, from continuity of $\gamma^B$ in $k$, and from monotonicity of $\gamma^B(\triangle\pi_2)$, there esists a threshold $\breve{k} = \frac{\triangle\pi_1}{\triangle\pi_2}$ such that, for $k \in [\underline{k}_2, \breve{k})$ we have $\gamma^B(\triangle\pi_2) < \gamma^M(\triangle\pi_1)$, otherwise for $k \in [\breve{k}, \underline{k}_1)$ we have $\gamma^B(\triangle\pi_2) > \gamma^M(\triangle\pi_1)$.

3. $\underline{k}_1 \leq k < \bar{k}_2$: here both $\gamma^B(\triangle\pi_1)$ and $\gamma^B(\triangle\pi_2)$ are given by (18). Thus, it is straightforward to show that $\gamma^B(\triangle\pi_2) > \gamma^B(\triangle\pi_1)$ holds.

4. $\bar{k}_2 \leq k < \bar{k}_1$: for this range of values for $k$, $\gamma^B(\triangle\pi_1)$ is still given by (18), whilst $\gamma^B(\triangle\pi_2) = 0$. Thus $\gamma^B(\triangle\pi_2) < \gamma^B(\triangle\pi_1)$ holds. ■

**Proof of Proposition 7**: we first study the expected benefit that firms get from inducing $PP$ to allocate a budget $s < s^M$. The "stake in collusion" between $M$ and $PP$ represents the maximum transfer that $M$ is willing to pay to $PP$ in order to induce a given level of budget lower than $s^M$ is given by:

$$U^M(s) - U^M\left(s^M\right) = \left[\rho\left(s^M\right) - \rho(s)\right](\triangle\pi + F) \tag{29}$$

where $U^M(\cdot)$ is given by (2).

By taking the derivative of the stake in collusion with respect to $s$ we get the marginal benefit to $M$ from inducing a variation in the budget. We have:

$$\frac{\partial\left[\left[\rho\left(s^M\right) - \rho(s)\right](\triangle\pi + F)\right]}{\partial s} = -\rho'(s)(\triangle\pi + F) \tag{30}$$

that gives the expected marginal benefit from inducing a lower budget level.

We now analyze the transfer that $M$ has to pay to $PP$ in order to induce the latter to reduce the budget devoted to $CA$ with respect to the level $s^M$. More specifically $M$ makes $PP$ just indifferent with respect to setting $s = s^M$, i.e. $M$ designs a transfer schedule $t(s) > 0$ for $s < s^M$, and $t(s) = 0$ for $s \geq s^M$, such that the following equality holds:

$$W^C\left(s^M\right) = W^M(s) + t(s) \quad \forall s < s^M$$

that is

$$t(s) = W^M\left(s^M\right) - W^M(s) \quad \forall s < s^M \tag{31}$$

where it is straightforward to derive $t(s) > 0$.

Formally, in stage 0 $M$ solves the following maximization problem:

$$\max_{\{s\}} \ \rho(s)\left(\pi^C - F\right) + (1 - \rho(s))\pi^M - \frac{t(s)}{\nu} \quad \forall s < s^M$$

$$s.t. \ \ t(s) \geq W^M(s^*) - W^M(s)$$

$M$ maximizes the difference between the profits from inducing a budget $s < s^M$ and the transfer paid to $PP$, under the constraint that $PP$'s welfare has to be not lower than $W^M\left(s^M\right)$.[43]

Since the objective function is decreasing in $t(s)$, then the constraint holds as an equality. The FOC is equal to:

$$-\rho'(s)(\triangle\pi + F) + \tag{32}$$
$$+\frac{\left\{\rho'(s)\left[\triangle S + (1-\beta)\left[S\left(q^C\right) - S\left(q^M\right)\right]\right] + \frac{\rho(s)\rho''(s)}{[\rho'(s)]^2}(1-\beta) - 2 + \beta\right\}}{\nu} = 0$$

The SOC is given by:

$$-\rho''(s)(\triangle\pi + F) + \left\{\frac{\rho''(s)\left[\triangle S + (1-\beta)\left(S\left(q^C\right) - S\left(q^M\right)\right)\right] + B(s)(1-\beta)}{\nu}\right\} < 0 \tag{33}$$

From (14) and (32) it is traightforward to show that the value of $s$ solving $M$'s maximization problem is equal to $s^M$ for $\nu = 0$, that establishes point 1 in Proposition 7.

As a by-product of this result we have that $M$ finds it profitable to lobby for reduced $s$ $\forall\nu$. First note that for $\nu = 0$, i.e. for $s^B_{PP} = s^M$, $M$ is indifferent between bribing or not $PP$. By totally differentiating $M$'s objective function with respect to $\nu$ we get:

$$\frac{d}{d\nu} f(s(\nu), \nu) = \underbrace{\frac{\partial f}{\partial \nu}}_{>0} + \underbrace{\frac{\partial f}{\partial s}}_{=0} \frac{ds}{d\nu} > 0$$

where the second term is equal to zero by the envelope theorem, i.e. $M$'s objective function is increasing in $\nu$, that establishes the previous statement.

If we totally differentiate (32) with respect to $\nu$, we get:

$$\frac{ds^B_{PP}}{d\nu} = \frac{\frac{1}{\nu^2}\left\{\rho'\left(s^B_{PP}\right)\left[\triangle S + (1-\beta)\left[S\left(q^C\right) - S\left(q^M\right)\right]\right] + \varphi\left(s^B_{PP}\right)(1-\beta) - 2 + \beta\right\}}{-\rho''\left(s^B_{PP}\right)(\triangle\pi + F) + \left\{\frac{\rho''\left(s^B_{PP}\right)\left[\triangle S + (1-\beta)\left(S\left(q^C\right) - S\left(q^M\right)\right)\right] + B\left(s^B_{PP}\right)(1-\beta)}{\nu}\right\}} \tag{34}$$

By substituting (19) in (32) we get:

[43] Formally, by proposing to $PP$ the transfer schedule $t(s)$, $M$ makes $PP$ indifferent between all the budget levels. We can assume that $M$ breaks $PP$'s indifference by offering her an additional $\varepsilon > 0$ in case she chooses $M$'s preferred level of budget, with $\varepsilon$ as small as one likes.

$$s_{PP}^{B}=\frac{\left[\frac{\triangle S+(1-\beta)\left[S\left(q^{C}\right)-S\left(q^{M}\right)\right]}{\nu}-\triangle\pi-F\right]^{2}}{4\hat{s}\left[\frac{3-2\beta}{\nu}\right]^{2}} \tag{35}$$

By susbstituting (19) in (33) we get:

$$-\left(\triangle\pi+F\right)\left(-\frac{s^{-\frac{3}{2}}}{4\hat{s}^{\frac{1}{2}}}\right)+\frac{\triangle S+(1-\beta)\left[S\left(q^{C}\right)-S\left(q^{M}\right)\right]}{\nu}\left(-\frac{s^{-\frac{3}{2}}}{4\hat{s}^{\frac{1}{2}}}\right)<0$$

since $B(s)=0$. Thus SOC holds if:

$$\nu<\frac{\triangle S+(1-\beta)\left[S\left(q^{C}\right)-S\left(q^{M}\right)\right]}{\triangle\pi+F}=\bar{\nu} \tag{36}$$

Thus for $\nu<\bar{\nu}$, the SOC holds, and $s_{PP}^{B}$ is given by (35). From (34) we have:

$$\begin{aligned}\frac{ds_{PP}^{B}}{d\nu}=&-\frac{\left[\triangle S+(1-\beta)\left[S\left(q^{C}\right)-S\left(q^{M}\right)\right]\right]\left[\frac{\triangle S+(1-\beta)\left[S\left(q^{C}\right)-S\left(q^{M}\right)\right]}{\nu}-\triangle\pi-F\right]}{2\hat{s}\left[\frac{3-2\beta}{\nu}\right]}+\\&+\frac{\left[\frac{\triangle S+(1-\beta)\left[S\left(q^{C}\right)-S\left(q^{M}\right)\right]}{\nu}-\triangle\pi-F\right]^{2}\nu}{2\hat{s}\left[\frac{3-2\beta}{\nu}\right]}\end{aligned} \tag{37}$$

From (37) it is easy to show that $\frac{ds_{PP}^{B}}{d\nu}<0$ for $\nu<\bar{\nu}$, and $\frac{ds_{PP}^{B}}{d\nu}=0$ for $\nu=\bar{\nu}$, that establishes point 2 in Proposition 7. Finally, from (35) we also have $s_{PP}^{B}(\bar{\nu})=0$. Given that, from (32) we have that $M$'s objective function is decreasing in $s$ for $\bar{\nu}<\nu\leq 1$, then for this range of values of $\nu$ we finally have $s_{PP}^{B}(\nu)=0$, that establishes point 3 in Proposition 7. ∎

**Proof of Proposition 8**: From (35), *ceteris paribus*, the higher $\alpha_{PP}$, the lower $s_{PP}^{B}$ (and, from *CA*'s **ICC**, the lower the associated $\gamma^{B}\left(s_{PP}^{B}\right)$) for each value of $\nu$. Therefore, from (36), we also have that the higher $\alpha_{PP}$, the lower $\bar{\nu}$, that establishes point 1 in Proposition 8.

Moreover, from (35) and (36), we also have that the higher $\triangle\pi$, the lower both $s_{PP}^{B}$ (and the associated $\gamma^{B}\left(s_{PP}^{B}\right)$) and $\bar{\nu}$.

Finally, still from (35) and (36) we have that the movement in both $\bar{\nu}$ and $s_{PP}^{B}$ is ambiguous with respect to $F$. ∎

# Appendix 3

Figure 1 presents the budget $s$ as a function of the bribing technology efficiency parameter when $CA$ is corruptible. The black bold line gives the equilibrium budget $s^B(k)$.

**Figure 1: Budget as a function of bribing efficiency of CA**

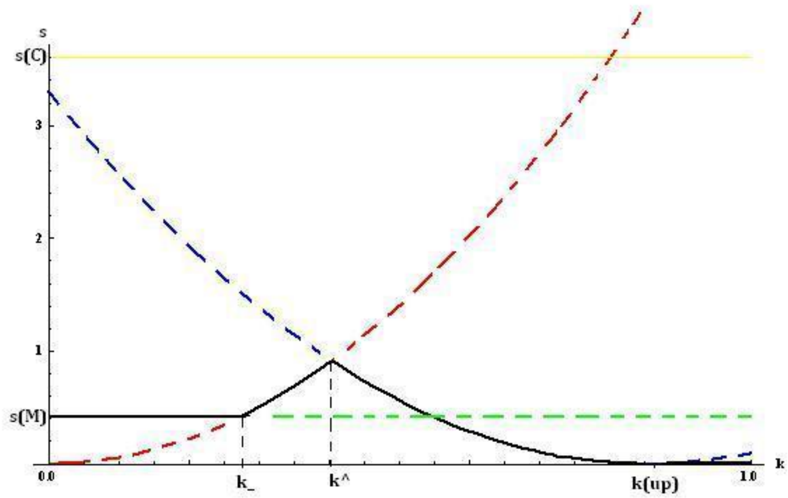


Figure 2 below plots the equilibrium budget $s^B_{PP}$ (red line) as a function of the bribing efficiency technology $\nu$ when $PP$ is corruptible:

Figure 2: Budget as a function of bribing effiency of PP